



Review Article

RESPONSE OF RAGI TO NUTRIENT MANAGEMENT INTERVENTIONS

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Abstract: Finger millet (*Eleusine coracana*. L.) is an important dry land millet crop and ranks third in importance among millets in India, after sorghum and pearl millet. For maintaining fertility status of soil on a long run, we should dependent on the different nutrient sources rather than single source chemical fertilizers. Ragi responds well to the integration of different nutrient sources which were imposed during preceding rice crop. The carry over effect of residual fertility was more beneficial to ragi to attain higher growth and yield parameters and yield of ragi.

Keywords: Ragi, Nutrient Management Interventions, Growth Parameters, Organic Manures

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Introduction

Finger millet (*Eleusine coracana*. L.) is an important dry land millet crop and ranks third in importance among millets in India, after sorghum and pearl millet. Ragi is being a C₄ plant; it has higher productivity among the small millets. It is a supplemental food for diabetic patients instead of regular food item like rice as it can reduce sugar levels in blood and urine because it as low glycemic index. In India, finger millet is grown in the area of 1.06 m. ha with production of 1.68 m. t and productivity of 1363 kg ha⁻¹. In Andhra Pradesh, it is grown in the area of 0.032 m. ha with production of 0.035 m.t and productivity of 1094 kg ha⁻¹(Ministry of Agriculture, Govt of India, 2018-19 [1].Integration of chemical fertilizers with organic fertilizers (INM) is one of the best management practices to run the soil fertility on a long run to achieve sustainable crop yields with less environmental pollution to the ecosystem. Organic fertilizers improve the soil physical, biological, and chemical properties. These increases the water holding capacity of soil, enabling the plant roots to have better access to available nutrients. Organic materials also increase the diversity microbial population. These are essential to transform fertilizer materials into available form for plant's use and to rejuvenate soil. So, integration of different nutrient sources is very much essential to achieve higher yields in the ragi crop.

Response of Ragi to different Nutrient Management Interventions in India

Growth parameters of rice as influenced by integrated nutrient management

According to Kumar and Gautam (2004) [2].combined application of FYM @ 5 t ha⁻¹ + biofertilizers (*Azospirillum* + PSB) + 90 kg N ha⁻¹ than recommended dose of nitrogen (60 kg N ha⁻¹) recorded significant improvement in plant height, total number of tillers per metre and dry matter per plant in pearl millet under semi-arid conditions of New Delhi, India. The integrated use of 100%RDF+FYM @ 3tha⁻¹recorded the maximum plant height (93.9cm) over other nutrient management systems in finger millet during Rabi season on sandy soils of Agricultural College Farm, Bapatla [3]. According to Kadali et al. (2006) [4] highest plant height (98.33cm) was recorded with 100%N, Pand K+7.5tha⁻¹FYM in ragi on sandy clay loam soil at All India Coordinated Small Millets Improvement Project, UAS,

Bangalore. Gavade (2010) [5] tested a field experiment on finger millet during Kharif in lateritic soil at Central Experiment Station, Wakawali, B.S.K.K.V., Dapoli (M.S.) and found that plant height, number of leaves, number of tillers, and dry matter accumulation per hill were significantly increased with the application of 100% RDF (60:30:00 kg NPK ha⁻¹) over 75% RDF, 50% RDF and organic manures alone. According to Kiran Kumar et al. (2017a) [6] maximum plant height (100.9 cm), dry matter accumulation (6845 kg ha⁻¹) and total tillers m⁻² (74.2) at harvest of finger millet was recorded with treatment T₇, which received 50 % RDP+ FYM @ 7.5 t ha⁻¹ + PSB @ 5.0 kg ha⁻¹.

Yield Attributing Characters

A field experiment was conducted by Ramamoorthy and Chirstopher Lourdraj (2002) [7] and the results revealed that 50%N throughFYMand50% N through urea + 50% P and K of recommended dose in combination with bio-fertilizer recorded highest number of productive tillers per plant(6.2) and fingers per earhead(9.0) in finger millet on clay loam soil of Tamil Nadu. According to Kadali et.al.(2006) [4] stated that highest number of ear heads(4.47) and number of fingers per ear head (7.2) of finger millet was recorded with application of 100%N, PandK + 7.5 tha⁻¹ FYM during kharif on sandy soil at GKVK, Bangalore. Whereas application of 100% RDF+FYM@3tha⁻¹ recorded the highest productive tillersm⁻² and number of grains per finger (178.9 and 167.7 respectively) than there maining treatments on a sandy soil of Agricultural College, Bapatla. According to Apoorva et.al.(2010) [8] significantly higher No. of ear heads per plant and test weight of finger millet was recorded with fertilizers +10tha⁻¹FYM (STCR)+*Azotobacter*+ Phosphorus Solubilizing Bacteria compared to other treatments on sandy loam soil at GKVK Bangalore. Recommended dose of fertilizer + FYM@5tha⁻¹ increased No. of earheadsm⁻²(107.13)and number of fingers ear head⁻¹(5.83) in finger millet during kharif season at Dapoli [9]. On the other hand Pradeep Kumar et al. (2014) [10] conducted an experiment during 2009-2010 at Agricultural Research Farm, Agra and found that the maximum Earhead length, test weight, No. of ear heads m⁻² and grain weight per ear head of pearl millet was recorded

with the treatment which received 100% NPK+10 t FYM + 25 kg S+ 25 kg ZnSO₄ ha⁻¹ (T₁₁). Kiran Kumar *et al.* (2017a) [5] conducted an experiment on sandy soil of Agricultural College Farm, Bapatla and concluded that the maximum No. of earheads m⁻² (62), No. of fingers per earhead (8.3) No. of filled grains per finger (161) and test weight (3.0 g/10000 grain) of finger millet was recorded with treatment T₇, which received 50 % RDP+ FYM @ 7.5 t ha⁻¹ + PSB @ 5.0 kg ha⁻¹.

Yield of Finger millet crop

Application of 100% RDF+FYM @ 3 t ha⁻¹ recorded the highest grain and straw yield of ragi (3215 and 5652 kg ha⁻¹ respectively) over the other treatment sat sandy soil of Bapatla as reported by Giribabu, (2006) [3]. According to Deshmukh (2007) [11] noticed that the application of 60 kg N and 30 kg P₂O₅ ha⁻¹ + FYM @ 5 t ha⁻¹ contributed to the highest grain (25.17 q ha⁻¹) and straw yield (54.72 q ha⁻¹) in finger millet at Dapoli. On the other hand Basavaraju and Purushotham (2009) [12] conducted an experiment under rainfed conditions at Zonal Agricultural Research Station, Konehally, Bangalore and found that the highest grain (2127 kg ha⁻¹) and straw (3191 kg ha⁻¹) yield of finger millet was recorded with 50% N through vermicompost + 50% NPK through chemical fertilizers. While, While, Manuja *et al.* (2013) [13] stated that the higher grain (4860 kg ha⁻¹) and straw (8300 kg ha⁻¹) yield of finger millet was recorded with the treatment, NPK @ 150% which was on par with the application of NPK @ 100% + FYM + lime (4820 kg ha⁻¹ and 8290 kg ha⁻¹) at GKVK, Bangalore. Arulmozhiselvan *et al.* (2013) [20] found that combined use of 100 % N, P and K + FYM was significantly increased by 27% in grain and 23% in straw yield of finger millet over the control on clay loam soil of Coimbatore, Tamil Nadu. The application of FYM @ 5 t ha⁻¹ + RDF produced the higher finger millet grain (22.27 q ha⁻¹) and straw (32.90 q ha⁻¹) yield at Central Farm, Central Experiment Station, Dapoli, Maharashtra and it was on par with FYM @ 5 t ha⁻¹ + 75% RDF + bio-fertilizers (Azospirillum + Phosphorus Solubilizing Bacteria Ahiwale *et al.* (2013) [9]. Pradeep Kumar *et al.* (2014) [10] concluded that the higher grain and straw yields were recorded with the application of 100% NPK+ 10 t FYM+25 kg S+ 25 kg ZnSO₄ ha⁻¹ in pearl millet at Raja Balwanth Singh College, Agricultural Research Farm, Agra. Kiran Kumar *et al.* (2017a) [5] conducted an experiment on sandy soils of Agricultural College Farm, Bapatla and found that the maximum grain (2200 kg ha⁻¹) and straw yield (4550 kg ha⁻¹) of finger millet was recorded with treatment T₇, which received 50 % RDP+ FYM @ 7.5 t ha⁻¹ + PSB @ 5.0 kg ha⁻¹.

Nutrient Uptake by Crop

A field experiment was conducted by Anil Kumar *et al.* (2003) [16] on red loam soil at the Regional Research Station, GKVK, Bangalore and noticed that the highest NPK uptake (172.60, 31.59 and 76.01 kg ha⁻¹) of finger millet was recorded with the application of 7.5 t ha⁻¹ compost along with 100% RDF. The application of N and P₂O₅ (60 kg N and 30 kg P₂O₅ ha⁻¹) + FYM @ 5 t ha⁻¹ contributed to the highest uptake of P (9.48 kg ha⁻¹) over the recommended level of fertilizers in finger millet at Dapoli [11]. The application of NPK @ 150% gave higher uptake of nitrogen (66.3 kg ha⁻¹), phosphorus (13.9 kg ha⁻¹) and potassium (34.3 kg ha⁻¹) in finger millet grain at GKVK, Bangalore reported by Manuja *et al.* (2013) [13]. Significantly highest N, P, K, Ca and Fe (73.1, 19.1, 39.5, 17.6 and 0.91 kg ha⁻¹ respectively) uptake by finger millet was recorded with the application of 50 % RDP through fertilizer + FYM @ 7.5 t ha⁻¹ along with 5.0 kg PSB ha⁻¹ in sandy soils of Agricultural College Farm, Bapatla [14].

QUALITY PARAMETERS OF FINGERMILLET CROP

Application of 100% RDF through inorganic source + 3 t FYM ha⁻¹ significantly increased the protein content of finger millet grain (9.8%) than the other treatments. The lowest protein content (8.3%) was recorded with only organic system and remaining two (inorganic system, 75% RDF through inorganic sources + 3 t FYM ha⁻¹) were remained on par with each other in finger millet at Bapatla, A.P [3]. Kiran Kumar *et al.* (2017b) [14] conducted an experiment on sandy soil at Agricultural College Farm, Bapatla and found that the maximum grain protein (12.2%), fibre (3.5%), Ca (0.40%) and iron content (0.02) of ragi was recorded with application of 50% Recommended dose of inorganic phosphorus + FYM 7.5 t ha⁻¹ + PSB @ 5.0 kg ha⁻¹. According to Rangesh Kumar *et al.* (2018) [15]

conducted an experiment at College of Agriculture, OUAT, Bhubaneswar and concluded that 100% NPK + vermicompost @ 2.5 t ha⁻¹ + lime + biofertilizer recorded highest protein (93 g kg⁻¹) and calcium (3.9 g kg⁻¹) content in ragi grain.

Economics of Finger millet Crop

Singh (2002) [17] investigated the effect of improved and local package of practices on the economics of finger millet under rainfed conditions and found that application of N:P:K @ 60:40:20 kg ha⁻¹ recorded higher net returns (Rs. 5280) than the FYM at 5 t ha⁻¹ (farmers practice). Patil *et al.* (2006) [18] found that 50 per cent RDF + FYM @ 2.5 t ha⁻¹ + biofertilizer as seed treatment significantly increased the gross monetary returns (12,911.10 ha⁻¹), net monetary returns (8867.75 ha⁻¹) and B:C ratio (3.14) over the other treatments. On the other hand, Maximum net returns of Rs. 9488.78 ha⁻¹ with B:C ratio of 1.32 in finger millet was noticed with the application of 100 % RDF through broadcasting [4]. In pearl millet, Ritu and Archana (2015) [19] found that highest B:C ratio (2.09) was noticed with the combined application of 2.5 t FYM ha⁻¹ + 1.0 t vermicompost ha⁻¹ followed by the application of 7.5 t FYM ha⁻¹ (2.00) at Pearl millet Research Farm, Dhule, Maharashtra. Kiran Kumar *et al.* (2017a) [5] conducted an experiment on sandy soil at Agricultural College Farm, Bapatla and found that the maximum gross returns (Rs. 28675), net returns (Rs. 18209 ha⁻¹) and returns per rupee investment (1.73) of finger millet was recorded with application of 50% Recommended dose of inorganic phosphorus + FYM 7.5 t ha⁻¹ + PSB @ 5.0 kg ha⁻¹.

Application of review: It can be summarized from the above review that grow the parameters, yield attributes; yield, quality parameters and nutrient uptake of rice as well as ragi were superior with the combined application of inorganic fertilizers along with any organic manure.

Review Category: Cropping system

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Study area / Sample Collection: Agricultural College Farm, Bapatla (Nutrient Management)

Cultivar / Variety / Breed name: *Eluesine coracana*. L. - Sri Chaitanya (VR -847)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number:

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