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Agronomic Interventions for Enhancing Productivity of Minor Millets

(*Banothu Chakravarthi[1] and Avuta Saipriya[2])
[1]M.Sc. Scholar, Department of Agronomy, Assam Agricultural University, Jorhat
[2]M.Sc. Scholar, Department of Genetics and Plant Breeding, SHUATS, Prayagraj, UP
*Corresponding Author's email: banothuchakri@gmail.com

Minor millets are a diversified collection of small-seeded grasses with extremely variable morphology that are adapted to a variety of poor growth environments. can survive extreme biotic and abiotic conditions with low inputs. superior in terms of nutrition than popular cereals marketed as "Miracle Nutri-cereals". They have historically had a significant impact on farming and culinary customs in many developing nations around the world. Although they are grown as orphan crops in subpar soils with a wide range of day lengths, their ability to adapt to difficult conditions makes them desirable climate-smart crops.

Traditional grains known as millets have been farmed and eaten in the Indian subcontinent for more than 5000 years. Millets are warm-weather cereals with small grains that are annual and in the grass family. Compared to other common cereals, they are resilient, rain-fed grains with minimal water and fertility needs. They can withstand drought and other adverse weather conditions very well. Sorghum, pearl millet, finger millet, foxtail, tiny, kodo, proso, and barnyard millet are among the nutrient-dense cereals known as millets.These are among the earliest foods that humans have ever consumed. One of the several varieties of coarse cereal grasses in the poaceae family, these are grown for their tiny edible seeds. Although pseudo millets do not belong to the Poaceae botanical family, which is the family to which "true" grains do, they are nutritionally comparable to "true" grains and can be used in similar ways.

Millets are a category of small-grained cereal food crops that can withstand drought and other adverse weather conditions well. They also require little in the way of fertilizer and pesticide use during growth. The majority of millet crops are indigenous to India and are referred to be "nutri-cereals" since they contain the majority of the nutrients needed for the body to operate normally. According to their grain size, millets are divided into Major Millets and Minor Millets. Although pseudo millets do not belong to the Poaceae botanical family, which is the family to which "true" grains do, they are nutritionally comparable to "true" grains and can be used in similar ways.

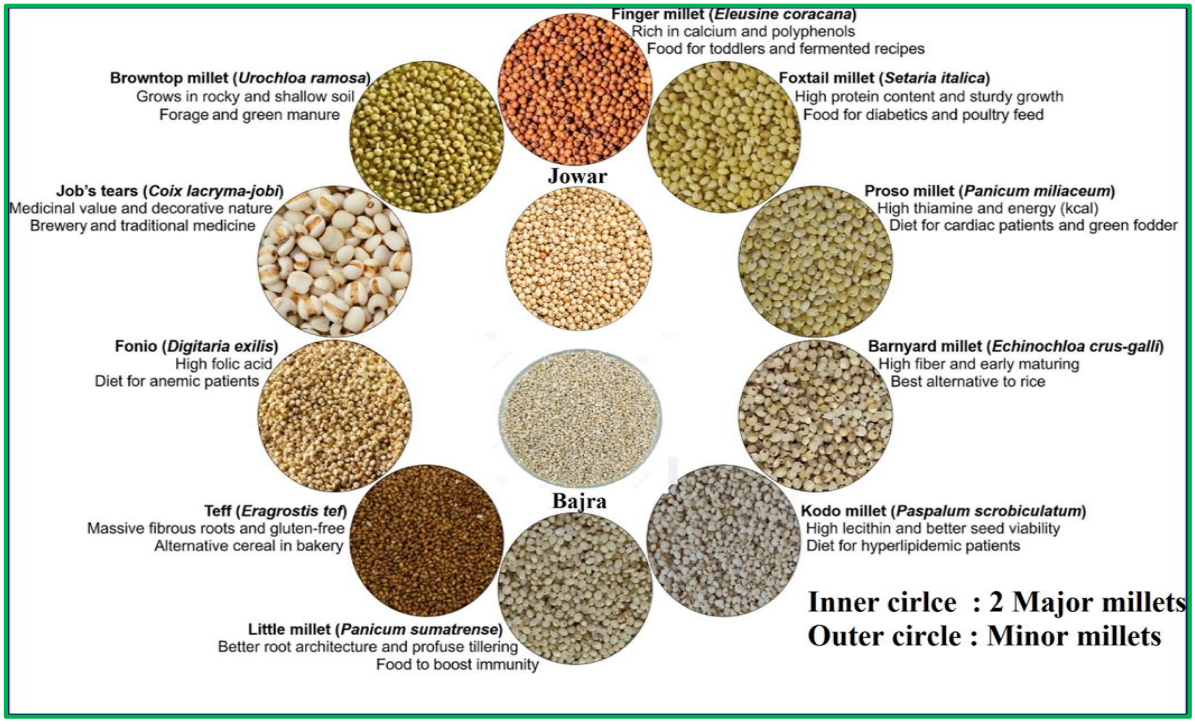
Millet's classification

Millets typically come in two varieties: major millets and mini millets. Major millets include jowar and Bajra, for example, while minor millets include finger millet, foxtail millet, barnyard millet, Koda millet, small millet, proso millet, teff millet, and fonio millet, among others.

Global and Indian scenario

The production of millet varies from countries to countries in that one India ranks first with the production of 1,02,80,000 tonnes, Niger ranks second with the production of 38,86,079 and China ranks third with the production of 19,95, 934.the share in the production of millets

also varies from countries-to-countries major share is from India with 36%, followed by Niger 4% and China 7%.



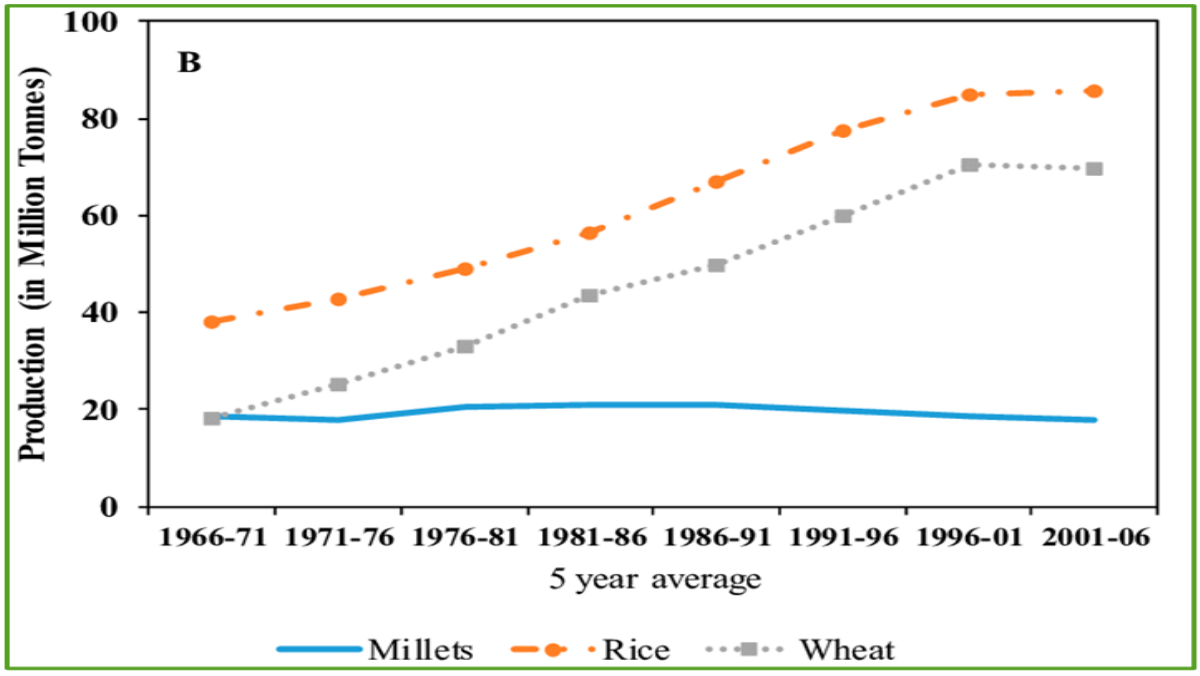
Minor millets: Area, production and yield in major producing states of India

The following table shows the area, production, and productivity of various millets in India. Karnataka ranks first in both categories with 5.46 lakh ha and 6.94 lakh t of production, while Tamil Nadu tops the productivity list with 3257 kg per ha.

States	Area (lakh ha)	Production (lakh t)	Productivity of ragi (kg ha^{-1})	Productivity of other small millets (kg ha^{-1})
Karnataka	5.46	6.94	1285	882
Tamil Nadu	1.01	2.91	3257	1573
Uttarakhand	1.48	1.80	1194	1248
Maharashtra	1.27	1.15	1164	453
Madhya Pradesh	0.89	0.59	-	663
Andhra Pradesh	0.45	0.49	1348	462
Odisha	0.69	0.42	690	518
Chhattisgarh	0.94	0.30	214	332
Arunachal Pradesh	0.27	0.27	-	1023
Jharkhand	0.14	0.11	805	-
Others	0.85	0.73	804	587
All India (2021-22)	13.45	15.72	1390	734
All India (1950-51)	68.08	31.79	596	380

Reasons for decline of area under minor

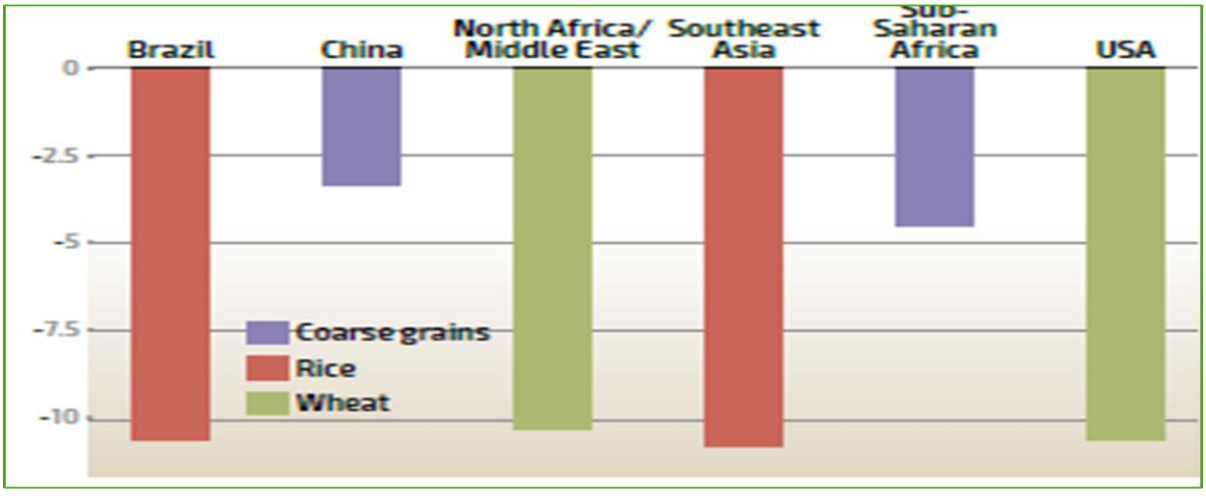
According to the farmers, the main cause of the decline in the small millet area was the low economic returns connected with the crop. Meanwhile, rain delays the crop's entire harvesting cycle, resulting in significant losses of grains and feed. Little millet was replaced by cotton, then maize, groundnuts, and soybeans by farmers. Comparing these crops to tiny millet, the economic returns are superior, and market prices are continuously high and profitable. The graph below shows that the output of millets did not rise between 1991 and 2006, although the production of rice and wheat increased significantly as a result of the green revolution.



Projected declines in cereal yields owing to climate change in 2050, without adaptation (%)

The yield of cereals like rice and wheat will decline due to climate change, but the production of coarse grains will decrease less than that of cereals. This is because rising temperatures, rising CO2 levels, and rising greenhouse gas levels, among other factors, will cause global warming and reduce crop yields.

Nutrient components of small millets and other cereals



Little millet is an excellent source of protein (10.13%), carbs (65.55%), fat (3.89%), fiber (7.72%), iron (1.26 mg/100g), phosphorous (130 mg/100g), zinc (1.82 mg/100g), magnesium (91.41 mg/100g), niacin (1.29 mg/100g), and polyphenols, making it an essential choice for nutritional security. Niacin lowers cholesterol, phosphorus aids in energy production and bodily tissue repair, and magnesium promotes heart health. Little millet is high in methionine, cysteine, and lysine and includes amino acids in a balanced ratio. It is especially useful for vegans who rely on plant-based diets for protein.

Little millets have a lot of potential for treating nutritional issues and can give different societal groups appropriate nutrients. 120 million healthy years of life lost as disability-adjusted life years (DALYs) globally (4.9% of all DALYs among adults) were attributed to the health effects of overweight and obesity, which contributed to an estimated 4.0 million deaths (7.1% of all deaths) and DALYs (disability-adjusted life years) of 120 million. Poor diets are the second-leading cause of fatalities and DALYs worldwide, accounting for 18.8% of deaths, of which 50.0% are caused by cardiovascular illnesses.

NUTRIENT COMPOSITION OF SMALL MILLETS AND OTHER CEREALS

(per 100 g of edible portion; @ 12 per cent grain moisture)

Food	Protein (g)	Fat (g)	Ash (g)	Crude fibre (g)	Carbohydrate (g)	Energy (kcal)	Ca (mg)	Fe (mg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)
Rice (brown)	7.9	2.7	1.3	1.0	76.0	362	33	1.8	0.41	0.04	4.3
Wheat	11.6	2.0	1.6	2.0	71.0	348	30	3.5	0.41	0.10	5.1
Maize	9.2	4.6	1.2	2.8	73.0	358	26	2.7	0.38	0.20	3.6
Sorghum	10.4	3.1	1.6	2.0	70.7	329	25	5.4	0.38	0.15	4.3
Pearl millet	11.8	4.8	2.2	2.3	67.0	363	42	11.0	0.38	0.21	2.8
Finger millet	7.7	1.5	2.6	3.6	72.6	336	350	3.9	0.42	0.19	1.1
Foxtail millet	11.2	4.0	3.3	6.7	63.2	351	31	2.8	0.59	0.11	3.2
Common millet	12.5	3.5	3.1	5.2	63.8	354	8	2.9	0.41	0.28	4.5
Little millet	9.7	5.2	5.4	7.6	60.9	329	17	9.3	0.30	0.09	3.2
Barnyard millet	11.0	3.9	4.5	13.6	55.0	300	22	18.6	0.33	0.10	4.2
Kodo millet	9.8	3.6	3.3	5.2	66.6	353	35	1.7	0.15	0.09	2.0

Nutritional importance of minor millets

- ❖ Gluten-free and low glycemic index (GI): - Retain control of diabetes and celiac disease.
- ❖ Rich in vitamin B and the minerals K, P, Ca, Fe, Zn, and Mg.
- ❖ Riboflavin and thiamine Niacin cut down on heart disease Loss of weight
- ❖ Detoxifying the body and rich in phytochemicals and anti-oxidants.

Constraints in minor millets production

Abiotic constraints

- Climatic
- Soil

Biotic constraints

- Pest and Diseases
- Weeds

Agronomic constraints

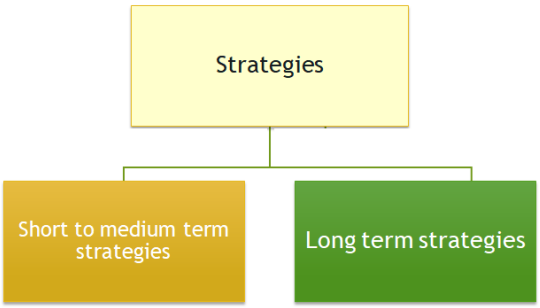
- Delayed sowings
- Lack of HYV
- low plant population
- cultivation in unfavorable soils without fertilizer
- lack of profitable cropping strategies
- weed invasion during early crop stages
- absence of protective irrigation during severe drought.

Socioeconomic variables

- Input availability issues and increased reliance on natural resources
- Low levels of socioeconomic development
- limited infrastructure; inadequate institutional capacity
- lack of proper marketing and financing systems

Short- and medium-term plans

• HYV distribution to farmers.
• Organized means of raising public awareness of better agronomic procedures.
• Upgrades to harvesting and processing equipment.
• Farmers receive a fair payment through a suitable buy-back arrangement.
• Purchasing millets through MSP and integrating millet into the public food supply.
• Increasing exports and adding value to products for sale.



Long-term planning

- research and development,
- promotion of FPOs,
- and inclusive policy support for tiny millets are all important.

Agronomic Interventions

Sowing season: The timing of sowing is determined by factors such as crop variety, cropping system, and rainfall.

• Increases yield as a result of a good environment.
• Following sufficient vegetative development, flowering is induced.
• Critical steps might be skipped to prevent moisture stress.

Variety & optimum plant population: To investigate the impact of spacing, nutrient, and weed nutrient management strategies on the productivity and profitability of foxtail millet, a field experiment was carried out during the kharif seasons of 2016 and 2017 at the farm of the S.V. Agricultural College in Tirupati. Foxtail millet's economics, yield, and growth have all been significantly influenced. The closest spacing, 20 cm x 10 cm, produced taller plants, more dry matter accumulation, the most panicles per square meter, the highest grain and straw production, and the highest financial returns and B: C ratio. With 100% RDF and two foliar applications of ZnSO4@ 0.5% applied at the beginning and end of flowering and 20 days later, increased growth height, yields, and financial returns were obtained. Furthermore, hand weeding at 20 DAS and 30 DAS increased the stature of growth and yield parameters, yield, and financial returns in foxtail millet. The study found that 20 cm x 10 cm spacing, 100% RDF + foliar ZnSO4 application at the beginning of flowering and 20 days later, as well as manual weeding twice at 20 DAS and 30 DAS, increased foxtail millet productivity and profitability.

Growth, yield components and yield of foxtail millet as influenced by spacing: At the College of Agriculture, Shivamogga, a field trial was done to standardize row spacing and determine the genotype of foxtail millet that is best suited to the Southern Transition Zone of Karnataka. Local, HMT-1, and SIA 2644 were the three foxtail millet genotypes that were cultivated at four different spacings: 30 cm by 10 cm, 20 cm by 10 cm, 20 cm by 5 cm, and 10 cm by 5 cm. The factorial Randomized Complete Block Design experiment had three replications. The experiment's combined findings reveal that, among the various spacings, plants grown at a 20 cm x 10 cm spacing had significantly higher plant heights (100.50 cm), leaf counts (35.14), tiller counts (14.43), productive tiller counts (12.19), test weights (3.48 g), and panicle lengths (16.26 cm).

When compared to other planting densities, panicle weight (4.38 g), grain yield (2227 kg ha-1), straw yield (4349 kg ha-1), and quality indices such as protein (10.08%) and fiber (6.33%) were all higher. In comparison to other genotypes, SIA 2644 had significantly higher values for plant height (86.90 cm), leaves (30.64), tillers hill-1 (11.55), productive tillers hill-1 (9.76), test weight (3.26 g), panicle length (14.29 cm), panicle weight (3.79 g), grain yield (1941 kg ha-1), straw yield (3919 kg ha-1), and quality parameters such as protein (10.08%) and fiber (6.33%). In comparison to other treatments, the combined effect of 20 cm x 10 cm + SIA 2644 resulted in significantly greater growth, yield, and quality parameters.

Influence of seed rate and row spacing on growth and yield attributes of finger millet: There is little information available on how finger millet responds to row spacing and seed rate in the Assosa Zone. Finger millet's reaction to row spacing and seed rate was studied in the field during a two-year period at each of two locations. Four row spacings (20, 30, 40, and 50 cm) and three seed rates (5, 15, and 25 kg/ha) were investigated in factorial combinations in a randomized complete block design (RCBD) with triplicates. The interactions between seed rate and row spacing had a significant impact on finger millet's responses in terms of plant height, the number of fingers per ear, total biomass, and grain production, according to the data. Significant increases were seen in the finger millet height (p0.05), number of fingers per ear (p0.05), total biomass (p0.01), and grain yield (p0.01). With a reduction in the seed rate from the broadcast (25) to 15 kg ha-1, grain yield improved highly substantially (p 0.01) from 1499.3 to 1926.8 kg ha-1. The seed rate of 15 kg/ha@40

cm row spacing produced the maximum grain production (1926.8 kg ha-1). Additionally, a preliminary budget analysis revealed that planting finger millet at a seed rate of 15 kg per ha with a 40 cm row spacing provided the first highest net benefit at the current cost of the grain and straw production. 22.2% (427.5 kg ha-1) more grain was produced over the broadcast due to the use of 15 kilogram of seed per hectare and 40 cm between rows.

22.2% (427.5 kg ha-1) more grain was produced over the broadcast due to the use of 15 kilogram of seed per hectare and 40 cm between rows (Table 2). Therefore, it can be concluded that, although more research is necessary to provide the advice a solid foundation, using a row spacing of 40 cm and a seed rate of 15 kg ha-1 to produce finger millet in the test region is recommended and may be adequate.

Intercropping system

Benefits include

- insurance against total crop failure,
- increased productivity per unit of land area, wise resource use,
- successful intercropping,
- minimal competition for light,
- complementarity, and maturation differences of at least 30 days.
- Peak nutrient demands should not overlap.

Different minor millets use different intercropping systems

Different minor millets are grown as intercrops in a variety of crops that also vary from state to state, such as pigeon pea, field pea, and soyabean in Karnataka and Tamil Nadu, and pigeon pea in Bihar. Different minor millets are used by different states.

State	System
Karnataka, Tamil nadu and Andra pradesh	Finger millet + Pigeon pea (8-10:2)
	Finger millet +Filed bean (8:1)
	Finger millet + Soybean (4:1)
Bihar	Finger millet + Pigeon pea (6:2)
Uttaranchal	Finger millet and Soybean mixed together in 90:10 per cent proportion by weight basis
North hilly areas	Finger millet + Soybean in *Kharif* and oats in rabi is an ideal remunerative sequence
Maharashtra (Kolhapur)	Finger millet + black gram / moong bean (6-8 : 1) (Sub-mountain regions)

Studies on castor (*Ricinus communis* L.) based intercropping systems under rainfed condition: The field experiment was carried out on medium black soils at the College of Agriculture, Vijayapur, during the kharif season of 2017–18 to examine how millets intercropped with castor (Ricinus communis L.) performed under rainfed circumstances. For the experiment, a Randomized Complete Block Design with three replications was used. The results showed that a single castor had a much larger seed output (2,416 kg ha-1) than any other castor intercropped, whereas a castor intercropped with pearl millet in a 1:2 ratio had the lowest seed production (1,456 kg ha-1). Only foxtail millet among intercrops had a greater grain production (2,431 kg ha-1).Castor + tiny millet (3,325 kg ha-1) produced a higher castor equivalent yield (CEY) and was comparable to castor + foxtail millet (3,159 kg ha-1) in 1:2 row proportions, however castor + pearl millet (711 kg ha-1) produced the lowest CEY. Castor + Little Millet had the highest land equivalent ratio (LER) of all the intercropping systems (1.58), whereas Castor + Pearl Millet had the lowest LER (1.37) in a 1:2 ratio. The net returns and BC ratio were also much higher for castor + tiny millet in a 1:2 ratio (78,720 ha-1 and 3.09, respectively).

Weed management

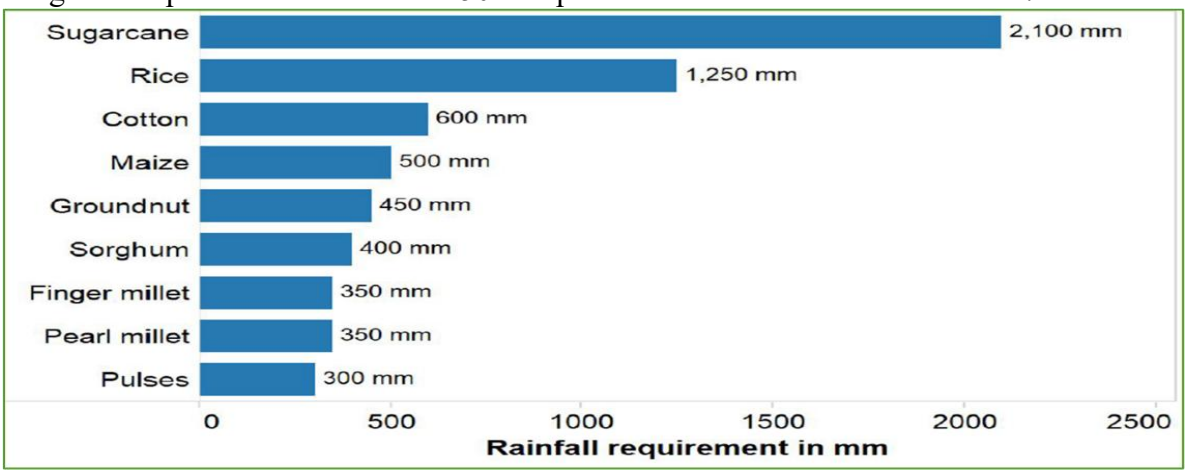
- Weeds are more active and contend for resources with millets.
- Thumb rule: 1/3 of the crop's growth cycle should be weed-free.
- Reduction in crop production relies on the crop's weed's critical period

Irrigation management: Crops that can withstand drought conditions .

• High WUE of finger millet

• Critical stages, including transplanting, heading, and flowering

• Irrigation is provided for millets at 50% depletion of the available soil moisture.



International Year of Millets (IYoM)-2023

- On March 5, 2021, the United Nations General Assembly decided 2023 to be the International Year of Millets after the Indian government suggested it to the organization. This proposal was backed by 72 other nations.
- The Indian government has now decided to commemorate IYOM in 2023 in an effort to galvanize the populace and ensure that Indian millets, recipes, and value-added goods are recognized internationally.

Conclusion

Improved high yielding cultivars, better plant geometry, balanced fertilizer treatment, efficient weed management, protective watering at critical phases, and profitable cropping strategies can all be used to increase the productivity of minor millets.

References

1. Anandha Krishnaveni, S. 2018. Effect of Method of Crop Establishment and Nutrient Management in Barnyard Millet under Sodic Soil Condition. *Int.J.Curr.Microbiol.App.Sci*. 7(12): 51-55.
2. Dereje, G., Adisu, T., & Anbessa, B. (2016). Influence of Row Spacing and Seed Rate on Yield and Yield Components of Finger Millet at Assosa Zone in BenshagulGumuze Region of Ethiopia. *Journal of Biology, Agriculture and Healthcare*, *6*(5), 2224-3208.
3. Gavit, H. D., Rajemahadik, V. A., Bahure, G. K., Jadhav, M. S., Thorat, T. N., & Kasture, M. C. (2017). Effect of establishment techniques and sowing time on yield and yield attributes of proso millet (Panicum miliaceum L.). *Int. J. Curr. Microbiol. App. Sci*, *6*(5), 1523-1528.

4. Himasree, B., Chandrika, V., Sarala, N., & Prasanthi, (2017). A. EVALUATION OF FOXTAIL MILLET (Setariaitalica L.) BASED INTERCROPPING SYSTEMS UNDER LATE SOWN CONDITIONS. *Agricultural Sciences*, 67.
5. Jyothi K. N., V Sumathi, D Subramanyam, P Sudhakar, T Giridhar Krishna and G Karuna Sagar 2021.Productivity and profitability of foxtail millet (*Setariaitalica* L.) as influenced by varied agro techniques under Southern agro-climatic Zone of Andhra Pradesh. *The Pharma Innovation Journal* 2021; 10(7): 907-911
6. Mallareddy, M.N, Thimmegowda& Sahukar, & Hebbal, Narayan. (2015). Effect of moisture conservation practices on growth & yield of finger millet + pigeonpea intercropping system.
7. Nandini, K.M. and Sridhara, S. 2019. Response of Growth, Yield and Quality Parameters of Foxtail Millet Genotypes to Different Planting Density. *Int.J.Curr.Microbiol.App.Sci*. 8(02): 1765-1773.
8. Natarajan, S., Ganapathy, M., Arivazhagan, K., & Srinivasu, V. (2019). Effect of spacing and nutrient sources on system of finger millet (Eleusine coracana) intensification. *Indian Journal of Agronomy*, *64*(1), 98-102.
9. Pandey S., R. K Lakra, K. P. Nargis, Alam and A. N. Puran 2018.Weed Management on Direct Seeded Finger Millet *(Eleusine coracana* L.) Under Rainfed Condition of Jharkhand.*Int.J.Curr.Microbiol.App.Sci*(2018) Special Issue-7: 844-850.
10. Triveni U, Sandhya Rani Y, Patro TSSK, Anuradha N and Divya M 2017. Evaluation of different finger millet based intercropping systems in the north coastal zone of Andhra Pradesh.*International Journal of Chemical Studies* 2017; 5(5): 828-831