Performance of finger and foxtail millet at different levels of nutrient and cultural management

M Roja, CH Deepthi and M Devender Reddy

DOI: https://doi.org/10.22271/chemi.2020.v8.i2z.9002

Abstract
In India, finger millet and small millets respectively occupy 11.93 and 6.82 lakh ha area with a production of 199.92 and 4.89 lakh tones and the productivity of 1661 and 633 kg ha⁻¹ (GOI, 2014). The yield potential of finger and foxtail millet is low as compared to the potentially achievable yield because of inadequate application of fertilizers, conventional cultivation of low yielding cultivars and lack of good management practices. The finger millet responded to fertilizer application from 90: 40: 25 to 100: 50: 50 Kg N, P₂O₅ and K₂O ha⁻¹ while foxtail millet responded from 30:15:15 to 50:30:20 Kg N, P₂O₅ and K₂O ha⁻¹ in red sandy loam to clay soils of South India. In this paper the research done on production technology of finger millet and foxtail millet in various regions of the country has been reviewed and presented comprehensively.

Keywords: Finger millet, foxtail millet, nitrogen, weed management, varieties

Introduction
India is the largest producer of different millets (foxtail millet, finger millet, barnyard millet etc.), which are often referred to as coarse cereals. Finger and foxtail millets are consumed by the rural / tribal population of warmer region in India (Andhra Pradesh, Odisha, Karnataka, Tamil Nadu, Uttar Pradesh and Southern Rajasthan). They are generally grown as a rain fed crop and in a variety of agro-ecological situations and in diverse soils with high rainfall variability. These crops are known for resilience and drought enduring capacity and well suited for contingency crop planning, addressing the issues of climate change. These crops withstand a certain degree of soil acidity and alkalinity, stress due to moisture and temperature and variation in soils from heavy to sandy infertile.

In India finger millet is grown in 11.93 lakh ha with a production of 19.92 lakh tones and productivity of 1661 kg ha⁻¹ (GOI, 2014) [7]. On the other hand, small millets are grown in an area of 6.82 lakh ha, with a production of 4.89 lakh tones and productivity of 633 kg ha⁻¹. The improved varieties of finger millet under good management can produce up to 4 t of grain per hectare. The major finger millet producing states are Karnataka, Uttarakhand, Tamil Nadu, Maharashtra, Andhra Pradesh and fox tail millet producing states are Andhra Pradesh, Karnataka, Arunachal Pradesh, Maharashtra and Rajasthan (GOI, 2014) [7].

The productivity of finger and foxtail millet in the country increased but there exists wide gap between the state average yield and outputs from frontline demonstrations as millets are mostly grown as rain fed crops under poor and marginal soils with poor soil fertility and non adoption of improved varieties and package of practices with no manure and fertilizer application, lack of proper disease and pest management.

The results obtained from the research done by All India co-ordinated Research Project on Millet Improvement (AICMIP) and State Agricultural Universities in different states of India on nutrient, weed and cultural management including the varietal identification of finger and foxtail millet has been summarized.

Research findings
The experiments conducted in various agro climatic regions under different soil and climatic variations resulted in suitable varieties, desired sowing / planting time, proper plant population...
requirements, fertilizer application rates, weed management are reviewed and presented in the following paragraphs.

**Varieties**
The important varieties suitable for major finger millet and foxtail millet growing areas are given in table 1 and 2.

| States       | Finger millet                                                                 | Foxtail millet                                                                 |
|--------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Karnataka    | Indaf-8, Indaf-9, HR-911, PR-202, MR-1, MR-6, L-5, GPU-26, GPU-28, GPU-66, GPU-45, VR-708 & OE10. | SSIA 326, HMT 100-1 and PS 45reelaxmi, KO 12, Narasimharaya, SSIA 3088, SSIA 3156 |
| Uttarakhand  | VL-146, VL-149, VL-315, VL-324, PRM-1 & PRM-2                               | PS 4 and PRK 1, Sreelaxmi, SSIA 326                                           |
| Tamilnadu    | GPU-28, CO-7, CO-10, CO-11, CO-12, CO-13, CO-14, Paiyur (Ra)-2, K-367, Indaf-5, Indaf-7, Indaf-9, Paiyur-1, PR-202 and TRY-1 | TNAU 196 and TNAU 43, CO (Ten) 7, TNAU 186, CO 1, CO 2, CO 4, CO 5, K2, K3     |
| Andhra Pradesh | Kharif: Short duration (80-90 days): Maruthi, Champavathi                       | Sri Laxmi, Suryanandi, SSIA 3085, SSIA 3156 Prasad, Krishna devaraya, and Narasimharaya |
| Rajasthan    | Kharif: Short duration (100-115 days): Bharathi, Srichaitanya, Godavari, Hima, Sapthagirii, Ratnagiri and Vakula Rabi: Bharathi, Maruthi, Godavari, and Hima (White seeded variety) | Prathap Kangani (SR 1) and SR 51, SR 11, Sreelaxmi, SR 16, SSIA 3085           |
| Odisha       | Odisha Subra, Chilika and Saura                                               | SiA 3085, SSIA 3156 Prasad, Krishnadevaraya, and Narasimharaya                |

| Varieties     | Soil type          | Region/state         | Reference           |
|---------------|--------------------|----------------------|---------------------|
| Finger millet |                   |                      |                     |
| SiA 3085     | Sandy loamy        | SVU, Tirupati        | Navaiyothi et al., 2016 |
| SiA 3085     | Sandy loamy        | Bangalore and Coimbatore | AICSMIP, 2010      |
| SIA 2644     | Red sandy clay     | ZAHRS, Transition Zone of Karnataka | Nandini and Sridhara, 2019 [15] |
| Foxtail millet |                 |                      |                     |
| VL 149       | Silty clay loam    | G.B.Pant University, Uttarakhand | Rashmi Yadav et al., 2010 [24] |
| VL-379 & 352 | Sandy loamy        | ARS, Visianagaram    | Triveni et al., 2018 [26] |

**Spacing**
Spacing in different states varied from 22.5 cm x 10 cm (Andhra Pradesh, Odisha, Bihar, Jharkand Bihar and Maharashtra) to 22.5 to 30 cm x 7.5 cm for finger millet and 25-30 cm x 8 to 10 cm for foxtail millet (Table 3). Adoption of spacing of 20 cm x 10 cm for foxtail millet (Nandini and Sridhara, 2019) [15] has given highest yield.

| State         | Spacing (cm) | Fertilizers (N,P2O5,K2O kg/ha) |
|---------------|--------------|--------------------------------|
| Andhra Pradesh| 22.5 x 10.0, 25-30 cm x 8-10 cm | 40:30:0, 40:20:20 |
| Orissa        | 22.5 x 10.0  | 20:20:20, 40:20:20             |
| Bihar         | 22.5 x 10.0  | 40:20:0, 40:20:20              |
| Jharkhand     | 22.5 x 10.0  | 30:15:0, 50:40:25              |
| Karnataka     | 22.5 to 30 x 7.5 to10 (Rainfed), 22.5 x 10 (Irrigated) | 20:20:0, 25:20:0 |
| Maharashtra   | 22.5 x 10.0  | 40:20:0, 40:20:20              |
| Tamil Nadu    | 22.5 x 15.0  |                                |

**Nutrient management**
Sandy soils inherently have low amounts of nutrients, low soil organic matter and are weakly structured so they have to be replenished by application of compost manure, incorporating crop residues during land preparations by green manuring.

| Fertilizer level (N: P2O5: K kg ha⁻¹) | Soil type          | Region/state         | Reference           |
|-------------------------------------|--------------------|----------------------|---------------------|
| Finger millet                       |                    |                      |                     |
| 100: 50: 50                         | Red sandy loam     | UAS, Bengaluru       | Prakash et al, 2018 |
| 40:20:20                            | Alfisol with sandy loam | ANGRAU, Hyderabad. | Pallavi et al, 2015 [21] |
| 90:45:17.5                          | Sandy clay loam    | TNAU, Coimbatore     | Arulmizhisevan et al., 2013 [4] |
| 50:40:37.5 + 7.5 t FYM              | Red sandy clay loam | GKV, UAS, Bengaluru. | Narayan hebbal and Ramachandrapra, 2017 [17] |
| 60: 30: 0                           | Silty clay         | ZARS, Kolhapur, Maharashtra | Nigade and More, 2013 |

**Table 1:** Varieties of finger and foxtail millet recommended for cultivation in various states of India

**Table 2:** High yielding varieties identified in different regions

**Table 3:** Recommended rate of spacing and fertilizers for foxtail and finger millet in India

**Table 4:** Finger millet and foxtail millet response to fertilizer at various locations in India
FOX MILL

**Weed management**

Weeds are the major problem, which needs frequent intercultural operations and integrated weed management has to be done (Table 5). Besides hand weeding, application of post-emergence application of 2, 4-D sodium salt (80%) @ 0.75 kg a.i ha\(^{-1}\) at 20-25 days after sowing and Isoproturon @ 1.0 kg a.i. ha\(^{-1}\) as pre-emergence spray is effective in controlling weeds (Research Achievements of AICRPs on Crop Science, 2008-12).

| Method of weed control | Soil type | Region/state | Reference |
|------------------------|-----------|--------------|-----------|
| **Finger millet**       |           |              |           |
| Bensulfuron methyl + pretichlor @ 3 kg ha\(^{-1}\) | Sandy loam soil | BAU, Ranchi, Jharkhand | Pandey Satish et al., 2018 [20] |
| Oxyfluorfen 0.50 kg ha\(^{-1}\) + one hand weeding at 20 DAS | Sandy loam | ARS, Jagdalpur | Adikanth Pradhan et al., 2010 [1] |
| Hoeing twice by wheel hoe between rows and intra-row manual weeding | Sandy loam | IGKV, Ambikapur | Kujur et al., 2018 [10] |
| Two hand weedicings at 20 and 40 DAS | Sandy loam | Research Station, Hebbal, Bangalore | Basavaraj Patil and Reddy, 2014 [5] |
| Butachlor | Red sandy loam | Main Research Station, Hebbal, Bangalore | Kiran Gowda et al., 2012 [8] |
| **Foxtail millet**      |           |              |           |
| Carfenlrazone @ 18.0 g ha\(^{-1}\) | Clay loamy | UWSAREC, Lingle, WY | Lyon et al., 2007 [12] |
| Hand hoeing | Clay loam | Rajasthan College of Agriculture, Udaipur | Kitaawat et al., 2007 [9] |
| Bispyrubic sodium @ 20g ha\(^{-1}\) | Clay | Annamalai University, Tamil Nadu | Nebila Chana et al., 2018 [4] |

**Pests and diseases**

Pink stem borer (Sesami ainferens) an insect pest and blast disease are common in finger millet. For control of pink stem borer spraying of phorate 10% CG @ 1 litre ha\(^{-1}\)at every 20 days interval after germination and for control of army and cut worms (Spodoptera frugiperda) spraying of Phasalone 5% @ 24 kg ha\(^{-1}\) or QuinolfoS 1.5% @ 24 kg ha\(^{-1}\) has been found effective.

In foxtail millet, the major insect pests are shoot fly and disease blast is common. Over a period of time the pest management developed include early sowing by second fortnight of July or with the onset of monsoon. If sown beyond July end, adoption of higher seed rate (1.5 times the recommended seed rate) to make up for seedling mortality helps to give normal yield. For reducing shoot fly incidence application of Phorate 20-25 kg ha\(^{-1}\) in furrow, Carbofuran 3G (1.5 kg a.i ha\(^{-1}\)) and quinphos (2ml l\(^{-1}\)) as soil application found effective. For control of blast disease, spraying of Saaf (0.2%) or carbendazim 0.05% with first spray at 50 per cent flowering followed by the second spray 10 days after first spray is effective.

Besides chemical control of pests and diseases, it is always advisable to grow tolerant or fairly resistant varieties (Table 6) for reducing cost of production and safe environment.

| Name of the variety | Foxtail millet | Special features |
|---------------------|----------------|------------------|
| SIA 3085            |                 | Resistant to blast and downy mildew. |
| RAU (Rajendra Kauni 1-2) | Resistance against leaf blast, rust, smut, brown spot, downy mildew and leaf blight. High iron content of 15.45 (mg/100g) and Zinc (5.02 mg/100g). |
| Co-7 (TNAU 196)     | High protein (13.62 to 14.0%) and fodder yield (3.7 to 4.0 l/ha) |
| HMT 100-1           | High tillering, suitable for early and late sowing |
| (SIA 3088) Suryanyandi | Non-lodging, early duration, suitable for double cropping |
| DHFt-109-3          | Variety suitable for contingency planting. |

Table 6: Finger and foxtail millet varieties having reasonable resistant to diseases and aberrant weather conditions

“1677”
Conclusions

Minor millets have the potential to provide food and nutrition security as well as ensure sustainability for poor farmers in fragile ecosystems. The crop improvement efforts focused in India for developing appropriate agro-production technology for maximizing production/productivity resulted in potential varieties and production technology for improving the productivity of finger and foxtail millets. Higher yield of finger and foxtail millet can be realized with improved varieties and adoption of proper sowing time, nutrient, weed and pest and disease management.

References

1. Adikant Pradhan, Rajput AS, Thakur A. Effect of weed management on growth and yield of finger millet. Indian Journal of Weed Science. 2010; 42(1-2):53-56.
2. AICSMIP (All India Co-ordinated Small Millets Improvement Project). Annual Report (2016-2017), project co-ordinating unit on small millets, ICAR, GKVK, Bangalore, 2017. AG34-37.
3. AICRP. Annual Progress Report: 2017-2018, AICRP-AICRP on Small Millets, Bengaluru, 2017.
4. ArulmozhiSelvan K, Elayarajam M, Sathysa S. Effect of Long Term Fertilization and Manuring on Soil Fertility, Yield and Uptake by Finger Millet on Inceptisol. Madras Agricultural Journal, 2013; 100(4-6):490-494.
5. Basavaraj Patil, Reddy VC. Weed management practices in irrigated organic finger millet (Eleusine coracana L. Gaertn.). Scholars Journal of Agriculture and Veterinary Sciences. 2014; 1(4A):211-215.
6. Bebila Chanu Y, Jawahar S, Nandini Devi K, Priyanka Irungbam, Jamkhoiling Lhungdim. To Study the Effect of Weed Observation Practices in Transplanted Kodomillet (Paspalums croobiculatum L.) International Journal of Current Microbiology and Applied Sciences. 2018; 7(11):824-831.
7. GoI. Status paper on coarse crops, Directorate of Millets Development, Department of Agriculture and Cooperation, Ministry of Agriculture, GoI, 2014.
8. Kirangowda SG, Naveen DV, Bhagyalakshmi T, Gowda RC. Weed management practices on nutrient removal by weeds and its relation to yield of finger millet in eastern dry zone of Karnataka. International Journal of Agricultural Sciences. 2012; 8(2):385-389.
9. Kitawat, Hari Singh, Kaushik MK. Study on Weed Control Systems in Foxtail Millet (Setaria italica L.) under Varied Methods of Sowing. Thesis submitted to SHIATS.
10. Kujur S, Singh VK, Gupta DK, Tandon A, Ekka V, Agrawal HP. Influence of Weed Management Practices on Weeds, Yield and Economics of Finger millet (Eleusine coracana L. Gaertn). International Journal of Bio-resource and Stress Management. 2018; 9(2):209-213.
11. Kumara O, Basavaraj Naik T, Palaiyap P. Effect of weed management practices and fertility levels on growth and yield parameters in finger millet. Karnataka Journal of Agricultural Sciences. 2007; 20(2):230-233.
12. Lyon, Drew J, Andrew Kniss, Stephen Miller D. Carfentrazone Improves Broadleaf Weed Control in Proso and Foxtail Millets. Weed science society of America. 2007; 21(1):84-87.
13. Mubeena P, Halepyati AS, Chittapur BM. Effect of Date of Sowing and Nutrient Management on Nutrient Uptake and Yield of Foxtail Millet (Setaria italica L.). International Journal of Bio-resource and Stress Management, 2019, 92-95.
14. Naik TB, Murthy RK, Pushpa K. Effect of integrated nutrient management on growth and yield parameters of foxtail millet (Setaria italica) under rainfed condition of allisol. Environment and Ecology. 2010; 28(2):762-765.
15. Nandini KM, Sridhara S. Response of Growth, Yield and Quality Parameters of Foxtail Millet Genotypes to Different Planting Density. International Journal of Current Microbiology and Applied Sciences. 2019; 8(2):1765-1773.
16. Nandini KM, Sridhara S, Kiran Kumar. Effect of different levels of nitrogen on yield, yield components and quality parameters of foxtail millet (Setariaitalica L.) genotypes in southern transition zone of Karnataka. International Journal of Chemical Studies. 2018; 6(6):2025-2029.
17. Narayan Hebbal, Ramachandrappppa BK. Effect of Method of Establishment, Planting Geometry and Nutrient Source on Growth and Yield of Finger Millet (Eleusinecoracana L.). Mysore Journal of Agricultural Science. 2017; 51(2):392-396.
18. Nigade RD, Jadhav BS, Bhosale AS. Response of long duration finger millet (Eleusinecoracana L.) variety to different levels of nitrogen under rainfed condition. International Journal of Agricultural Sciences. 2011; 7(1):152-155.
19. Ojha E, Adhukari BB, Katuwal Y. Nutrient Management Trial on Foxtail Millet at Sundarbazar, Lamjung. Journal of institute of agriculture and animal science. 2018; 35:89-94.
20. Pandey Satish, Lakra RK, Kumari Nargis, Alam P, Puran AN. Weed management on direct seeded Finger millet (Eleusinecoracana L.) under rainfedcondition of Jharkhand. International Journal of Current Microbiology and Applied Sciences. 2018; 7:844-850.
21. Pallavi CH, Joesh B, Aarif Khan MA, Hemalatha S. Nutrient management in finger millet (eleusinecoracana L.) Under meliaazedarach based agri-silvi system. Thesis submitted to ANGRAU, 2015.
22. Priyanka SM, Rajkumara S. Growth, yield and economics of pigeonpea and foxtail millet intercropping system under different nutrient levels. Journal of Farm Sciences. 2019; 32(1):45-49.
23. Ramyasri K, Ramana AV, Upendra Rao A, Guru Murthy P. Nutrient Uptake Vis a Vis Grain Yield of Foxtail Millet Varieties as Influenced by Nitrogen Levels in Rice Fallows. International Journal of Current Microbiology and Applied Sciences. 2018; 7(9):2626-2629.
24. Rashmi Yadav, Naresh Malik, Yadav VK. Response of finger millet (Eleusine coracana (L.) Gaertn) genotypes to nitrogen under rainfed situations of western Himalayan
25. Roy AK, Ali N, Lakra RK, Alam P, Sah A, Yadava MS. Production potential and economics of finger millet (Eleusine coracana L. Gaertn.) as affected by integrated nutrient management. Journal of Pharmacognosy and Phytochemistry. 2018; 7(4):2442-2445.

26. Triveni U, Sandhya Rani Y, Patro TSSK, Anuradha N, Divya M. Fertilizer responsiveness of short duration improved finger millet genotypes to different levels of NPK fertilizers. Indian Journal of Agricultural Research. 2018; 52(1):97-100.

27. Tuti MD, Sher Singh, Pandey BM, Bisht JK, Pattanayak A. Weed management in rainfed finger millet. Indian Journal of Weed Science. 2016; 48(1):74-75.

28. Veeresh Hatti, Ramachandrappa BK, Mudalagiriyappa. Studies on effect of different tillage and nutrient management approaches on growth, yield and weed index in finger millet. Mysore Journal of Agricultural Sciences. 2016; 50(2):301-304.