

International Conference on Millets, Organic & Natural Farming

December 9 to 11, 2023



Proceedings

Editors

B Boraiah
T E Nagaraja
Prabhu C Ganiger
K B Palanna
N S Saniga
Kushal
Sujata Bhat

Organized by

University of Agricultural Sciences, Bangalore &
Sri Sri Naisargik, Art of Living



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Dr. S. V. Suresha
Vice-Chancellor
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FOREWARD

In the face of global climate change, farmers must adapt their practices to deal with changing temperatures and more frequent extreme weather events. These adaptations must first and foremost build resilience within the agro ecosystem, increasing its ability to continue functioning when faced with unexpected events. The global quest for nutritious food, farmer security, sustainable agriculture, and conservation of the environment has created a revolution in millet, natural and organic farming.

Organic farming is a production system that promotes the health of soils, ecosystems, and people and its primary goal is to cultivate the land and raise crops in such a way that the soil remains alive and healthy. Natural farming, also known as 'Do Nothing Farming,' holds that farmers are merely facilitators, with nature doing the majority of the work. Organic farming reduces environmental impact by avoiding synthetic chemicals, preventing soil and water pollution and promoting biodiversity. Overall, natural and organic farming provides a holistic approach to balancing environmental conservation, soil health, and human well-being in the face of modern agricultural challenges.

Millets are also an excellent solution to a variety of crises, including water, nutrition, and climate change, and they hold the promise of alleviating the misery of malnutrition, which is widespread in the country. More importantly, its better suitability to different cropping systems and mid-season correction during monsoon vagaries in contingent plans made millets even more popular. Millet consumption has fallen drastically in recent decades, with production falling by 40% since the Green Revolution. The loss of Millets is not just an agricultural loss, but a civilization loss. However, today with more people realizing the health and lifestyle benefits associated with millets, there is an increased global demand for this crop.

On this Occasion, International Conference on Millets, Organic and Natural farming, be a crucial platform for the exchange of knowledge, ideas, and innovative practices that shape the future of sustainable agriculture and be a platform to explore the realms of millet cultivation, organic farming, and the broader spectrum of natural agricultural practices. May these proceedings pave the way for insightful discussions, breakthrough solutions, and a shared commitment towards a more resilient, environmentally conscious, and nutritionally abundant future

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PREFACE



Technological advancements have significantly shaped agriculture in India. The introduction of 'Green Revolution' technologies, played a pivotal role in transforming the country from a food-deficient to a food-surplus nation. However, this progress came with drawbacks such as soil degradation, loss of biodiversity, increased cultivation costs, and other adverse effects. The widespread use of chemical fertilizers and pesticides, coupled with stagnant or declining crop productivity, exacerbated challenges amid unpredictable market conditions and the impacts of climate change. Consequently, many farmers found themselves trapped in debt, leading to widespread distress in the agricultural sector. Over time, organic farming and natural farming could be a viable alternative, gaining recognition and importance in addressing these challenges.

Organic farming, also known as ecological farming, is an agricultural system that uses fertilizers of organic origin such as compost manure, green manure, and bone meal and places emphasis on techniques such as crop rotation and companion planting. Currently, 10.17 million hectares of cultivated area is estimated to be under organic farming in India. There are 1.6 million organic producers in India. The demand for organic food products is on constant rise worldwide and In India there is an increase of 51 per cent exports of organic products.

Natural Farming is a chemical-free farming system rooted in Indian tradition enriched with modern understanding of ecology, resource recycling and on-farm resource optimization. It is considered as agroecology based diversified farming system which integrates crops, trees and livestock with functional biodiversity. It is largely based on on-farm biomass recycling with major stress on biomass mulching, use of on-farm cow dung-urine formulations; maintaining soil aeration and exclusion of all synthetic chemical inputs. Many states have taken up initiatives for natural farming promotion Andhra Pradesh, Gujarat, Himachal Pradesh, Odisha, Madhya Pradesh, Rajasthan, Uttar Pradesh and Tamil Nadu are among the leading states. About 10 lakh ha area is covered under natural farming in India.

Millets are nutritious minor cereal crops with small grains that are resistant to various abiotic stresses caused by climate change. The climate-resilient properties of millets continue to support sustainable agriculture without the use of chemical fertilizers. Millet cultivation is expected to support environmentally sound farming with no environmental impact, as agricultural production can cause serious environmental damage due to the careless application of fertilisers and pesticides. Considering the importance of millets, recently the government many tropical countries including India give more emphasis to millets cultivation and improvement. Moreover, Food and Agricultural Organization of the United Nations (FAO) declared 2023 to be the "International Years of Millets"

The aim of the International Conference is to unite global researchers dedicated to organic farming, natural farming, and millets. The objective is to evaluate the significance of embracing these agricultural practices and reintroducing traditional crops on a worldwide scale. This compilation included the abstracts presented on various theme areas viz., Genetic Resources, Genomics and Crop Improvement; Production systems and Crop Management; Nutrition, Processing, Value Addition; Government Policies and support systems.

The conference will serve as a hub for thought leaders, innovators, and practitioners to exchange insights, placing special emphasis on the integration of millets into our agricultural practices. By sharing the invaluable experiences and innovative approaches, we hope to collectively propel the discourse around organic and natural farming. Furthermore, the event will offer a unique opportunity to dissect the challenges and intricacies faced by the community, fostering collaboration and knowledge exchange. Millets, a focal point of our discussions, will be explored for their potential to enhance food security and promote sustainable agricultural practices. We eagerly anticipate your participation, and convey our greetings and best wishes to all delegates and sponsors for their joint venture for organizing this International Conference.



December, 2023 Boraiah., T. E.
Nagaraja., Prabhu C. Ganiger., K.B.
Palanna.,
Bangalore N.S. Saniga., Kushal and Sujata
Bhat



MESSAGE

Gurudev Sri Sri Ravi Shankar

Spiritual guru and founder
Art of Living, Bangalore

Agriculture, while essential for sustaining human life, has been associated with a range of adverse effects on the environment. Intensive use of chemical fertilizers and pesticides contributes to soil degradation and water pollution, posing threats to ecosystem health. The expansion of agricultural land often leads to deforestation, causing the loss of biodiversity and disrupting delicate ecological balances. Addressing these environmental challenges requires a shift towards sustainable and regenerative agricultural practices that prioritize soil health, biodiversity conservation, and reduced reliance on synthetic inputs.

Embracing the cultivation of millets, along with the adoption of organic and natural farming practices, is imperative for a sustainable and resilient agricultural future. Millets contribute significantly to biodiversity, exhibiting adaptability to diverse climates while requiring minimal water, thus aiding in water conservation efforts. Their nutritional richness addresses public health concerns, offering essential vitamins and minerals.

Organic and natural farming methods, which often involve millet cultivation, prioritize soil health, reduce environmental impact, and contribute to carbon sequestration. Together, these approaches foster resilience against climate change, mitigate ecological degradation, and establish a foundation for long-term food security, promoting a holistic and environmentally conscious paradigm for agriculture.

As you embark on this insightful journey at the Conference on Millets, Organic and Natural Farming, I extend my warmest wishes to each of you. May this gathering be a forum of knowledge exchange, innovation, and collaboration, propelling us towards a more sustainable and resilient agricultural future. Your expertise and dedication to the principles of millet cultivation, organic farming, and natural farming are integral to addressing the challenges our world faces today. May your interactions be enriching, your insights profound, and your contributions pave the way for transformative advancements in agriculture. Here's to a conference filled with inspiration, fruitful discussions, and the collective pursuit of a greener and healthier planet.

Best Regards,

December, 2023 Sri Sri Ravi Shankar
Bangalore



MESSAGE

Sri. D K Shivakumar
Deputy Chief Minister
Government of Karnataka

The Green Revolution, while initially credited with increasing agricultural productivity, has had adverse effects over time. Intensive use of chemical fertilizers and pesticides has led to soil degradation, loss of biodiversity, and water pollution. Furthermore, the reliance on high-yielding varieties has narrowed crop diversity, making the agricultural system more vulnerable to pests and diseases. In the context of current climate change, traditional farming methods are facing unprecedented challenges. Erratic weather patterns, increased temperatures, and extreme events pose threats to crop yields and food security. The urgency to mitigate climate change impacts necessitates a shift towards sustainable and resilient agricultural practices. Organic farming, natural farming, and the cultivation of millets emerge as crucial alternatives. These approaches prioritize soil health, biodiversity, and water conservation. Organic and natural farming methods eschew synthetic inputs, reducing the carbon footprint associated with conventional agriculture. Millets, being hardy crops, require less water and exhibit resilience to climate variations, making them valuable in the face of changing environmental conditions. In essence, the necessity of embracing organic farming, natural farming, and millet cultivation lies in their potential to provide sustainable solutions, mitigating the adverse impacts of the Green Revolution and addressing the challenges posed by current climate change. These practices offer a path towards resilient and environmentally conscious agriculture, promoting both food security and ecological sustainability.

The International Conference is an opportune moment to share our experience with all, who are working on Organic, natural farming and millets. On this occasion, a document containing abstracts of research articles on different aspects of Organic, natural farming and millets will be useful for all the stakeholders, researchers and policy makers

December, 2023
Shivakumar
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D K

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TECHNICAL SESSION-1

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- Overview of millets
- Crop improvement of millets
- Trait discovery and pre-breeding activities
- Conservation and utilization of genetic resources of millets



I-OP-01

Leveraging Genomic Resources of Millets - Genome Assisted Breeding to Counter Biotic and Abiotic Stresses Using Genome Engineering

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Owing to higher nutritional content over prevalent staples like rice and wheat, a large range of millets are grown worldwide for human consumption as well as for use as feed for animals. Although most of the millets are native to Africa, they are cultivated, domesticated, and consumed in large quantities by developing nations. The reason being that the millets are recognized for their exceptional ability to endure environmental stress and adapt to low-input farming methods with limited resources. Yet, because of the shifting climate, biotic and abiotic stresses there is an increase in the decline of millet crop productivity. At the heart of crop development today, driven by next-generation genomics, are the identification of genetic variation underpinning phenotypic distinctions, the discovery of new sources of genetic diversity, and an understanding of molecular and biochemical mechanisms involved in biotic and abiotic stress tolerance. Genomic resources must be evaluated and developed in order to incorporate trait-associated genomic segments into crop varieties by genetic engineering or molecular breeding techniques. The whole genome sequences for foxtail, pearl, finger, and broomcorn millet that are currently available provide an excellent opportunity for their genetic evaluation. Studies of finger millet's blast resistance have been conducted using comparative genomics, and several techniques involving genetic engineering have been used for modifying the grain to provide substantial resistance to critical diseases. Finger millet has a number of quantitative trait loci (QTL) and R-genes associated with the blast pathogen. A robust genetic transformation system has been constructed for crop genetic improvement, and an effective *Agrobacterium*-mediated transformation system has already been developed for finger millet, foxtail, and pearl millet. A recently developed *Agrobacterium*-mediated genetic transformation technology in foxtail millet with an estimated 27 percent gene integration frequency is expected to propel the millet transgenic study to unprecedented heights. In regions like Africa or India, where there is an abundance of germplasm resistant to abiotic stressors and disease, there is a vacuum in the field due to a lack of genetic resources. With the advancement of technologies leading to targeted genome sequencing and resource development, genome assisted breeding, genetic engineering, and genome editing may become feasible. Overall, the integration of genomic approaches and advanced technologies holds promise for improving millet varieties, enhancing their resilience to environmental challenges, and contributing to food security in regions where millets play a significant role in agriculture and nutrition.



In-Silico Identification of Gene Markers for Plant Architectural Genes in Browntop Millet

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Brachiaria ramosa is a warm-season perennial grass cultivated for both cereal and forage purposes. It helps to control high blood pressure, acts as a probiotic for respiratory disorders, eases constipation, and helps detoxify the body. It faces significant challenges, including seed-shattering, lodging, and dwarfism, leading to substantial yield losses. Special attention was given to seed-shattering genes due to their direct relevance to the identified challenges that cause a yield loss in brown top millet. This study aimed to pinpoint genetic markers associated with these challenging traits in brown top millet. Initially, a literature survey targeted plant architectural gene; around 130 genes were screened. The study was narrowed down to seed-shattering genes, namely *An1*, *Laba1*, *Spr3*, *Qsh1*, *Sh1*, *Sh4*, *Shat1*, and *Ssh1*. Subsequent orthology analysis clustered the screened seed-shattering genes among seven closely related species of brown top millet, namely Finger millet, Pearl millet, Foxtail millet, Great millet, Signal grass, Brown top millet, Barnyard millet, Halls panic grass, Brown top signal grass, Switchgrass, and Maize. Domain analysis confirms that the functional domains are aligned with those reported in the literature. Additionally, leveraging the available transcriptome data of signal grass, a comprehensive transcriptome assembly and analysis were conducted to optimize intra-species amplification efficiency. The presence of gene markers confirmed by the PCR experiment amplifies two genes, *QSH1* and *Sh4*, thereby conclusively associating them with the challenging trait in brown top millet. This combined *in silico* and experimental approach provides nuanced insights into the genetic markers linked to plant architecture and yield-related challenges in brown top millet. The identification of *QSH1* and *Sh4* genes not only enhances our understanding but also offers avenues for targeted interventions and breeding strategies aimed at mitigating seed-shattering, lodging, and dwarfness, ultimately supporting the yield and agronomic performance of this vital cereal crop. These gene marker expressions in brown top millet can be studied using transcriptome sequencing analysis or real-time PCR analysis. This combined *in silico* and experimental approach is a powerful strategy for gaining nuanced insights into the genetic aspects of crop traits, allowing for informed and targeted efforts in crop improvement.

I-OP-03

Enhancing growth and activating drought-tolerant traits in finger millet through modification of the hologenome

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The finger millet (*Eleusine coracana*), also referred to as "ragi," is a cereal crop that is widely cultivated in South Asia and Africa. Although the crop is naturally resistant to a number of abiotic stresses, its susceptibility to drought stress has increased recently due to erratic precipitation patterns. Ongoing initiatives are dedicated to the comprehensive exploration of the genetic and physiological underpinnings governing drought tolerance in finger millet. These endeavors aim to unravel intricate mechanisms that can be leveraged to augment its cultivation in arid regions. Research across diverse plant and crop systems has consistently demonstrated that stress-related traits can be triggered through the influence of endophytes residing in the apoplast. The phenotypic outcomes are intricately governed by the collective genetic makeup of both the host plant and its endophytes, a phenomenon recognized as the hologenome. The hologenome concept encapsulates the notion that a plant, in conjunction with its associated microbiome, operates as a functional unit. This concept underscores the interdependent relationship between the genomic factors of the host plant and the diverse microbial communities thriving within various plant tissues. The hypothesis implies the loss of beneficial endophytes and the benefits they confer on modern domesticated types is correlated with domestication, especially in the case of cereals. The current study aims to investigate the role of the hologenome in finger millet within this framework. The investigation aims to probe the potential of activating traits by employing stress-adapted fungal endophytes, isolated from plants thriving under extreme weather conditions. Finger millet seedling growth was significantly suppressed as a result of the deliberate suppression of endophytes using chemical interventions, such as fungicides and antibiotics. On the other hand, the finger millet cultivar GPU28 was successfully colonised by the introduction of K23, an abiotic stress-tolerant endophyte. Growth-related features, such as plant height, tiller count, photosynthetic area, and efficiency, were subsequently activated as a result of this colonization. When finger millet partnered with the abiotic stress-tolerant endophyte K23, the plants showed significant resistance to drought and yielded more than their non-colonized counterparts. This highlights the considerable potential of hologenome modification in finger millet, particularly in terms of triggering drought-tolerant characteristics. The microbiome-enrichment method is shown to be a viable strategy with the ability to significantly increase finger millet yield in dry areas. These discoveries represent a significant advancement in crop development and adaptability, essentially revealing a novel route towards resilient and sustainable agricultural practices.



I-OP-04

***In Vitro* Evaluation of Bio Control Agents against *Rhizoctonia solani* (J. G. Kuhn) causing Root Rot of French Bean**

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Rhizoctonia solani Kühn is an important pathogen in common bean (*Phaseolus vulgaris* L.) causing web blight (WB) in the tropics, as well as a soilborne pathogen causing root rot (RR) worldwide leading to heavy yield loss. Detrimental effects of fungicides render an indispensable need to identify bio-agents with beneficial activity, environmental safety, and a broad collection of biocidal strains against the pathogen. With this regard, a total of six fungal and bacterial bioagents viz., *Trichoderma* spp., *Bacillus subtilis* and *Pseudomonas fluorescens* were evaluated for their antagonistic properties against *Rhizoctonia solani* by using dual culture technique. Highest inhibition of mycelial growth was observed in *Trichoderma harzianum* (74.07 %), followed by *Trichoderma viride* (68.89 %). Least mycelial growth inhibition was recorded in *Bacillus subtilis* (UAS Raichur) with 22.22 per cent inhibition. The results revealed that, the fungal bio- agents were better than bacterial bio-agents in inhibiting the mycelial growth of the pathogen. This research contributes valuable insights into the potential of specific bioagents for managing *Rhizoctonia solani*-induced diseases in common beans. The emphasis on environmentally friendly alternatives and the identification of effective bio agents is crucial for sustainable agriculture and minimizing the reliance on chemical fungicides.

I-OP-05

Male Sterility: A Breeding Strategy in Millets

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In recent years, millets production is decreasing due to replacement by other remunerative crops. To address this, emphasis must be given to increase the productivity millets. Majorly, commercially cultivated varieties in millets have been developed through selection or hybridization followed by selection. To achieve higher yield potential, release of variability is essential which is difficult in millets due to their self-pollinated nature, in addition to small flower size, furthermore anthesis takes place in mid night which makes emasculation an arduous task. Slow release of variability and difficulty in hybridization due to polyploidy makes a crossing program difficult. This could be overcome with the availability of versatile male sterile system. Therefore, male sterile system becomes the need of hour to facilitate intense recombination and deployment of population improvement programs in



millets. A novel partial sterile line (PS1) in finger millet was developed at Project coordinating unit, ICAR-AICRP on Small millets, Bengaluru where its maintenance is easy just by selfing. Attempts are being made to use these lines in crossing program to develop finger millet hybrids. Male sterile lines are also developed in foxtail millet targeting disease resistance and yield components that could be utilized in breeding program.

I-OP-06

Assessment of Genetic variability for morpho-metric traits in grain amaranth (*Amaranthus* spp.) germplasm accessions

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Thousands of traditional crops are well known, but have sustain little attention in the last century and breeding endeavor were limited. Grain amaranth is such an underutilized indigenous potential pseudo cereal crop that is particular interest because of its balanced amino acid and micronutrient profiles. Grain amaranth belongs to the family Amaranthaceae, subfamily Amaranthoideae and genus *Amaranthus*. The proteins have a high sulphur containing essential amino acids (Lysine, Methionine and Cysteine), which makes it better than cereals crops. Its importance is in the quality of the leaves and tender stem for food, high biocompatibility, nutritional value, antioxidants, mineral contents and low cost of production and sale than cereal crops. Broadening the genetic base and enhancing crop cultivar diversity is the key to attaining sustainable production and productivity of any crop with no exception to grain amaranth. This requires greater use of diverse plant genetic resources (PGR). Realizing this, crop researchers have amassed a large number of germplasm accessions. Germplasm is likely to harbor a sizable number of duplicate accessions. Large numbers of germplasm entries and possible existence of duplicate/redundant accessions are impediments to effective management, characterization and evaluation for quantitative traits, which display complex inheritance and a large genotype $\times$ environment interaction. In this context, 1900 germplasm accessions (received from NBPGR New Delhi, Regional station, Phagli, Shimla, HP and Regional station, Akola, Maharashtra) were evaluated in augmented design for 10 quantitative traits at the dedicated experimental fields of AICRN on potential crops, UAS, GKVK, Bengaluru during 2022 *kharif* season with a spacing of 45cm $\times$ 10 cm. Since, the number of accessions evaluated were in higher number, grouping of these accessions into different classes has been attempted. Descriptive statistics reveals that there was a substantial amount of variability for all the quantitative traits studied. The entries showed minimum of 31 days for 50% flowering and test weight (g/10ml) is one of the important trait for yield contributing trait and the mean test weight was 7.17g/10ml.

Assessment of Genetic variability and micronutrient analysis through k-means clustering in finger millet (*Eleusine coracana* L. Gaertn) core germplasm accessions

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An investigation was carried out to unravel the genetic variability for yield and its component traits in 97 finger millet core germplasm accessions with 3 checks (KMR 204, ML3, GPU48) were evaluated during summer 2022 at College of Agriculture, Karekere, Hassan, UAS GKVK, Bengaluru, Karnataka, in simple lattice design with 02 replications. Results revealed that Significance difference for all the quantitative traits indicated the presence of adequate diversity. The PCV estimates for all the traits higher than GCV values, shows the influence of environment for this expression of these traits. heritability traits were controlled by both additive and non-additive gene actions.

With its exceptional calcium content, finger millet outperforms both rice and wheat, providing 8-10 times more calcium. Further investigation into the nutrient content of finger millet grains identified that GE71 exhibits a notable calcium concentration, while GE217 was higher zinc content. These germplasm accessions show promise and can be leveraged in future breeding programs to enhance current cultivars.

An analysis of twenty-two germplasm lines and three checks using principal component analysis highlighted two significant principal components (PCs). Combined, these components accounted for 94.48% of the observed variability in the adjusted correlated and standardized micronutrient contents. These findings offer valuable insights for the refinement and optimization of future cultivation strategies

In a bid to promote millet farming, the year 2023 has been designated as the International Year of Millets, underscoring the significance of this crop in global agriculture

Skewness, the third-order statistical measure, and kurtosis, the fourth-order statistical measure, were computed to ascertain the distribution characteristics of quantitative traits within the core accessions. Kurtosis provides insights into the proportion of genes influencing the traits. The skewness values for most of the quantitative traits studied in the germplasm were between -0.5 and 0.5, except the trait “finger length,” which had a value of 0.70, indicating a normal distribution in the population. Additionally, all the quantitative traits had kurtosis values greater than zero, indicating that the distribution of these traits had leptokurtic tails with a relatively peaked shape. Skewness and kurtosis estimates are highly optimistic for Finger length (0.70) and ear head length (0.72) which means that more germplasms are below the mean than expected in a normal distribution. Distribution was negatively skewed for the traits, Days to maturity (-0.58), Plant height (-1.03) and Peduncle length (-0.32) which means that more germplasms are above the mean than expected in a normal distribution. High value of

kurtosis was observed for the traits like days to maturity (1.7) showing leptokurtic distribution that indicates average complementary gene action.

I-PP-01

Reaction of Pearl Millet Hybrids against Downy Mildew caused by *Sclerospora graminicola* (Sacc.) Schoret

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Pearl millet (*Pennisetum glaucum* L.) popularly known as bajra is a major warm-season cereal, largely grown under rainfed conditions in India. Downy mildew caused by *Sclerospora graminicola* (Sacc.) Schoret is identified as the most widespread and destructive disease affecting pearl millet in both India and the Marathwada region of Maharashtra. India is indeed the largest producer of pearl millet (*Pennisetum glaucum*), leading in terms of both cultivated area and production. Pearl millet is an important cereal crop in India, particularly in arid and semi-arid regions. This indicates the significance of addressing and managing this particular disease to ensure successful pearl millet cultivation in these areas. Forty pearl millet hybrids were screened against *Sclerospora graminicola* in the downy mildew sick plots during *Kharif* season of 2019-20 and 2020-21 at Aurangabad lies between latitude and longitude 19.8762 North and 75.3433 East, respectively. Downy mildew susceptible cultivar '7042 S' was sown as infector rows to develop maximum disease pressure in downy mildew sick plot which were planted three weeks earlier than the test rows. The infector rows were sown at every ninth row throughout the entire length of the experimental field. The test entries of the respective trial were sown about three weeks of the sowing of infector rows. Downy mildew incidence was scored twice, first at 30 and second at 60-days after emergence of the crop. At 30 DAS, all 40 hybrids showed a highly resistant reaction in both the *Kharif* seasons of 2019-20 and 2020-21 while at 60 DAS, 38 out of 40 hybrids maintained a highly resistant reaction. One entry showed a resistant reaction (MH 2477), and another showed a moderately resistant reaction (MH 2462). None of the entries were susceptible or highly susceptible during both seasons. This methodology allows for a comprehensive assessment of the resistance of different pearl millet hybrids to downy mildew under field conditions, considering the crucial stages of 30 and 60 days after the emergence of the crop.



Precision Breeding Strategies: Orchestrating Resilience in Biotic and Abiotic Stress Management

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Precision breeding, a cutting-edge approach in plant breeding, leverages advanced genomic technologies to precisely manipulate specific genes associated with stress response mechanisms. This paper underscores the significance of precision breeding in addressing the dual challenge of biotic and abiotic stress, which often acts synergistically to compromise global food production. In the context of biotic stress, precision breeding empowers scientists and breeders to identify and incorporate resistance genes with pinpoint accuracy. The ability to target specific genetic elements associated with resistance to pests, diseases, and pathogens enhances the effectiveness of crop protection strategies. By understanding the intricate molecular interactions between plants and their biotic stressors, precision breeding offers a nuanced and proactive approach to managing these challenges. Simultaneously, the paper explores how precision breeding can mitigate the impact of abiotic stressors, including extreme weather events, water scarcity, and soil degradation. By unraveling the genetic basis of traits related to drought tolerance, heat resistance, and nutrient efficiency, precision breeding enables the development of crops that can thrive under adverse environmental conditions. This not only ensures stable yields but also contributes to the sustainable use of natural resources. The COVID-19 pandemic has underscored the critical importance of ensuring food security in the face of unprecedented global challenges. Precision breeding emerges as a strategic tool in this context, offering a means to fortify major food crops against uncertainties in production caused by both biotic and abiotic stressors. The ability to tailor crops to specific stress conditions enhances the adaptability of agricultural systems, contributing to the overall resilience of the food supply chain. As the global population continues to burgeon, and environmental challenges escalate, precision breeding stands as a beacon of hope for sustainable agriculture. The integration of this innovative strategy into mainstream crop improvement practices holds the promise of bolstering global food security, fostering resilience, and mitigating the risks posed by pandemics and environmental uncertainties. In conclusion, this paper advocates for the widespread adoption of precision breeding strategies as a transformative force in the face of biotic and abiotic stress challenges in major food crops. By unlocking the full potential of genetic resources, precision breeding not only contributes to the resilience of crops but also paves the way for a more secure and sustainable global food future.

I-PP-03

Heritability and Variability Studies of Barnyard Millet (*Echinochloa frumentacea*) for Grain Yield and its Yield Attributes

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Barnyard millet is one of the hardiest, climate resilient and fast-growing crop that is bestowed with high nutrient content in grains. Twenty-one genotypes of Barnyard millet including check were evaluated at Agricultural Research Station, Vizianagaram to assess genetic variability, heritability and genetic advance for seven yield contributing traits. The characters included under study are days to 50 % flowering, plant height, days to maturity, number of productive tillers per plant, panicle length, grain yield and fodder yield. Moderate PCV and GCV was recorded for days to 50 % flowering, days to maturity, number of productive tillers per plant and fodder yield. High heritability coupled with high genetic advance as percent of mean was observed for days to 50 % flowering and days to maturity indicating that these traits are under influence of additive gene action and selection may be effective for these traits.

I-PP-04

Assessment of Genetic Diversity and Contribution of Root Traits for Drought Tolerance in Finger Millet (*Eleusine coracana* L.) Genotypes.

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Twenty-one SSR markers linked to drought tolerance were used to characterize twenty finger millet genotypes. The 19 microsatellite primers (SSR markers) generated a total of 303 amplified bands, with an average of 15.94 bands per primer in the set of 20 finger millet genotypes for 29 loci of which, 25 loci were polymorphic with a mean of 1.32 alleles per primer and four (13.79 %) were monomorphic. Polymorphism information content (PIC) and Nei's genetic diversity were 0.48 and 0.51, respectively. The percentage of polymorphic loci (PPL) of 86.2 per cent showed threefold variation among the genotypes. Clustering based on UPGMA separated 20 genotypes into three clusters. Six tolerant genotypes KMR-204, GPU-45, ML-365, GPU-28, KMR-301 and L-5 as identified by morphological preliminary screening were in same cluster 1. These six genotypes can be explored for further scientific investigations under PVC columns. APVC column experiment was conducted in College of Agriculture, Shivamogga during summer 2022 on sandy clay loam soils to assess contribution of root traits for drought tolerance in finger millet (*Eleusine coracana* L.) genotypes. Degrees of stress imposed at vegetative, reproductive and grain filling stages for 15 days were tested on selected

short, medium and long duration finger millet genotypes. Stress imposed at vegetative stage caused highest percent increase in root characteristics as compared to other stress treatments.

I-PP-05

Analysis of Genetic Parameters in Little Millet (*Panicum sumatrense* L.)

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One of the nutria-cereal, Little millet is mostly grown as neglected and under-utilized crop with limited utilization of resources. It is highly valued for high nutritional properties in the grain. The most critical factor affecting the effectiveness of a breeding programme is the level of genetic variability present in any population. The more diversity is there in the material, the higher the likelihood of choosing genotypes that have the potential to be useful. In this background, twenty-nine advanced breeding lines of little millet including two checks were evaluated at Agricultural Research Station, Vizianagaram to estimate the genetic variability, heritability and genetic advance for ten traits including grain. The traits included in the study were plant height, days to 50 % flowering, days to maturity, number of productive tillers per plant, panicle length, leaf length, leaf width, number of leaves per main tiller, grain yield and fodder yield per hectare. All of the traits under study had statistically significant differences, which suggests that the material under study had a lot of variation. High genotypic and phenotypic coefficient of variation was observed for days to 50% flowering and No. of productive tillers per plant indicating high variability for these two traits. Days to 50% flowering, days to maturity, number of productive tillers per plant, and leaf width all showed high heritability together with substantial genetic advance as percentage mean, showing that these parameters were primarily controlled by additive gene action. Grain yield and fodder yield recorded moderate heritability with medium genetic advance as per cent mean indicating that these traits were governed by both additive and non-additive gene action.

I-PP-06

Role of millet land races in preserving biodiversity for providing food and nutritional security

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Millets represent a diverse group of coarse cereal crops that typically produce small seeds. They comprise about a dozen crop species, belonging to various genera that were originated, domesticated and are cultivated by small and marginal farmers in Africa and Asia. The historical roots of millets in India can be traced back to the Indus valley civilization, where evidence of millet cultivation has been found. Africa is home to important centres of origin,



diversity and cultivation of millets. African farmers are custodians to an enormous genetic diversity of finger millet including many cultivars adapted to adverse agro-ecological conditions. Around 6000 types of millets can be found worldwide. Sorghum, pearl millet, finger millet, proso millet, little millet, kodo millet, foxtail millet, browntop millet and barnyard millet are a few of them. Millets stand out for their capacity to adapt to challenging environmental circumstances, low input needs, and superior nutritional qualities. Landraces are cultivated, genetically heterogeneous varieties that have evolved in a certain eco-geographical area and are therefore adapted to the edaphic and climatic conditions and to its traditional management and uses. Millet biodiversity constitutes the ecological heritage of millions of small scale and traditional farmers, playing a vital role in their agricultural systems, food security, livelihood and sense of cultural identity. There is a need to strengthen the interface between agro biodiversity, food security and rural development by recognizing genetic diversity, indigenous knowledge systems and cultural aspects. Efforts should be made to encourage the preservation of millet genetic diversity in its natural habitat and its cultivation by supporting programs like farmer networks, seed fairs, and community seed banks. It is the need of the hour to promote participatory programmes for conservation, research, and optimal use of the millets, focusing on the associated indigenous knowledge and cultural values. Besides, empowering rural women to utilize and conserve the biodiversity of millet should be encouraged. In India, Odisha Millet Mission is taking the lead in the conservation of millets by involving farmers. The Farmer Producers Organizations (FPO's) and Women Self Help Groups (SHGs) should be uplifted in bringing the land races into seed system. The Deccan Development Societies efforts in Telangana have highlighted the role of indigenous millet varieties in maintaining biodiversity. Sahaja Samrudha, a non-governmental organization (NGO) has developed a programme for revival and promotion of millet diversity in Karnataka. On farm conservation, participatory crop improvement, value addition and marketing has brought more than 10,000 farmers into the millet conservation program. Traditional farming systems need to be strengthened to achieve the goals of sustainable development and biodiversity conservation.

I-PP-07

Variability, Heritability and Genetic Advance in Browntop Millet

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Browntop millet (*Brachiaria ramosa* (L.) Stapf.) is one of forgotten crop with very small grains which is mainly used as food and fodder. It is a climate resilient crop which can come well with limited water. It is highly valued for its high fiber and mineral content in grains. Genetic variability of a crop plays an important role in crop improvement. Hence, present study was attempted to assess the genetic variability and associations of various economic traits at Agricultural Research Station, Vizianagaram. Significant differences for all six traits studied were noticed among 16browntop millet genotypes. GCV was low for all the studied traits



indicating low genetic variability and phenotypic variability was ranged from low (days to 50% flowering 4.3) to moderate (panicle length 10.8) indicating moderate phenotypic variability. The difference in GCV and PCV was very narrow for days to 50% flowering and days to maturity indicating least influence of surrounding environment. While panicle length recorded high heritability with moderate GAM indicating the presence of both additive and non-additive gene action. Selection for high grain and fodder yield can be relied upon selection for more number of days to 50% flowering and days to maturity as grain and fodder yield are significantly associated in positive direction with days to 50% flowering and days to maturity.

I-PP-08

YIELD STABILITY UNDER DIFFERENT AGRONOMIC SITUATIONS IN LINSEED (*Linum usitatissimum* L.)

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The present investigation was carried out to study the stability parameters for seed yield in Linseed. The studies on the estimation of stability parameters revealed that no genotype was stable for all characters. For plant height, genotypes FRW-09 and LSL-19-604 demonstrated stable performance, whereas genotypes FRW-09 and Binwa and LSL-19-604 demonstrated stable performance for number of primary branches per plant and secondary branches per plant, respectively. For number of capsules per plant, the genotypes EX-301-1 and EC-1628 demonstrated a fair amount of stability and are predicted to do well in all environments. Special adaptations were made for TL-189 and FRW-12 to thrive in environments with few seeds per capsule. The 1000 seed weight varieties GS- 49 and FRW-12 were specially adapted to a favourable environment (g). For oil content (%), EC-567 displayed average stability across all environments. With higher mean values, the genotypes TL-189 and Pratapalsi-2 demonstrated excellent adaptability to all environments with regard to the most crucial characteristic, seed yield per plant (g).

I-PP-09

Functional Genomics: A Tool to Intervene Millet Breeding

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A genome is the entire genetic makeup of an organism and it contains all its hereditary information, known as genes. Plant genomic data is utilized in genetic engineering to breed better and fitter small millet to ensure food security to the masses. Variants in coding as well as non-coding genome sequence range from single nucleotide changes to large microscopically visible chromosomal aberration(s). These variants may have a huge impact on the function of the genes. They can be either beneficial with no negative effect on the phenotype, or pathogenic



resulting in several disorders and diseases. Knowing the variation and the function of the genes present in the crop will help us in inserting or deleting such genes from a breeding program to develop elite small millet cultivars with the aid of tools like sequencing platforms, gene expression studies *via*, blotting and DNA micro array technologies, transcriptomics, proteomics. Millets are now gaining importance owing to their nutritional and pharmaceutical value in addition to photosynthetic efficiency. Information on their genomic resources is scarce, except foxtail millet and finger millet. It's a dire necessity to use these genomic tools to develop cultivars which are high yielding since current commercial varieties have reached stagnation with respect to yield.

I-PP-10

Selection Criteria of Linseed Genotypes for Seed Yield Traits through Correlation, Path Coefficient and Principal Component Analysis

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The present investigation was negative association with seed yield per plant. Path coefficient analysis revealed high positive direct effect of number of capsules per plant conducted to estimate the extent of genetic variability, heritability, genetic advance, character association and path analysis. The experimental material comprising of 31 genotypes were evaluated at Experimental farm Department of Agril. Botany, College of Agriculture, Latur during Rabi-2021. The material was sown in randomized block design with two replications, on 29th of October, 2021. Observations were recorded for ten characters Viz., days to 50% flowering, days to maturity, plant height (cm), number of primary branches, number of secondary branches, number of capsules per plant, number of seeds per capsule, 1000-seed weight, oil content (%) and seed yield per plant. Substantial amount of genetic variability had been found for all the characters, which was indicated by significant difference among and between treatments. Correlation studies indicated that number of primary branches, number of secondary branches, 1000- seed weight, and number of capsules per plant had highly significant positive association with seed yield per plant. However, traits days to 50% flowering, days to maturity exhibited significant followed by number of 1000-seed weight, number of seed per capsule and number of primary branches for seed yield per plant. Keywords: Linseed, Variability, Heritability, Correlation analysis, Path analysis.

I-PP-11

Isolation and Molecular Analysis of Endophytic Microorganisms and Their Effect on the Growth of Chia (*Salvia hispanica* L.)

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The enhancement of plant growth through the promotion of robust root development, optimized nutrient absorption, and subsequent yield increase is a crucial function of endophytic microorganisms. This research focuses on the isolation, identification, and molecular characterization of efficient endophytic microorganisms from Chia plants in Bhukkapatna, Tumakuru, exploring their impact on Chia growth. Microscopic examination, along with biochemical and physiological analyses, identified twelve bacterial isolates. Eight of these endophytic microorganisms demonstrated efficiency in nitrogen fixation, phosphate and potassium solubilization, as well as the production of IAA, GA, siderophore, and exopolysaccharides. Molecular characterization using 16S rRNA identified these isolates as *Pseudomonas fluorescens*, *Bacillus cereus*, *Stenotrophomonas maltophilia*, and *Enterobacter cloacae*. Greenhouse experiments involved treating Chia seedlings with individual isolates (*Pseudomonas fluorescens* - CEPB2, *Enterobacter cloacae* - CEPB8, *Bacillus cereus* - CEPB5, and *Stenotrophomonas maltophilia* - CEPBA) and various combinations of these isolates. The treated seedlings exhibited positive effects on growth parameters, including the number of leaves, branches, plant height, root length, root dry weight, and overall plant biomass. *Enterobacter cloacae* (CEPB8) demonstrated the highest positive impact on Chia plant growth. Treatments combining all four isolates showed superior performance, surpassing the control group in plant height (35.467 cm), number of leaves (32.2), number of branches (22.67), root length (57.13 cm), root dry weight (12.31 grams), and biomass (158.37 grams) at harvest. The combined treatments exhibited a synergistic effect, outperforming individual strains. This study confirms that these endophytic microorganisms significantly enhance Chia plant growth.

I-PP-12

Investigating the Performance of Elite Finger Millet Genotypes against Blast Disease across Diverse Geographical Locations in India

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FINGER MILLET blast, induced by *Pyricularia grisea*, stands as an economically impactful disease, leading to substantial yield reduction. The identification of resilient sources displaying superior blast resistance remains the most cost-effective approach to mitigate yield loss from this disease. This study assessed 58 highly promising genotypes of varied origins, alongside



several cultivars, for leaf, neck, and finger blast across six major finger millet cultivation regions in India during the *Kharif* season of 2022. Disease severity was assessed following standardized protocols, employing artificial pathogen inoculation at specific stages. Among the fifty-eight genotypes studied, nineteen exhibited resistance to leaf blast, eight to neck blast, and five to finger blast, respectively. Notably, five genotypes (GE 5772, GE 5092, GE 4259, GE 132, and GE 1330) showcased resistance to both leaf and neck blast, while two genotypes, GE 5230 and GE 1559, demonstrated resistance to leaf and finger blast alongside desirable agronomic traits. A strong correlation between neck and finger blast incidences, ranging from 0.27 to 0.6, was observed. Stability analysis identified two, eleven, and one genotype as stable for leaf, neck, and finger blast, respectively. These superior, stable, and blast-resistant genotypes are poised to serve as major contributors in finger millet breeding programs aiming for enhanced resistance.

I-PP-13

Biodiversity in Peril: Unraveling the Impact of Climate Change

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Climate change is rapidly reshaping our world, profoundly impacting biodiversity and disrupting the delicate balance of our planet. This abstract delves into the intricate connections between climate change and biodiversity loss, unveiling direct and indirect consequences on ecosystems and species. As the Earth's climate undergoes unprecedented shifts, biodiversity faces escalating threats, leading to profound ecological transformations. Rising temperatures, changing precipitation patterns, and extreme weather events directly impact ecosystems, disrupting the intricate web of interactions among species and resulting in habitat loss, altering the distribution and abundance of various organisms. An immediate consequence of climate change is the accelerated rate of species extinction. Many plants and animals struggle to adapt or migrate swiftly enough, placing unique and irreplaceable species at risk and diminishing overall biodiversity. Habitat loss, driven by factors like rising sea levels and altered temperature regimes, exacerbates challenges for numerous species. Fragmentation and degradation of habitats make it difficult for species to find suitable areas for reproduction, feeding, and migration, intensifying the vulnerability of biodiversity to climate-induced stressors. Climate change also challenges the adaptive capacities of ecosystems and species. Some may find refuge in new areas, while others may struggle to survive or reproduce under altered conditions, potentially triggering a domino effect throughout entire ecosystems. Urgent conservation efforts must address the nexus between climate change and biodiversity loss. Implementing strategies to enhance ecosystem resilience and assist species in adapting to changing conditions is paramount. Global initiatives focusing on mitigating climate change are essential to alleviate long-term pressures on biodiversity. In conclusion, understanding the intricate web of interactions between climate change and biodiversity is imperative for effective conservation and adaptation strategies. Urgent and coordinated efforts are needed to mitigate climate change,



protect vulnerable ecosystems, and ensure the survival of countless species in the face of an ever-changing climate.

I-PP-14

Impact Of Different Farming System on The Rhizosphere Microbial Diversity and Soil Enzymes of Field Bean (*Dolichos lablab*)

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A natural farming system is an ecological farming practice that entails cultivating crops without using chemical fertilizers and pesticides. To understand the diversity and functions of root microbiomes associated with natural farming systems, a study was conducted to compare the microbial community in the rhizosphere of finger millet under organic farming systems. An experiment was conducted during Kharif 2019-20 and 2020-21 in field bean crop at experimental plot, RIOF and NSP field, UAS, Bengaluru. Where we have imposed various farming production systems to study the status of rhizosphere microbial population at various growth stages of the crop. The beneficial microbial consortia include biofertilizers, and Beejamrutha was provided externally through the seed treatment application and jeevamrutha was provided throughout the crop growth period at 15 days interval. The field bean crop showed significantly higher population of the total bacteria (58.55×10^5 CFU/g soil), fungi (20.0×10^4 CFU/g soil), actinomycetes (23.65×10^3 CFU/g soil), free-living N-fixers (4.37×10^5 CFU/g soil) and PSMs (37.03×10^5 CFU/g soil) was observed in the treatment T₂: organic production system followed by T₃: natural farming (NF protocol as given by Shri. Subhash Palekar) and least soil microbial population viz., total bacteria (38.07×10^5 CFU/g soil), fungi (11.03×10^4 CFU/g soil), actinomycetes (11.23×10^3 CFU/g soil), N-fixers (2.94×10^5 CFU/g soil) and PSMs (24.37×10^5 CFU/g soil) was observed in treatment T₅: absolute control. Highest dehydrogenase and urease activity was observed in the treatment T₃: Natural farming ($190.07 \mu\text{g of TPF g}^{-1}\text{hr}^{-1}$) followed by the treatment T₂: Organic farming ($182.15 \mu\text{g of TPF g}^{-1}\text{hr}^{-1}$). Significantly highest urease activity was observed in the treatment T₂: Organic farming ($37.93 \mu\text{g NH}_4^{+}\text{-N g}^{-1}\text{hr}^{-1}$) followed by T₃: Natural farming ($35.06 \mu\text{g NH}_4^{+}\text{-N g}^{-1}\text{hr}^{-1}$) whereas the least enzyme activity was found in the treatment T₂: Absolute control (which was significantly different from all the other treatments).

I-PP-15

Biocontrol Activity of *Bacillus Subtilis* Strains Producing Metabolites against *Fusarium solani* and *Sclerotium rolfsii* under In Vitro Condition

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Plant diseases play a major role in altering/reducing the natural resources in agriculture. The dependence on synthetic agrochemicals to meet the growing food demands has led to the environmental and health hazards. Research to develop biological control agents against the



plant pathogens to replace the synthetic agrochemicals gained the considerable attention. Biological control of plant pathogens has been considered as a potential control strategy in recent years. The present study was conducted to assess the potential antagonistic bacteria against fungal pathogens from GKVK campus Bengaluru, Karnataka. Sixty isolates were screened against *Fusarium solani* and *Sclerotium rolfsii*. Further, morphological, biochemical and molecular characterization revealed that *Bacillus subtilis* strain OTG009 showed inhibition (55.55 %) against *Sclerotium rolfsii*, similarly *Bacillus subtilis* strain JC43 and *Bacillus subtilis* strain P showed inhibition (45.55 % and 43.33 %, respectively) against *Fusarium solani*. The microscopic study of revealed that *Bacillus subtilis* is a rod shaped and gram-positive bacteria. The *Bacillus subtilis* found that were able to produce siderophores (chelating agents). Spectrophotometer analysis showed that the extract showed maximum absorption from 200nm to 400nm indicated the present of active compounds. The qualitative analysis of compounds presents in the ethyl acetate extract using GCMS revealed the presence of compounds like Eicosane, Octadecane, n-Hexadecanoic acid, Heneicosane, Hexadecane, Benzene acetic acid etc were antimicrobial, antifungal, antibacterial in nature. *Bacillus subtilis* strain OTG009 was effectively inhibiting the pathogen growth *in vitro*. These beneficial soil microbes can be used for the control of plant fungal diseases caused by *Fusarium solani* and *Sclerotium rolfsii*.

I-PP-16

Diversity Unveiled: Exploring the Nutritional Richness of Foxtail Millet

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This abstract delves into the nutritional profile of foxtail millet, presenting a comprehensive exploration of its unique contributions to human health. Foxtail millet, scientifically known as *Setaria italica*, has recently garnered attention for its promising nutritional attributes and potential benefits in promoting overall well-being. A detailed nutritional analysis reveals that foxtail millet is a rich source of essential nutrients, including dietary fiber, vitamins, and minerals. Its notable fiber content not only supports digestive health but also contributes to weight management and disease prevention. Additionally, foxtail millet contains essential amino acids, essential for optimal protein synthesis and muscle health. The presence of antioxidants in foxtail millet underscores its potential in mitigating oxidative stress, a key factor in preventing chronic diseases. Furthermore, being gluten-free, foxtail millet emerges as a valuable alternative for individuals with gluten sensitivities, diversifying dietary options. This abstract emphasizes the importance of recognizing and harnessing the nutritional richness of foxtail millet, positioning it as a viable and nutritious grain for diverse dietary needs. Integrating foxtail millet into dietary recommendations and agricultural practices not only enhances individual nutrition but also contributes to the broader goals of sustainable and diversified food systems. As the global discourse on food security and sustainable agriculture



continues, understanding and promoting the nutritional richness of foxtail millet becomes imperative. This abstract advocates for further research, awareness, and utilization of foxtail millet, unlocking its potential to foster a healthier and more resilient future for both individuals and agricultural systems.

I-PP-17

Biodiversity Conservation: A Strategic Investment for Future Food Security in the Face of Climate Change

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Biodiversity is a key buffer against climate-induced disruptions, is integral to the adaptive capacity of ecosystems. Conserving diverse genetic resources and ecosystems is essential for developing climate-resilient crops and livestock. Moreover, preserving diverse habitats and species ensures the stability of ecosystem services critical for agriculture, such as pollination, pest control, and nutrient cycling. Climate change poses unprecedented challenges to biodiversity and ecosystems, threatening the delicate balance that sustains life on Earth. Rising temperatures, extreme weather events, and altered precipitation patterns contribute to habitat loss and disrupt the intricate relationships between species. The resulting consequences, including species extinction and the degradation of ecosystems, reverberate through the agricultural sector, directly impacting food security. Climate change adaptation strategies must be integrated into conservation practices to enhance resilience. Conservation efforts should not only focus on preserving existing biodiversity but also on facilitating the migration and adaptation of species in response to changing climatic conditions. This proactive approach is vital for maintaining the functionality of ecosystems and ensuring the continued provision of ecosystem services crucial for agriculture. In the pursuit of effective biodiversity conservation, advanced conservation tools emerge as indispensable allies. Remote sensing technologies provide a comprehensive view of changing landscapes, aiding in the identification of areas vulnerable to habitat loss and enabling targeted conservation efforts. Genomic technologies, through DNA analysis, contribute to the preservation of genetic diversity, allowing for the development of climate-resilient agricultural varieties. The urgency of addressing climate change and biodiversity loss requires a multifaceted approach. Conservation tools can aid in monitoring and assessing the impacts of climate change on biodiversity, guiding the formulation of adaptive management strategies. The integration of climate-smart practices into conservation initiatives ensures that biodiversity is equipped to withstand and adapt to the ongoing and future challenges posed by a changing climate. In conclusion, the symbiotic relationship between biodiversity conservation, food security, and the impacts of climate change necessitates a strategic and forward-thinking approach. Investing in advanced conservation tools is imperative for navigating the complexities of a warming world. By preserving biodiversity, embracing adaptive strategies, and leveraging innovative technologies, we can lay the foundation for resilient and sustainable food systems capable of withstanding



the challenges posed by climate change. The commitment to biodiversity conservation today is an investment in securing the abundance and diversity of our global food supply for generations to come.

I-PP-18

Concurrent Selection for Stable Grain Iron and Zinc Content in Pearl Millet

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Pearl millet is widely cultivated as a source of food and fodder in arid and semi-arid regions of sub Saharan Africa and India and is considered as a crop for food and nutritional security. It is nutritionally rich having high amount of protein, fibre, essential amino acids, macro and micro nutrients. Lack of enough quantities of micronutrients like iron and zinc in our daily diet are main culprits of micronutrient malnutrition. As like grain yield, iron and zinc content are also affected by environmental variations. Hence, the present study includes to unravel the Genotype Environment Interaction of grain iron and zinc content in pearl millet. One hundred and thirty diverse pearl millet genotypes including two checks, namely, ICTP 8203Fe and ICMB 98222 were evaluated agro climatic zones of pearl millet (New Delhi, Jodhpur and Dharwad) over two consecutive years (2014 and 2015) for grain iron and zinc content. Pooled ANOVA across three locations and two years recorded genotypes, environments and GEI as highly significant for both grain and zinc content. Substantial part of genotypic variations existing in the panel, indicate that there is scope for enhancing pearl millet with these micronutrients through some effort in breeding approach. High observed GEI variance obtained for grain iron and zinc content, emphasize the importance of interaction. GEI was observed to be more for grain iron content compared to grain zinc content, indicating that different genotypes reacted differently for grain iron and zinc content in different locations. Further, Genotype $\times$ environment interactions studied by AMMI analysis revealed two significant Principal components. From AMMI1 biplots, PPMI 708, PPMI 1102 and PPMI 683 were identified as stable genotypes for both micronutrients, expressing more than 90 and 65.0 mg/kg grain iron and zinc content respectively. Based on the AMMI stability values (ASV) and mean values, PPMI 1102, PPMI 683, PPMI 1116, PPMI 1267 and PPMI 1231 were found as stable for grain iron content. Similarly, PPMI 708, PPMDMGMP 60, PPMI 683 and PPMI 1108 were stable for grain zinc content. Considering, AMMI1 biplots and ASV, PPMI 1102 and PPMI 683 are better stable genotypes having higher levels of both grain iron and zinc content. The identified stable genotypes can further be utilized as parents for developing iron and zinc rich high yielding genotypes in pearl millet.

I-PP-19

Nutritional and Antinutritional Profiling of Foxtail Millets Germplasms (*Setaria italica* L.) and their Morpho-Physiological Characterization

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Foxtail millet (*Setaria italica* L.) is a self-pollinating diploid ($2n=18$), important nutria-cereal crop. It contains good dietary fiber, minerals, amino acid, phenolic compounds, phytic acid, protein, sugar carbohydrates and several anti-nutritive compounds and hence considered as an important nutria-cereal crop for human feed and can fulfill sustainable nutritional security demand for future. The present research was carried out to investigate different foxtail millet genotypes for various biochemical parameters viz., total sugar (TS), total amino acids (TAC), carbohydrate, tannins, total phenolic content (TPC) proline and protein content. TPC ranges from 22.20 mg/gm (foxtail 16) to 25.8 mg/gm (foxtail 201, 1780), whereas TS ranged 2.60 mg/100 gm (foxtail 31, 16) to 11.8 mg/100 gm (foxtail 1000). TAC from 11.20 g/100 mg in foxtail millet 1136 to 13.9 in foxtail 1251 and tannin from 2.10 mg/gm in foxtail 295 to 4.8 mg/gm in foxtail 1013. Carbohydrate and protein content was found minimum in foxtail 16, 969 and 1606. Maximum protein was recorded in foxtail 1037 (11.9 gm/100gm), foxtail 1013 (11.6 gm/100gm) while maximum carbohydrates recorded in foxtail 1071 (73.50g/100gm). Correlation studies conclude that Total sugar significant and positively correlated with carbohydrate, Total phenolic content is significantly correlated with total amino acid and proline. Analyzed foxtail genotypes of different foxtail genotypes can be considered as therapeutic functional foods due to presence of total phenolic content (TPC), total Sugar, total amino acids, carbohydrate and tannins, however further more studies are required to characterize other antioxidant, nutritional and antinutritional properties of foxtail millets.

I-PP-20

Evaluation of brown top millet (*Urochloa ramosa*) germplasms against shoot fly, *Atherigona approximata*

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Urochloa ramosa (formerly *Brachiaria ramosa*) the brown top millet or Dixie signal grass is an annual millet grass belonging to the grass family (*Poaceae*). The native range of *Urochloa ramosa* is from Africa to tropical and subtropical Asia. Browntop millet being crop of rain fed area is often cultivated under marginal management. Little millet is short duration crop and it can able to provide green fodder and grain even in a short period of 60-80 days. The observations were recorded at 28 days after seedling emergence (DASE). Total 116 germplasms were screened against shoot fly, 3 (IC-617957, TNAU-122, VBTG 9) were highly



tolerant, 3 (IC-617956, IC-613553, VBTG-47) moderately tolerant, 17 tolerant and 76 were found to be moderately susceptible and 17 are susceptible. Across the germplasms the per cent shoot fly incidence ranged from 6.67 to 63.33 % with average of 41.8 per cent. The shoot fly occurring on brown top millet is reporting for the first time in India.

I-PP-21

Diversity for Mineral Element Concentrations in Small Millets and their Bio-availability

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Millets include Finger millet, Foxtail millet, Barn yard millet, Proso millet, Brown top millet, little millet, Jowar and pearl millet. These are group of small grained cereal food crops which are highly tolerant to drought and other extreme weather conditions and are grown with low chemical inputs such as fertilizers and pesticides. Nutritional insecurity is a major menace in the world that needs to be addressed on a priority basis. Millets can play an important role in addressing the challenge of nutritional insecurity, worldwide especially address malnutrition in rural areas. The millet grains are gluten-free, non-acid forming, easy to digest, low glycemic index and health food diet for people with celiac disease- common disease caused by cereal protein ingestion. Diversified accumulation of mineral elements in different millet like in finger millet is a rich source of calcium content than any other crops 344-490 ppm. Foxtail and barnyard millets are high in protein (10-12.50 %) and fiber content (8-10 %). Proso millet also good in fiber content of 11.2 % and pearl millet, barnyard millet and little millets are excellent amount of iron element (9.30 – 16.9%). Millets are acknowledged for being rich in minerals. Nevertheless, the existence of anti- nutrients like phytates, polyphenols, and tannins restricts the accessibility of nutrients for absorption within the human body. Raw sorghum, pearl millet, and finger millet possess phytic acid contents of 8.6 ± 0.15 , 4.77 ± 0.07 , and 5.69 ± 0.19 mg/g, respectively. Among the millet varieties, finger millet stands out with the lowest phytic acid content. Reducing anti-nutritional attributes in millets is imperative to enhance mineral bioavailability. To improve accessibility of nutrients by employing efficient and suitable grain processing techniques, breed new varieties with less antinutritional factors. In conclusion, the expression of these anti-nutritional factors varies across crops, necessitating tailored strategies to deliver high-nutrition foods in the future.

I-PP-22

Genome Editing in Millets – An Opportunity for Food and Nutritional Security

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Millets are a class of hardy, small-seeded crops that grow well in arid and marginal lands. Compared to other staple grains like rice and wheat, millets are nutritionally superior,



require less water and fertilizer and are referred to as "nutri-cereals" given that they contain most of the nutrients required for human health. Millets are considered a superfood owing to the energy, proteins, healthy fats, minerals, and vitamins they contain. Major cereal crops like rice and wheat have been benefited from the successful application of genome editing techniques, which has allowed the introduction of several desirable traits in them. Despite their high nutritional content, most millets have not yet been improved using genome editing techniques. So far, only foxtail millet has been used for genome editing works due to limited genomic resources and lack of complete and annotated genome sequences in other millets. In systems like CRISPR/Cas9-mediated genome editing, a fully annotated genome sequence and information on the entire structure of gene is required to target individual gene. Therefore, the potential to apply genome editing in millets hinges on two crucial elements: an effective transformation mechanism and a fully annotated genome sequence. Understanding the mechanism of nutrient fortification and climate resilience, alongside exchanging such beneficial traits within millets and with other cereals, could potentially be facilitated by genome editing. Given the changing climate scenario and prevailing hidden hunger, the application of genome editing techniques in millets will pave the way for future millet research and contribute towards achieving global security in terms of food and nutrition.

I-PP-24

Influence of temperature and photoperiod on morpho-physiological and yield traits of proso millet varieties under staggered sowing

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Proso millet (*Panicum miliaceum*) stands out as a recognized minor millet, exhibiting a high nutritional value and protein content of 11–12%. With its short growth cycle, adaptability to various soils and climates, and C₄ characteristics, it efficiently uses water, showcasing drought resistance and the ability to withstand dry conditions. By 2050, a rapid global population increase to 9.2 billion is anticipated, resulting in a 60% surge in food consumption. Climate change exacerbates challenges posing threats to food production, potentially leading to widespread shortages and famine by the end of the century. Despite India's Green Revolution success in achieving self-sufficiency, the persistent challenge of undernourishment necessitates a transition to millets to address ongoing nutritional needs. Realizing the full yield potential of crops in specific agro-climatic conditions primarily tilts on selecting optimal planting times and well-suited cultivars which significantly governs crop phenological development and the efficient conversion of biomass into economic yield. A study was conducted to investigate the impact of temperature and photoperiod on morpho-physiological and yield traits of proso millet varieties through staggered sowing during the Kharif season in the dryland farm of S. V. Agricultural College, Tirupati, Andhra Pradesh. The study employed a split-plot design with three sowing dates (D₁: I FN of June, D₂: II FN of June, D₃: I FN of July) as main plots and three varieties (V₁: CO 5, V₂: TNAU 202, V₃: GPUP 8) as



subplots, replicated thrice. Proso millet sown during the second fortnight of June displayed notable improvements in growth parameters, with CO 5 exhibiting the highest and GPUP 8 the lowest among the varieties. Crop maturity duration was longer for the first fortnight of June and shorter for the first fortnight of July. Climatic indices varied significantly across sowing dates and varieties, with GPUP 8 accumulating the highest and TNAU 202 the lowest. Morpho-physiological parameters, including AGR, CGR, HI, and LAI, were highest for the second sowing date and TNAU 202, while RGR and SLA were maximum in the first sowing date and SLW was highest in the first fortnight of July. The D₂ yielded the highest biochemical parameters and grain yield, resulting in superior economic returns for CO 5 compared to GPUP 8. The research findings suggested that for the southern Agro-climatic zone of Andhra Pradesh, the recommended proso millet variety is CO 5, and it is optimal to sow it during the second fortnight of June to achieve increased grain yield and economic benefits for farmers.



TECHNICAL SESSION-2

Theme -2. Production systems and crop management

- Future Sustainable Food Security through organic/natural farming
- Scope and Potential of organic and Natural Farming
- Recent advances & Nutrient Management in Organic Farming
- Challenges and opportunities of Organic and Natural farming



Performance of Brown Top Millet Intercropping with Ground Nut under Natural, Organic and Integrated Farming System

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A field experiment was carried out in Ground nut + Brown top millet intercropping system in 4:2 row ratios at College of Agriculture, Hanumanamatti, Haveri on red soil from 2019-20 to 2021-22 on permanent site to study the impact of Natural Farming (NF), Organic Farming (OF) and Integrated crop management (ICM) practices on productivity, economics and soil health. The pooled results showed that, ICM recorded significantly higher Ground nut pod yield (1315 kg ha^{-1}), Brown top millet (569 kg ha^{-1}) and Ground nut equivalent yield (CEY) (1629 kg ha^{-1}) than NF (1513 kg ha^{-1}) and OF (1516 kg ha^{-1}). The reduction in Ground nut yield was 5.98 and 1.57 percent and Ground nut equivalent yield (CEY) were lower by just 7.08 and 0.15 percent in natural farming over ICM and Organic Farming, respectively. However, Natural Farming practices yielded 7.0 percent higher brown top millet yield than Organic farming and 12 percent lower yield than ICM. The pooled results showed lower cost of cultivation under NF (Rs. 47426 ha^{-1}) than ICM (Rs. 62461 ha^{-1}) and OF (Rs. 62129 ha^{-1}). About 24.0 and 23.7 per cent total costs and 33.6 and 32.1 per cent material costs were saved under NF over ICM and OF, respectively. Without premium prices, the higher gross return was obtained under ICM (Rs. 94812 ha^{-1}) than Natural and organic Farming (Rs. 88693 and 88527 ha^{-1} , resp.). However, the net returns were higher in natural farming (Rs. 42790 ha^{-1}) than both ICM and Organic farming (Rs. 32351 and 26399 ha^{-1} , resp.). Further, with premium price, the net return was enhanced under NF (Rs. 57348 ha^{-1}), which was 77 per cent higher than ICM and 35 per cent higher than OF. Similarly, the returns obtained per rupee invested were higher with natural farming (2.21 and 1.87 with and without premium price, respectively) than other farming practices due to lesser cost of cultivation and very less grain yield reduction. The organic carbon content was increased slightly in organic and natural farming over 2 years. Available N is maintained. But, the available soil P, K, secondary nutrients (S, Ex. Ca and Mg) and micro nutrients (Cu, B and Mn) were declined in natural farming compared to the initial status. This envisages the nutrient mining in NF and needs personal attention to maintain and improve the available nutrients in the soil. However, the micro nutrients viz., Zn and Fe were maintained and improved under Natural Farming. Soil micro flora (Bacteria, fungi, actinomycetes, N₂ fixers and PSM's) and enzymatic activities (Dehydrogenase, Phosphatase and Urease) in groundnut + brown top millet rhizosphere soil were significantly higher in organic and natural farming practices than other treatments at flowering stage. Similarly, the dehydrogenase activities in the rhizosphere soil at both flowering and harvesting stages were higher under natural and Organic farming than chemical farming and ICM. Hence, cultivation of Ground nut + Brown top millet intercropping system under natural farming practices can be recommended for getting optimum productivity, profitability and enriching soil bio-diversity.

Fertilizer Prescription Model through Soil Test Crop Response Approach for Little Millet on Alfisols of Southern India

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Fertilizer requirement for the crop should be based on yield response to the added fertilizer nutrient, nutrient requirements of a crop, nutrient supply from indigenous sources and the fate of added fertilizers to the soil in the short and long term. Thus, the soil test crop response (STCR) approach can be adopted for calculating fertilizer requirements by crops. In this context, the study was conducted under dryland condition on *Alfisols* of Zonal Agricultural Research Station (ZARS), GKVK, Bengaluru, during *Kharif*, 2019 to develop the fertilizer prescription equations through NPK alone and NPK + FYM for desired yield targets of little millet. Soil test data, little millet grain yield and NPK uptake by crop were used for achieving four important basic parameters viz., nutrients required to produce one quintal of little millet grain (NR), contribution of nutrients from fertilizers (%CF), contribution of nutrients from soil (% CS) and contribution of nutrients from organic matter-FYM (% COM). The percent contribution of N, P₂O₅, K₂O from soil and fertilizer sources under sole NPK were 9.45, 11.38 and 24.39; 38.67, 64.54 and 304.68 percent respectively. Similarly, the contribution of N, P₂O₅, K₂O from soil, fertilizer and FYM under NPK + FYM were 9.45, 11.38 and 24.39; 46.06, 63.14 and 237.47; 0.258, 0.113 and 0.107 percent respectively. These basic parameters were used to develop fertilizer prescription equations for little millet under sole NPK and NPK + FYM

Fertilizer nutrients (kg ha ⁻¹)	STCR- NPK alone	STCR- NPK + FYM
F.N. =	6.935 T – 0.244 SN	5.972 T – 0.203 SN – 0.258 OM
F.P ₂ O ₅ =	2.357 T – 0.176 SP	2.015 T – 0.180 SP – 0.113 OM
F.K ₂ O =	1.194 T – 0.080 SK	1.590 T – 0.103 SK – 0.107 OM

separately as follows.

Where, FN, FP₂O₅ and FK₂O are fertilizer N, P₂O₅ and K₂O in kg ha⁻¹ respectively; T is the yield target in q ha⁻¹; SN, SP and SK are available soil nutrients as KMnO₄-N, Bray's-P₂O₅ and NH₄OAc-K₂O in kg ha⁻¹ respectively and OM is the amount of FYM (organic manure) added in t ha⁻¹. Further, ready reckoner of fertilizer doses was equipped for varying soil test values and desired yield targets of little millet for NPK alone and NPK + FYM from the above equations.

II-OP-03

Significance of Organic Sources on Nitrogen Transformation and Productivity of Finger Millet in Finger Millet-Groundnut Cropping Sequence

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A field experiment was conducted at research and demonstration block of Research Institute on Organic Farming, UAS, GKVK, Bengaluru during *kharif*, 2021, 2022 and summer 2022, 2023 to study the significance of organic sources on nitrogen transformation and productivity of finger millet in finger millet-groundnut cropping sequence. The experiment was laid out in randomized block design with factorial concept and replicated thrice. The experiment consists of 12 treatment combinations of two levels of N equivalent and six organic sources along with control and UAS-B package. The study proven that application of bio-compost at 150% N equivalent resulted in higher ammonical nitrogen (19.34 mg kg^{-1}), nitrate nitrogen (7.80 mg kg^{-1}), organic nitrogen ($231.66 \text{ mg kg}^{-1}$) and total nitrogen ($258.81 \text{ mg kg}^{-1}$) followed by application of poultry manure at 150% N equivalent. Significantly higher number of tillers hill^{-1} (9.24), total dry matter accumulation ($81.58 \text{ g hill}^{-1}$), grain yield (3459 kg ha^{-1}) and straw yield of finger millet (5842 kg ha^{-1}) was recorded in application of bio-compost at 150% N equivalent followed by application of poultry manure at 150% N equivalent and found significantly superior over other treatments in the studies. However, UAS (B) package *i.e.*, 50:40:37.5 kg N: P_2O_5 : $\text{K}_2\text{O ha}^{-1}$ recorded significantly higher number of tillers hill^{-1} (9.36), total dry matter accumulation ($82.29 \text{ g hill}^{-1}$), grain yield (3493 kg ha^{-1}) and straw yield (5942 kg ha^{-1}) and was on par with application of bio-compost at 150% N equivalent.

II-OP-04

Soil Health and Crop Productivity of Sunflower (*Helianthus annuus* L.) – Chickpea (*Cicer arietinum*) under Natural Farming Practices in Northern Karnataka

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Conventional long-term chemical farming practices can impact greatly on soil health and crops in tropics. Natural farming (NF) practices aims at building soil carbon, conservation of resources from crop and livestock sources with minimum or zero external inputs. This study aims to explore the potential impacts of NF practices on crop productivity, soil health profitability over conventional chemical farming (CF). A field experiment was conducted in fixed plots over three years at Raichur, India. Practices studied included NF, organic farming (OF), regional production of practice (RPP) and CF practice with yearly sequence of sunflower and chickpea over three years. All the inputs in NF are from plant and animal sources within a farm field. Higher available N, S and activity of dehydrogenase and phosphatase were greater in OF practice. While available P, K, exchangeable Ca, Mg were higher in RPP including grain yield of sunflower (1208 kg ha^{-1}) and chickpea (1616 kg ha^{-1}) whereas water holding capacity (WHC) and porosity were found higher in natural farming. The most prominent soil quality



indicators from the principal component analysis (PCA) are dehydrogenase, K, WHC, N and soil pH. The soil quality index based on PCA was higher in OF (0.95) and least in CF (0.85). It was confirmed that alternative to conventional farmers practice, these farming practices were variable technology in sustaining the crop productivity under adverse vagaries of climate and soil in subtropics for sustainable intensification and soil productivity in production system.

II-OP-05

Geographical Distribution and Species Composition of Shoot Fly, *Atherigona* spp. (Atherigoninae: Muscidae) on Millets and other Host Plants in India

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Among the major insect pests of millets, shoot flies are reported to be the dominant ones causing 25-90 per cent damage with peculiar dead-heart (DH) symptoms. Study was carried out to know its diversity of shoot flies on millets and other host plants. A total of 1611 adult flies were collected from ten states of the country through sweep net and light trap catches and the maggots causing dead-heart symptoms were transported to the laboratory and reared to obtain the emerging adults. Extensive field surveys were conducted for six consecutive years (2016-2021) throughout the Indian sub-continent and the geographical distribution map of shoot flies infesting cereals, millets and other host plants was developed. The shoot fly specimens were morphologically characterized and they were observed to belong to two genera; *Atherigona* and *Acritochaeta*. Out of all the specimens' characterized, eighteen species belonged to *Atherigona* spp. infesting thirteen host plants. *Atherigona pulla* (Weidemann) was noticed to infest seven millet hosts, among which maximum infestation was observed on little millet and proso millet. Whereas, *A. approximata* Malloch was collected from five millet hosts, three cereals and several other host plants and it was found to be dominant species in foxtail millet. *A. atripalpis* Malloch and *A. eriochloae* Malloch were observed to infest little millet,



sorghum and foxtail millet, whereas *A. bidens* Henning was collected from foxtail millet and wild grasses through sweep net. *A. falcata* (Thomson) were collected from barnyard millet, little millet and foxtail millet and among them maximum specimens were collected on barnyard millet. *A. gamma* Pont, *A. laeta* (Weidemann), *A. lamda* Pont and *A. omega* Pont were collected through sweep net surveys from various host plants and *A. lamda* was found to be first report from India (will be re-described shortly). Low density of *Atherigona acritichaetaorientalis* Schiner was recorded on five millet and several other host plants. *A. oryzae* Malloch was reared on proso millet and sorghum whereas one specimen was collected through light trap. The dead-hearts of foxtail millet and kodo millet hosts collected from fields showed the presence of *A. punctata* Karl. *A. reversura* Villeneuve adult specimens were collected on grasses through sweep net, light trap and malaise trap catches. *A. simplex* (Thomson) was reared on foxtail millet and kodo millet. *A. soccata* Rondani samples were obtained by rearing host plants like maize, wheat and sorghum and also from proso millet by sweep net surveys. *A. zeta* Pont and one unidentified specimen each were also collected during our field surveys. By knowing diversity shoot flies on various hosts plants, dominant species prevalence on millets. Management strategies can be developed in near future based on these findings.

II-OP-06

Mechanical Type Inter-Intra Row Robotic Weed Control System for Organic Farms

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In the present scenario, organic farming has emerged as a new trend of farming in several parts of the world. In organic farming all the farming activities should be carried out in a chemical free environment. Among them weeding activities poses a challenge to the farmers as weedicides cannot be used in the field. Nowadays, there are many tractors drawn cultivators, harrows but they are restricted to inter row regions only. Again, for intra row regions the farmer has to hire labours to remove intra row weeds. There is a need in advancement of technologies to weed out the intra row region also while weeding the inter row region. To conquer such difficulties of weeding operations in organic farms, mechanical type inter-intra row robotic weed control systems have been evolved. These robotic weed control systems will avoid the soil deterioration as weeds will be suppressed in the fields through mechanical tools. The basic components of robotic weed control system are sensing system, data processing system and mechanical weeding unit. Weed detection and identification is a crucial step in these systems. It can be achieved through machine vision or by hyperspectral images. In machine vision systems, sensors like ultrasonic, infrared, LIDAR and camera can be used to discriminate crop and weed. In more advanced systems, artificial intelligence is used as a means to accurately detect the crop position. If detection and identification process is successfully done, then the tools will be precisely moved in inter and intra row regions of crop fields. Thus, efficient weeding will be achieved in crop fields. This type robotic weed control systems not only significantly increase the crop production but also becomes a soil pollutant free way of weeding in organic farms.



Millets Scenario in India: Predictions and Strategies for Shaping the Future

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Millets are often termed nutri-cereals and include large millets like Sorghum (Jowar) and Pearl Millet (Bajra) and small millets like Finger Millet (Ragi), Little Millet (Kutki), Foxtail Millet (Kakun), Proso Millet (Cheena), Barnyard Millet (Sawa) and Kodo Millet (Kodon). These are also referred to as dry land cereals, as these hardy plants thrive in dry regions as rain-fed crops, often in areas with limited soil fertility and moisture. Millets are unique for their short growing season. Millets are also rich in minerals like iron, magnesium – Proso millet (153 mg 100g⁻¹), calcium Finger millet (364 mg 100g⁻¹), phosphorous, and potassium. According to FAO, at present, millets are being grown in about 21 states, and India is the largest producer in the world. With 173 lakh metric tonnes millets produced, India accounts for 80 per cent of Asia's millet production and 20 per cent of global production. In India, the cultivated area of millets is 12.45 m ha and produces 15.53 million metric tonnes with a yield of around 1,247 kg ha⁻¹. However, Millet production in India has been facing major problems such as low productivity, Non-availability of good-quality seeds, lesser shelf life of millets, lack of technologies and machines for primary and secondary processing, absence of market linkages, and a lack of uniform standards and grades. To overcome the above-mentioned problems, and to scale up production of millets, cultivation of high-yielding product-specific varieties, creation of seed hubs, bridging the gaps in R&D related to shelf life, primary and secondary processing machines, are the primary concerns. Additionally, a successful millet value chain model developed by ICAR- IIMR to incentivize millet cultivation and mainstreaming millets in public-funded programs such as MDM and ICDS were the major recommendations for improving the status of millets in India. Over the years, India's millet cultivation has faced a significant challenge characterized by declining cultivation area and a negative trend of demand-supply gap. In light of the circumstances outlined above, a comprehensive analysis has been done, with a specific emphasise on increasing millet production by 2030. Data were collected from the *Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Government of India*. The study analyzed the compound annual growth rate (CAGR) and the Caddy Della Valle instability index of millet cultivation in India. And explored four scenarios: 1. Implementing ARIMA modeling; 2. (Case-I) a 10percent expansion in cultivation area; 3. (Case-II) closing a 30percent yield gap while maintaining a constant area; and 4. (Case-III) integrating both diversified cultivation and yield gap closure. Notably, the findings revealed that the fourth scenario, combining diversified cultivation and yield gap demonstrated the highest millet production potential and proved to be the most effective in bridging the demand-supply gap from 2023 to 2030. Demand-supply gap analysis, using a time-series ARIMA model, indicated a negative gap of-1.16 MT for Sorghum in the year 2030. In Case-I, with a 10 per cent area increase, sorghum production reached 5022.18 thousand metric tons with a yield of 1201.22 kg hectare⁻¹, reducing the demand-supply gap to-

0.54 MT by 2030. Case-II, focusing on bridging the yield gap, achieved a yield of 1419.63 kg hectare⁻¹, resulting in a production of 5395.73 thousand metric tons over an area of 3800.81 thousand hectares, narrowing the gap to -0.14 MT. In Case-III, integrating both strategies resulted in the highest yield of 6358.61 kg/hectare, producing 1494.50 thousand metric tons over an area of 4254.66 thousand hectares. With this approach, the supply slightly exceeded the demand, resulting in a positive gap of 0.16 MT by 2030. The study highlights the importance of multifaceted scenarios to enhancing millet production. While increasing the cultivation area by 10 percent and bridging the yield gap of 30 percent reduces the demand-supply gap, the combined approach surpasses the demand, indicating a potential surplus by 2030. Similar trends were observed for Bajra, Ragi, and small millets, emphasizing the effectiveness of integrated strategies. By integrating diversified cultivation techniques with targeted yield improvement strategies, India can not only meet millet demand by 2030 but also ensure enhanced food security and economic stability for the future.

II-OP-08

Non-Chemical Approaches in Growing of High Value Ornamental Plants- An Experience

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Ornamental plants industry contributes to environmental pollution in ways but is in general ignored. Growing of high value ornamental plants mostly inside greenhouses involves usage of chemical fertilizers and pesticides. The numerous ill effects of usage of these toxic chemicals go unsaid, both for the environment and for living beings. Non-chemical practices used for growing of high value ornamentals like Orchids and Anthuriums that are standardized is discussed in the paper. Quality plants and blooms are achieved with the usage of different organic manures, pest repellants and biocontrol agents instead of chemical inputs. Compost or enriched compost is added to the substrate. Further, liquid manure is applied as foliar sprays or drenched which is a potent source of macro and micro nutrients, plant growth promoting substances and immunity enhancers. The organic manures used with excellent results are Panchagavya and Fish emulsion foliar spray and Jeevamruth application to the growing medium. Panchagavya, a fermented liquid formulation derived from five ingredients of indigenous cow *Bos indicus* is an excellent plant nutrient, growth promoter, and a bio-pesticide. Fish emulsion rich in macro, micro and trace elements is an easier to prepare ingredient that improve quality of the plants and enhance blooming. Both the preparations are excellent for orchid growing. Fortnightly application of Jeevamruth increased the number of suckers and flowers in Anthuriums manifold. Growing of high value ornamentals involve intense attention to the appearance of the flowers and also the foliage in case of pot plants. Protection from pests and diseases were achieved using biocontrol agents. Excellent results have been observed in the management of deadly diseases caused by *Erwinia carotovora*, *Phytophthora* sp., *Fusarium oxysporum* and *Xanthomonas compestris* by using *Pseudomonas fluorescens*. In addition to curbing of the disease spread, *Pseudomonas fluorescens* is observed to be a good plant growth promoter. Damage due to *Sclerotium rolfsii* was managed using *Bacillus subtilis*. The occurrence of leaf sucking pests like aphids, whiteflies and thrips were managed using



Verticillium lecanii. Manual removal of snails was found to be the most effective. Thus, non-chemical approach in growing high value crops not only reduces the cost of production but also enhances value of the produce along with being eco-friendly.

II-PP-01

Insights of Foxtail Millet (*Setaria italica*) Response to Different Spacing and Organic Nitrogen Levels

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Millets are considered to be the most significant crop of cereal grains and most suited to Eastern Dry Zone of Karnataka for cultivation. Updated study on millets cultivation and its improvement in this region warrant due attention. In view of this, an attempt has been made to evaluate the growth and yield performance of Foxtail millet (*Setaria italica*) to different spacing and nitrogen levels through organic manures. A field experiment was conducted during *kharif*, 2017, 2018 and 2019 at Agricultural Research Station, Chintamani. The experiment was laid out in factorial randomized complete block design with three replications comprising of twelve treatment combinations. The treatments comprising of two spacings (22.5 x 7.5 cm and 30 x 7.5 cm) and six nitrogen levels through organic manures (75 % N equivalent + FYM 5 t/ha, 100 % N equivalent + FYM 5 t/ha, 125 % N equivalent + FYM 5 t/ha, 75% N equivalent + FYM 7.5 t/ha, 100% N equivalent + FYM 7.5 t/ha, 125% N equivalent + FYM 7.5 t/ha). Among nitrogen levels through organic manures, increased growth, yield attributes and yield were observed. The treatment receiving 125% N equivalent + FYM 7.5 t/ha was recorded significantly higher plant height (138.85 cm), number of tillers per plant (13.15), No. of panicles per plant (12.44), grain weight per panicle (3.14 g), grain yield (2084 kg ha⁻¹) and straw yield (4900 kg ha⁻¹) over other treatments. However, it was found on par with 125 % N equivalent + FYM 5 t ha⁻¹. Among spacing treatments did not showed any significant difference for growth and yield attributes however, the spacing of 30 x 7.5 cm recorded maximum grain yield (2083 kg ha⁻¹).

II-PP-02

Comparative Evaluation of Natural Farming Practices on Different Crops and Cropping Systems in Zone 2 of Karnataka

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The field experiments on comparative evaluation of natural farming practices on different crops and cropping systems in zone 2 of Karnataka was conducted from 2018-19 to 2022-23. The experiments were laid out in a randomized complete block design with five replications. The treatments comprised of natural farming, organic farming, recommended package of practice and farmer's practice. The data of 4 years revealed that, the recommended package of practice recorded significantly higher seed yield, net returns and B:C ratio when compared to rest of the



farming practices. However, the natural farming system registered significantly lower seed yield in all the crops tested across the different locations of zone 2. The extent of yield reduction in different crops under natural farming over recommended package of practice in different crops; Maize (47-55%), Paddy (16-36%), Pearl millet (6-19%), Rabi sorghum (13-22%), Pigeon pea (24-31%), Green gram (20-24%), Chickpea (14-17%), Sunflower (19-27%) and Groundnut (19-26%). But, the cost of cultivation under natural farming practice was lower than rest of the farming systems. With regard to soil physical and chemical properties, there was slight improvement in bulk density, porosity and soil organic carbon. Soil samples at different stages of crop growth were analysed for general microflora such as bacteria, fungi and actinomycetes and the data revealed that, in almost every crop at different stages of crop growth, organic farming system recorded higher population of general micro flora followed by natural farming system. Enzyme activities such as dehydrogenase and phosphatase were significantly higher in organic farming system at different stages of crop growth followed by natural farming system. Whereas lower enzyme activities at different stages of crop were recorded in farmers practices in all the experiments. Natural and organically managed fields contain a greater abundance and diversity of arthropods than recommended package of practice and farmers practice fields. Higher disease incidences were noticed in natural farming practices compared to the other farming practices. While recommended package of practice showed better disease control compared to natural farming practices in different cropping patterns. Contrastingly, obligate parasite viz., powdery mildew causing pathogen in Sunflower; Green gram and Rust causing pathogen in Bajra; Chickpea were effectively controlled by spraying of fermented Butter milk in natural farming practices, while other diseases viz., Alternaria leaf spot in Sunflower; *Cercospora* leaf spot in Green gram and Pigeon pea; Macrophomina root rot in Pigeon pea; brown spot in Paddy; Blast disease in Bajra were less managed by natural farming practices and also highest disease incidence were found in natural farming practices. The insect pest management in natural farming practices were least controlled compared to the other farming practices. Agniastra spray were little effective against sucking pests in all crops. While majority of natural farming practices were least effective against pest management compared to the recommended package of practices.

II-PP-03

Software Based Fertilizer Prescription in for Foxtail Millet through STCR Approach in Tumakuru District of Karnataka

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Fertilizer recommendation through the soil test crop response (STCR) approach ensures efficient and sustainable use of fertilizers, optimizing crop productivity while minimizing environmental impact and resource waste. But, it is very difficult to convince the farmers about the soil test-based fertilizer application, since, it is a tedious process as it includes collection of soil sample, their analysis and fertilizer recommendation based on soil test values. In this regard, All India Coordinated Research Project on Soil Test Crop Response, University of Agricultural Sciences, Bangalore, has developed web / mobile application software Dhartimitra



where, soil health card including fertilizer recommendations based on the STCR approach and through soil fertility rating/Low-Medium-High (LMH) approach (crops without STCR equations) could be downloaded by fetching the geo coordinates of the location or survey number of the farmer's field. The validation studies on this software on soil parameters through correlation showed a positive and significant correlation between actual soil test values with the software predicted values with respect to pH ($r=0.258$), EC ($r=0.395$) and Mn ($r=0.182$), whereas the accuracy showed a very good correlation for most of the soil parameters studied with more than 88% accuracy for the entire Tumakuru district. In this regard, the present study was conducted to evaluate different approaches of fertilizer recommendation in comparison with Dhartimitra app for foxtail millet crop at different talukas of Tumakuru District, Karnataka during *khari* 2022, by taking 5 treatments viz., T₁: STCR approach of NPK application through Dhartimitra software for yield target of 15 q ha⁻¹, T₂: STCR approach of NPK + application through Dhartimitra software for yield target of 15 q ha⁻¹, T₃: STCR approach of NPK application based on actual analytical data, T₄: STCR approach of NPK + FYM application based on actual analytical data, T₅: General Recommended Dose, T₆: Soil fertility rating / LMH approach, T₇: Farmer's practice and T₈: Absolute control. Mean yield data of 15 trials on foxtail millet crop clearly indicated significantly higher grain yield of 15.23q ha⁻¹ was recorded with fertilizer recommendation through STCR approach with NPK + FYM based on actual analytical data which was on par with Dhartimitra software generated fertilizer recommendation. Among the fertilizer applied plots farmer's practice recorded significantly lower grain yield (9.02 q ha⁻¹). The value cost ratio (VCR) was highest (9.29) in actual analytical data based STCR recommendation followed by software generated fertilizer recommendation report (8.68). Also, STCR approach outperformed the general recommended dose and soil test fertility rating approaches, resulting in enhanced yields, increased NPK uptake, improved nutrient use efficiency and better profitability.

II-PP-04

Comparative Study on Estimation of Energy Budgeting from Natural Farming, Organic and Conventional Farming in finger Millet

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The field experiment was conducted on "Comparative study on estimation of energy budgeting from natural farming, organic and conventional farming in finger millet" during 2020-21 at experimental sites of the Research Institute of Organic Farming and National Seed Project, UAS, GKVK, Bangalore for finger millet crop consisting of five treatments of different farming practices (Natural farming, Organic farming, UASB POP, Farmers practice and Absolute control) laid out in RCBD and replicated five times. The results of the experiment show that input-output data was obtained from each treatment with 5 replications in a unit area



of 0.072 ha. Labour requirement for UASB POP (522 h) treatment was found higher followed by organic farming (515.04 h), farmers practice (448.96 h) and NF (436.64 h). The fossil fuel consumption from the machine labour was found highest in UASB POP (61.56 L, 10.26 h) followed by farmer practice (54.24 L, 9.04 h), organic farming (51.66 lit, 9.04 h) and natural farming (48.3 L, 8.05 h). The electricity consumption for irrigating crops was the same for all farming practices (2.16 kWh, 108 L) except natural farming (1.08 kWh, 54 L) because the number of irrigations given is less compared with other farming practices. The seed, fertilizers consumption, FYM, natural fertilizers, herbicides, pesticides, biopesticides and mulching material was applied as per the requirement of farming practices. The total input energy was found higher in organic farming (8622.26 MJ ha⁻¹) followed by natural farming (8040.36 MJ ha⁻¹), UASB POP (6059.02 MJ ha⁻¹) and farmers practice (5386.71 MJ ha⁻¹). The energy output of the main product (seed) was found to be higher in UASB POP (1571.72 MJ ha⁻¹) followed by farmer's practice (1390.77 MJ ha⁻¹), organic farming (1328.29 MJ ha⁻¹) and natural farming (1006.51 MJ ha⁻¹). The total energy output was found higher in UASB POP (4788.35 MJ ha⁻¹) followed by farmer's practice (4457.89 MJ ha⁻¹), organic farming (4304.54 MJ ha⁻¹) and NF (3026.11 MJ ha⁻¹). The energy use efficiency (EUE) and EUE of the main product were found higher in farmer's practice (0.83, 0.26) followed by UASB POP (0.79, 0.26), organic farming (0.5, 0.15) and natural farming (0.38, 0.13). Net energy and net energy for the main product were found negative in natural farming (-5014.25, -7033.85) followed by organic farming (-4317.72, -7293.97), UASB POP (-1270.67, -4487.29) and farmers practice (-928.82, -3995.94). Energy profitability was found higher in natural farming (-0.62) and organic farming (-0.5), UASB POP (-0.21) and farmer's practice (-0.17). Human energy profitability was found higher in farmers practice (5.07) followed by UASB POP (4.68), organic farming (4.26) and natural farming (3.54). Energy productivity was found similar in farmer practice (0.02) and UASB POP (0.02) followed by natural farming (0.01) and organic farming (0.01). Specific energy was found to be higher in NF (117.43) followed by organic farming (95.42), farmer's practice (56.94) and UASB POP (56.67). The input energy was higher in organic farming followed by natural farming practices and the output energy was found higher in UASB POP followed by farmers practice.

II-PP-05

Status of Shoot Flies (*Atherigona* spp. : Muscidae) of Small Millets in India

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Millets are important nutri-cereal crops cultivated by farmers in the adverse environmental conditions. Millets are rich in minerals and vitamins compared to rice and wheat; millets have the huge potential to provide security of food, nutrition, fodder, fiber, health, livelihood and ecology. Major millets include sorghum and pearl millet whereas small grain millet includes finger millet, foxtail millet, kodo millet, proso millet, barnyard millet and little millet. However, insect pests and diseases are the major constraint in production of small millets. Among insect pests, shoot fly is the major pest occurring on small millets at seedling stage causing economic loss to crop. Here, the five-year data on per cent incidence of shoot fly, *Atherigona* sp. on different millets were compiled to know its pest status on small millets of India. In Kodomillet (2017 - 2021), the incidence of dead-heart was ranges from 9.79 to 20.60 with average of 13.06 per cent. Whereas highest incidence was noticed irrespective of years in Bangalore (18.27) followed by Dindori (17.23), Ranchi (11.13), Dholi (7.11) and Ranichauri (3.56). Among the different millet growing centres highest incidence of shoot fly was observed in Dindori (52.32), Bangalore (37.86) and Ranchi (18.09) in the year 2020, 2018 and 2017, respectively. In little millet (2017 -2021), the incidence of dead-heart was ranged from 12.85 to 23.77 with an average of 14.43 per cent, whereas highest incidence was noticed in Bangalore (27.62) followed by Dindori (24.65), Ranchi (12.37), Dholi (9.28) and Ranichauri (2.51). Among the different millet growing centres highest incidence (> 30) of shoot fly was observed in Dindori (41.44) and Bangalore (37.57) in the year 2019. In proso millet (2017 to 2021), the incidence of dead-heart was ranged from 15.73 to 57.21 with average of 40.60 per cent, whereas highest incidence was noticed in Ranchi (54.77) followed by Bangalore (38.49), Dindori (23.94), Berhampur (16.11) and Dholi (9.77). In foxtail millet, the incidence of dead-heart was ranges from 10.38 to 27.70 with average of 18.61 per cent during 2017 to 2021, whereas highest incidence was noticed in Bangalore (29.94) followed by Ranchi (12.18) and Dholi (4.16). In barnyard millet the incidence of dead-heart was ranges from 11.44 to 22.40 with average of 18.23 per cent during 2017 to 2021, whereas highest incidence was noticed in Ranichauri (20.55) followed by Bangalore (18.86). In browntop millet, the incidence of dead-heart was ranges from 2.81 to 18.48 with average of 13.94 per cent during 2017 to 2021, whereas highest incidence was noticed in Bangalore (28.56) followed by Dindori (15.23), Berhampur (6.32), Dholi (5.08) and Ranichauri (4.64).

Set Furrow- A Sustainable Production System for Enhancing Productivity in Finger millet + Pigeonpea (8:2) Intercropping System

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A field experiment was conducted for sustainable production of finger millet + pigeonpea (8:2) intercropping system during *kharif* 2022 at AICRP for Dryland Agriculture, GKVK, UAS, Bangalore with two seed placement techniques in main plots (sowing in centre of the furrow and sowing on sides of the furrow) and five moisture conservation practices in sub plots (Finger millet + pigeon pea (8:2) with conservation furrow, set furrow cultivation of finger millet + pigeon pea (8:2), set furrow cultivation of finger millet + pigeon pea (8:2) + vermicompost @ 2.5 t ha^{-1} , set furrow cultivation of finger millet + pigeonpea (8:2) + gliricidia @ 2.5 t ha^{-1} and set furrow cultivation of finger millet + pigeonpea (8:2) + horse gram as *in-situ* mulching) was laid out in split plot design replicated thrice. The results revealed that, sowing in centre of the furrow recorded significantly higher finger millet grain and straw yield (3213 & 4819 kg ha^{-1} , respectively) and pigeonpea seed and stalk yield (339 & 679 kg ha^{-1} , respectively) as compared to sowing on sides of the furrow (finger millet: 2691 & 4037 kg ha^{-1} & pigeonpea: 305 & 550 kg ha^{-1} , respectively). Further, finger millet equivalent yield (3849 kg ha^{-1}) and rain water use efficiency ($3.19 \text{ kg ha-mm}^{-1}$) with net returns ($\text{₹ } 83,614 \text{ ha}^{-1}$) and B:C ratio (2.90). It also recorded 19.71 higher soil moisture per cent at 15-30cm depth of soil at grand growth stage of pigeonpea (90DAS) compared to sowing on sides of the furrow (18.02 %). Among moisture conservation practices, set furrow cultivation of finger millet + pigeonpea (8:2) + vermicompost @ 2.5 t ha^{-1} recorded significantly higher finger millet grain and straw yield (3247 & 4870 kg ha^{-1} respectively) and pigeon pea seed and stalk yield (379 & 722 kg ha^{-1} , respectively). Further significantly higher finger millet equivalent yield (3957 kg ha^{-1}) and rain water use efficiency ($3.28 \text{ kg ha-mm}^{-1}$) with higher net returns ($\text{₹ } 74,630 \text{ ha}^{-1}$) and B: C ratio (3.28). It also recorded 21.55 higher soil moisture per cent at 15-30cm depth of soil at grand growth stage of pigeon pea (90DAS) compared to different moisture conservation practices. With respect to soil fertility status significant results were observed in soil available nitrogen, phosphorus and potassium with respect to seed placement and moisture conservation practices. Among main plots, higher available nitrogen (200.2 and 161.3 kg ha^{-1}), phosphorous (93.6 and 83.8 kg ha^{-1}) and potassium (138.4 and 126.9 kg ha^{-1}) was observed in M_1 (Sowing in centre of the furrow) in pigeonpea and finger millet plots respectively. Among sub plot treatments, available nitrogen (246.5 and 184.5 kg ha^{-1}), phosphorous (102.5 and 99.1 kg ha^{-1}) and potassium (155.3 and 141.1 kg ha^{-1}) was significantly higher in set furrow cultivation of finger millet + pigeon pea (8:2) + gliricidia @ 2.5 t ha^{-1} (S_4) in pigeon pea and finger millet plots respectively.



Jaivik krushi Inputs for Sustainable Agriculture in the Current Scenario

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Green revolution has helped to increase food production from 50.83 m t in 1950's to 315.72 million tons in 2021-22 through the use of HYV's and agrochemicals. Consequently, the indiscriminate use of agrochemicals has resulted paradigm shift towards sustainable practices in the loss of soil health, soil biodiversity, degradation of soils (salinization, acidification, etc.), loss of agro-ecosystem, biodiversity (predators and parasites) and nutrient deficiencies. It is also affecting the nation's economy as more than 500 billion rupees worth of agri-inputs is imported. To mitigate the ill effects of green revolution impact, there is need to adopt the age old practice i.e., organic farming, out of various methods of this system, Jaivikkrushi emerges as a promising approach to sustainable agriculture by prioritizing ecological harmony, soil health and the overall well-being of ecosystems. It is a system of farm design and management that creates ecosystem which can achieve sustainable productivity without the use of agrochemicals. Any inputs that are living, i.e., plants, animals, and microbes, or derived from them by decomposition and fermentation processes, can be considered jaivikkrushi inputs, e.g., vermicompost, biofertilizers, neem oil, panchagavya, etc. Apart from the organic inputs mentioned in IFOAM standards, jaivikkrushi production systems prevalent in India are biodynamic farming, rishi krishi, panchagavyakrishi, agnihotrakrishi, and natural farming. Key components include the use of organic manures, crop residues, and green manures to enhance soil fertility and structure. Biopesticides derived from plant extracts, beneficial insects, and microbial agents are employed to manage pests and diseases without harming the environment or human health. Crop rotation and intercropping strategies are implemented to optimize resource utilization and minimize the risk of soil degradation. The most essential requirement to practice these systems is desi cow. The dung and urine form the key component in most of the inputs like panchagavya, kunapajala, jeevamrutha, vermiwash, etc. Firstly, organic farming methods enhance soil fertility and structure, leading to improved water retention and reduced vulnerability to erosion. Secondly, the avoidance of synthetic pesticides and herbicides promotes biodiversity by safeguarding beneficial organisms and pollinators crucial for ecosystem balance. Thirdly, the use of organic inputs contributes to the reduction of greenhouse gas emissions and mitigates climate change effects. The integration of jaivikkrushi inputs in agriculture is a crucial step towards achieving a sustainable and resilient food production system. By prioritizing ecological balance, soil health, and biodiversity conservation, jaivikkrushi inputs offer a pathway to address the pressing challenges facing modern agriculture and pave the way for a more sustainable and regenerative future.

II-PP-08

In-Vitro Efficacy of Bio-Agents and Fungicides against Pearl Millet Downy Mildew Caused by *Sclerospora graminicola* (Sacc.) Schoret

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Pearl millet (*Pennisetum glaucum* (L.)) climate-smart crop with nutritious grains. It is popularly known as Bajra in India. India is the largest producer of pearl millet, both in terms of an area, production and productivity. Downy mildew incited by *Sclerospora graminicola* (Sacc.) Schoret is the most widespread and destructive disease of pearl millet in India. The efficacy of eight bio-control agents with 1 x10⁸ CFU/ml and nine fungicides were evaluated against *Sclerospora graminicola*, causing pearl millet downy mildew in screen house conditions during *Kharif* season of 2019-20. In case of bioagent, seeds treated with the bioagent were sown in earthen plastic pots filled with autoclaved soil, sand and manure in the ratio 2:1:1. While in case of fungicides, seed treatment and foliar application of fungicides to inoculated plants was made on 7th and 15th day after emergence. Three replications per treatment were arranged in a randomised complete block design (RCBD). Seedlings were maintained at 25–30°C with 95% relative humidity. Two -day-old seedlings were whorl-inoculated with *S. graminicola* zoospore suspension. The disease incidence was recorded after 30 days of sowing. Among biocontrol agents seed treatment of *Pseudomonas fluorescens* @ 8 gm/ Kg seed (4.00 %), *Trichoderma harzianum* (ST) @ 8 gm/ Kg seed (5.33 %). While among fungicides, foliar application of Azoxystrobin 23 % SC @ 2ml/L (5.33 %), Provalicarb 5.5% + Propineb 61.25% w/w WP (@ 1 gm/, Trifloxystrobin WG 50 @ 1ml/L (6.66 %), and Kresoxim-methyl WG 50% (7.33%) significantly reduced the incidence of downy mildew disease.

II-PP-09

Promoting Organic Production Technology for Augmenting Higher Productivity of Foxtail Millet Under *Melia dubia* Based Agroforestry System

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The transformation of agriculture to more productive systems has often been accompanied by increased production in a fewer crop species. Concurrently, the area and production of a great diversity of traditional crops have declined. Yet in many parts of the world, traditional crops play an important role in maintaining stable and sustainable forms of agriculture. Among the crops, minor millets which are cultivated on low fertile lands are completely neglected. Millets are important cereals which play a significant role in the food and nutritional security of developing countries in the semi-arid tropics of Asia and Africa especially country like India. Among the eight millets, foxtail millet (*Setaria italica*) is extensively cultivated in Kalyana Karnataka region and it is an indigenous crop known for its rich nutritive value and fairly



drought tolerant. Due to its quick growth, it can be grown as short term catch crop either as sole crop or inter crop with least management practices viz., without applying the nutrient fertilizers or with less quantity of organic manures alone. The yield of this crop is not stable under rainfed conditions due to its cultivation on marginal or low fertile soils with less inputs use. The potential yields are yet to be achieved. The crop responds very well to organics due to its low nutrient requirements and yield decline is mainly due to low soil fertility status and can be maintained on sustainable manner under organic system. In this context, either under sole cropping or with agroforestry system, it is worth to mention that nutrient management through organics plays a major role in exploiting the potential crop yields apart from maintaining soil health as a results of buildup of soil organic matter, beneficial microbes and enzymes thus improving soil physical and chemical properties under organic production system. In an organic manurial experiment, sole foxtail millet without tree component with recommended organic manures recorded significantly higher grain yield (1656 kg ha^{-1}) than all other the treatments in agroforestry system. With tree association, FYM (50%) + poultry manure (50%) equivalent to recommended N along with foliar spray of panchagavya (3%) at 30 DAS alternated with vermi-wash (5%) at 45 DAS recorded significantly higher grain yield (1487 kg ha^{-1}) over control. This treatment also resulted insignificant improvement in growth and yield parameters, soil available NPK, microbial population and carbon sequestration. The system economic analysis showed that crop associated with tree with application of FYM + poultry manure + panchagavya alternated with vermi-wash and FYM + poultry manure + panchagavya recorded significantly higher net returns and B: C ratio over all other treatments.

II-PP-10

Harmony in Agriculture: Embracing Natural Farming for Ecological Balance

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As the world faces increasing challenges in ensuring food security and mitigating the environmental impact of agriculture, the concept of "Harmony in Agriculture" emerges as a crucial paradigm. This abstract explores the transformative potential of natural farming as a key driver for establishing sustainable food systems. natural farming, characterized by minimal human intervention and a deep connection with ecological processes, promotes harmony between agricultural practices and the natural environment. Natural farming, often synonymous with "no-till farming" or "do-nothing farming," embodies principles that prioritize the integration of cover crops, crop rotations and the preservation of natural landscapes. This approach aims to enhance soil fertility and structure while minimizing the reliance on synthetic fertilizers and pesticides. The cultivation of diverse polycultures is a fundamental aspect, fostering resilience and reducing the susceptibility to pests and diseases through a balanced ecosystem. The concept of "Harmony in Agriculture" extends to the philosophy of non-action, where farmers, inspired by the teachings of visionaries like Masanobu Fukuoka, observe and understand natural processes, allowing ecosystems to self-regulate. This mindful approach minimizes disruptions to soil structure, preserving the intricate web of life beneath the surface.



By embracing this philosophy, natural farming contributes to the restoration of degraded landscapes and the conservation of biodiversity. The emphasis on organic matter and microbial activity in the soil is pivotal in natural farming. Cover crops, mulches, and minimal disturbance contribute to a healthy soil microbiome, enhancing nutrient availability and water retention. This not only improves crop yields but also ensures the long-term sustainability of agricultural systems. In conclusion, as the global community strives to reconcile agricultural productivity with environmental preservation, embracing Natural farming becomes imperative.

II-PP-11

Long-Term Effect of Fertilization on Carbon Pool and Carbon Management Index in Rhizosphere Soil of Finger Millet

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The information on impact of long-term fertilization on soil organic carbon (SOC) pools in rhizosphere (R) and non-rhizosphere soil (NR) of finger millet mono-cropping is scanty. So, the present investigation was taken up in one of the ongoing long-term experimental plots All India Co-ordinated Research Project for Dryland Agriculture (AICRPDA), Bangalore established in the year 1978. The major objectives of this study were to evaluate long-term (43 years) fertilization impacts on 1) SOC, labile carbon (CL) and non-labile carbon (CNL) 2) carbon management index (CMI) in rhizosphere and non-rhizosphere soil. The experiment comprised eight treatments, replicated three times: (T1) Control; (T2) RDF 100% [50:50:25 (N: P₂O₅:K₂O) kg ha⁻¹]; (T3) FYM (10 t ha⁻¹); (T4) FYM (10 t ha⁻¹) + 50% RDF; (T5) FYM (10 t ha⁻¹) + 100% RDF; (T6) MR (5 t ha⁻¹); (T7) MR (5 t ha⁻¹) + 50% RDF; (T8) MR (5 t ha⁻¹) + 100% RDF (where, RDF: recommended dose of fertilizer, FYM: farmyard manure and MR: maize residue). The results revealed that SOC, CL and CNL were found to be higher in rhizosphere soil by 19.14%, 18.51% and 19.40% respectively, as compared to non-rhizosphere soil. Among the different treatments, application of FYM (10 t ha⁻¹) + 100% RDF (T5) was more effective for increasing SOC, CL, CNL and CMI as compared to organic (T3) or inorganic (T2) alone and control (T1) treatment plot and the contents of SOC, CL, CNL in T5 is 11.2 g kg⁻¹, 3.20 g kg⁻¹, 8.0 g kg⁻¹ respectively, in rhizosphere soil and 9.4 g kg⁻¹, 2.7 g kg⁻¹, 6.7 g kg⁻¹ respectively, in non-rhizosphere soil and the least was recorded in control plot of both rhizosphere and non-rhizosphere soil. Similarly, CMI was found to be significantly higher in T5 (FYM (10 t ha⁻¹) + 100% RDF) treatment 887.06 in R and 1137.56 in NR as compared to organic/inorganic alone and control plot. The increased soil organic carbon pools in T5 treatment of rhizosphere soil were mainly due to higher residue input and increased microbial activity in root vicinity as when compared to control plot. In addition to this higher CMI is generally associated with improved overall soil health. Indicating that a balanced and sustainable INM approach contributes to increased crop yield, reduced environmental impact and long-term agricultural sustainability.



II-PP-12

Harnessing the Potential of Mighty Millets of 21st Century

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Millets are the group of small-seeded annual grasses that are grown as grain crops primarily on marginal lands in dry areas and belong to the Poaceae family. Millets are the only crops which can address important issues in the future like food, feed, fuel, malnutrition, health, and climate change. Millets are undoubtedly “climate smart crops” because they are extraordinarily tolerant to drought, high temperatures, demanding less water and fit well even in the low fertile soils. Millets are commonly known as the nutri-cereals due to their nutritional values in terms of carbohydrates, crude fibers, antioxidants, minerals and vitamins. Recognizing their unique potential, the United Nations-Food and Agriculture Organization has announced the year 2023 as the “International Year of Millets”. Due to climate change, there is a decline in yield leading to food insecurity, more attack of pests and diseases, soil degradation, change in crop schedules, and desertification. Small-millets production is majorly hampered by various biotic and abiotic factors. Biotic stresses, such as bacteria, fungus, virus and nematodes etc. causes severe yield losses. Of the several fungal diseases, Banded leaf and sheath blight incited by *Rhizoctonia solani* Kuhn is one of the emerging malady in successful cultivation of millets and causes yield losses in all major millet growing areas. The pathogen has wide host range, most wide spread, destructive and versatile found in most parts of the world. Keeping in view of the sustainable yields, a field experiment was conducted at Agricultural Research Station, Vizianagaram on yield loss assessment in seven millets due to banded leaf sheath blight during 2021-2022, Among the five different treatments, maximum percent disease index in Proso millet (8.86%), Little millet (8.73%), Kodo millet (8.62%), Finger millet (8.57%), Browntop millet (8.33%), Barnyard millet (8.45%) and Foxtail millet (8.26%) was recorded in the treatment, where the pathogen was soil inoculated to all the plants. While minimum percent disease index in Proso millet (2.01%), Little millet (1.93%), Finger millet (1.84%), Browntop millet (1.78%), Barnyard millet (1.66%), Foxtail millet (1.61%) and Kodo millet (1.52%) was recorded in control plot (Un-inoculated + Fungicide treated plot).

II-PP-13

Abiotic and Biotic Stress Management in Millets

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Millets are resilient and versatile crops that play a crucial role in global food security, particularly in regions with challenging environmental conditions. However, millet production faces significant challenges from both abiotic and biotic stresses, which can adversely impact yield and quality. This abstract provides an overview of the strategies employed for the management of abiotic and biotic stresses in millets. Abiotic stresses, such as drought, salinity



and temperature fluctuations, pose substantial threats to millet cultivation. To address these challenges, a combination of traditional and modern approaches is essential. Traditional agricultural practices, including crop rotation and intercropping, help maintain soil health and minimize the impact of abiotic stress. Additionally, the development and cultivation of stress-tolerant millet varieties through conventional breeding and biotechnological interventions have shown promising results. Precision agriculture techniques, such as the use of sensors and remote sensing, enable farmers to optimize resource use, thereby mitigating the effects of abiotic stress. Biotic stresses in millets encompass a range of pests and diseases that can significantly reduce crop yields. Integrated pest management (IPM) strategies, combining biological control, cultural practices and judicious use of pesticides, have proven effective in controlling pest populations while minimizing environmental impact. Breeding for resistance against prevalent diseases and pests is a key component of sustainable biotic stress management. Molecular techniques, including marker-assisted selection, facilitate the rapid development of resistant varieties. Furthermore, promoting biodiversity within and around millet fields enhances natural pest control mechanisms. The most effective strategies for managing stress in millets involve an integrated approach that addresses both abiotic and biotic stressors simultaneously. Agroecological practices that focus on enhancing soil health, water-use efficiency and promoting natural ecosystems contribute to overall stress resilience. Farmer education and extension services play a vital role in disseminating knowledge about sustainable agricultural practices. Government policies that support research and development of stress-tolerant millet varieties, as well as incentivize the adoption of environmentally friendly practices, are crucial for the long-term success of stress management efforts. In conclusion, the management of abiotic and biotic stresses in millets requires a holistic and multifaceted approach. By integrating traditional wisdom with cutting-edge technologies, stakeholders can foster resilient millet production systems that contribute to global food security in the face of changing climates and evolving pest pressures.

II-PP-14

A comprehensive analysis of Trend, Instability of Area, Production, Productivity and Trade Competitiveness of Millets in India

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Study on millet trend, focusing on their significance, instability and trade competitiveness. Global millet production is predominantly in Asia, India being the top producer of millets. An examining Compound Annual Growth Rate (CAGR) for world millets production from 2000-2021, area -0.69 per cent with negative significant growth, production (0.48 %), and productivity (1.18%) have positive growth rates. In India (2000-2021), millet farming witnessed a decline in cultivated area with CAGR of -1.92 % but an increased growth rate of millets production (0.77%) and productivity (2.75%). Instability indices were used to assess variability in millet area, production and productivity. Instability of millets at global level for



a period of 2000-2021, Cuddy Della Velle Index 3.93 %, 8.99% and 6.76% of area, production and productivity of millet respectively with low level of instability. Instability of millets at India level for a period of 2000-2021, Cuddy Della Velle Index 7.09 %, 14.99% and 10.98% of area, production and productivity of millet respectively with low level of instability. The major importing markets for millet exported by India during the year 2021, with a total exported quantity of 91,288 tones, among UAE (26.59%) was the largest importing market, followed by Nepal (24.18%) was the second-largest importing market. Revealed Comparative Advantage (RCA) has been estimated for top 10 millet exporting countries in globe. Ukraine has the highest average RCA of 40.75 for millets exports to the world followed by India with an average RCA of 10.62. The transitional probability matrix, observed Nepal is the most stable importer of the Indian Millets as the probability that Nepal retained its original share from previous year was 81.63 percent. Herfindahl-Hirschman Index (HHI) is used to measure the concentration of Millets exports. Global millets export, HHI values for millets is 0.141 which is moderately concentrated, global millet imports, the estimated HHI value was 0.277 which is highly concentrated. With respect to millet exports from India, the estimated HHI value was 0.17, which falls under Moderate Concentration.

II-PP-15

Diversification of Cropping Systems Through Organic Farming: A Sustainable Approach for Agricultural Resilience

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The global agricultural landscape is facing unprecedented challenges, including climate change, soil degradation, and the depletion of natural resources. In response to these issues, there is a growing interest in sustainable farming practices, with organic farming emerging as a promising approach. This abstract explores the concept of diversifying cropping systems through organic farming and its potential to enhance agricultural sustainability. Organic farming is characterized by the use of natural inputs, avoidance of synthetic chemicals, and emphasis on ecological balance. One of its key features is crop diversification, a strategy that involves cultivating a variety of crops within a single farm or field. This approach contrasts with conventional monoculture, providing numerous environmental, economic, and social benefits. Diversification of cropping systems in organic farming promotes biodiversity, as different crops attract a variety of beneficial organisms, reducing the reliance on chemical pesticides. This enhances ecosystem resilience, making farms more adaptable to changes in climate and pest dynamics. Moreover, diverse crops contribute to improved soil health through reduced erosion, increased organic matter, and enhanced nutrient cycling, fostering long-term sustainability. From an economic perspective, diversification minimizes the risks associated with market fluctuations and climate variability. Farmers engaged in organic farming often find that a mix of crops can provide a more stable income compared to relying on a single commodity. Additionally, diversification supports local food systems by offering a wider range of products, contributing to food security and reducing dependence on a few staple crops. Socially, diversification through organic farming encourages traditional and indigenous



agricultural knowledge, fostering community resilience. By promoting agroecological practices, organic farming can empower farmers to become stewards of their land, preserving cultural heritage and contributing to the overall well-being of rural communities. In conclusion, diversification of cropping systems through organic farming represents a holistic and sustainable approach to agriculture. Embracing this strategy can lead to increased environmental resilience, economic stability, and social well-being, making it a viable pathway towards a more sustainable and resilient future for global agriculture.

II-PP-16

Effect of Crop Residue Management on Soil Health and Yield of Finger Millet

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Crop residue management through conservation agriculture can improve soil productivity and crop production by maintaining soil organic matter levels. Extensive use of land and increased use of chemical fertilizers has led to the deterioration of the land leading to the decrease in the inherent capacity of the soil day by day. Burning of the crop residues is usually a common practice done in an attempt to improve tillage efficiency, to enhance the growth of the new crop, to reduce diseases as crop residues may sometimes serve as a host for pathogens and to control weeds and insects. Repeated removal of residues by burning can cause significant environmental problems and loss in soil fertility due to land degradation. With the adoption of conservation agriculture-based technologies these residues can be used for improving soil health, increasing crop productivity, reducing pollution and enhancing sustainability and resilience of agriculture. A field experiment was carried at Agricultural Research Station, Vizianagaram during 2018-2021 with an objective to study the effect of straw incorporation on soil fertility and crop yield in finger millet in Red Sandy Loam soils. It was observed that incorporation of ragi straw shredded material + Urea @ 5 kg/ha + SSP @ 5 kg/ha +75% RDF has shown the highest grain yield (2700 kg/ha) which was on par with 100% RDF (2571 kg/ha) with highest B:C ratio of 2.38 and is considered as the best treatment. Post-harvest soil analysis showed that soil available N and P₂O₅ were found significantly high in the treatment in which microbial consortium (decompo A + decompo B) was applied for decomposition of finger millet straw.

II-PP-17

Emerging pest on small millets: Rice gundhi bug, *Leptocorisa oratorius*(Thunberg) (Hemiptera: Alydidae)

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Small millets are one of the major staple food of the poorest of the poor and a larger section of tribal and hill peoples. It is widely cultivated in Asia and Africa and India occupying an area of about seven million hectares. During *Kharif* 2021, the heavy incidence of bug was observed



feeding on proso millet, little millet and browntop millet plant affected ranges from 8 -10, 6-8 and 4-6 per cent, respectively. In prosomillet, the panicles affected within plant was 30-40 per cent. The number of adults per meter row was 1-4 in little millet and brown top millet. The bugs feed by inserting their needle like mouthparts tender stems and developing grains. It can lead to growth retardation and excessive feeding can cause yellow spots on the leaves economically important damage caused by adults and nymphs feed on the developing grains. Such damage causes discoloration of the grains, which reduces market quality. The bug identified as rice gundhi bug, *Leptocorisa oratorius* (Thunberg) with ventro-lateral spots on the abdomen affects the millets, Whereas *Leptocorisa acuta* (Thunberg) characterised by without ventro-lateral spots on the abdomen.

II-PP-18

Organic Farming Studies in Finger Millet (*Eleusine coracana*)

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Experiment was conducted at Agricultural Research Station, Seethampeta during *Kharif* season, 2018-19 and 2019-20 to study the effect of organic farming on yield and yield attributes of finger millet and on soil quality parameters. Experiment was carried out with three different treatments namely: (1) T1: FYM @ 5t/ha + Vermicompost @ 4t/ha (2) T2: RDF N-P₂O₅-K₂O 60-30-20 kg/ha (3) T3: 50% N through FYM + 40% N through Neem cake + Biofertilizers (Azospirillum & PSB). Among the three treatments, T2 treatment through RDF recorded highest Plant Height (100.04 cm), No of fingers per ear head (5.8), No. of heads per plant (2.52), 1000 Grain weight (2.8 gms), Grain Yield (1876 kg/ha) followed by T3 treatment Plant Height (84.28 cm), No of fingers per ear head (5.26), No. of heads per plant (2.48), 1000 Grain weight (2.6 gms), Grain Yield (1699 kg/ha). Post-harvest analysis of soils showed higher organic carbon, Water holding capacity and lower Bulk density and lower N, P₂O₅, K₂O in T3 treatment compared to T2 treatment.

II-PP-19

Performance of Little Millet (*Panicum sumatrense*) to Different Spacing and Organic Manures levels

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Millets are nutrient-rich seeded grasses that serve as excellent food and fodder for millions of resource poor farmers and are essential crops of dryland/ low rainfall areas. Millets are resilience to adverse climate conditions, contributes to stable yields even in challenging environments and minimizing production risks for farmers. So, millets are considered as future crop in India as majority of agriculture area represent rainfed situation. In connection to this the present study is more insightful to understand the performance of little millet (*Panicum*



sumatrense) to different spacing and organic manures levels. A field experiment was carried out at Agriculture Research Station, Chintamani during *kharif* 2017, 2018 and 2019. The treatments comprised of two spacings (22.5 x 7.5 cm and 30 x 7.5 cm) and six organic manures (75 % N equivalent + FYM 5 t/ha, 100 % N equivalent + FYM 5 t/ha, 125 % N equivalent + FYM 5 t/ha, 75% N equivalent + FYM 7.5 t/ha, 100% N equivalent + FYM 7.5 t/ha, 125% N equivalent + FYM 7.5 t/ha) with twelve treatment combinations. The experiment was laid out in factorial randomized complete block design with three replications. The results of the study revealed that 30 x 7.5 cm recorded significantly higher plant height (154.43 cm), number of tillers per plant (11.25), number of panicles per plant (18.20), grain yield (1575 kg/ha) and straw yield (7754 kg/ ha). Among organic manure levels application of 125% N equivalent organic manures + FYM 7.5 t/ha recorded significantly higher growth and yield parameters, viz., higher plant height (158.15 cm), number of tillers per plant (11.68), Number of panicles per plant (17.95), grain yield (1648 kg/ha) and straw yield (8009 kg/ha).

II-PP-20

Evaluation of Organic Methods of Weed Management in *Kharif* Foxtail Millet *Setaria italica* (L.) P. Beauv

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A field experiment was conducted during *kharif* season 2018-19 and 2019-20 at AICRP on Weed Management, Main Research station, Hebbal, University of Agricultural Sciences, Bengaluru, to identify suitable methods of managing weeds under organic farming system in Foxtail millet cultivation. Experiment comprised nine treatments, laid out in Randomized Complete Block Design (RCBD) with three replications. The gross and net plot sizes were 4.2 m X 3.6 m and 3.3 m X 3.3 m respectively. According to treatment Stale seed bed treatment was initiated 20 days before sowing of the foxtail millet crop. One irrigation was given to stale seed bed plots and weed seeds were allowed to germinate. The germinated weeds were removed by passing cultivator criss-cross. The procedure was repeated 2-3 times. Organic Mulching was done with crop residues @ 5t/ha at 15-20 days after sowing. Seed of cowpea and coriander was sown in between two rows of fox tail millet and was mulched between rows at 30 days after sowing and inter-cultivation at 40 days after sowing. Pooled analysis revealed that Stale seed bed technique + inter-cultivation twice at 25 & 45 days after sowing and Inter cultivation at 25 days after sowing + 1 hand weeding at 45 days after sowing was found to be effective for weed management under organic system of foxtail millet cultivation. At 30 and 60 days after sowing weed dry weight were significantly lower in hand weeding at 20 and 40 days after sowing (1.63 and 2.28 g/m²) treatment, and was on par with Stale seed bed technique + inter-cultivation twice at 25 & 45 days after sowing (1.83 and 2.29 g/m²) followed by Inter cultivation at 25 days after sowing + 1 hand weeding at 45 days after sowing (1.96 and 2.33 g/m²). With reference to weed density, same trend was followed at 30 and 60 days after sowing in Inter cultivation at 25 days after sowing + 1 hand weeding at 45 days after sowing (6.94 and 6.17 no./m²) and Stale seed bed technique + inter-cultivation twice at 25 & 45 days after sowing (7.41 and 6.39 no./m²), which was on par with hand weeding at 20 and 40 days after sowing



(7.07 and 5.96 no./m²). While other treatments recorded higher weed dry weight. Seed yield was significantly higher in hand weeding at 20 and 40 DAS (1.38 t/ha), which was on par with Stale seed bed technique + inter-cultivation twice at 25 & 45 days after sowing (1.31 t/ha) and followed by Inter cultivation at 25 days after sowing + 1 hand weeding at 45 days after sowing (1.28 t/ha). The highest yield might be due to better control of weeds at (tillering stage) which is critical stage of crop weed competition. Lower seed yield (0.58 t/ha) was obtained in unweeded control. This reduction in yield might be due to highest competition with foxtail millet throughout the crop growth period. The B:C ratio was higher in Inter cultivation at 25 days after sowing + 1 hand weeding at 45 days after sowing (2.28) due to lower cost of cultivation than Hand weeding at 20 and 40 days after sowing (2.03). Hand weeding twice at 20 and 45 days after sowing did produce higher gross return, but net return and B:C ratio was lower because of availability of labour at crucial stage besides, the labour demands higher wages increased higher cost of cultivation thus results in lower B:C ratio.

II-PP-21

Role of Nano Nitrogen for Enhancing Productivity and Nutrient Use Efficiency in Finger Millet

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The widespread use of fertilizers is a result of the increased global demand for food. The commonly used chemical fertilizers may increase plant growth and output, but they have deleterious effects on the soil and environment. Therefore, nano fertilizers are one of the alternative solutions for conventional fertilizers. Nano-fertilizers are a new concept of nutrient management in crop and it is in its belonging stage there is a great thrust area in agriculture for sustainable crop improvement. Nano-enabled fertilizers contribute to sustainable resource management by reducing the overall usage of fertilizers and ensuring that nutrients are utilized more efficiently. By decreasing nutrient runoff and leaching, nano fertilizers and nutrients help preserve soil fertility, protect water bodies from contamination, and reduce the ecological footprint of agriculture. Nitrogen is deficient in most of the Indian soils particularly the light textured ones which is one of the basic plant nutrients. Thus, there is an urgent need to give a fresh look to fertilizer requirement specially nitrogen under rainfed conditions. 75 per cent RDN + recommended PK along with foliar spray of nano nitrogen because of its high solubility, retention which is rapidly and efficiently absorbed by leaves resulted in higher photosynthates, dry matter production, nitrogen use efficiency and ultimately higher yield in finger millet. Thus, application of nano-N along with 75 per cent RDN + recommended PK is an economically optimum nourishment to the crop while minimizing nutrient losses from the field. By enhancing nutrient use efficiency, optimizing nutrient delivery, and fine-tuning crop health, these nano-enabled fertilizers offer immense significance in shaping the future of farming in India.



Microbial Alchemy: Harnessing Agricultural Microbes for Sustainable Organic Farming on Millets

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The global agricultural landscape is witnessing a paradigm shift towards sustainable and organic practices to address the environmental and health challenges associated with conventional farming. Millets, being resilient and nutritious crops, have gained attention as key players in sustainable food systems. This abstract explores the integration of agricultural microbes in organic farming practices to enhance millet production. The use of agricultural microbes, such as beneficial bacteria and fungi, offers a promising avenue for promoting soil health, nutrient uptake and overall crop resilience. This paper delves into the mechanisms by which these microbes interact with millet crops, highlighting their role in nutrient cycling, disease suppression and soil structure improvement. The discussion will encompass various microbial agents, including mycorrhizal fungi, nitrogen-fixing bacteria and plant growth-promoting rhizobacteria, exploring their specific benefits for millet cultivation. Emphasis will be placed on the potential of these microbes to reduce the reliance on synthetic fertilizers and pesticides, fostering a more sustainable and environmentally friendly approach to millet farming. Furthermore, the abstract will touch upon practical applications and challenges associated with the implementation of microbial-based organic farming on millets. It will address the need for tailored microbial inoculants, optimized application methods and considerations for different millet varieties and agroecological contexts. In conclusion, this abstract seeks to contribute to the growing body of knowledge on organic farming practices, specifically focusing on millets and the integration of agricultural microbes. By exploring the intricate relationship between microbes and millets, this research aims to provide insights that can guide farmers, researchers and policymakers toward a more sustainable and resilient agricultural future.

II-PP-23

Study on Incidence Pattern of Shoot Fly, *Atherigona* sp. (Muscidae: Diptera) in Relation to Meteorological Variables in Little Millet, *Panicum sumatrense*

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In the current study was made to investigate the relationship between incidence pattern of shoot fly, with meteorological variables on little millet, during *Kharif* 2019. This field experiment was carried out at Agricultural Research Station, V. C. Farm, Mandya, Karnataka. The result indicated that incidence of shoot fly in little millet varied from 7.01 to 60.87 per cent dead heart. The shoot fly infestation started from the first week and gradually increased until fourth week after emergence of seedling. Then, as the crop stage progressed, the infestation eventually began to decrease. The infestation started from 33rd Standard Meteorological Week (SMW) with 10.28 per cent dead heart and continued up to 44th SMW with 7.01 per cent dead heart. Maximum dead heart was observed during 36th SMW (60.87 %) i.e. second week of September and minimum dead heart later on. The incidence declined gradually to 7.01 per cent during second week of November (44th SMW). From the correlation studies, it can be concluded that the per cent dead heart was non-significant and positively correlated with maximum temperature ($r=0.36$), morning relative humidity ($r=0.02$), afternoon relative humidity ($r=0.02$), rainfall ($r=0.12$) and number of rainy days ($r=0.02$). On the other hand, minimum temperature had significant and positively associated with dead heart ($r=0.71^{**}$).

II-PP-24

Weed Management in Organically Grown *Kharif* – Kodo Millet (*Paspalum scrobiculatum*)

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Field experiment was conducted during *kharif* season 2020 and 2021 in collaboration with Regional Institute of Organic Farming (RIOF), GKV, Bengaluru, to know the effect of organic weed management practices on weed flora and weed growth in cultivation of organic Kodo millet and also to identify the suitable methods of managing weeds in organic cultivation of Kodo millet. Experiment comprised ten treatments, laid out in Randomized Complete Block Design (RCBD) with three replications. The gross and net plot sizes were $5.4\text{m} \times 4.8\text{m}^2$ and $4.8\text{m} \times 4.2\text{m}^2$ respectively. Stale seedbed treatment was initiated 15 days before transplanting



of the crop. One irrigation was given to stale seedbed plots and weeds were allowed to germinate. The germinated weeds were removed by passing cultivator criss-cross one day before transplanting of the crop. Organic Mulching was done with crop residues @ 5t/ha at 15-20 days after sowing. Cowpea seeds were sown in between two rows of kodo millet and was mulched between rows as per treatment. In this study, all the non-chemical weed management practices showed the lowest density of weeds. Stale seed bed technique + Inter cultivation at 25 DAS & 45 DAS followed by Straw Mulching 5t/ha at 10-15 DAS recorded lower weed density significantly which was comparable to hand weeding at 20 DAS and 40 DAS. Hand weeding at 20 & 40 DAS recorded significantly higher seed yield (1.48 t/ha). Stale seed bed technique + Inter-cultivation at 25 DAS & 45 DAS (1.24 t/ha) was on par with Inter-cultivation at 25 DAS + one hand weeding at 45 DAS (1.20 t/ha) and Two mechanical weeding (Cycle weeder) at 20 and 40 DAS (1.20 t/ha) and Kodo millet + Fodder cowpea as intercrop with in-situ incorporation on 35 DAS + 1 Intercultivation at 40 DAS (1.19 t/ha). The pooled results indicated that though the gross return is higher in the case of hand weeding twice at 20 DAS and 40 DAS followed by Stale seed bed technique + Intercultivation at 25 DAS & 45 DAS (Rs. 43,636/ha), Intercultivation at 25 DAS + one hand weeding at 45 DAS (Rs. 42,135/ha), Two Mechanical (Cycle weeder) weeding at 20 and 40 DAS (Rs. 40,928/ha) and Kodo millet + Fodder cowpea as intercrop with in-situ incorporation on 35 DAS + 1 Intercultivation at 40 DAS (Rs. 40,512/ha). The benefit: cost ratio was higher in Hand weeding twice at 20 and 40 DAS (2.3) and Stale seed bed technique + Intercultivation at 25 DAS & 45 DAS (2.35) which is comparable with Intercultivation at 25 DAS + 1 Hand weeding at 45 DAS (2.20). However, lowest B: C ratio was recorded in unweeded control (1.05) in pooled kodo millet.

II-PP-25

***Atherigona miglioanno* sp. nov. A New Species of Shoot Fly (Diptera: Muscidae) from India**

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The muscid shoot-fly *Atherigona* 1856 Rondani (Diptera: Muscidae) is a major pest in millets grown in different parts of India. Family Muscidae, classified into seven sub-families such as Muscinae, Stomoxydinae, Phaoniinae, Mydaeinae, Coenosiinae, Atherigoninae and Azeliinae. The group Atherigona have tri-nomenclature i.e. *Atherigona acritochaeta* sp. and *Atherigona Atherigona* sp. The two subgenera: *Acritochaeta* Grimshaw, which contains generally saprophagous taxa, and *Atherigona* Rondani, whose phytophagous larvae are shoot-flies that feed on a variety of wild and cultivated grasses (Poaceae). At present sub-family Atherigoninae is represented by 37 species of the genus *Atherigona*. A new species of the shoot fly genus *Atherigona* 1856 is described from the Bangalore, Karnataka based on morphological characters from male specimen. The male adult has characters palpi yellow. Vibrissae black, inter-frontalia bicoloured, orangish yellow in anterior half, black posteriorly. Mesonotum greyish-yellow dusted, humeri yellow. Fore femur yellow, tibia infuscated with black apically, tarsi black with distinct long setulae. Mid and hind legs yellow. Abdomen yellow, tergite 3 with two linear rectangular black spots extending upto 3/4th the tergal length, tergite 4 with two oval spots. The male genitalia have hypopygial prominence small truncate, lateral sides



sloping. Trifoliate process with stalk long, uniformly thick. Shoulders produced over a distinct triangular base over the stalk; shoulders poorly formed. Lateral plate with inner lobe at basal one third, plates foliate above. Median piece capitate, stalk thin and slender, tip with apical and lateral setulae; hood absent. In italics “miglio” mean millet, “anno” mean year; in celebration of International year of Millets, 2023, the species has been named as *A. miglioanno*.

II-PP-26

**Effect of Different Enriched Insect Biomass Compost on Nutrient Content and Uptake
by Finger millet (*Eleusine coracana* L.)**

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An field experiment was conducted at the College of Sericulture, Chintamani, Chickkaballapur District, Karnataka, India. The experiment utilized silkworm pupae, silkworm moth, uzifly, and fruit fly to enrich the compost. The compost was made for ninety days, and the impact of these insect species on the finger millet nutrient content and uptake were investigated. All 11 treatments in the field trial, which was conducted with three replications, worked well when combined with enriched insect biomass compost. In the case of finger millet grain and straw, there was a significant difference in major nutrients between the various enriched composts. Higher major nutrient content of 3.01, 0.48 and 2.74 per cent of N, P and K in grain and 2.13, 0.32 and 4.06 per cent of N, P and K in straw were recorded in T₄ treatment which receives 100 % N equivalent of FYM through silkworm pupae enriched compost which was significantly superior over other enriched insect biomass compost and was followed by T₆ (2.90, 0.48 and 2.63 per cent of N, P and K in grain and 2.04, 0.31 and 3.94 per cent of N, P and K in straw) which received 100 % N equivalent of FYM through silkworm moth enriched compost and T₁₀ which received 100 % N equivalent of FYM through fruit fly enriched compost (2.80, 0.46 and 2.47 per cent of N, P and K in grain and 1.96, 0.30 and 3.40 per cent of N, P and K in straw). The lower major nutrient content in finger millet grains and straw was recorded in control T₁. Significantly higher nitrogen uptake (86.84 kg ha⁻¹ and 79.06 kg ha⁻¹ by grain and straw, respectively), phosphorus uptake by grain and straw (13.97 and 12.29 kg ha⁻¹, respectively) and potassium uptake by grain and straw (78.76 and 153.05 kg ha⁻¹, respectively) was recorded in treatment imposed of 100 % N equivalent of FYM through silkworm pupae enriched compost (T₄), it was followed by T₆ (82.51 and 78.08 nitrogen kg ha⁻¹, 13.71 and 11.22 phosphorous kg ha⁻¹ and 74.86 and 151.93 potassium kg ha⁻¹ by grain and straw) which received 100% N equivalent of FYM through silkworm moth enriched compost.

II-PP-27

Demonstration on Yield Advantage of Foxtail Millet Var. DHFt-109-3 in Farmer's Field

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A frontline demonstration was carried in two clusters of Mandya district during *Kharif* season under rainfed situation to demonstrate the potential of foxtail millet Var.DHFt-109-3 in comparison with local variety under standard recommended cultivation practices. 15 demonstrations were conducted in an area of 0.4 hectare each. The improved variety DHFt-109-3 performed better with the grain yield of 11.10 q per hectare, 36.86 percent higher than the local variety (8.11 q/ha) under standard similar crop management practices. Higher tiller number per plant (5.42) and panicle length (12.67 cm) in the improved variety are the contributing factors for higher yield in comparison to local variety (3.12 tillers/plant and 7.14 cm panicle length). Economically, improved variety earned higher returns of Rs. 3.71 per rupee invested as indicated by B:C ratio and also the higher net returns (Rs. 30616 / ha).

II-PP-28

Response of Quinoa (*Chenopodium quinoa* Wild.) to Different Sowing Windows and Varied Crop Geometry under Protective Irrigation

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Quinoa earns the label “Super food” due to its exceptional nutrient profile. Packed with complete protein (15-22%), fibre, vitamins (B-vitamins) and minerals (Fe, Mn and Zn), it supports overall health. Its gluten free nature, antioxidants [α -tocopherol (5.3 mg), γ -tocopherol (2.6 mg)] and versatility in culinary applications contribute to improved digestion, heart health and overall wellbeing. In spite of this quinoa is also comparable with milk due to its nutritional value. A field experiment was carried out during *Kharif* 2019 at Main Research Station Hebbal, University of Agriculture Sciences, GKV, Bangalore to find out optimum date of sowing and crop geometry for quinoa crop. The experiment was laid out in split plot design with three replications. The dates of sowing in main plots (D₁: July second fortnight, D₂: August first fortnight, D₃: August second fortnight and D₄: September first fortnight) and crop geometries (S₁: 30 × 15 cm, S₂: 45 × 15 cm, S₃: 60 × 15 cm and S₄: 75 × 15 cm) in subplots. The results revealed that crop sown during July second fortnight recorded significantly higher number of panicles (16.20), panicle length (36.89), grain yield (2051 kg ha⁻¹), stover yield (2439 kg ha⁻¹), net returns (Rs. 176538) and B: C ratio (6.18). Among crop geometry, spacing of 45 × 15 cm was recorded significantly higher number of panicles (14.95), panicle length (32.43), grain yield (1941.25 kg ha⁻¹), stover yield (2346 kg ha⁻¹), net returns (Rs. 164869) and B: C ratio (5.64). The interaction effect of July second fortnight sowing with spacing of 45 × 15 cm recorded higher number of panicles (16.30), panicle length (36.12) grain yield (2392 kg ha⁻¹),



net returns (Rs. 209944 Rs. ha⁻¹) and B:C ratio (7.18). Also recorded higher protein and lower fibre content. Due to its wider adaptability, it is also called as “climate resilient crop”. Therefore, sowing during July second fortnight sowing with 45 x 15 cm is economical for growing quinoa crop during *Kharif* season in Eastern Dry Zone (Zone V) of Karnataka.

II-PP-29

Host Range Study of *Sclerotium rolfsii* Sacc causing Foot Rot in Finger Millet

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Sclerotium rolfsii. Sacc is one of the most destructive soil inhabiting pathogen occur on diverse agroclimatic regions of tropical and sub-tropical continents, which causes 10 to 25 per cent crop loss. In finger millet it is responsible for foot rot which results in stem rotting at the collar region above the soil. Though the pathogen is minor and sporadic in finger millet even the lesser incidence will cause huge economic loss. It is needed to identify *S. rolfsii* diversity with respect to virulence against other millet crops. So, pot experiment was conducted at ZARS, College of Agriculture V C Farm Mandya, where twenty days old mass multiplied foot rot pathogen (grown on sorghum grains and enriched with compost) incorporated into soil to create the sick condition in pots. Apparently, healthy surface sterilized seeds of eight other small millets were sown in the pots and the pots without inoculum kept as control. Alternative wetting and drying conditions were maintained for better establishment of pathogen. The observations taken at 7 days interval revealed that no foot rot symptoms was observed on any millet crop up to 15 DAS but after 30 DAS bit of infection was observed in proso millet and finger millet with inoculum. Typical symptoms like yellowing of leaves and wilting was noticed on finger millet and on little millet moderate disease progress was seen after 45 DAS. During 60 DAS disease progresses like yellowing of leaves, increasing of collar lesion length was observed on proso millet and little millet, maximum disease pressure was observed on finger millet with inoculum and no infection was observed on other small millets and control. This shows that *S. rolfsii* causing foot rot in finger millet was also able to infect proso millet and little millet.

II-PP-30

Effect of Establishment Techniques and Fertilizer Rates on Productivity, Economics and Energetics of Teff- An Emerging Super millet in the Indian Context

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Millets are known as nutritional powerhouse, yet their cultivation faces a challenge due to the modest market returns they offer to growers. There is an urgent need for alternative crops that can meet both consumer nutritional demands and provide better economic returns for farmers.



Teff, an Ethiopian millet introduced to India by CFTRI, Mysore, emerges as a promising alternative for marginal farmers. A field experiment conducted at ICAR-KVK, Haveri during *Kharif*, 2019, employed a Randomized Complete Block Design with a Factorial concept composed of two factors viz., planting methods (M_1 : line sowing and M_2 : transplanting) and nutrient management [N_1 : control, N_2 : 100 % organics (6 t FYM ha^{-1}), N_3 : 20:10:10 kg N:P₂O₅:K₂O ha^{-1} , N_4 : 30:15:15kg N:P₂O₅:K₂O ha^{-1} and N_5 : 40:20:20 kg N:P₂O₅:K₂O ha^{-1} and replicated thrice. Transplanting of teff recorded significantly higher number of effective tillers (449.0 m^{-2}), grain weight (0.31 g ear^{-1}), grain yield (239.95 kg ha^{-1}), net returns (₹ 53,106 ha^{-1}) and B-C ratio (2.66) over line sowing. Though, application of 40:20:20 kg N:P₂O₅:K₂O ha^{-1} produced significantly higher growth attributes, significantly higher grain weight (0.33 g ear^{-1}), grain yield (269.27 kg ha^{-1}), net returns (₹ 63,136 ha^{-1}) and B-C ratio (2.96) were noticed under application of 20:10:10 kg N:P₂O₅:K₂O ha^{-1} which was on par with application of 30:15:15 kg N:P₂O₅:K₂O ha^{-1} because of less lodging per cent. The interaction effect didn't show any significant influence on the performance of teff crop. An elucidation on energetic showed that application of 20:10:10 kg N: P₂O₅: K₂O ha^{-1} found to be more energy efficient in terms of higher energy output, intensity, productivity and net energy compared to other treatments. Hence, teff is recommended as a climate smart and energy efficient nutri-millet for cultivation by the Indian farmers, promising higher economic returns compared to other traditional millet crops.

II-PP-31

Eco-Friendly Management of Ragi Blast (*Magnaporthe grisea*) using Potential Bio-Agents

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Blast disease incited by the fungus *Magnaporthe grisea* is the most devastating diseases of ragi (finger millet) causing more yield loss in major ragi growing regions. Farmers use chemicals to control the disease which harms the ecosystem and also there is problem of resistance development in the pathogen. Therefore, eco-friendly strategies need to be implemented as an alternate method to avoid crop losses and to protect the natural ecosystem. The present study was thus undertaken to identify potential bio-agents against *Magnaporthe grisea* infecting ragi crop. Field experiment was conducted at Agricultural Research Station, Vizianagaram during *kharif*: 2021-22 to control the blast disease with different bio-agents and chemicals which includes; Seed treatment with Carbendazim @ 2g/kg seed, seed treatment with chitosan @ 3.75g/kg seed, seed treatment with *P. Fluorescens* @ 10g/kg seed, seed treatment with *B. subtilis* @ 10g/kg seed, seed treatment with carbendazim+2 foliar sprays with *P. fluorescens*, seed treatment with chitosan+2 foliar sprays with *P. fluorescens*, Seed treatment with *P. fluorescens*+2 foliar sprays with *P. fluorescens*, seed treatment with *B. subtilis*+2 foliar sprays with *B. subtilis* and control without any treatment. Among the treatments, lowest disease severity of leaf blast (2.0 Grade), neck blast (6.8%) and finger blast (7.2%) with highest grain yield of 1674.0 kg/ha and fodder yield of 4117.4 kg/ha was recorded with seed treatment with



chitosan+2 foliar sprays with *P. fluorescens*. However, in control highest disease severity (leaf blast-3.7 Grade; Neck blast-78.0% and Finger blast-78.0%) with less grain yield (876.6 kg/ha) and less fodder yield (2376.6 kg/ha) was recorded. The study suggests that the combination of chitosan seed treatment and foliar sprays with *P. fluorescens* is an effective and eco-friendly strategy for controlling blast disease in ragi, providing higher yields and reduced disease severity compared to other tested treatments, including chemical control methods.

II-PP-32

Effect of Long-Term Integrated Nutrient Management on Crop Yield and Soil Fertility under Finger Millet -Groundnut Rotation System

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The long-term effect of 50% substitution and 100% application of inorganic fertilizer along with different organics viz., FYM (Farm Yard Manure) and MR (Maize Residue) on crop yield, and physical, chemical, and biological properties of soil were studied under 31-year-old Finger millet -Groundnut rotational cropping system at AICRP for Dryland Agriculture. The data of the long-term experiment revealed that application of FYM @ 10 t ha⁻¹ + 50% RDF (Recommended Dose of Fertilizer) recorded significantly higher pod (2067.44 kg/ha) and haulm yield (4711.33 kg/ha) and was on par with application of 100% RDF. The groundnut pod yield declined under control and application of only inorganics without organic supplement, while positive yield increment was observed under treatments receiving only organics viz., FYM and MR compared to control. The analysis of soil samples showed improvement in soil pH. The soil organic build-up was more with the application of FYM as an organic source than maize residue. However, conjugate use of organics along with 50% and 100% RDF resulted in increase in organic carbon (0.26 & 0.35%), available nitrogen increases (178.78 & 191.23 kg ha⁻¹), available P₂O₅ (51.78 to 62.87 kg ha⁻¹), and available K₂O (118.87 & 130.21 kg ha⁻¹) over the control (0.33%, 69.92, 54.40 & 79.18 kg ha⁻¹ N, P₂O₅ & K₂O, respectively). Combined application of organics and inorganics (50% & 100%) increased Microbial Biomass Carbon (MBC) (365.99 & 399.50 µg g⁻¹, respectively) and Microbial Biomass Nitrogen (MBN) (35.32 & 42.03 µg g⁻¹, respectively) compared with control (208.64 & 23.51 µg g⁻¹, respectively). In conclusion substitution of 50% RDF to groundnut under Finger millet -Groundnut rotational system along with organics (FYM). Significant increase in groundnut yield as well as buildup of organic carbon, available N, P₂O₅, and K₂O, and biological properties like MBC and MBN of post-harvest soil after 31 years of the experiment.



II-PP-33

**Evaluation of Plant Based Bio Active Compounds against *Sclerotium rolfsii* sacc.
Causing Foot Rot of Finger Millet**

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Finger millet is one of the important millet crops widely cultivated across India. Although, it found to be a hardy crop it also affected by many diseases, among them foot rot caused by *Sclerotium rolfsii* has become a major threat especially in irrigated and heavy rainfall areas. Management is highly rely on the chemical fungicides, which makes the cost of cultivation higher and cause environmental pollution in this backdrop the current study has been conducted to know the efficacy of 13 plant extracts at three different concentrations (10, 15 and 20 %) by following poison food technique. Among the botanicals were tested, the maximum per cent mycelial inhibition of 100 per cent was recorded by garlic clove extract at 15 and 20 per cent followed by Eucalyptus (88.15%), Datura (87.03%), Calotropis (86.30%), Parthenium (81.11%) and turmeric rhizome extract (80.37%) at 20% concentration. The least mycelial inhibition of 14.81 per cent was recorded by Calotropis followed by lantana (16.63%) and Parthenium (20.37) at 10% concentration respectively compared to control. The effectiveness of botanicals may due to synthesis of secondary metabolites *i.e.*, toxins, gibberellins, alkaloids, antibiotics and biopolymers. It's important to note that the use of botanical extracts for disease management in crops is an area of ongoing research, and further studies may be needed to understand the long-term effectiveness, economic feasibility, and potential ecological impact of such treatments.

II-PP-34

**Yield Loss Assessment of Banded Leaf and Sheath Blight incited by *Rhizoctonia solani*
Kuhn in Proso Millet**

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Proso millet is one of the staple food among the majority of people of Asia, Africa, and parts of Europe. Nutritionally, proso millet grains are rich in proteins, vitamins and minerals. However, proso millet-based products own a lower glycemic index (GI) than corn, appears to be a good ingredient for producing low-GI products. The protein content accounts for 12% and the essential amino acid index (EAAI) of proso millet. However, the area in proso millet cultivation is declining as it is influenced by various biotic stresses which includes diseases such as smut, rust, blast, brown spot, foot rot, banded blight, and some other viral diseases. Among these, Banded leaf and sheath blight incited by *Rhizoctonia solani* Kuhn. is one of the dreadful diseases in its successful cultivation. The results of the yield loss assessment study



revealed that the yield loss in proso millet varied from 47 % to 61.2 %. Disease severity in Block V where none of the plant was artificially inoculated and also fungicide treated plot is the lowest (14.67 %) with highest average grain yield (15.55 kg ha⁻¹). Similarly, disease severity in Block I where every plant was inoculated was the highest (93.78 %) with lower grain yield of 592 kg ha⁻¹ indicating yield loss increased with increase in severity of the disease. The information underscores the importance of managing Banded leaf and sheath blight in proso millet cultivation to mitigate yield losses. Integrated pest management strategies, including the use of fungicides and other cultural practices, may play a crucial role in controlling the impact of this disease and ensuring sustainable proso millet production.

II-PP-35

Productivity Enhancement in Finger Millet (*Eleusine coracana* L.) through Organic Nutrient Management under Guni Method

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A study on Productivity enhancement in finger millet (*Eleusine coracana* L.) through organic nutrient management under guni method' was carried out in farmers' field of Mylandalahalli village near College of Sericulture, Chintamani. The Finger millet variety ML-365 was transplanted under guni method with varied organic nutrient sources with the spacing of 60 cm × 60 cm. The experiment comprised of twelve treatments with three replications laid out in RCBD. The results revealed that Sericulture Waste Compost (SWC) @ 50 % N eq. + Enriched Bio Digested Liquid Manure (EBDLM) @ 50% N eq. ha⁻¹ + Panchagavya Gavya (PG) spray @ 3 % observed significantly higher grain (4087 kg ha⁻¹) and straw yield (5760 kg ha⁻¹) as compared to recommended FYM (10 t ha⁻¹) + 100:50:50 kg N: P₂O₅: K₂O ha⁻¹ (3138 kg ha⁻¹ and 3564 kg ha⁻¹, respectively). However, which was on par to treatments i.e., SWC @ 50 % N eq. + EBDLM @ 50 % N eq. ha⁻¹ + Vermi-Wash (VW) spray @ 3 % (grain 4022 & straw yield 5712 kg ha⁻¹ respectively), SWC @ 50 % N eq. + BDLM @ 50 % N eq. ha⁻¹ + PG spray @ 3 % (grain 3905 and straw yield 5632 kg ha⁻¹, respectively) and SWC @ 50 % N eq. + BDLM @ 50 % N eq. ha⁻¹ + VW spray @ 3 % (grain 3625 & straw yield 5412 kg ha⁻¹). While, lower grain (3138 kg ha⁻¹) and straw yield (3564 kg ha⁻¹) recorded in recommended FYM (10 t ha⁻¹) + 100:50:50 kg N: P₂O₅: K₂O ha⁻¹. Further, soil nutrient status and microbial population were significantly higher with SWC @ 50 % N eq. + EBDLM @ 50% N eq. ha⁻¹ + PG spray @ 3 % (available N 413.82, P₂O₅ 44.62, K₂O 233.13 kg ha⁻¹ respectively) and bacteria, fungi and actinomycetes population (49.96 CFU x 10⁶, 27.36 CFU x 10³ and 14.44 CFU x 10⁶ g⁻¹ of soil, respectively) as compare to recommended FYM (10 t ha⁻¹) + 100:50:50 kg N: P₂O₅: K₂O ha⁻¹ (258.36, 27.13 and 166.69 kg ha⁻¹, respectively) and (21.13 CFU x 10⁶, 15.20 CFU x 10³ and 6.46 CFU x 10⁶ g⁻¹ of soil, respectively) at harvest. Further, treatment received SWC @ 50 % N eq. + EBDLM @ 50% N eq. ha⁻¹ + PG spray @ 3 % recorded higher gross returns (Rs. 1,37,381 ha⁻¹), net return (Rs. 73,830 ha⁻¹) and Benefit: Cost ratio (2.16) as compared to varied organic nutrient sources. While, lower gross returns (Rs. 63,180 ha⁻¹), net return



(Rs.12,065 ha⁻¹) and Benefit: Cost ratio (1.24) were noticed with recommended FYM (10 t ha⁻¹) + 100:50:50 kg N: P₂O₅: K₂O ha⁻¹.

II-PP-36

Organic Food Production for Sustainable Agriculture

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Over 70 per cent of India's workforce is employed in agriculture, which is the foundation of the nation's economy. The India since independence has been producing enough food to feed the country's expanding population. Thus, irrigation water, fertilisers, or insecticides are infused with high-yielding cultivars. In addition to helping the nation create a food surplus, this combination of high-yielding production technologies has raised issues with soil health, environmental pollution, pesticide toxicity, and the sustainability of agricultural production. As a result, scientists and policymakers are re-evaluating farming methods like organic farming that depended more on biological inputs than heavily on chemical pesticides and fertilisers. Natural farming methods like organic farming provide society's needs for food and nutrition without depleting natural resources. Thus, the nation was able to improve not only its excess food supply but also its environmental pollution, pesticide toxicity, and sustainable agricultural output by fusing organic resources with high-yielding varieties and technologies. In addition to providing crops with macro- and micronutrients, organic farming enhances the physical, chemical, and biological properties of the soil. Alternatives to curative therapies for pest and disease management in organic farming mostly focus on preventive measures because they are based on environmentally safer management techniques. Preserving the health of the ecosystem has taken precedence, enabling plants to develop resistance against diseases and insect pests. The depletion of all natural resources, such as air, water, soil, forests, biodiversity, and so on, as well as environmental degradation present serious challenges to the Green Revolution in the current context. The only practical and effective way to address these important issues is through organic farming.

II-PP-37

Green Harmony: Humic and Fulvic Acids as Cornerstones of Soil Health in Organic Farming

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The sustainable agriculture, the spotlight shines on the profound influence of humic and fulvic acids, unveiling a transformative narrative as they emerge as the cornerstones of soil health in



the realm of organic farming. This abstract delves into the intricate orchestration of these organic acids, exploring their multifaceted roles in fostering soil vitality, nurturing soil microorganisms, and cultivating a rich organic carbon landscape. At the heart of this narrative lies the profound impact of humic and fulvic acids on soil health. These natural compounds, derived from decomposed organic matter, act as bio-stimulants, fortifying the soil structure and enhancing water retention capabilities. The abstract unravels the nuanced mechanisms through which humic and fulvic acids play a pivotal role in mitigating soil erosion, promoting nutrient availability, and creating an optimal environment for root development a trifecta essential for the flourishing of organic farming systems. The organic carbon of soil emerges as a canvas painted by the hands of humic and fulvic acids, and this is exploring the artistic intricacies of this process. These acids act as carbon custodians, sequestering atmospheric carbon dioxide into the soil, thereby mitigating the impacts of climate change and creating a carbon-rich haven that supports diverse microbial life. In this symbiotic dance with soil microorganisms, humic and fulvic acids stimulate microbial activity, fostering a vibrant community that aids in nutrient cycling and disease suppression. As cornerstones of soil health, humic and fulvic acids are instrumental in promoting sustainable agriculture practices. It delves into their ability to enhance the cation exchange capacity, facilitating nutrient uptake by plants and contributing to overall soil fertility. This, coupled with their natural chelating properties, sets the stage for a balanced and resilient organic farming system that aligns seamlessly with the principles of sustainable agriculture. "Green Harmony" encapsulates not merely a metaphorical concept but a call to action. a harmonious integration of humic and fulvic acids into the agricultural landscape, redefining the way we approach organic farming. In embracing these natural cornerstones, we embark on a journey toward a regenerative future where soil health flourishes, organic carbon abounds, and sustainable agriculture thrives in unison with the rhythm of the Earth.

II-PP-38

***In Vitro* Efficacy of Fungicides and Nano Particles against *Pyricularia grisea* Inciting Blast Disease of Finger Millet**

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Finger millet (*Eleusine coracana* (L) Gaertn), commonly known as ragi, stands as a vital minor millet crop, extensively cultivated in Africa and Asia. Its grains surpass those of major staple cereals in nutritional value, serving as an excellent source of quality protein and various minerals. Finger millet production is challenged by a number of biotic and abiotic factors that affect the ultimate yields. Among the biotic factors is finger millet blast disease caused by *Magnaporthe grisea* (teleomorph: *Pyricularia grisea*), affecting different aerial parts of the plant (Leaf, Neck and Finger) throughout its growth stages, from seedling to grain formation. To address this challenge, the current study investigates the *in vitro* efficacy of fungicides and



nanoparticles using poison food technique. Among the fungicides tested, Propiconazole exhibited the highest recorded mycelial inhibition of 98.60 per cent. Meanwhile, among the various nanoparticles tested, silver nanoparticles demonstrated superior efficacy with a mycelial inhibition of 53.60 per cent. Conversely, Aluminum nanoparticles exhibited the least mycelial inhibition at 10.57 per cent. This exploration into the effectiveness of fungicides and nanoparticles offers valuable insights for potential strategies to mitigate the impact of blast disease on finger millet crops.

II-PP-39

Millets in Organic Agriculture: A Sustainable and Nutritious Approach to Farming

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Millets, a group of small-seeded, drought-resistant cereal grains, have gained recognition as a sustainable and nutritious crop when cultivated in organic farming systems. This abstract highlight the significance of millets in the context of organic agriculture, focusing on their compatibility with organic farming principles and the benefits they offer. Organic farming emphasizes practices that are environmentally friendly, promote soil health and reduce synthetic chemical inputs. Millets align well with these principles due to their natural resilience to pests and diseases, as well as their ability to thrive in diverse Agro-climatic conditions. When cultivated using organic methods, millets contribute to sustainable and regenerative farming practices. Millets, including species like pearl millet, foxtail millet and finger millet, are rich in essential nutrients, including dietary fiber, proteins, vitamins and minerals. Their gluten-free nature and low glycemic index make them suitable for a wide range of dietary requirements, including those of individuals with gluten sensitivity or diabetes. In organic farming, millets are integrated into crop rotations, providing an important tool for pest and disease management. This diversity helps break the pest life cycle and reduces the need for chemical pesticides. Additionally, millets act as cover crops and improve soil health through their root systems, enhancing organic matter content and nutrient availability in the soil. Millet cultivation in organic farming systems also promotes biodiversity. The cultivation of multiple millet varieties and other companion crops encourages diverse insect populations, which can help mitigate pest pressures and enhance ecosystem stability on organic farms. The organic certification process ensures that millets grown using organic practices meet strict standards, providing consumers with confidence in the authenticity of organic millet products. The increasing demand for organic food has created opportunities for organic millet farmers in the market. In conclusion, millets cultivated in organic farming systems offer a sustainable and nutritious solution to the challenges of modern agriculture. They align well with organic principles, contribute to soil health, reduce the need for synthetic inputs and promote biodiversity. The growing awareness of the benefits of millets and organic farming practices highlights their role in achieving food security, environmental sustainability and healthier food systems.



Role of Mechanization in Enhancing the Productivity of Finger Millet in India

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Millets are important cereal crops which play a significant role in food and nutritional security. Among the millets, finger millet occupies a prime position due to its climate resilience and nutritional significance. However, finger millet cultivation in India has traditionally been associated with smallholder farmers, and in many cases, the level of mechanization has been limited. Mechanization in finger millet cultivation represents a transformative approach to traditional farming practices. This shift involves the adoption of mechanized equipment, such as tractors, fertilizer cum seed drills, planters and harvesters to streamline various agricultural operations. The importance of mechanization in finger millet cultivation lies in its ability to ensure timely operations, increase efficiency, reduce labour intensity, drudgery and enhance overall productivity and quality of the produce. By enabling timely and precise farming operations, mechanization contributes to optimal yields and the economic sustainability. Moreover, mechanized post-harvest processing ensures a more efficient extraction of finger millet grains, further increasing the profitability of finger millet cultivation. In the face of climate change, the adoption of mechanization emerges as a critical strategy to scale up production and ensure the sustainable growth in finger millet farming. Smaller farm holdings, undulated topographies, economic constraints, and a lack of awareness or access to modern farming equipment have been contributing factors of low mechanization in India. In addition to it, high initial cost of machinery, maintenance issues, and lack of knowledge of farmers in the use of new machinery and technologies are the other factors contributing to low level of mechanization. On-going research and development efforts should be focused on designing and promoting machinery specifically tailored for small farm holdings and undulated topographies. Establishment of custom hiring centres, where farmers can access mechanized equipment on a rental basis helps address the issue of affordability and allows smallholder farmers to benefit from mechanization without the burden of ownership. Government schemes and subsidies should be in such a way to encourage the millet farmers to adopt modern farming equipment and practices. Awareness programs and training sessions are conducted by agricultural extension services and NGOs to educate farmers about the use of machineries, benefits of mechanization and its role in overall improvement of farm productivity.

II-PP-41

Effect of Various Levels of Chickpea Magic on Growth and Yield of Chickpea (*Cicer arietinum* L.)

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A field experiment was conducted during Rabi season of 2021-22 at ZAHRS, Babbur farm, Hiriur, Chitradurga, to know the “Effect of various levels of chickpea magic on growth and yield of chickpea (*Cicer arietinum* L.)”. The field experiment consists of nine treatments viz., 100 per cent RDF (13:25:25 kg NPK + FYM @ 7.5 t/ha) (T1), Farmers practice (T2), 100 per cent RDF (13:25:25 kg NPK only) + 2 per cent DAP (T3), 100 per cent RDF (13:25:25 kg NPK only) + 0.75 per cent chickpea magic (T4), 100 per cent RDF (13:25:25 kg NPK only) + 1 per cent chickpea magic (T5), 100 per cent RDF (13:25:25 kg NPK + FYM @ 7.5 t/ha) + 2 per cent DAP (T6), 100 per cent RDF (13:25:25 kg NPK + FYM @ 7.5 t/ha) + 0.75 per cent chickpea magic (T7), 100 per cent RDF (13:25:25 kg NPK + FYM @ 7.5 t/ha) + 1 per cent chickpea magic (T8) and 1 per cent chickpea magic only (T9) replicated thrice and laid out in RCBD. Among treatments tried, significantly higher plant height (40.28 cm), number of primary and secondary branches plant⁻¹ (4.46 and 13.95 plant⁻¹, respectively), number of nodules and effective nodules plant⁻¹ at 45 DAS (31.59 and 25.69 plant⁻¹, respectively), dry matter accumulation plant⁻¹ (20.39 g plant⁻¹), number of pods plant⁻¹ (47.03), pod yield plant⁻¹ (28.24 g) and 100 seed weight (24.66 g) were recorded in treatments with the application of 100 per cent RDF (13:25:25 kg NPK + FYM @ 7.5 t/ha) + 1 per cent chickpea magic (T8). The better values of these indices in T8 resulted in higher seed yield (18.53 t) and haulm yield (26.96 q ha⁻¹) as well as higher protein content (21.12 %) in seeds. Further, higher nitrogen, phosphorus, potassium and zinc uptake by chickpea crop (95.25, 14.98, 82.01 kg ha⁻¹ and 150.53 g ha⁻¹) also noticed in the above said treatments. The higher net returns (₹58,045 ha⁻¹) and benefit cost ratio B: C ratio (2.61) was recorded in treatment received 100 per cent RDF + FYM along with foliar spray of 1 per cent chickpea magic at 45 DAS. The magnitude of increase in seed yield was up to 39.63 per cent over farmers practice treatment without chickpea magic application.

II-PP-42

Effect of Different Organic Manures on Growth, Yield, Nutrient Uptake by Radish and Nutrient Content in Soil

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Radish (*Raphanus sativas* L.) is one of the most popular root vegetable crop and is widely acclaimed for its excellent nutritive and medicinal values. It is a good source of vitamin C, carbohydrate, protein, fat, fiber and minerals like calcium, potassium and phosphorous.



Liquid organic manures are used as a foliar fertilizer or applied to the soil contain plant nutrients and numerous plant growth-promoting bacteria (PGPB), which may enhance plant growth by nitrogen fixation, growth hormone production and control phytopathogens. In view of the cost effectiveness and eco-friendly characteristics of the liquid organic manures, a field experiment was carried out at organic farming block of Zonal Agricultural Research Station, V. C. Farm, Mandya during late *Kharif*, 2020 to study the effect of liquid organic manures on growth, yield, quality of radish and their effect on soil nutrient status. The experiment was laid out in Randomized Complete Block Design with nine treatments and replicated thrice. The treatments comprised of soil application of Panchagavya and Jeevamrutha at the time of sowing and 30 DAS along with the application of 50% and 75% RDN through FYM and 100% RDN through FYM only as standard check. The results revealed that significantly higher plant height (28.16 cm), leaf area (302.38 cm²), root length (27.91 cm), root yield (38.38 t ha⁻¹), shoot yield (30.26 t ha⁻¹), nutrient uptake for macro, secondary and micro nutrients were recorded in treatment T₉ (75% RDN through FYM +two times application of Panchagavya). Higher soil available N (336.46 kg ha⁻¹), P (61.92kg ha⁻¹), K (239.46kg ha⁻¹) and secondary nutrients Ca (8.33cmol (p⁺) kg⁻¹), Mg (3.42cmol (p⁺) kg⁻¹) and S (28.57mg kg⁻¹) was found in T₉ followed by T₅ and thus both the treatments found to be economical in saving 25% FYM input resulting in greater resource use efficiency.

II-PP-43

Assessment of Novel Fungicides and Bioagents against *Colletotrichum lindemuthianum* causing Anthracnose of Field Bean under Field Conditions

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Field bean does not show its full production potential due to several biotic and abiotic stresses. Its productivity is affected by many pathogens that often plays major constraints on production, among which, *Colletotrichum lindemuthianum*, the causative agent of anthracnose, is responsible for yield loss. During *kharif* 2020 a field experiment was conducted at college of Sericulture, Chintamani, Chikkaballapura District, Karnataka, India to study the effectiveness of different systemic, contact, combi fungicides and bio against *Colletotrichum lindemuthianum*. The investigation was carried out in Randomized Complete Block design with nine treatments and replicated thrice. T₅- a combination of seed treatment with *T. viride* @ 5g Kg⁻¹ of seeds followed by two foliar sprays of metiram 55 % + pyraclostrobin 5 % WG (Cabrio top) @ 0.2 % was found to be the best with lowest mean disease severity of 21.66 per cent and highest yield (9.94 q/ha) over the untreated control (53.33 % and 7.72 q/ha). Next best was observed in T₆- (seed treatment with *T. viride* @ 5g Kg⁻¹ of seeds followed by two foliar sprays of cymoxanil 8 % + mancozeb 64 % WP (curzate) @ 0.2 %) with 26.66 per cent disease severity and yield (9.78 q/ha). However, highest benefit cost ratio of 1.74 was recorded in T₃ seed treatment with *T. viride* @ 5g Kg⁻¹ of seeds followed by two foliar sprays of hexaconazole 5 % EC @ 0.1 per cent, followed by T₄- seed treatment with *T. viride* @ 5g Kg⁻¹ of seeds followed by two foliar sprays of carbendazim 50 % WP @ 0.1 with benefit to cost ratio of 1.70.



II-PP-44

Epidemiological Factors Responsible for Powdery Mildew Disease in Okra, Green Gram, Black Gram and Wild Poinsettia

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The studies on effect of weather factors on development of disease revealed that the powdery mildew disease index during late *kharif* season was found higher at 49th SMW of 2019 in okra (88.7%), at 2nd SMW of 2020 in green gram (85.6%) and black gram (82.5%) respectively and in the case of wild poinsettia (milk weed/Mexican fire plant) (98.2%) it was found higher at 8th SMW of 2020. There was a negative correlation between the disease index and all-weather parameters except bright sunshine hours in okra and wild poinsettia and wind speed in the case of green gram and black gram, respectively. The multiple linear regression of PDI of powdery mildew in relation to weather parameters and crop age indicated that specific factors were most responsible for the development of powdery mildew disease in different crops *ie.*, crop age in okra, minimum temperature and crop age in the case of green gram, black gram and wild poinsettia, respectively. The aerobiological studies on effect of weather factors on the development of spore load of *E. cichoraeorum*, *E. polygoni* and *Leveillula clavata* indicated that more conidial counts were observed during November and December in *E. cichoraeorum* and *E. polygoni* while it was during November to January in the case of *Leveillula clavata*. Viability of conidia of *Erysiphe* and *Leveillula* were observed up to 16 and 17 weeks in freeze condition followed by 13 and 15 weeks under tree shade condition. Under field condition, it was noticed up to 11 and 13 weeks and in room temperature viability was up to 10 and 11 weeks, respectively.

II-PP-45

Management of Blast Disease of Pearl Millet by using Chemicals and Consortia

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Pearl millet (*Pennisetum glaucum* (L.) R. Br.) is one of the most widely grown millet and an important crop in India and Africa, extensively cultivated in arid and semi-arid regions after rice, wheat and sorghum. India is the single largest producer of pearl millet in the world. The importance of pearl millet as food crop is increasing. Pearl millet plays an imperative role in the food and energy security to the rural people especially in the rainfed areas. Pearl millet crop is affected by various biotic and abiotic stresses. Among biotic stresses, blast disease caused by *Magnaporthe grisea* is the most devastating and widespread disease that causes substantial grain and forage yield losses and is a key constraint to pearl millet. Hence, a field experiment was conducted to manage the Pearl millet (*Pennisetum glaucum* (L.) R. Br.) blast caused by *Magnaporthe grisea* with different chemicals (Tricyclazole 75% WP, Propiconazole 25% EC, Trifloxystrobin 50% + Tebuconazole 25% WG), bioagents (*Bacillus subtilis* and *Pseudomonas*



fluorescens) and soil amendments like Biochar and microbial consortia (combination of Mycorrhiza, Phosphate Solubilising Bacteria, *Pseudomonas* and *Trichoderma*) at Agricultural Research Station, Vizianagaram located in Andhra Pradesh, during *kharif*-2023 under natural disease pressure. Among nine treatments tested, T₅ (spray treatment with Tricyclazole) recorded lowest blast disease severity 55.03% and 63.07% at 45 and 60 days after emergence (DAE) respectively with highest grain yield (22.3 q/ha) and straw yield (51.5 q/ha).

II-PP-46

Permaculture Perspectives: Navigating the Interplay of Biodiversity, Ecosystem Wellness and Sustainable Wisdom

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Permaculture is a design philosophy and set of principles that offer a holistic and sustainable approach to human living systems. The term Permaculture is derived from the words Permanent Agriculture and was coined by Bill Mollison. This abstract unveils the principles and characteristics, of permaculture. At its core, permaculture emphasizes the importance of mimicking natural ecosystems in the design of human settlements, agriculture, and communities. Earth care, People care, Fair share are the principles upon which permaculture relies emphasizing environmental sustainability, social wellbeing, equal resource distribution. It also integrates ecological principles, traditional wisdom, and modern scientific understanding to create resilient and regenerative systems that benefit both people and the environment. One such example being is food forests in which fruit trees, nitrogen fixing shrubs, this approach not only provides food but also increases the soil fertility which in turn enhances the biodiversity. It mainly aims to maximize symbiotic and synergistic relationships between side components, by which it can be fitted into pure organic farming, integrated green revolution system or integrated farming system. The main strength of permaculture is its adaptability to diverse climates which results in development of regenerative agriculture, agroforestry and eco villages worldwide which highlight the potential for sustainable living prioritizing ecological health, social harmony, economic viability. As climate change and environmental degradation continue to pose challenges permaculture provides sustainable and practical framework for designing systems that mitigate the needs of current and future generations. It is a dynamic approach to sustainable living integrating ecological wisdom, ethical considerations, with practical solutions.



Evaluation of Virulent Isolates of *Sclerotium rolfsii* on Popular Finger Millet Varieties in Field Condition

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Finger millet referred as "poor man's food" and the "nutri-millet". Despite its hardiness in nature, it has been harmed by a variety of biotic and abiotic stresses. In recent years, due to farmer's continuous monoculture practice, their cultural practices and the use of high yielding cultivars in the irrigated ecosystem, which has prompted the emergence of many diseases. Among foot rot caused by *Sclerotium rolfsii* is one of the production constraints of finger millet is seriously threatened the crop growth leads to substantial crop loss. The investigation was conducted to evaluate virulent isolates viz., SrVcM (Mandya), SrTH (Hassan), SrCT (Tumakuru) and SrKaMy (Mysuru) against popular finger millet cultivars in field condition. Out of four different virulent isolates of *S.rolfsii* evaluated on ragi varieties, SrVcM(Isolate-1) followed by SrTH (Isolate-2) and SrCT (Isolate-3) were discovered to be the highly virulent to induce the foot rot disease with minimum latent period, highest per cent disease incidence during tillering and maturity stage, virulence index and basal lesion length in 30th DAI. The lowest latent period was taken by the SrVcM isolate (2.78 days) followed by SrTH isolate (3.93 days) on Indaf-5 variety were found to be highly virulent and the highest latent period was observed in SrKaMy isolate (8.50 days) followed by SrCT isolate (7.52 days) on KMR-630 variety were found to be less virulent compared to other isolates. Lesion length recorded from the different isolates ranged from 3.36 cm to 12.21 cm at 30 DAI. Maximum lesion length of 12.21cm was observed in SrVcM isolate followed by SrTH isolate (11.65 cm). Whereas, minimum lesion length of 3.36 cm was observed in SrKaMy isolate. PDI recorded from the different isolates ranged from 5.24 to 36.54 per cent on 30DAI. Maximum PDI was observed in SrVcM (36.54%), followed by SrTH isolate (34.90%). Whereas, minimum PDI was observed in SrKaMy isolate (5.24%). Virulence index recorded from the different isolates ranged from 0.38 to 12.66 during tillering and 1.01 to 17.48 in maturity stage. Maximum virulence index was observed in SrVcM (17.48), followed by SrTH isolate (11.29). Whereas, minimum virulence index was observed in SrKaMy isolate (1.13) during maturity stage. Based on the lesion length, latent period, per cent disease incidence and virulence index. The isolates Mandya (SrVcM) and Hassan (SrTH) were more aggressive than remaining isolates of Mysuru (SrKaMy) and Tumakuru (SrTH).

II-PP-48

Significance of Nutri-Cereals in Three-Fold Security and Management of Banded Leaf and Sheath Blight in Proso Millet

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Most of millet crops are native of India and are popularly known as Nutri-cereals as they provide most of the nutrients required for normal functioning of human body. It is adapted to wide range of temperatures, moisture-regimes and input conditions supplying food and feed to millions of dry land farmers. Biotic stresses, such as bacteria, fungus, virus and nematodes etc. causes severe yield losses. Of the several fungal diseases, Banded leaf and sheath blight incited by *Rhizoctonia solani* Kuhn is one of the dreadful diseases in the successful cultivation of millets and causes yield losses in all major millet growing areas. *R. solani* is a species complex which includes several anastomosis groups (AGs) based on the hyphal fusion of different isolates which differ in their genotypic and phenotypic characters. Molecular approaches including DNA based sequence homology, restriction analysis of ribosomal DNA have been confirmed as reliable tools to differentiate isolates of *R. solani* into distinct clades. Field experiments during *kharif* and *rabi*, 2021-22 revealed that Tebuconazole + Trifloxystrobin offered greater protection against BLSB by reducing its disease severity with lowest PDI (15.55 % and 12.5 %) and highest grain (1359.77 and 1450.30 kg ha⁻¹) and fodder (3294.50 and 3401.93 kg ha⁻¹) yields in both *kharif* and *rabi* seasons respectively. These findings suggest that the application of Tebuconazole and Trifloxystrobin could be an effective strategy for managing BLSB in proso millet, contributing to improved yields and overall agricultural productivity.

II-PP-49

Management of Finger Millet Blast Caused by *Pyricularia grisea* (Cke.) Sacc. with Bio agents and New Fungicides

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A field experiment was conducted to manage the finger millet blast (*Pyricularia grisea*) with bio agents (*Bacillus subtilis* and *Pseudomonas fluorescens*) in combination with new fungicides (Trifloxystrobin, Tebuconazole and Chitosan) at Agricultural Research Station, Vizianagaram located in Andhra Pradesh, India, during *kharif*- 2022 under natural disease pressure. A total of six treatments were formulated (T₁: Seed treatment with Chitosan @3.75g/kg seed + 2 sprays of *Pseudomonas fluorescens* @10g/l after 20 DAS and 35 DAS; T₂: Seed treatment with Chitosan @3.75g/kg seed + 2 sprays of *Bacillus subtilis* @10g/l after 20 DAS and 35 DAS; T₃: Spray treatment with *Pseudomonas fluorescens* @10g/l 20 DAS and Trifloxystrobin 50% + Tebuconazole 25% WG @ 0.04% after 35 DAS; T₄: Spray treatment



with Trifloxystrobin50% + Tebuconazole 25% WG @0.04% 20 DAS and *Bacillus subtilis* @ 10g/l after 35 DAS; T₅: Trifloxystrobin50% + Tebuconazole 25% WG @ 0.04% 2 sprays at 20 DAS and 35 DAS; T₆: Control). Results revealed lowest incidence of leaf blast (26.59%), neck blast (12.67%) and finger blast (13.0%) with the highest yield of grain (15.53 q/ha) and fodder (35.0 q/ha) was recorded in spray treatment of *Pseudomonas fluorescens* @10g/l 20 DAS and Trifloxystrobin50% + Tebuconazole 25% WG @ 0.04% after 35 DAS (T₃) followed by Spray treatment with Trifloxystrobin50% + Tebuconazole 25% WG @0.04% 20 DAS and *Bacillus subtilis* @ 10g/l after 35 DAS (T₄) in which an incidence of 40.74% leaf blast, 33.91% neck blast, 35.67% finger blast were recorded with 12.16 q/ha of grain yield and 25.70 q/ha of fodder yield.

II-PP-50

Feeding Habit, Biology, and its Ecological Aspects of Fall Armyworm, *Spodoptera frugiperda* on Different Millets

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The fall armyworm, *Spodoptera frugiperda* is one of the invasive devastating pests which occurred recently in India. The occurrence of fall army worm on maize was reported for first time in Karnataka, India as well as in Asia by in 2018. Maize plants damaged by the early instar larvae scrape the leaves and makes white patches and showed characteristic pin holes symptoms on the leaves. Grown up larvae are confined to the deep whorls and fed extensively on bud and soft whorl. Such plants appeared to have been torn. The nature of damage in finger millet varies from maize crop. Whereas in case of finger millet, early stage instars scrape the leaves present below the emerging new leaves at nodal region and frass material seen on the leaf sheath. The larva hides within the leaf sheath and make a hole on to the stem from which new leaves emerges. Due to this damage drying of emerging leaves/roughly teared or torn appearance is seen in field. Number of larvae per plant was found to be 1 to 3 larvae per plant. The female moth laid 176 eggs on maize and 224 eggs on ragi. An average incubation period was 3.4 and 3.6 days in maize and ragi, respectively. Hatching percentage was found to be 97.26 percent in maize and 95.45 percent in ragi. There were six larval instars on ragi were observed. The duration of first, second, third, fourth, fifth and sixth instar recorded was 2.9, 3.1, 2.6, 2.3, 2.7 and 4.3 days in ragi, respectively. The total pupal period lasts for 9.6 days on maize and 9.7 days on ragi. The total life cycle was completed in 46.87 days on finger millet crop. Male and females were identified based on morphological and genetical characters. Other millets incidence of fall armyworm noticed on proso millet, finger millet, sorghum pearl millet and barnyard millet with per cent damage plants was 4.2, 7.4, 58.8, 26.8 and 8.2, respectively.



Biological Control of Ragi Blast

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Millets are traditionally grown and eaten in the Indian subcontinent for the last 5000 years. Millets have the tag of “poor man’s food grain” due to its sheer affordability. Millets are known as dry crops since they need very little water for their production. Millets contain high level of proteins, minerals, vitamins, antioxidants, and they are non-glutinous and non-acid forming diets compared to other cereals and therefore called as ‘nutritious millets’ or ‘nutri-cereals’. Millets are low in simple carbohydrates and high in complex carbohydrates, making it a low-glycaemic index (GI) food. Millets are rich in dietary fibre- both soluble and insoluble (prebiotic). Finger millet (*Eleusine coracana* (L.) Gaetn.) is commonly known as Ragi is one of the most important and largely grown small millet in India. It is widely consumed as the staple food in the rural community of Southern Karnataka, Tamil Nadu, Andhra Pradesh, Bihar, Orissa and Chhattisgarh. It is an important group of rainfed and dry land field crop, also known as ‘Nutri cereals’ in human dietary components. Even though, finger millet is known to be one of the hardiest crops, it is affected by number of diseases such as blast, foot rot, smut, streak and mottling virus. Among these, blast caused by *Pyricularia grisea* is the most devastating disease affecting different aerial parts of the plant at all stages of its growth starting from seedling to grain formation and considered as most destructive disease. Yield loss due to blast may be around 28 per cent but under favourable conditions it may go higher to 80-90 per cent. Biological control is an alternative to synthetic chemical pesticides and have several benefits to human beings and ecosystem, besides improving soil fertility and safety to environment. Seed treatment with *Pseudomonas fluorescens* and *Bacillus subtilis* @ 10 g/kg seed + seedling dip + foliar spray @ 0.1% inhibit *Pyricularia grisea* causing blast disease of finger millet.

In Vitro Evaluation of Bio Control Agents against *Rhizoctonia solani* (J. G. Kuhn) causing Root Rot of French Bean

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Rhizoctonia solani Kühn is an important pathogen in common bean (*Phaseolus vulgaris* L.) causing web blight (WB) in the tropics, as well as a soil borne pathogen causing root rot (RR) worldwide leading to heavy yield loss. Detrimental effects of fungicides render an indispensable need to identify bio-agents with beneficial activity, environmental safety, and a broad collection of biocidal strains against the pathogen. With this regard, a total of six fungal



and bacterial bioagents viz., *Trichoderma* spp., *Bacillus subtilis* and *Pseudomonas fluorescens* were evaluated for their antagonistic properties against *Rhizoctonia solani* by using dual culture technique. Highest inhibition of mycelial growth was observed in *Trichoderma harzianum* (74.07 %), followed by *Trichoderma viride* (68.89 %). Least mycelial growth inhibition was recorded in *Bacillus subtilis* (UAS Raichur) with 22.22 per cent inhibition. The results revealed that, the fungal bio- agents were better than bacterial bio-agents in inhibiting the mycelial growth of the pathogen. This research contributes valuable insights into the potential of specific bioagents for managing *Rhizoctonia solani*-induced diseases in common beans. The emphasis on environmentally friendly alternatives and the identification of effective bio agents is crucial for sustainable agriculture and minimizing the reliance on chemical fungicides.

II-PP-53

Effects of Organic Farming on Soil Fertility and Crop Production

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Food security and soil fertility are inextricably linked since soil fertility is a key fac in influencing the productivity of all farming systems. The ability of the soil to provide nutrients to crops is a common definition of soil fertility, but it can also be broader understood as an ecosystem concept that integrates the many ways that soil supports plant growth, including nutrient provision. The idea that "the health of soil, plant and animal is one and indivisible" is fundamental to organic farming. To maximize crop output and heal organic farming techniques rely on managing the organic matter in the soil to improve the son chemical, biological, and physical characteristics. Thus, a variety of management choices as soil management practices and rotation design and manure management, ultimate determine the availability of nutrients to crops, and consequently to livestock and humans these systems, the application of legume-based multi-annual rotations in conjunction with the cautious application of on-farm manures is the fundamental idea of soil fertility. Organ's farming is not mere non-chemical agriculture, but it is a system integrating relations between soil, plant and water. Organic farming helps in soil health, proper energy flow in soil, crop water environment systems, keeps biological life cycle alive and helps in sustaining considerable levels in yield. Its fundamental principles are the regeneration of soil organic matter in the form of humus, the growth of the microbial population, the precise application of the elements that support soil life and health, and the biodynamic treatment of manures. In addition to enhancing the physical, chemical, and biological qualities of the soil, which have a direct impact on moisture retention, root development, and nutrient conservation, applying organic matter- a crucial component of organic farming can lower the cost of production in agriculture. A high proportion of humus in the soil gives uniform distribution of nutrients and also plant hygiene. Crop rotations and crop mixtures are designed with a strong awareness of their impact on soil structure. One of the key elements that supports sustainable agriculture and higher production is the usage of compost. The comparatively stable decomposed organic elements that come from the rapid biological decomposition of organic materials in regulated, aerobic environments make up compost.



Because compost adds low-density organic matter to the mineral soil component, it generally has a positive effect on soil structure by lowering soil density. In order to speed up the microbial activities that increase the availability of nutrients that are easily absorbed by plants, biofertilizers are commonly utilized. By fixing atmospheric nitrogen, solubilizing insoluble phosphates, and producing chemicals in the soil that promote plant growth, they increase soil fertility. The goal of these biofertilizers is to harness the biological mechanism of nutrient mobilization that exists naturally. This greatly improved soil fertility and, eventually, crop productivity.

II-PP-54

Long Term Influence of Nutrient Management Practices in Different Production Methods on Yield, Economics and Soil Carbon Sequestration in Pigeonpea Based Crop Rotation System in North Eastern Dry Zone of Karnataka

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A field experiment was conducted to optimize the long-term nutrient management practices under different production methods for yield, economics and soil fertility status of pigeonpea based crop rotation system (greengram *fb rabi* sorghum and pigeonpea) in North Eastern dry zone of Karnataka during *kharif* and *rabi* seasons of 2021 and 2022 at Zonal Agricultural Research Station, Kalaburagi with ten treatments and three replications laid out in randomized block design. The experiment was initiated in the year 2004 and modified in 2021-22. Organics were applied equivalent to recommended N (*rabi* sorghum) and P (greengram and pigeonpea). The results indicated that INM treatment (50% organic: 50% inorganic) recorded higher seed and stalk yields of greengram, *rabi* sorghum and pigeonpea but was found on par with that of organics (100% and 75% organics) and RPP treatments. Among, organic treatments, 100% and 75% organics received plots recorded significantly higher net returns when compared to inorganics and INM treatments. Thus, emphasizing the saving of 25% organics in nutrient management on a long run. Whereas, all organic treatments reported higher carbon sequestration than INM, RPP and inorganic treatments. However, organic produce fetched premium price because of better quality and acceptability.

II-PP-55

Organic Farming and Its Impact on Soil Fertility

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The modern system of farming is becoming unsustainable as evidenced by declining crop productivities, damage to environment, chemical contaminations, *etc.* The necessity of having an alternative agriculture method which can function in a friendly eco-system while sustaining



and increasing the crop productivity is realized now. Organic farming was recognized as the best known alternative to the conventional agriculture and has been adopted in a wide range of climates and soil types. Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs. It combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved. Organic farming generally promotes soil fertility by emphasizing sustainable practices. Soil fertility refers to the ability of soil to provide essential nutrients to plants for optimal growth. Fertile soil contains an appropriate balance of nutrients, organic matter and microorganisms, supporting plant development. It avoids synthetic pesticides and fertilizers, relying on natural alternatives like compost and manure. This helps to maintain soil structure, encourages beneficial microbial activity and enhances nutrient content. Over a time, organic farming can positively influence soil fertility, contributing to enhanced soil health, water retention and overall agricultural sustainability compared to conventional methods.

II-PP-56

Soil Management Practices to Reduce Runoff and Soil Loss in *Alfisol* of Eastern Dry Zone of Karnataka

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Under changed climatic scenario, high intensity rainfall events are very common and it leads to high runoff under *Alfisol* dryland situation which results in severe erosion, shallow soil, less fertility and poor water holding capacity creates soil moisture stress during crop growth. To address this several land treatments such as contour trenching, broad bed furrows are being followed for erosion control and rain water conservation measures are proving better conservation of water in the soil profile. In addition to this a study on soil management practices was undertaken in treated and untreated micro-catchment at AICRP for Dryland Agriculture, UAS, GKVK, Bengaluru, with two factors viz., Crops (C_1 : Finger millet and C_2 : Groundnut) and three land treatment practices (T_1 : Trenches at 10 m interval, T_2 : Trenches at 25 m interval, T_3 : Control) in factorial RCBD with 3 replications. The results of the experiment clearly indicating that significantly higher soil moisture was noticed with trenches at 10 m interval at 30, 60 and 90 DAS (11.17, 14.78 and 17.73 %, respectively) followed by trenches at 25 m interval and lower moisture was found in control plot i.e., no trenches. Further, significantly higher finger millet and groundnut grain/pod yield (3007 kg ha^{-1} and 1795 kg ha^{-1} , respectively), net returns (Rs. 66284 ha^{-1} and Rs. 33358 ha^{-1} , respectively), benefit cost ratio (3.01 and 1.80, respectively) and higher rain water use efficiency ($4.23 \text{ kg ha-mm}^{-1}$ and $3.26 \text{ kg ha-mm}^{-1}$,



respectively) was recorded with trenches at 10 m interval as compared to other treatments. During 2020, a total of 923 mm of rainfall was received and 6 runoff events were noticed in all treatments. Less runoff (28704 litres in finger millet and 22908 litres in groundnut), soil loss (1719.48 kg ha⁻¹ in finger millet and 1515.24 kg ha⁻¹ in groundnut) and less nutrient losses were noticed under trenches at 10 m interval followed by trenches at 25 m interval and higher runoff, soil loss and nutrient loss was noticed under no trenches (control).

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Embracing Millets: Nourishing the Future of Global Diets

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The 21st century has witnessed a growing recognition of millets as pivotal components of a sustainable and nutritious diet. Aptly hailed as the "Foods of the 21st Century," millets have emerged from the shadows of traditional grains to assume a central role in addressing contemporary global food challenges. This abstract explores the multifaceted significance of millets in the context of their nutritional richness, environmental resilience, and potential to enhance food security. Millets, encompassing a diverse group of small-seeded grains, stand out as nutritional powerhouses. Rich in essential nutrients such as proteins, fibers, vitamins and minerals, millets offer a wholesome alternative to conventional staple foods. Their low glycaemic index and gluten-free nature make them particularly valuable for combating modern dietary concerns, including diabetes and gluten-related disorders. In addition to their nutritional prowess, millets exhibit remarkable adaptability to diverse agro-climatic conditions, requiring minimal water and exhibiting resilience in the face of climate change. As climate-smart crops, millets contribute to sustainable agriculture, mitigating the environmental impact associated with resource-intensive food production. The renaissance of millets extends beyond their nutritional and environmental attributes to encompass social and economic dimensions. Millet cultivation provides livelihood opportunities for smallholder farmers, contributing to rural development and fostering agricultural diversity. In conclusion, millets have rightfully earned their status as the "Foods of the 21st Century". Their nutritional richness, environmental resilience and socio-economic impact position millets as a cornerstone of sustainable and inclusive global food systems, offering a promising solution to the complex challenges of our era. Embracing millets represents a transformative step toward a healthier, more resilient and equitable future.

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ICM Technologies in Enhancement of Blackgram Production through Cluster Front Line Demonstrations in Parvathipuram Manyam District of Andhra Pradesh

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Blackgram is one of the important pulses crop in India, grown in both *Kharif* and *Rabi* seasons. It can also be grown as pure or mixed crop during *kharif* season. The productivity of this crop is 601 kg/ha during *kharif* season is very low due to non-adoption of improved technologies by small and marginal farmers. By keeping these facts in view, present investigation was conducted by Krishi Vigyan Kendra of Parvathipuram Manyam district, Andhra Pradesh to find out the yield gaps among scientific package of practices under cluster front line demonstrations and local farmer's practice. CFLD Blackgram programme under NFSM Pulses during *Kharif* 2022-23 conducted in 25 locations covering 10 ha in different villages. Blackgram variety TBG 104 is a medium duration variety (70-75 days) with a yield potential of 21.25 q/ha was introduced to the farmers. In this ICM practices like timely sowing of seeds in lines, seed treatment with mancozeb, spraying of neem oil, integrated pest and disease management were demonstrated in area of 10 ha. The observations on selected parameters of demonstration plots as well as control plots were recorded. There was a yield improvement to the extent of 22.87 % with the new Blackgram variety TBG 104 and by adoption of seed treatment, timely plant protection measures and spraying of potassium nitrate to mitigate the terminal moisture stress practices as compared to farmers practice i.e., cultivation of local variety. Demonstration plots recorded highest yield of 6.93 q/ha with a CBR of (1: 3.16) as compared to the farmers practice with a yield of 5.64 q/ha and CBR of 1: 2.57.

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Agro-forestry: Crop Diversification for Climate Resilience

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Agroforestry, as an integral component of agroecology, represents a departure from conventional monoculture approaches. This paper navigates the synergies between agroforestry, crop diversification, and the overarching goal of ensuring food security in the face of a changing climate. Agroforestry systems, characterized by the intentional integration of trees and shrubs into agricultural landscapes, contribute to enhanced ecological diversity and sustainability. The strategic incorporation of diverse plant species within agroforestry systems not only promotes soil health and fertility but also fosters resilience against extreme weather events, pests, and diseases. By embracing the principles of agroecology, agroforestry harmonizes ecological processes, minimizing the reliance on external inputs and promoting natural systems that are adaptive to changing environmental conditions. The multifaceted benefits of agroforestry are intricately linked to its positive impacts on soil health and nutrient cycling. The integration of trees and shrubs into agricultural landscapes facilitates improved



water retention, reduced soil erosion, and enhanced nutrient availability. These ecological benefits, in turn, create an environment conducive to diversified crop production, breaking away from the limitations imposed by traditional monoculture systems. Moreover, the paper explores how agroforestry contributes to sustainable food security by providing a continuous and diverse yield throughout the year. The variety of crops grown in agroforestry systems not only ensures a more stable and resilient food supply but also promotes dietary diversity, addressing nutritional challenges associated with mono-cropping practices. The concept of sustainable agriculture is redefined within the framework of agroforestry, where ecological harmony is a guiding principle. Agroforestry systems demonstrate the potential to sequester carbon, mitigating the impacts of climate change, and offering a solution to the global challenge of reducing greenhouse gas emissions. In conclusion, this advocates for the widespread adoption of agroforestry as a transformative strategy for crop diversification and climate resilience in sustainable agriculture. By intertwining ecological principles, agroecology, and diversified cropping systems, agroforestry stands as a beacon of hope for resilient and sustainable food production. The lessons learned from agroforestry practices can inform policies and practices that foster a paradigm shift towards agricultural systems that are not only productive but also resilient in the face of climate uncertainties, thereby contributing to the overarching goal of global food security.

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Influence of Strip Cropping on Soil Moisture Dynamics, Growth and Yield of Different Crops under Dryland Condition

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Finger millet is one of the major food crops of Southern region of Karnataka. However, the productivity is very low due to inadequate moisture availability during critical stages. In rainfed uplands more than 25% of rainwater is lost as runoff. Agronomic practices such as ridge and furrow, broad bed and furrow, intercropping, strip cropping, cover cropping etc., are recommended to increase infiltration rate of water and reduce the runoff. Finger millet can be grown as strip cropping with different crops; the main purpose of introduction of strip crop is to reduce soil erosion, conservation of runoff water in sloppy regions. The experiment comprised of 6 treatments of finger millet-based strip cropping system viz., T₁: Finger millet + Cowpea, T₂: Finger millet + Horse gram; T₃: Finger millet + Field bean, T₄: Finger millet + Rice bean, T₅: Finger millet + Sunflower, T₆: Finger millet + Niger strip cropping system were assessed by deploying Randomized Complete Block Design with 4 replications. The data pertaining to soil moisture at 15 cm depth recorded in 15 days interval upto harvest revealed that among the treatments, the strip crop combination of Finger millet + Cowpea (T₁) showed significantly higher soil moisture (12.51, 21.64, 30.28, 16.21, 14.24, 7.89, 17.03, and 7.53 at 15, 45, 60, 75, 90, 105, DAS, and at harvest, respectively) compared to all other treatments and lower moisture content was found in T₆: Finger millet + Niger (7.24, 13.64, 23.36, 9.36, 7.25, 5.02, 9.82 & 4.93% at 15, 45, 60, 75, 90, 105 DAS and at harvest, respectively). Further, yield of each crop was converted into finger millet equivalent yield (FMEY). Among different



treatments, finger millet + sunflower (T₅) showed significantly higher finger millet equivalent yield (2462 kg ha⁻¹) compared to all other treatments and lowest finger millet equivalent yield was found in T₆: finger millet + niger (1869 kg ha⁻¹).

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Identification of Contingent Crops for Delayed Sowing under Changed Climate in Dryland Situations

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Rainfed agriculture plays a major role in Indian economy and rural livelihoods. It is spread over 55 per cent of net cultivated area, contributing over 39 per cent to the national agricultural production. Monsoon failures result in drought which has serious implications for small and marginal farmers and livelihoods of the rural poor. Hence; there is a need for adopting suitable crops and cropping system suitable for weather aberrations in different agro climatic regions of the country. Therefore, identification of contingency cropping plan that helps for development of strategic measures under dryland agriculture to sustain during the monsoon failure or delay of monsoon. In this background an experiment was conducted on identification of contingent crops for delayed sowing under changed climate in dryland situations at AICRP for Dryland Agriculture, UAS, GKVK, Bengaluru with two factors viz., Sowing windows (S₁: Aug 2nd fortnight, S₂: Sep 1st fortnight, S₃: Sep 2nd fortnight) and crops (C₁: Foxtail millet, C₂: FM, C₃: Field bean, C₄: French bean, C₅: Quinoa) comprised of 15 treatment combinations by deploying Factorial Randomized Complete Block Design, with three replications. The results revealed that higher yield of crops viz foxtail millet, finger millet, field bean, French bean and quinoa was recorded by sowing during August 2nd fortnight (S₁). Among the different crops, higher yield was recorded with French bean (3150 kg ha⁻¹) followed by finger millet (1975 kg ha⁻¹), while lowest yield of 567 kg ha⁻¹ was noticed with quinoa. Further, yield of each crop was converted into finger millet equivalent yield (FMEY) and higher finger millet equivalent yield (3289.9 kg ha⁻¹) was recorded with Frenchbean followed by finger millet (1632.5 kg ha⁻¹). However, sowing of crops during August 2nd fortnight (S₁) recorded significantly higher finger millet equivalent yield (1994.13 kg ha⁻¹) compared to late sowing (S₃). Among the different crops and different sowing windows the performance was better with French bean (3289.9 kg ha⁻¹) in August 2nd fortnight sowing and produced significantly higher finger millet equivalent yield (1994.1 kg ha⁻¹) followed by September 1st fortnight sowing (1712.2 kg ha⁻¹) and September 2nd fortnight sowing (1250.2 kg ha⁻¹). With respect to economics, among the different dates of sowing, August 2nd fortnight sowing recorded higher net return (Rs 34,791) and B:C (2.09). However, with respect to different crops French bean recorded higher net returns Rs 91,215 and B:C 3.62.

Role of Conservation Agriculture in Sustainable Agriculture

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The conventional mode of agriculture through intensive cultivation has led to the degradation of natural resources such as soil, water and vegetation. Increasing concerns for sustainable agriculture has been seen as a positive response to both low-input, conventional agriculture, and intensive modern agriculture, which rely on high inputs for crop production. Sustainable agriculture relies on practices that help to preserve ecological equilibrium and promote natural regenerative processes such as nitrogen fixation, nutrient cycling, soil regeneration, and the conservation of natural enemies of pest and diseases, as well as the efficient use of inputs. Conservation agriculture can be seen as a new way forward for conserving resources and enhancing productivity. Conservation agriculture maintains a permanent or semi-permanent organic soil cover. This can be a growing crop or crop mulch. Its function is to protect the soil physically from direct heat of sun, beating rain drops, blowing wind and to feed soil biota. The soil micro-organisms and soil fauna take over the tillage operation and soil nutrient balancing, but mechanical tillage disturbs this process. Therefore, zero or minimum tillage and direct seeding are important elements of conservation agriculture. These practices can provide many soil and water conservation benefits, potential to combat erosion and nutrient loss and also makes them an important tool for protecting natural resources. Adoption of reduced tillage practices improves soil physical, chemical and biological properties of soil ultimately leading to higher yield. Thus, conservation agriculture has come up as a new paradigm to achieve the goal of sustainable agricultural production.

First Report of Shoot Fly *Atherigona lamda* Pont, 1981(Diptera: Muscidae) from India

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The muscid shoot-fly *Atherigona* 1856 Rondani (Diptera: Muscidae) is a major pest in millets grown in different parts of India. In India, till now a sub-family Atherigoninae is represented by 37 species of the genus *Atherigona*. The specimen collected through sweep net on grasses from Delhi IARI campus during 2017. Here, the report of shoot fly *Atherigona lamda* Pont, 1981 for the first time and is described from India based on morphological characters of male specimens. The adult males with palpi yellow. Inter frontalia black. Mesonotum black to grey dusted, tinged with golden yellow. Fore femur yellow, fore tibia infuscated with brown except at base, fore tarsi yellowish brown, with long erect setulae on segments 2-4. Wings without any smudge around Sc. Tergites 3-5 slightly infuscated with brown; tergite 3 with a pair of elongate subquadrate spots, tergite 4 with a pair of small oval spots, tergite 5 devoid of any spots. Male

genitalia have hypopygial prominence with arms diverging, forwardly and outwardly directed. Trifoliate process weakly sclerotized on apical 2/5th of the stalk, shoulders and basal 3/4th of lateral plates; apical 1/4th of lateral plates dark brown; shoulders well developed with prominent indications on inner surface; inner surface of lateral plates straight, without any inner lobe; apex of median piece with an e margination.

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Cultivating Sustainability: The Synergy between Organic Farming and Millets for A Healthy Planet

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In the pursuit of a sustainable and healthy planet, the symbiotic relationship between organic farming and millets emerges as a transformative force. This abstract delves into the interconnected narrative of these two agricultural paradigms, exploring their collective impact on global well-being and environmental harmony. Organic farming, characterized by ecological balance and minimal synthetic inputs, stands as a beacon of sustainability. Paired with the nutritional prowess of millets, a diverse group of small-seeded grains, this dynamic duo presents a holistic approach to agriculture. Millets, rich in essential nutrients, serve as resilient crops capable of thriving in diverse agro-climatic conditions, making them integral to sustainable food production. The synergy between organic farming and millets addresses contemporary challenges, including environmental degradation and public health crises. By eschewing chemical inputs, organic farming mitigates ecological harm, promoting soil health and biodiversity. Millets, as low-input crops, contribute to water conservation and climate resilience, aligning with the goals of sustainable agriculture. Moreover, the combination of organic practices and millet cultivation fosters a more resilient and decentralized agricultural system. This not only provides nutritional security but also offers economic opportunities for smallholder farmers, contributing to rural development. As the global community grapples with the imperative for sustainable practices, embracing the synergy of organic farming and millets emerges as a promising solution. The amalgamation of these practices is not merely a cultivation method; it represents a conscientious choice towards cultivating sustainability- a choice that holds the promise of a healthy planet for current and future generations.



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In Vitro Evaluation of Commercial Botanicals and Plant Extracts against *Rhizoctonia solani* (J. G. Kuhn) causing Root Rot of String Bean

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Root rot of String bean is caused by *Rhizoctonia solani* (J. G. Kuhn) is a devastating soil borne fungus infecting wide range of crop species across the world. The disease occurs at an exorbitant form in the seedling stage leading to significant economic yield loss. Fungicide treatment of soil-borne diseases is prohibitively expensive. There are additional environmental risks involved. As a result, pathogen management employing environmentally safe botanicals serves to be the best option. Higher plant extracts have shown a wide spectrum of efficacy against plant pathogenic pathogens. *In vitro* analysis, based on poison food technique was carried out using different plant extracts and commercial botanicals against the *Rhizoctonia solani* pathogen infecting string beans. The study showed that commercially available once showed maximum inhibition than the plant extracts. Among the five commercial botanicals, Perfect recorded 100 per cent mycelial growth inhibition followed by crude neem oil (83.46%), least inhibition was recorded in crude Pongamia extract (65.93%). Among the four plant extract evaluated, garlic bulb extract showed highest mycelial inhibition of 96.17% followed by Parthenium leaf extract (61.48%). Least mycelial inhibition was recorded by Durantha leaf extract (21.85%). The findings suggest that certain commercial botanicals, particularly Perfect, and garlic bulb extract as a plant extract, demonstrated high efficacy in inhibiting the mycelial growth of *Rhizoctonia solani*. This underscores the potential of environmentally safe botanicals as an effective alternative for managing root rot in string beans.

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Organic Farming: Nurturing Sustainability in Agriculture"

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Organic farming is an ecologically conscious agricultural paradigm that prioritizes sustainability, eschewing synthetic inputs in favour of natural and regenerative practices. This abstract explores the key principles, ecological benefits, and challenges associated with organic farming, highlighting its potential to foster a resilient and environmentally friendly food production system. Organic farming emphasizes a holistic approach to cultivation, rejecting the use of synthetic pesticides and fertilizers. Instead, it relies on practices such as crop rotation, composting, and biological pest control to maintain soil fertility and ecological balance. By promoting a harmonious relationship between crops and the environment, organic farming aims to create a resilient and sustainable agricultural system. One of the primary advantages of organic farming lies in its positive impact on biodiversity. The absence of chemical inputs



creates a habitat that supports a diverse range of plant and animal species. This biodiversity not only contributes to the overall health of the ecosystem but also enhances the resilience of crops to pests and diseases, reducing the need for external interventions. The promotion of soil health is another key aspect of organic farming. Through techniques like cover cropping and minimal soil disturbance, organic farmers nurture a thriving soil ecosystem. This not only improves nutrient availability for plants but also enhances water retention and prevents soil erosion. The result is a robust and fertile soil structure that supports sustainable crop growth while mitigating the environmental risks associated with conventional farming practices. While organic farming presents a promising model for sustainable agriculture, challenges such as lower initial yields and the need for enhanced education and infrastructure persist. Addressing these challenges will be crucial in realizing the full potential of organic farming as a viable and scalable solution for fostering ecological balance and sustainability in agriculture. In conclusion, the principles of organic farming offer a pathway towards a more resilient and environmentally conscious food production system, aligning with the global imperative to safeguard both the planet and future generations.

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Phytochemical Analysis of Different Plant Extracts on *Aspergillus niger* and *Fusarium solani*

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Plant extracts constitutes versatile phytochemicals which can be substituted with commercial synthetic chemicals to inhibit the growth of pathogens. In this study, the methanol and aqueous extracts of guava, jackfruit, tulsi, peppermint and eucalyptus leaves were evaluated *in-vitro* against *Aspergillus niger* and *Fusarium solani* isolated from Pomegranate and Guava respectively. Plant extracts were prepared using Soxhlet apparatus and condensed the extract by rotary evaporation. Highest yield was obtained in methanol plant extracts compared to aqueous extract, as it causes differences in the polarity of the extraction which leads to wide variation in the level of bioactive compounds in the extract. Poison food technique was used to test the antifungal activity of plant extracts. Jackfruit leaves methanol extract at 7000ppm showed maximum inhibition of 88.89% and guava leaves aqueous extract at 3000ppm showed minimum inhibition of 48.15% against *Aspergillus niger*. In case of *Fusarium solani* maximum inhibition was observed in jackfruit leaves methanol extract at 7000ppm of 87.89% and minimum inhibition was recorded in eucalyptus leaves aqueous extract of 57.41% at 3000ppm. The qualitative phytochemical screening of selected plant extracts showed various phytochemicals in plant extracts like tannins, phenols, flavonoids, terpenoid, saponin and alkaloid. GC-MS analysis of jackfruit methanol extract showed the presence of 9-Octadecenoic acid (Z)-, 2-hydroxy-1, Octadecanoic acid and Benzene, 1, 2-dimethoxy-4-(1-propenyl). All these findings implied the availability of various phytochemicals might be a source of antifungal agent for inhibition of pathogens and to improve the postharvest quality of fruits.



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Role of Millets in Organic Production

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Millets assume a pivotal role in organic production, epitomizing sustainable and environmentally conscious agriculture. These small-seeded grains are inherently suited for organic farming practices due to their hardiness and minimal input requirements. Their remarkable drought resistance makes them well-adapted to arid conditions, allowing cultivation in regions with limited water resources, aligning with the water conservation ethos of organic agriculture. Millets are champions of low-input farming. Thriving in poor soil conditions, they demand minimal synthetic fertilizers and pesticides, embodying the core principles of organic cultivation. By reducing reliance on chemical inputs, millets contribute to the creation of healthier ecosystems and safeguarding soil quality. Beyond their agronomic benefits, millets support biodiversity in organic farms. Acting as hosts for various beneficial organisms, they foster a balanced and resilient agricultural environment. Incorporating millets into crop rotation systems enhances soil fertility, minimizing the need for external inputs and promoting a sustainable nutrient cycle within the organic farm. These grains are nutrient powerhouses, enriching the overall diversity of organic crops. Their cultivation fosters a holistic approach to farming, where nutritional density and ecological balance are paramount. Millets also play a vital role in climate resilience, with their adaptability to diverse climatic conditions contributing to the overall robustness of organic farming systems. In essence, millets stand as exemplars of sustainable and organic agriculture, embodying principles of resource efficiency, biodiversity conservation, and climate resilience. Their integration into organic production models underscores a commitment to cultivating food in harmony with nature, promoting long-term environmental and agricultural sustainability.

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Crop Production Practices, Soil Conditions and Major Constraints Under Organic and Natural Farming Production Systems in Charkhi Dadri District of Haryana

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As India being sufficient in food grain stock now there is need to shift towards quality and sustainability in agriculture sector. Organic and natural farming systems are one of the best options to achieve this. Common practices used in organic and natural farming are Pusa waste decomposer treated well decomposed FYM application intercropping, crop rotation, incorporation of summer moong and dhaincha, mulching, insect traps including light, yellow sticky and pheromone lure traps, Jivamrita, Beejamrita, Ghan jivamrita. Seed treatment using Biofertilizers mainly (Azotobacter + PSB, Rhizobium, Phospho teeka) for seed, soil and Bio teeka for nursery plant and root diseases. For insect-pest control use of neem seed kernel extract products, Neemastra, Agniastra and Bharmastra are used. Soil structure of fields varied from



very loose, friable, coarse, structureless, single grained, somewhat flat to undulated topography due to transportation and deposition of sand dunes and alluvial parent material. Soil texture varied from Loamy soil to sandy soils having sprinkler irrigation due to less availability of underground irrigation water which is suitable for crops mainly Bajra, Jowar, Mustard, Cotton, Barley and vegetables etc. Soil organic carbon status of major soils lied in low range except some organic farms where continued use of cow-urine-dung based FYM, compost and liquid formulation some of soils have good nutrient status. Major crop grown under organic farming production in crops is wheat, bajra, mustard followed by vegetables mainly watermelon, muskmelon etc. and to some extent cotton. Less insect, pest attack was observed in cotton crop under three-year field observations which prevented farmers from unusual insecticide spray loads. Constraints observed are weed control, above ETL losses, timely unavailability of biofertilizers, lack of packing, processing, sorting, grading and packaging, labelling and certification channel, lack of marketing facility and channel to develop product according to market demand and export-oriented selling of quality products. To fulfil “Doubling the Farmer’s income” an integrated approach by state government, agricultural department and universities, progressive farmers feedback, NABARD and other funding agencies assistance, PGS certification regional councils’ awareness camps, SFAC activated to promote infrastructure and marketing must be there.

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Eco-Resilience: Biotic and Abiotic Stress Management Strategies for Thriving Organic Farming and Sustainable Ecosystem

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The ever-evolving narrative of agriculture and ecology, the concept of "Eco-Resilience" emerges as both a philosophy and a practical guide. This abstract intricately examines the symbiotic relationship between Biotic and Abiotic Stress Management Strategies, unravelling their specific contributions to not only ensure the prosperity of organic farming but also to sculpt resilient and sustainable ecosystems. Biotic stressors, ranging from pest infestations to microbial diseases, and abiotic stressors, encompassing climatic fluctuations and soil health challenges are inevitable facets of agricultural landscapes. However, their management can be more than a response; it can be a proactive strategy for enhancing eco-resilience. Integrated pest management practices, rooted in organic farming principles, emerge as key tools to navigate the intricacies of biotic stress, fostering a dynamic equilibrium where pests are not eradicated but coexist in a balanced ecosystem. The exploration extends to abiotic stress, where sustainable agriculture practices become the bulwark against environmental challenges. Regenerative approaches, such as cover cropping, precision agriculture, and water-use efficiency measures, work hand-in-hand with biotic stress management to bolster soil health and mitigate the impact of climatic uncertainties. It highlights how these strategies collectively contribute to the creation of resilient agricultural ecosystems. Central to the narrative is the role of organic farming within the paradigm of eco-resilience. Beyond being a set of agricultural practices, organic farming becomes a holistic approach that synergizes with biotic and abiotic



stress management strategies and also sheds light on how organic farming principles, emphasizing biodiversity, natural nutrient cycling, and soil health, align seamlessly with the objectives of enhancing eco-resilience. A deeper exploration reveals that eco-resilience extends its influence beyond crop-centric concerns. It fosters environments that support a rich tapestry of biodiversity, from beneficial insects to soil microorganisms. This is emphasizing how a resilient ecosystem, cultivated through biotic and abiotic stress management, becomes a self-sustaining entity where the intricacies of nature are harnessed rather than suppressed. In summary, "Eco-Resilience" emerges not merely as a theoretical construct but as a tangible roadmap for transforming challenges into opportunities in agriculture and ecology. Through a nuanced understanding of the dynamic interplay between biotic and abiotic stress management strategies, we pave the way for thriving organic farming practices and the cultivation of truly sustainable ecosystems. This abstract invites a closer examination of the practical applications of eco-resilience, urging a collective re-evaluation of our approach to agriculture and ecological stewardship.

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Effect of Different Organic Sources of Nutrients on Growth and Yield of Grain Amaranth (*Amaranthus hypochondriacus* L.)

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Grain amaranth is one of the lesser known nutri-rich crops for its higher and quality protein (14-16 %) and high micronutrients content. The proteins have a high Sulphur containing essential amino acids (Lysine, Methionine and Cysteine), which makes it better than cereals crops. Its importance is in the high biocompatibility, nutritional value, antioxidants, mineral contents and low cost of production and higher market price than cereal crops (FAO, 2020). In this context, a field experiment was conducted at organic farming unit, University of Agricultural Sciences, GKVK, Bangalore during *Kharif* 2021 and 2022 for two consecutive years for developing organic production practices for grain amaranth. The soil was red sandy loam in texture with neutral pH (6.24), medium organic carbon (0.65), medium in available N ($344.14 \text{ kg ha}^{-1}$) and medium in available P_2O_5 (28.32 kg ha^{-1}) and K_2O ($186.04 \text{ kg ha}^{-1}$). The experiment was laid out in Randomized Complete Block Design (RCBD) with 12 treatment combinations which were replicated thrice. The cultivar used was KBGA-15 a newly released high yielding variety from UAS Bangalore. The treatments consisted of different sources of organic nutrients viz., FYM, pongamia Cake, Biodigester Liquid Organic Manure and microbial consortium which were applied in different combinations as per nitrogen equivalent basis along with RDF as a check in different block. The data revealed that application of 50% N equivalent through FYM and 50% N equivalent through pongamia cake recorded significantly higher plant height (147.47cm), panicle length (48.35cm), number of fingers per panicle (33.58) and grain yield (1799 kg/ha) which was on par with application of 50%N equivalent pongamia cake + 50% N equivalent bio digester liquid organic manure (BDLM) as



compared to other treatments. Whereas, net returns (Rs.57911/ha) and B:C (2.86) ratio was higher with application of 50% N equivalent pongamia cake + 50% N equivalent bio digester liquid organic manure (BDLM) during both the years of study. Hence, it can be concluded that pongamia cake and Biodigester Liquid Organic Manure (BDLM) are the cheap and rich source of nutrients for higher yield in grain amaranth crop.

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Organic Production Technology in Fruit Crops

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Organic production technology for fruit crops has gained popularity due to concerns about environmental and health impacts of conventional agriculture. India is a growing market for organic farming, particularly in regions with diverse climates and increasing population. Organic farming involves natural and sustainable practices, such as using organic fertilizers, biological pest control, and crop rotation to maintain soil fertility and reduce reliance on synthetic chemicals. Organic production emphasizes biodiversity and ecosystem health, providing numerous environmental benefits. Organic fertilizers, such as compost, manure, and crop residues, nourish the soil, promoting healthier and more resilient fruit crops. Biological pest control, using beneficial insects and natural predators, minimizes the negative impacts of chemical pesticides on the environment and human health. Crop rotation prevents pest build up, improves soil fertility, and reduces synthetic inputs. Organic fruits are known for their superior taste, quality, and nutritional value, with higher levels of antioxidants, vitamins, and minerals compared to conventionally grown fruits.



TECHNICAL SESSION-3

Theme -3. Nutrition, Processing and Value addition

- Processing and value addition
- Value addition of Millets and Empowerment of women through organics and Millets
- Government support for processing and Export of Millets
- Market linkages and entrepreneurship development

III-OP-01

A Comparative Evaluation of Two Hydrothermal Treatments on Rancidity and Antioxidant Activity in Pearl Millet Flour

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Pearl millet flour has a low shelf life due to the rapid onset of rancidity. To overcome these grains were subjected to hydrothermal (microwave heat treatment for 40, 60, 80, and 100 secs and steaming treatment for 4, 6, 8, and 10 min). Change in moisture, TBARS, and total antioxidant activity of control and processed hydrothermal millet during the accelerated storage study ($40\pm 2^\circ\text{C}$ and 75 % RH) for 9 days was studied to assess storage stability. The treatments impacted the moisture, shelf life, and total antioxidant activity of pearl millet flour. A lower increase in moisture during storage was observed in treated samples compared to the control. TBARS values of all treatments increased significantly throughout the storage. These differences were statistically significant throughout the storage period ($P\leq 0.05$). Microwave-treated grains showed lower TBARS than all other treatments. Steaming treatment resulted in reduced total antioxidant activity in fresh and stored samples. Hydrothermal treatment of pearl millet grains which considerably lower lipid peroxidation resulted in a significantly longer shelf life of flour.

III-OP-02

Organoleptic Evaluation and Microstructure of Finger Millet Batter and Idli

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The objective of the study was to evaluate organoleptic attributes and observe the microstructure of finger millet batter and idli. Scanning electron microscopy (SEM) is used to study the influence of processing conditions and ingredients on food and it has been a very attractive technology for food scientists because, both surface and internal structure can be studied. The organoleptic evaluation and microstructure of batter and idli prepared from finger millet and black gram in the ratio 85:15, 80:20, 75:25 and 70:30 along with control (rice: black gram) was examined. The organoleptic score of the different blend ratios of the idli was done by 21 semi-trained panellists and the highest score recorded blend ratio was 70:30 followed by 75:25. The microstructure of batter and idli was observed using scanning electronic microscope (SEM). The intact structure of starch granules and protein bodies were observed in the batter as well as in the idli in different blend ratios. Starch granules disappeared during fermentation period i.e. 12hr. The surface of idli prepared from blend ratio 70:30 was cohesive, dense and sponge like structure and is on par with the control idli. The remaining blend ratios was little compact and not spongy due to partial utilization of starch and protein bodies.



III-OP-03

Formulation, Nutritional Evaluation and Glycaemic Response Assessment of Kodo Millet (*Paspalum scrobiculatum*) Pulav in Normoglycaemic Subjects

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Minor millets play an important role in achieving food and nutritional security and also address life style disorders. Millets including kodo contains a high proportion of complex carbohydrate, dietary fiber and possess low to medium GI which helps in lowering blood glucose response among diabetic patients. Hence, the present study was undertaken to formulate kodo millet pulav and to assess the postprandial glycemic response in normal healthy volunteers. Kodo millet pulav was standardized by incorporating kodo millet rice with broken rice at 50 per cent (KPT1), 75 per cent (KPT2), and 100 per cent (KPT3) and control pulav was prepared from 100 per cent broken rice (KPC). Among the variations highest scores for sensory attributes were recorded for KPT1 and hence was selected for the development of kodo millet pulav mix, which was safe for consumption for three months when packed in MPP covers at ambient temperature. Except carbohydrate and energy content all macro nutrients and micro nutrients were higher in test pulav (KPT1) compared to control pulav. Test food (kodo millet pulav) was effective in reducing the mean blood glucose levels at 30 and 60 minutes (115 mg dL⁻¹ and 104 mg dL⁻¹) compared to reference (126.3 and 118.1mg dL⁻¹ respectively) and control pulav (121 and 110.5mg dL⁻¹ respectively). Test pulav had the moderate glycemic index (67.66) when compared to the standard white bread (100) and control pulav (84.69) and test pulav can be classified under moderate glycemic index food. Thus, the general population can exploit the nutritional and health benefits of kodo millet products in their regular diet. SHG groups can take up this technology for their entrepreneurship development

III-OP-04

Millets: A Nutrient-Rich Resurgence in Sustainable Agriculture and Nutrition

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Millets, often relegated to the sidelines of mainstream agriculture, are experiencing resurgence due to their exceptional nutritional profile, adaptability to diverse climates, and contributions to sustainable agriculture. This abstract explores the multifaceted significance of millets in addressing contemporary challenges in food security, health, and environmental sustainability. Millets, comprising a group of small-seeded grains such as sorghum, pearl millet, finger millet, and foxtail millet, have been staple crops in various regions for centuries. With an ability to thrive in diverse climates, including arid and semi-arid regions, millets contribute to agricultural resilience in the face of climate change. Their short growing cycles and low water requirements make them well-suited for regions facing water scarcity and unpredictable weather patterns. From a nutritional standpoint, millets are rich in essential nutrients, including



fiber, vitamins, and minerals. Their gluten-free nature makes them an ideal choice for those with dietary restrictions and contributes to combating malnutrition. As a climate-smart and nutritionally dense crop, millets play a crucial role in addressing global food security challenges. Sustainable agriculture practices are further underscored by millet cultivation. These crops exhibit low input requirements, reducing the dependence on synthetic fertilizers and pesticides. Additionally, millet cultivation enhances biodiversity, promoting a more resilient and ecologically balanced agricultural landscape. This abstract delves into the potential of millets to bridge the gap between sustainable agriculture and nutrition, offering a viable solution to contemporary challenges. As a diverse and resilient group of crops, millets emerge as key players in promoting food security, health, and environmental sustainability in a changing world.

III-OP-05

Finger Millet: Reviving Ancient Wisdom for Modern Health Challenges

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Finger millet is amongst the major crops of Uttaranchal. Over the years there has been rapid decline both in production and consumption of millets. Chemical composition of finger millet revealed that total carbohydrate content of finger millet has been reported to be in the range of 72 to 79.5 per cent. Finger millet has nearly 7 per cent protein but large variations in protein content from 5.6 to 12.70 per cent have been reported by various studies. Total ash content is higher in finger millet than in commonly consumed cereal grains. The ash content has been found to be nearly 1.7 to 4.13 per cent in finger millet. Calcium content of 36 genotypes of finger millet ranged from 162 to 487 mg per cent. Singh and Srivastava (2006) reported the iron content of 16 finger millet varieties ranged from 3.61 mg 100g⁻¹ to 5.42 mg per cent. Finger millet is the richest source of calcium and iron. Calcium deficiency leading to bone and teeth disorder, iron deficiency leading to anemia can be overcome by introducing finger millet in our daily diet. Maximum utilization of the nutrient potential of the millet is limited by the presence of phytates, phenols, tannins and enzyme inhibitors but their effect can be reduced by using processing techniques like popping, roasting, malting and fermentation. The use of these techniques not only decreases the content of antinutrients but increases the bioavailability of certain minerals like calcium and iron. Composite flours made by using finger millet can be used for preparation of various nutrient dense recipes which can be effectively used for supplementary feeding programs.



Grain amaranth: A nutri-rich potential crop for fighting poverty, hunger and malnutrition

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Grain amaranth (*Amaranthus* spp.) is one of the ancient nutri-rich crop belongs the family amaranthaceae and originated from South America. This crop possesses an exceptionally high nutritive value with high content of protein, lipids and minerals as well as balanced composition of essential amino acids. The tiny seeds of grain amaranth can be compared favourably with maize and other true cereals for its nutritional values and yield. It is an excellent source of iron and β -carotene and thus can help in circumventing iron and vitamin A deficiency. The presence of higher amount of folic acid also helps in increasing the blood haemoglobin level in human beings. The grains are gluten free and act as a good food supplement among the patients suffering from celiac disease. Amaranth is thus an ideal crop having better nutritional properties and endowed with C4 metabolism suited to survive and thrive in an environment affected by climate change. By adopting improved varieties and agro-techniques as developed already, the yield of grain amaranth can be substantially increased. It has many uses viz., Amaranth's tender leaves are used as vegetable. The grains are used in various culinary preparations. Popped grains are used in the form of pudding or are mixed with sugar syrup to make sweet balls (Laddoo) and for making candy. The grains can be used in the preparation of breads, biscuits, flakes, cake, pastry, crackers, ice-cream and lysine rich baby foods. Amaranth oil containing squalene, a cosmetic ingredient and skin penetrate, is also used as a lubricant for computer discs. The tribal people use its grains for the treatment of measles and snakebites as well as for foot and mouth diseases of animals. The stem and leaf extracts are used in the treatment of kidney stones. Lack of awareness on nutritional benefits of this crop is one of the major reasons for expanding area under this crop. In view of this, in Karnataka, efforts are being made for creating awareness, popularization and expansion of area under grain amaranth crop by all India Co-ordinated Research Network (AICRN) on Potential Crops, University Agricultural Sciences, GKVK, Bangalore. In order to create entrepreneurship among rural farm womens, we distributed processing and value addition machineries with free of cost for women Self Help Groups in seven districts of southern Karnataka with the financial assistance from RKVY, Govt. of Karnataka. There are few success stories by using these machineries one women called Smt. Rathnamma from Gundamanatta village of Kolar district preparing value added products viz., Rajagira Chikki, Laddu and Mixture from grain amaranth. She exploring local market for grain amaranth products and earning around 1-1.5 lakhs rupees per month from grain amaranth products alone. However, another one farmer's producer company from Chilakavadi village of Chamarajanagara districts has started preparing valued added products form grain amaranth. Hence, it will not only ameliorate the economic condition of the farmer's dwelling in the rural but it also enhance the availability of nutritious food to check malnutrition in human beings.

Value Addition to Millets – A Worthy Income Generation to Farm Folks

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Income generation refers to the process of enhancing productive skills and knowledge through structured training and institution-building programmes. Income Generation activities helps in alleviating poverty when employment opportunities are created through new tactical endeavours start-up or the growth of existing ones. This eventually result in boosting social wealth through the emergence of new market, new industries, new institutional form, new technology and increase in income which result in enhanced living standards for the populace. Millets are a group of small-seeded crops, the world's initial food plants domesticated by humans. Their ability to grow in the toughest climatic conditions has provided them a status of “famine crops” in the semi - arid tropics and drylands of Africa and Asia. They are highly nutritious and provide important nutrients such as niacin, magnesium, potassium, manganese, iron and phosphorous. They also contain higher amount of protein with essential amino acids, fibre and vitamin E. Despite their exceptional nutritional profile, food use of millets is still confined only to traditional consumers and economically deprived sections of the society. The gluten-free nature of protein, bioactive compounds with medicinal value, and high micronutrient density makes them an ideal candidate for developing several functional and value-added food products. Even though they are rich in nutritional profile, some natural features like hard seed coat, anti-nutritional factors, poor digestibility, and low micronutrient bioavailability are the major obstacle in the processing and cooking of millets giving importance to process of value addition to make them consumer ready. Value addition is the process of creating new and innovative products with which market value of the original product increases and this may be in forms of primary or secondary processing including cleaning, grading, packing, labelling making them suitable for readily cooking or eating. Various techniques which convert the raw millet grains into edible form with enhancement in quality are known as processing. Small millet grains can be converted into various edible forms like rice, flour, sprouts, salted ready-to-eat, flaked, popped, porridge, and fermented products through primary processing techniques. It is important in terms of technological advances, socio economic growth and environmental benefits. This article provides a brief account of various processes, traditional and functional including ready-toeat (RTE) millet value-added food products developed from millets and their nutritional benefits which can be a fruitful source of incomes.

III-PP-02

Millet Marvels: A Symphony of Nutritional Brilliance and Cardiovascular Wellness

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The millets are emerging as unsung heroes, orchestrating a symphony of well-being that resonates through cardiovascular health. It delves into the profound interplay of millets, their nutritional brilliance, and the harmonious melody they compose in fostering cardiovascular wellness. Millets, often relegated to the side-lines, take center stage in this narrative as nutritional powerhouses. Rich in essential nutrients such as fiber, vitamins, and minerals, millets form the cornerstone of a diet that transcends mere sustenance. This unravels the nutritional tapestry of millets, exploring their role in providing a diverse array of nutrients vital for cardiovascular health. From magnesium, known for supporting heart rhythm, to fiber, a champion in cholesterol management, millets offer a holistic nutritional profile that becomes the foundation for cardiovascular well-being. The symphony of millets extends beyond nutrient content; it is an intricate dance of antioxidants, phytochemicals, and bioactive compounds. These nutritional maestros play a pivotal role in mitigating oxidative stress, inflammation, and supporting overall cardiovascular resilience. The abstract navigates the intricacies of these components, shedding light on how millets contribute not only to heart health but to a comprehensive approach to wellness. In the cardiovascular wellness narrative, millets emerge as guardians against the rising tide of non-communicable diseases. Their unique nutritional composition contributes to blood pressure regulation, cholesterol management, and overall heart function. This abstract explores the scientific underpinnings of these benefits, painting a vivid picture of millets as not just sustenance but as a proactive measure in nurturing cardiovascular vitality. Furthermore, this touches on the versatile nature of millets, celebrating their inclusion in diverse culinary landscapes. From traditional dishes to modern gastronomic creations, millets offer a canvas for culinary artistry that transcends cultural boundaries. This inclusivity amplifies their potential as nutritional staples, making cardiovascular wellness accessible and culturally enriching. In conclusion, "Millet Marvels" unfolds as a lyrical ode to the nutritional brilliance of millets and their role in composing a symphony of cardiovascular wellness. Beyond the confines of dietary choices, millets emerge as ambassadors of a holistic approach to health, bridging the realms of nutrition, culture, and heart well-being to lead harmonious life.

III-PP-03

Nutrients-Rich Millets in Indian Farming System as Secondary Agriculture

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Millet is a diverse group of small-seeded grains or cereals that have been cultivated and consumed for both food and fodder purposes. The origins of millet cultivation can be traced back to several ancient civilizations, including those in Africa and Asia. Over time, millet has



become an integral part of the diets and culinary traditions of many cultures, particularly in countries like India, China, Nigeria and Russia. The limited nutritional quality in the human diet in present days affecting millions of people worldwide, leading to a condition known as "hidden hunger." Hidden hunger results from insufficient intake of vitamins and micronutrients, such as zinc, magnesium, and iron. It's estimated that nearly half of the world's micronutrient-deficient population lives in developing countries. Millets are nutritional powerhouse high in proteins, dietary fibre, B-Complex vitamins, essential amino acids, folic acids and minerals. This superior nutritional value and health benefits of millet products favoured by increased consumers with increasing incidences of lifestyle diseases especially among urban areas. Millets can be a source of income for rural communities. With a growing market for millets and millet-based products ultimately promotes secondary agriculture. Millet straw and by-products can serve as nutritious fodder for livestock, contributing to animal health and productivity. Millet cultivation often requires fewer inputs like synthetic fertilizers and pesticides, promoting more sustainable and environmentally-friendly farming practices. It is presumed that the world is looking towards India's traditional foods, and it turned to be the mandate of the Government of India to scale up the interventions for increasing the millets area and production, diversifying the processing machinery and technologies, expanding the private food processing ecosystem.

III-PP-04

Impact of Organic Farming on Soil Quality, Crop Productivity and Produce Quality

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The functioning of agro-ecosystems, soil processes and the sustainability of agricultural production systems are impacted by soil and crop management practices. Organic farming production system is being promoted as a low-cost environment friendly production system for, improved human and soil health, better environment and increased agricultural sustainability. Organic farming undoubtedly improves soil quality due to application of organic manures, composts and adoption of legume-based diversified cropping systems. Conversely, there is also consensus on lower productivity of crops (5–58%) under organic farming than the conventional system though exceptions are there. Despite the lower crop productivity, it may become more profitable if price premiums are available on organic produce. Its role in improving nutritional quality of produce though is debatable; but owing to absence of synthetic inputs organic produce is generally considered to be safer and healthy. The organic farming practices are expected to improve the soil quality over imbalanced and discriminate use of agro-chemical inputs. In sole productivity terms, organic farming may not be a viable farming system but in terms of overall ecosystem services, the system definitely has an edge over the conventional system.



Millets: Nutritional Composition, Health Benefits and Processing

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Millets are the staple food for millions of poor people in Africa and Asia. Millets are a major food source in arid and semi-arid parts of the world. Millets are good sources of protein, fatty acids, minerals, vitamins, dietary fibre and polyphenols. Protein contains in millets high quantity of essential amino acids especially the sulphur containing amino acids (methionine and cysteine). Consumption of sorghum and other millets usage declined the demand for small millets over the past three decades. The decline in demand has led to the decline in millets production considerably in India. Millets are highly nutritious, non-glutinous and non-acid forming foods. Millets have many nutraceutical and health promoting properties especially the high fibre content. Millets act as a probiotic feeding for micro - flora in our inner ecosystem. Millets hydrate our colon to keep us from being constipated. Niacin in millet can help lower cholesterol. Millets contain major and minor nutrients in good amount along with dietary fibre. Millets are gluten free and can be a substitute for wheat or gluten containing grains for celiac patients. The nutritional significance of millets demands for an examination of the nutritional characteristics and functional properties of different millet cultivars as well as developing value-added products from millets. Processing is a crucial step in accessing the nutrition that millets offer. At the other end of the supply chain, the lack of small-scale processing has adversely affected the availability of the processed millets for use by the farming communities themselves and rural household cannot afford to buy millet rice from the market. This problem magnifies when the small millets are aggregated for processing. So, in that sense, there is an inherent advantage in small scale processing. Successful improvement of these attributes would be a crucial key to expand the spectrum of applications of millet grains. Future trends should focus on the millet consumption in the developed countries that could help its industrial revolution.

Microstructure of Finger Millet Batter and Idli

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The objective of the study was to study the microstructure of finger millet batter and idli. Scanning electron microscopy (SEM) is used to study the influence of processing conditions and ingredients on food and it has been a very attractive technology for food scientists because, both surface and internal structure can be studied. The microstructure of batter and idli prepared from finger millet and black gram in the ratio 85:15, 80:20, 75:25 and 70:30 along with control (rice: black gram) was examined. Intact structure of starch granules and protein bodies were observed in the batter as well as in the idli in different blend ratios. Starch granules disappeared during fermentation period *i.e.*, 12hr. The surface of idli prepared from blend ratio 70:30 was



cohesive, dense and sponge or foam-like and is on par with the control idli. The remaining blend ratios was little compact and not spongy due to partial utilization of starch and protein bodies.

III-PP-07

Millet's Role in Ensuring Nutritional and Food Security

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Globally, billions of people are experiencing food insecurity and malnutrition. The United Nations has set a global target to end hunger by 2030, but we are far from reaching it. Over the decade, climate change, population growth and economic slowdown have impacted food security. Many countries are facing the challenge of both under nutrition and over nutrition. Thus, there is a need to transform the food system to achieve food and nutrition security. Crop diversification is important in this context of persistent poor nutrition and food insecurity despite the growth in global food production, supply, and distribution. Millets could be offering a versatile solution to address these pressing global issues. The resilience of millets to climate variability and their minimal water requirements positions them as a sustainable crop option, especially in regions facing water scarcity and unpredictable weather patterns. Their short growing cycle and ability to thrive in diverse agro ecological zones make millets a suitable choice for smallholder farmers, contributing to their income stability and overall food security. Owing to their exceptional nutritional profile in terms of micronutrients concentration, fiber content, gluten free nature, resistant starch, and various phytochemicals of therapeutic uses they are known as miracle grains making them a valuable tool in combating malnutrition and micronutrient deficiencies. The nutritional richness, adaptability to adverse conditions, and sustainability make them a valuable asset in addressing the challenges posed by climate change, malnutrition, and food insecurity.

III-PP-08

Millets Economic Ballet: Unveiling the Impact of Marketing on Import-Export Dynamics in the Indian Economy

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In the intricate dance of economic progress, millets emerge as virtuoso performers, orchestrating an economic ballet that not only resonates with nutritional richness but also reveals the profound impact of strategic marketing on import-export dynamics within the Indian economy. "Millets' Economic Ballet," in this abstract embarks on a captivating exploration of the pivotal role that millets play in shaping the economic landscape of India. Beyond their nutritional significance, millets have become protagonists in a larger narrative, Where marketing strategies act as choreographers, guiding their movements in the global trade arena. At the forefront of this ballet is the strategic marketing of millets, a nuanced interplay



of branding, awareness campaigns, and market positioning. The abstract delves into the intricacies of how these marketing initiatives propel millets into international markets, creating a demand that transcends geographical boundaries. The ballet unfolds on a global stage, where millets, once overshadowed, take center spotlight, impacting the import-export dynamics of the Indian economy. It unravels the symbiotic relationship between the strategic marketing of millets and the consequential shifts in import-export patterns. Millets, once primarily consumed domestically, now find their way into international markets, contributing not only to the economic prosperity of farmers but also to the nation's balance of trade. The ballet's movements are underscored by the economic significance of millets. As these grains gain prominence in international markets, the abstract explores how this economic ballet fosters rural development, empowers local farmers, and positions India as a key player in the global agri-commodity landscape. Moreover, it contemplates the multifaceted impacts on the Indian economy. The economic ballet of millets goes beyond the realm of trade balances; it becomes a narrative of sustainability, resilience, and cultural richness. The strategic marketing initiatives not only elevate the economic status of millets but also contribute to the preservation of traditional agricultural practices and biodiversity. In conclusion, "Millets' Economic Ballet" is witness of the grace, precision, and transformative power of millets in the economic dance. The abstract encapsulates the synergy between strategic marketing, import-export dynamics, and the profound impact on the Indian economy, where millets emerge not only as grains of sustenance but as economic maestros, shaping a narrative of prosperity and sustainability on both local and global stages.

III-PP-09

Millets: A Scientific Perspective on Their Nutritional and Health Relevance

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Millets are resilient crops with the ability to endure various climatic conditions, making them sustainable and drought-resistant. Over the past few decades, their production has increased to meet the nutritional needs of the growing global population. These grains are rich in essential nutrients, including proteins, carbohydrates, fats, minerals, vitamins, and bioactive compounds. Millets are recognized for their high-energy content, addressing malnutrition effectively. They serve as a valuable source of medicinal and nutraceutical properties, offering antioxidants that play a role in preventing health issues such as high blood pressure, heart disease, obesity, cancer, cardiovascular diseases, and diabetes. Additionally, millets contribute to a decrease in tumour cases. Due to their nutritional composition and bioactive components, millets are considered a long-term and sustainable solution for ensuring a stable supply of food and feed materials. This review aims to emphasize the scientific aspects of millets, focusing on their nutritional content, biologically active compounds, and pharmaceutical properties



III-PP-10

Proso Millet: A Nutritious and Healthy Cereals

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Proso millet (*Panicum miliaceum* L.) is an annual cereal crop, belonging to the *Poaceae* family, is primarily grown in India. Proso millet is a rich source of energy, protein, fibre, calcium, and iron. This millet contains 309 kcal of energy, 8.30 gm of protein, 65.90 gm of carbohydrate, 9.00 mg of crude fiber, 27.00 mg of calcium, and 50 mg of iron (per 100 gm) as per NIN, ICAR 2018. It is high in thiamine, copper, phosphorus, magnesium, zinc and sources of iron, selenium, riboflavin, niacin, pantothenic acid and vitamin B6. Proso millet boasts significantly higher mineral content when compared to major cereal grains. In comparison to rice, wheat and barley, proso millet is an ideal food for people with type-2 diabetes mellitus and cardiovascular disease (CVD) because of its low glycaemic index. The abundant presence of dietary fiber and antioxidants in proso millet contributes significantly to its efficacy in mitigating the risk of cardiovascular diseases and cancer. They can reduce the chances of breast cancer by more than 50% by eating more than 30 gm of fiber every day. Proso millet's high lecithin content plays an indirect but significant role in the promotion and sustenance of optimal nervous system functionality. Memory diseases such as dementia and Alzheimer's disease can also be reduced due to high lecithin. They can reduce the chances of breast cancer by more than 50 per cent by eating more than 30 gm of fiber every day. The gluten-free nature of proso millet confers advantageous attributes for individuals dealing with celiac disease, gluten sensitivities and conditions associated with obesity and overweight, thereby offering therapeutic potential in these contexts. Integrating proso millet into diets can represent a sustainable approach to addressing nutritional related disorders.

III-PP-11

Millets: A Superfood for Nutritional Security

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India's economy has grown significantly over the past several years and is now expanding at one of the fastest rates in the world. Despite India's astounding economic growth, there are still concerns regarding hunger and malnutrition. Significant issues have evolved around the world such as food security, livelihood security, as well as natural resources conservation. As per the Global Hunger Index Report 2022, India secured the rank of 107 out of 121 countries scoring 29.1 coming under 'serious' category. One of the main causes of the prevalence of malnutrition is the lack of a diverse diet. The Government of India is encouraging and promoting the production of millets in order to raise consumer level of knowledge on nutrition and enhance farmers' income in the nation. In 2020, India accounted for over 41% of the world's millets



production. The United Nations General Assembly also declared 2023 as the International Year of Millets. Millets are a crop that is exceptionally nutrient-dense and contain significant levels of vitamins and minerals. They are otherwise referred as “super-food” and its production can address the issues related nutrition security and farmer’s livelihood. They are regarded as store house of nutrition and are widely consumed by vegans. Millets are by far more superior as compared to rice and wheat in terms of nutritional parameters. Millets have a number of health advantages, including the ability to improve digestive system, lower the risk of cancer, improve respiratory health, strengthen the immune system *etc.* Apart from nutrition, Millets are dry crop which consume 2.5% less water than other major cereal crops. The Government of India is taking necessary steps such as implementing schemes like POSHAN Abhiyan, Nutri-Sensitive Agriculture, Millet Mission *etc.* to boost and strengthen the supply chain. Diversification of crop in favour of millets and increasing MSP for millets can encourage the farmers.



TECHNICAL SESSION-4

Theme -4. Government Policies and Support Systems

- Business opportunities in organic and natural farming products
- Role of FPOs in promotion and enhancing income of small and marginal stake holders
- Building sustainable Farmer-Producer Organizations (FPOs): Opportunities and challenges
- International market and Quality standards for Export
- Central and State government initiatives for mainstreaming



IV-OP-01

Trend and Minimum Support Price relevance to Millet Farmers in India: An Analysis

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Agricultural Price Policy plays a crucial role in achieving growth and equity in the Indian economy in general, and the agriculture sector in particular. The main objective of the Government's Price Policy is to protect both producers and consumers. Government of India at the beginning of the sowing season announces a Minimum Support Price (MSP) to insure agricultural producers against any sharp fall in farm prices. In case of millets for Jowar, Bajra and Ragi are given MSP. The MSP policy has drawn criticism, though, as farmers consistently demand MSPs that are higher than the cost of production. Proponents of free agricultural trade contend that MSPs frequently do not reflect both domestic and international demand and supply dynamics (Menon, Gulati and Jain, NITI Aayog), which reduces the effectiveness of the production system. Also, further argued that MSP is being used more as a political means than an economic mechanism. The United Nations has designated 2023 to be the International Year of Millets in response to a proposal made by India to raise awareness of the benefits of millets for producers, consumers and to the environment, as well as for the security of food and nutrition on a national and international scale. In this context it is critical to examine the relevance of millets (Jowar, Bajra and Ragi) MSP in relation to the production cost. Cost C2, which represents the total cost of production (Rs/q) was used to compare with MSP. The data on cost of production of jowar, bajra and ragi for major millet growing states were collected from CACP for the period of 15 years, 2007-08 to 2021-22 and the weighted averages at national level were worked out. The analysis shown that almost in all the years except during 2018-19, 2019-20 and 2020-21 (12 years in 15 years) MSP is less than Cost C2 indicating that if the farmer has to sell his millets at MSP most of the times in most of the states, he will incur losses. Jowar, Bajra and Ragi cost of production significantly varies among the states hence single MSP for all states is not relevant. Most of the period FHP was higher than the MSP making it more irrelevant. Cost rise during the season should also be considered and MSP should be revised at the time of marketing season accordingly. Also, there is no MSP for small millets, hence government must expand the coverage of small millets under MSP and more procurement of millets through MSP.



IV-OP-02

Role Played by KVK in Developing SHG Group as a Millet Entrepreneur in Kolar District

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The present study was conducted to determine the impact of Krishi Vigyan Kendra on successful women entrepreneur of Kolar district. Krishi Vigyan Kendra, the front-line extension centres it plays an important role and imparts need-based and skill-oriented training to improve the economic status of women has become a major development priority. Encouraging the women by providing more opportunities to earn income has proved to be a significant contribution to the achievement of development outcomes. Smt. Rathnamma, Gundamanatta, Srinivasapura Taluk, Kolar district is a farm woman become the Millet entrepreneur. She completed PUC and got married to Sri Narayanaswamy. The family has 3 acres of land growing Mango, Ragi and rearing sericulture. She was interested to go for minor millets processing and value-added products preparation. She approached KVK and explained about her needs and looking into her interest we conducted a group discussion and formed interested farm women as a SHG group of twenty women exclusively for preparation of value-added products of minor millets. Considering the importance to conduct vocational training programme on “Minor Millets value addition, Branding and marketing” improves the women's economic security, increases employment and nutritional security. Conducted five days vocational on campus training programme on “Women Empowerment through Value addition, Marketing and Health benefits of Minor Millets” at ICAR-KVK, Kolar on from 3.7.2017 to 7.7.2017 for this group. We have trained to prepare Diabetic mix, Upma mix, Dosa mix, idly mix, Minor Millets rice and Papads and their packaging. Conducted a training programme on production technology of minor millets and their value addition at Gundamanatta on 24.7.2017. On the same day we have distributed Saame, Navane and Araka seeds in collaboration with Department of Agriculture, Srinivasapura and other two progressive farmers who have supplied Same and Araka. We have formed “Vaibhav Siridhanya Swasahaya Sanga” for preparation value added products and marketing of minor millets. The prepared value-added products sold at Krishimelas, Dasara Festival, Udyana Mela, Mango and Jackfruit Mela, Lalbagh Bengaluru, Flower Show organized by Dept. Horticulture, Kolar, KVK programmes etc. KVK has guided to get FSSAI and GST number for marketing. She was awarded first prize in food show organized by Department of Women and child development, Kolar and Minor Millets and flower show arranged by Department of Horticulture, Kolar. She was awarded best farmers award Taluk level by UAS Bangalore, Super Star Raitha Award by Vijay Karnataka, District level Best Farmers award by UAS Bangalore, Zilla Rajyothsava Award, Kolar District, Kolar, Udaynmuka Krishi pandit award, Department of Agriculture, GOK. The entrepreneur has been generated income after establishment of Minor millet processing unit is about average net profit from the year 2017 to 2023 is Rs. 9,80,000/- per year and average B:C ratio 1:2.32.



IV-OP-03

Buying Behaviour of Consumers of Organic Food Products in Bengaluru City, Karnataka

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The awareness of consumers about organic foods is increasing rapidly and there is an increasing trend in the purchase of organic foods among people. As per IMARC report, 2023, the market for organic foods is estimated to be US\$ 1,582.20 Million in India. The present study was carried out to identify the factors influencing the buying behaviour of consumers of organic food products in Bengaluru City. For the study primary data was collected from 120 consumers, using random sampling method. The Factor Analysis was used to analyse the factors influencing the buying behaviour of consumers. To examine the internal consistency of the factors, reliability test was conducted and it was found that the Cronbach's Alpha was 0.86, indicating a high level of internal consistency among the identified factors influencing buying behaviour. This implied that the given items in the test are highly related and can be used together to accurately measure this construct. It was also observed that the factor "chemical free / naturally grown" had a mean of 4.59, indicating that it was strongly accepted by the consumers, with most of the consumers either strongly agreed (65.70 %) or agreed (27.50 %) with this factor followed by the factor "safe" with a mean of 4.47, suggesting that it was also widely accepted, with a major portion of consumers strongly agreed (55.00 %) or agreed (37.50 %). The factor "ideal for all age groups" has a mean of 4.32, indicating general acceptance, with majority of consumers either strongly agree (54.20 %) or agree (27.50 %) with this factor. The factors "healthy and tasty" and "hygiene and freshness" had means of 4.18 and 4.23, respectively, but it was considered the least accepted among the factors. From the findings, it can be implied that the perception of organic food products being chemical free or naturally grown strongly influenced their buying behaviour. It also indicated that organic food products are safe and ideal for all age groups, which was a key influencer in consumers' buying behaviour. Further, the study found that there was positive perceptions and behaviour of consumers towards organic food products in Bengaluru City.

IV-OP-04

Entrepreneurship opportunities in Processing and Value Addition of Nutri-Cereals

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Millets are the sixth most important cereal grains in the world, sustaining more than one-third of the world's population. Millets are still the staple food for millions of poor people in Africa and Asia. Like many other cereals, millets are high carbohydrate energy content and nutritious;



making them useful components of dietary and nutritional balance in foods. Millets are high in nutritional value as they contain nutrients including carbohydrates, protein, sugar, soluble and insoluble fiber, sodium, vitamins, minerals, fatty acids, amino acids and more. Majority of millet grains contain higher protein, fibre, calcium and minerals than wheat and rice. Therefore, these are now also being called as “Nutri-cereals”. Millets are least allergic and most digestible grain available among all food grains. Millets are being promoted in a big way by both the State and Central Governments as nutria-cereals and climate resilient crops that hold the promise of meeting the nutritional security of the nation. Formation and promotion of 10,000 FPOs launched by the Govt. of India has a target of formation of 10,000 FPOs across the country by 2023-24. It's very important to help the entrepreneurs including FPOs to install processing capacity built for processing and to provide adequate handholding to each of them. Processing of millets is required to make them edible. Millets are small grains with different sizes. The variation in the size and shape of grains makes their processing is difficult. In order to make the millets edible following steps may be adopted. Those are De-husking, Pearling, Hydrothermal Treatment (Parboiling), Milling, Malting, Popping, Cooking etc. Proper processing is the need of the hour for creating better avenues for the utilization of millets into many values added products. Value addition may help in development of various millet based dairy foods and other millet-based food products. Consumption of millets can benefit under-nourished children, geriatric population. The formulation of millet-based foods helps not only in creating better avenues for the utilization of millets in various millet-based value-added food products but also in health foods. Future trends should focus on the millet consumption in the developed countries that could help its industrial revolution. Increased utilization of millets for consumption can add to the food basket of the world. Karnataka is the hub for start-ups and entrepreneurs. Highest numbers of start-ups are registered from Karnataka and especially from Bangalore. The present article dealt with various processing opportunities for the start-ups and entrepreneurs in processing and value addition of millets to make them not only edible but also make them tasty alternatives to the daily diet in various forms across the day.

IV-OP-05

Constraints faced by Retailers in Marketing of Organic Food Products in Bengaluru City, Karnataka

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The present study was carried out in Bengaluru City of Karnataka to identify the constraints faced by retailers in marketing of organic food products. For the study, primary data was collected from 40 organic outlets and from 120 consumers, the purposive, snowball and random sampling method were used for the selection of these organic retailers. The Garrett's Ranking Technique was used to rank the constraints in marketing of the organic food products. The results revealed that organic food products are expensive was the major constraint with the Garrett's mean score of 46.42 and thus ranked 1st followed by consumers do not prefer to buy organic food products regularly that ranked 2nd, there is limited availability of a diverse range



of organic food products (III), consumer awareness about organic food is lacking (IV), the sources of organic food products are often very far (V) and profit margins for organic food products are lower compared to non-organic options (VI). It was also observed from the results that large number of respondents were aware about the terms like eco-friendly accounting for 46.70 per cent of consumers accepting followed by organic food (38.30 %). On the other hand, the terms like sustainability (29.20 %) and effects of chemically produced and processed food (26.70 %) were accepted by least consumers. It can be implied from the findings that the major concern among consumers was regarding the affordability of organic food products. Further, the results indicated that a significant portion of respondents had a majority acceptance and a very high level of understanding of both “Eco Friendly” and “Organic Food.” This suggested a strong awareness and positive perception of environmentally friendly and organic concepts among consumers in Bengaluru. Thus, it is important to implement the initiatives such as promotional pricing or subsidies to encourage the consumption of organic food products by the consumers. It could be concluded that addressing these constraints through targeted strategies and collaborative efforts holds the potential to stimulate the growth and acceptance of organic food products in Bengaluru City.

IV-OP-06

Decarbonization Sustainability in India

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Decarbonization sustainability refers to the process of reducing carbon emissions and transitioning to a low-carbon economy in order to mitigate climate change and achieve long-term environmental sustainability. The physical manifestations of climate change are increasingly visible across the globe, and India is not untouched. More than 75 percent of India’s districts—home to 638 million people, or 1.4 times the population of the European Union (EU)—are categorised as hotspots. Though India’s emissions currently stand at a mere 1.8 tons CO₂e per capita (versus the United States at 14.7 and China at 7.6), it is still the world’s third-largest emitter at 2.9Gt CO₂e (4.9 percent of global emissions).² India has reduced its emissions intensity of GDP by 1.3 percent per annum over the last decade, somewhat decoupling emissions from GDP growth.¹⁴ However, this pace of intensity reduction is not quick enough. first-hand experience in implementation of sustainable farming with results measured across the parameters, tested for climate resilience, judicious use of resources. Role of Sustainable Agriculture in decarbonization with case studies of demonstration of climate resilience in agriculture, judicious use of land, water, power and other resources thus achieving sustainable growth and decarbonization in India, with relevance to the ROADMAP TO INDIA’S 2030 DECARBONIZATION TARGET.



IV-PP-01

Constraints Faced by Tribal Farmers in Millet Cultivation in Parvathipuram Manyam District of Andhra Pradesh

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Millets are highly nutritious, and one of the popular foods known to humans which are considered to be least allergenic and most digestible grains available. Though they occupy relatively a lower position among feed crops in Indian agriculture, they are quite important from the point of food security at regional and farm level. The way and speed in which millet cultivation is on decline within in no time we might lose our natural traditional crop millets forever. In hilly and tribal areas, millets are major source of livelihood and are intensively cultivated by mostly resource-poor farmers for their food and income. Tribal communities use to practice millet farming because of its adaptability to this environment. Therefore, millet farming needs promotion in these regions. Improved practices of millet cultivation will lead to nutrition and food security for tribal communities. The present study was conducted in Parvathipuram Manyam district to know the constraints faced by farmers in millet cultivation. The study was conducted in four villages namely Durbili, Suryanagaram, Shantinagaram and Vanjarapuguda with a sample size of 90 members. The respondents were interviewed personally administering a well-structured and pre-tested interview schedule. The statistical tools viz., frequency and percentage analysis were used to analyze data. The constraints encountered by the tribal farmers were thoroughly analyzed and discussed. Important constraints encountered tribal farmers were lack of availability of good quality seed, small land holdings in scattered areas, non-availability of labour, lack of processing units, announcement of remunerative price, due to water scarcity – irrigation at critical stages, lack of proper marketing channel.

IV-PP-02

Revitalizing Agriculture and Nutrition: The Impact of the Odisha Millets Mission (OMM)

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Millets are vital for sustainable agriculture, thriving in diverse environments and requiring less water. Packed with nutrients, they offer a gluten-free, nutritionally dense alternative for a balanced diet. Their cultivation enhances soil health, provides income diversification for farmers, and contributes to food security amid changing climates. Millets play a crucial role in fostering agricultural resilience, nutritional diversity, and environmental sustainability. Keeping this in mind Odisha Government started mission for enhancing millet



production and cultivation. The Odisha Millets Mission (OMM), initiated in April 2017, aims to revitalize millet cultivation in the state of Odisha, India. With a multifaceted approach, the mission focuses on improving productivity, promoting household consumption, establishing decentralized processing facilities, fostering farmer collectives and marketing, and integrating millets into nutrition programs. From 2018-19 to 2021-22, the OMM procured 6.39 lakh quintals of millet (ragi) and transferred 209.94 crores to farmers through Direct Benefit Transfer (DBT) at a remunerative price. Notably, the mission distributed ragi under the Public Distribution System (PDS) to over 50 lakh beneficiaries in 14 districts, including providing 1.5 kilograms of ragi per person through PDS. The OMM's impact extends to tribal districts, where it procured and distributed finger millet (ragi) among 1.6 million cardholders. This comprehensive initiative signifies a concerted effort to not only revive millet farming but also incorporate millets into essential welfare programs, contributing to both agricultural sustainability and improved nutrition for households in Odisha.

IV-PP-03

Demonstration of Ragi Variety Indravathi in Tribal Areas of Parvathipuram District

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Finger millet (*Eleusine coracana*) also known as Bird's foot millet, commonly called as ragi is an essential millet in terms of nutrient profile ranked third in India in area and production and has the pride of place in having the highest productivity among the millets after sorghum and pearl millet. Ragi is an important millet crop in Parvathipuram-Manyam district. Farmers are not aware of newly released high yielded varieties and non-adoption of improved package of practices, productivity is less. Therefore, efforts have been made to demonstrate newly released varieties and improved varieties in Parvathipuram-Manyam district to increase the area and production of millets. The present study was carried out by Krishi Vigyan Kendra, Rastakuntubai during 2021 and 2022 in *kharif* season to assess the impact of frontline demonstration on popularization of Ragi variety Indravathi. Results showed the Indravathi variety had recorded highest grain yield (21.6 q/ha) under rainfed condition in frontline demonstration and in farmer practices it was just 18.3 q/ha. Thus, the average technology gap, extension gap and technology index of 14.7 q/ha, 3.3 q/ha and 40.4 per cent were observed.

IV-PP-04

Revolutionizing Millets in India: Exploring Central and State Government Incentives for Millet Integration

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Millet grains represent some of the earliest cultivated foods, characterized by their small seeds and resilience to thrive in arid or rainfed regions with limited soil fertility and moisture. Millets thrive in challenging climates and soils, yielding nutritious grains and fodder. The multifaceted



benefits of millets can tackle concerns surrounding nutrition security, food system stability, and farmers' welfare. Millets have garnered recent attention, prompting efforts to create convenient and value-added processed products from them. As numerous households in arid and mountainous areas rely on millets for their sustenance, the government acknowledges the crucial role of millets in the food chain. Recently, the government increased the Minimum Support Price (MSP) for millets, presenting a significant price incentive for farmers. Additionally, in a bid to establish a consistent market for the produce, the government has integrated millets into the public distribution system. It has introduced initiatives such as providing seed kits and agricultural inputs to farmers, fostering value chains through farmers' producer organizations, and bolstering the marketability of millets. The Ministry of Women and Child Development has been actively engaged at the nexus of agriculture and nutrition. Their efforts include establishing nutri-gardens, advancing research on the interconnectedness between crop diversity and dietary variety, and orchestrating a behavioral change campaign to stimulate consumer demand for nutritious cereals. In regard to millet production, the Government of India has several ongoing schemes. These include the Integrated Cereal Development Programme in Coarse Cereals (ICDP-CC), which focuses on cropping systems and macro management of agriculture. Additionally, there are incentives aimed at nutritional security through Intensive Millet Promotion (INSIMP), a part of the "Rastriya Krishi Vikasa Yojana" (RKVY), the sole comprehensive initiative supporting millet production. Moreover, there's the Rainfed Area Development Programme (RADP), a component of the RKVY. The Karnataka government has introduced a new program called Raitha Siri specifically for farmers in the state. In the Raitha Siri scheme in Karnataka, the state government aimed to offer Rs. 10,000 per hectare to all millet growers. Karnataka has introduced a brand called 'Siri' for millets, recognizing them as 'Siridhanya' or rich grains. The state has initiated the distribution of millets through the Public Distribution System (PDS), sourcing and distributing the grains locally. Presently, Karnataka stands as one of the foremost producers and consumers of millets in the country, occupying a prominent position in the market due to substantial demand. The state government is striving to position millets as 'The Food of the Future' through diverse initiatives while ensuring fair compensation for farmers. Procurement of Ragi and Jowar involves offering farmers a bonus of 20-25 per cent above the Minimum Support Price (MSP). The Government of India designated 2018 as the National Year of Millets to bolster the production of these nutrient-rich grains and the agro-industries associated with their cultivation. Observing the International Year of Millets 2023 is anticipated to facilitate the promotion of millet production and consumption nationwide. Increased millet production will aid in combating hunger and mitigating the long-term effects of climate change.



IV-PP-05

Study on Factor Influencing on Purchasing Behaviour of Organic Fertilizer in Ballari district of Karnataka

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The present study was conducted in Ballari to analyse the factors influencing the usage of organic fertilizers and to assess the challenges associated with using organic fertilizers. For the study primary data was collected from 180 farmers using random sampling method. The results revealed a high adoption rate of organic fertilizers, with 91.67 per cent of respondents incorporating them into their farming practices. The dominant pattern of fertilization involved a combination of organic and chemical fertilizers based on specific crop requirements (64.44 %), reflecting a pragmatic approach aimed at optimizing yield. It was observed that the frequency of organic fertilizer application per crop in a season, 49.44 per cent of respondents applied organic fertilizers 1-2 times, indicating a moderate and balanced approach to meeting crop nutrient requirements. The study found that 82.22 per cent of respondents had a positive perception of using organic fertilizers, emphasizing the growing awareness of the environmental and health benefits associated with sustainable agricultural practices. The analysis of the benefits of organic fertilizers indicated strong agreement on factors such as increasing soil organic matter, improving soil health (59.32 %), and enhancing crop quality (41.81 %). Challenges associated with organic fertilizer usage revealed significant concerns, with 68.52 per cent strongly agreeing that organic fertilizers may reduce crop yield. Addressing this perception is crucial for promoting the widespread adoption of organic farming practices. The study concluded that a multifaceted approach, including targeted education, research, and policy support, is essential to address challenges and promote a more universally accepted understanding of the benefits of organic fertilizers in agriculture. The findings contribute valuable suggestions for policymakers, researchers, and practitioners aiming to enhance sustainable agricultural practices.

IV-PP-06

A Study on Adoption and Constraints of Foxtail Millet Production Technology in North Karnataka

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Foxtail millet, one of the earliest cultivated crops, played a vital role in ancient civilizations, particularly in Asia. Delving into the botanical traits and agronomic features of foxtail millet offers insights into its unique adaptability to diverse agro-climatic conditions. Its short growing season, drought tolerance, and low input requirements make it an ideal choice for smallholder farmers and marginal lands. Foxtail millet is a highly nutritious grain with a well-balanced



nutritional profile, making it a valuable addition to a healthy diet. The present study was conducted to know the adoption and constraints of foxtail millet production technology in North Karnataka. The study was carried out in Gadag and Haveri district of North Karnataka, a sample of 120 farmers were purposively selected based on highest area under foxtail millet crop cultivation and interviewed with the help of structured pre-tested interview schedule. The data obtained was analysed applying appropriate statistical procedure viz., mean, frequency and percentage. The results showed that 44.16 per cent of the overall foxtail millet growers belonged to medium adoption level category, whereas, 29.16 and 26.66 per cent were observed in low and high level of adoption categories, respectively. The majority of the foxtail millet growers expressed interference of middleman in market (89.16 %), followed by high labour wages (85.00 %), shortage of labour, (82.50 %), lack of storage facilities (81.66 %), lack of awareness about agricultural schemes (76.66 %), non-availability of input in time (66.66 %), inadequate market information (63.33 %) and lack of knowledge about seed treatment (62.50 %).



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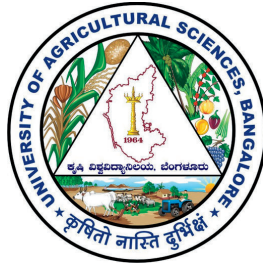
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