The Andhra Agric. J 70 (4): 431-436, 2023
doi :10.61657/aaj.2023.64

Growth, Yield Attributes and Yield as Influenced by Crop Establishment and Nutrient Management in Fingermillet (*Eleusine coracana* L.)

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ABSTRACT

A field experiment was conducted on method of crop establishment and nutrient management in fingermillet during *Rabi*, 2022-23 at Agricultural College Farm, Naira. The soil was sandy loam having pH 6.24, low in organic carbon (0.62), low in nitrogen (265 kg ha^{-1}), medium in available phosphorus (40.5 kg ha^{-1}) and high in available potassium (388 kg ha^{-1}). The experiment was laid out in a split plot design with three main plot treatments and five sub plot treatments replicated thrice. Results revealed that, among methods of sowing, maximum plant height (80.2 cm), number of tillers $plant^{-1}$ (5.9), number of grains per $head^{-1}$ (1508), ear head weight (7.1g), grain yield (2496 kg ha^{-1}) and straw yield (3542 kg ha^{-1}) was noticed in SRI method of planting (M_1). In case of nutrient management treatments, 75% RDF (45-30-22.5 NPK kg ha^{-1}) + poultry manure @ 3.0 t ha^{-1} resulted in significantly higher number of grains per $head^{-1}$ (1508), ear head weight (7.3g), grain yield (2590 kg ha^{-1}) and straw yield (3591 kg ha^{-1}).

Key words: *Crop establishment, Fingermillet grain yield and Nutrient Management.*

Finger millet (*Eleusine coracana* L.) is a most important millet crop extensively grown in various regions of India and Africa. It is considered as a staple food for a low-income group. The grain of finger millet has outstanding nutritional properties *viz*., calcium (8.3%), iron (0.017%), dietary fibres and polyphenols (0.3 to 3%). Vitamins A, B and phosphorous are also present in smaller quantities. In India finger millet (*Eleuine coracana L.*) occupies an area of 0.93 Million hectares with a production of 1.58 Million tonnes (GOI, 2021) and it has the pride of place in having the highest productivity among small millets. Finger millet land races are potential source of nutrients. Finger millet has been identified as one of the future smart food crops by FAO (Li and Siddique, 2018) because of its nutrient dense and climate-resilient features moreover it can produce a reasonable yield at a relatively low cost of cultivation (Gupta *et al*., 2017).

Method of establishment plays an important role to fully exploit all available resources for growth as it provides optimum growing conditions. The method of sowing is an important agronomic factor affecting the productivity of the crop. The proper sowing method is an important non-monetary practice in crop production, which affects crop growth, yield and quality to a greater extent. Establishment techniques, plant density, nutrient and water management etc., need to be standardized to achieve the reported yield potential of finger millet under different durations in various environments. Method of establishment is one of the cultural practices, which influences the crop through its effect on growth and development (Gopi *et al*., 2006).

Nutrient management should be done targeting production sustainability and integrated nutrient management (INM) is the most suitable option in this regard is a limitation in the horizontal expansion of area under plough. Management of nutrients has a crucial role to play in sustainable agriculture. Recent research developments in research in precision agriculture suggests soil test crop response (STCR) approach in different crops for targeting nutrient inputs and yield output. On the basis of published work on nutrient management of finger millet an initiative has been taken to bring information together on the options and methods of nutrient management under different situations to achieve production sustainability. The major objectives of INM are enhancement of crop

productivity by providing essential nutrients and increase in resource use efficiency. The balanced use of fertilizers not only increases finger millet yields but also help the volume of nutrients required for crop growth and productivity which is frequently limited under such conditions (Nath *et al*., 2021). Farmers can attain higher yields and sustainability both in the short and medium term by adopting good crop and nutrient management practices (Singh *et al*., 2017). Keeping all these points in view, the present investigation was undertaken to find out the best methods of crop establishment and nutrient management to enhance yield in finger millet.

MATERIALS AND METHODS

A field experiment was conducted at Agriculture College Farm, Naira of Acharya N. G. Ranga Agricultural University located at North Coastal Zone of Andhra Pradesh *Rabi,* 2022-23. The soil was sandy loam having pH 6.24, low in organic carbon (0.62), low in available nitrogen (265 kg ha^{-1}), medium in available phosphorus (40.5 kg ha^{-1}) and high in available potassium (388 kg ha^{-1}). The weather conditions during the crop growth period were normal. The experiment was laid out in a split plot design with three main plots *viz*., M_1: SRI method of planting (45cm x 45cm, 18days seedling 2 $hill^{-1}$), M_2: transplanting method (20 cm x 15 cm, 25 days seedling 3 $hill^{-1}$), M_3: direct method of sowing (dibbling at spacing 20 x15cm) and five sub plots *viz*., S_1: 100% RDF (60-40-30 NPK kg ha^{-1}), S_2 : 150% RDF (90-60-45 NPK kg ha^{-1}), S_3: STCR based nutrient application (45-25-20 NPK kg ha^{-1}), S_4: 75% RDF (45-30-22.5 NPK kg ha^{-1}) + poultry manure @ 3.0 t ha^{-1}, S_5:75% RDF (45-30-22.5 NPK kg ha^{-1}) + ghanajeevamrutham @ 500 kg ha^{-1}. The cultivar Sri Chaithanya was used for this experiment. poultry manure and ghanajeevamrutham was incorporated in to soil. One third of the recommended dose of nitrogen, total dose of phosphorus and one third of recommended dose of potassium was applied at the time of sowing as basal dose as per the treatments. the remaining nitrogen and potassium were applied at panicle initiation and flowering stage. Nitrogen, phosphorus and potassium were applied in the form of urea, single super phosphate (SSP) and murate of potash (MOP) respectively. The data was recorded on plant height, dry matter production and number of tillers $plant^{-1}$, number of panicles m^{-2}, number of grains per $head^{-1}$, panicles head weight (g), grain yield (kg ha^{-1}) and straw yield (kg ha^{-1}).

RESULTS AND DISCUSSION

Growth parameters

The maximum plant height (80.2 cm) and number of tillers $plant^{-1}$ (5.9) were recorded in SRI method of planting (M_1) where as the highest drymatter production (5470 kg ha^{-1}) was recorded in transplanting method (M_2). Among the nutrient management treatments, the highest plant hight (83.0 cm), number of tillers $plant^{-1}$(6.1) and drymatter production (5605 kg ha^{-1}), were recorded in 150% RDF (S_2) followed by 75% RDF + poultry manure @ 3 t ha^{-1} (S_4) (Table 1). Interaction effect between methods of sowing and nutrient management treatments at harvest, the maximum plant height was noticed with 150% RDF (S_2) in SRI method of planting (M_1). However, it was on a par with 75% RDF + poultry manure @ 3 t ha^{-1} (S_4) in transplanting method (M_2). Significantly the highest dry matter production (kg ha^{-1}) was observed with 150% RDF (S_2) which was followed by 75% RDF + poultry manure @ 3 t ha^{-1} (S_4) in transplanting method (M_2) (Table 2).

Maximum plant height and number of tillers $plant^{-1}$ was in SRI method of planting (M_1) could be attributed to the fact that the increase in plant height is always advantageous from point of light interception. More light interception there by resulted in increased dry matter production per unit area. The present findings are in conformity with the result reported by Narayan Hebbal *et al*.,(2018), Triveni *et al*.,(2018) in fingermillet. Highest plant height,dry matter production and number of tillers $plant^{-1}$ with150% RDF (S_2) is due to the higher nitrogen availability could be the reason for increased plant height. Higher levels of nitrogen might have accelerated the synthesis of more chlorophyll and amino acids and stimulated cellular activity which is useful for the process of cell division, coupled with cell enlargement resulting in vertical increase in the culm length and production of large number of tillers with cell higher stature and more leaf area which ultimately leads to enhanced dry matter production. These findings were in agreement with Navya jothi *et al*.,(2016) and Maitra *et al*.,(2020).

Yield attributes

Among methods of sowing, yield attributes *viz.*

number of grains per head^{-1} (1508) and ear head weight (7.1g) were significantly higher in SRI method of planting (M_1) where as numbers of ears m^{-2} was found to be maximum in transplanting method (M_2). Lowest numbers of ears m^{-2} (87.2), number of grains ear head^{-1} (1438) and ear head weight (6.7g) was found in direct method of sowing (M_3). In case of nutrient management treatments,75% RDF (45-30-22.5 NPK kg ha^{-1}) + Poultry manure @ 3.0 t ha^{-1} resulted in significantly higher number of grains per head^{-1} (1508), ear head weight (7.3g), where as maximum numbers of ears m^{-2} (93.4) was noticed in 150% RDF (S_2). Lowest numbers of ears m^{-2} (84.2), number of grains ear head^{-1} (1440) and ear head weight (6.3g) was observed in STCR based nutrient application (S_3) (Table 1). Interaction effect between methods of sowing and nutrient management treatments, significantly the highest number of grains ear head^{-1} and ear head weight (g) were recorded with 75% RDF + Poultry manure @ 3.0 t ha^{-1} (S_4) and with 150% RDF (S_2) with on parity in SRI method of planting (M_1). Significantly inferior values for number of grains ear head^{-1} and ear head weight (g) of finger millet were observed with STCR based nutrient application (S_3) in direct method of sowing (M_3) (Table 2).

Number of grains ear head^{-1} and ear head weight of fingermillet was found to be maximum in SRI method of planting (M_1), it might be provided better aeration, more spacing and less competition, which enabled the plants to grow vigorously. Prolonged and adequate supply of nutrients coinciding with the critical crop growth stages reflecting in improved growth and yield attributes. These findings are in conformity with the results reported by Ananda *et al*, (2017). Similar views were also expressed by Sakadazo *et al*.,(2019) and Jayadeva *et al*.,(2008). Number of grains ear head^{-1} and ear head weight was significantly higher in 75% RDF + Poultry manure @ 3 t ha^{-1} (S_4) is might be due to higher macro and micro nutrient content of the poultry manure which enables continuous slow and steady release of nutrients might have helped in better tillering, finger length, grain filling, number of grains earhead^{-1}. Similar findings were observed with Bhavani Reddy *et al.,*(2022) and Sanju choudary *et al*.,(2021).

Yield:

Among methods of sowing, significantly higher grain yield (2496 kg ha^{-1}) and straw yield (3542 kg ha^{-1}) of fingermillet was recorded in SRI method of planting (M_1). Significantly lower grain yield (2326 kg ha^{-1}) and straw yield (3304 kg ha^{-1}) were recorded in direct method of sowing (M_3). In case of nutrient management treatments, significantly the highest grain yield (2590 kg ha^{-1}) and straw yield (3591 kg ha^{-1}) of fingermillet was recorded with application of 75% RDF + Poultry manure @ 3 t ha^{-1} (S_4). Significantly lower grain yield (2236 kg ha^{-1}) and straw yield (3231 kg ha^{-1}) of fingermillet was recorded in STCR based nutrient application (S_3) (Table 1). Interaction effect between methods of sowing and nutrient management techniques, significantly the highest grain yield and straw yield was recorded with application of 75% RDF + Poultry manure @ 3 t ha^{-1}) (S_4) in SRI method of planting (M_1) followed by 150% RDF (S_2) in SRI method of planting (M_1). Significantly inferior values for grain yield and straw yield was recorded in STCR based nutrient application (S_3) in direct method of sowing (M_3). The increase in the percentage of grain yield was 27.33% in M_1S_4 over M_3S_3 (Table 2).

Significantly higher grain and straw yield was noticed in SRI method of planting (M_1), this may have been attributed to more space between plants that resulted in higher number of tillers, panicle number and more grains from the wider spacing in transplanting compared to the closer spacing and scattered stands in broadcasting establishment method. The adverse effect of competition between plants associated with closer spacing and scattered stand may have been significant positively affecting yield in broadcasting establishment method. These findings are in conformity with the results reported by Gavit *et al*.,(2017) and Bekele *et al*.,(2016). Significantly higher grain and straw yield was noticed in 75% RDF + Poultry manure @ 3 t ha^{-1} (S_4), it might be due to the synergistic effect of integration of organic and inorganic sources along with biofertilizers resulted in better nutrient uptake, which accelerated the photosynthetic rate, adequate biomass production that reflected on grain and stover yield. The results were also obtained by Barad *et al.,*(2017). Poultry manure has efficient source of NPK along with beneficial micronutrients enhance plant activity which result better plant stand, more dry matter and more grain filling ultimately resulted more yield. Similar findings were also reported by Pallavi *et al*.,(2016).

Table 1 : Growth parameters, yield attributes and yield as influenced by methods of crop establishment and nutrient management in finger millet.

Treatments details	Plant height (cm)	Number of tillers plant^{-1}	Drymatter production (kg ha^{-1})	Number of ear m^{-2}	Number of grains ear head^{-1}	Earhead weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Main plots: Methods of crop establishment								
M_1:SRI method (45cmx45cm, 18days seedlings 2 hill^{-2})	80.2	5.9	5435	88.7	1508	7.1	2496	3542
M_2: Transplanting (20cm x 15cm, 25days seedlings 3hill^{-3}	78.8	5.4	5470	91.6	1479	6.9	2422	3422
M_3: Direct sowing (Dibbling at spacing 20cm x 15cm)	77.2	4.7	5309	87.2	1438	6.7	2326	3304
SEm(±)	0.53	0.02	14.94	0.27	8.5	0.04	17.59	10.40
CD(P=0.05)	0.85	0.10	58.78	1.15	28.80	0.17	69.06	40.18
CV%	7.6	5.8	6.1	7.9	7.3	7.2	9.1	8.6
Subplots: Nutrient management techniques								
S_1: 100% RDF (60-40-30 NPK kg ha^{-1})	78.7	5.3	5277	87.2	1464	6.6	2365	3363
S_2: 150% RDF (90-60-45 NPK kg ha^{-1})	83.0	6.1	5605	93.4	1482	7.2	2510	3524
S_3: STCR based nutrient application (40-25-20 NPK kg ha^{-1})	72.4	4.5	5165	84.2	1440	6.3	2236	3231
S_4: 75% RDF (45-30-22.5NPK kg ha^{-1}) + Poultry manure @ 3.0 t ha^{-1})	80.8	5.7	5520	92.1	1508	7.3	2590	3591
S_5: 75% RDF (45-30-22.5NPK kgha-1)+ Ghanajeevamrutham@500 kg ha^{-1})	80.6	5.6	5457	88.8	1480	7.1	2375	3391
SEm(±)	0.93	0.09	13.75	0.63	8.73	0.09	25.08	24.26
CD(P=0.05)	2.81	0.28	40.15	1.12	17.50	0.01	75.10	67.26
CV(%)	7.9	9.8	6.2	8.8	7.6	6.8	9.6	8.2
Interaction								
CD(P=0.05)	**S**	**NS**	**S**	**S**	**S**	**S**	**S**	**S**

Table 2:Interaction effect of methods of crop establishment and nutrient management on growth parameters, yield attributes, grain and straw yield of fingermillet.

Treatments	Plant height (cm)	Dry matter production (kg ha^{-1})	Number of ears m^{-2}	Number of grains ear head^{-1}	Ear head weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
M_1S_1	82	5297	87.3	1441	6.9	2440	3405
M_1S_2	84	5581	91	1560	7.3	2586	3672
M_1S_3	75.2	5222	85	1455	6.5	2323	3316
M_1S_4	80.2	5586	91	1591	7.5	2759	3773
M_1S_5	79.6	5513	89.3	1493	7.2	2375	3452
M_2S_1	82.4	5304	89.6	1532	6.6	2411	3470
M_2S_2	82.2	5723	97.6	1458	7.2	2495	3501
M_2S_3	70.5	5222	87.6	1455	6.3	2212	3308
M_2S_4	82.5	5612	83.6	1474	7.3	2519	3552
M_2S_5	81.4	5512	89.3	1476	7.2	2471	3336
M_3S_1	71.9	5230	84.6	1421	6.3	2244	3214
M_3S_2	82.1	5511	91.6	1427	7.1	2449	3400
M_3S_3	71.5	5097	80	1411	6.2	2167	3071
M_3S_4	79.6	5364	91.6	1459	7.1	2493	3450
M_3S_5	80.9	5344	88	1473	7.01	2280	3385
SEm (±)	1.65	25.08	1.1	14.44	0.11	43.45	42.29
CD(P=0.05)	1.53	73.12	3.5	31.14	0.17	155.4	125.56

CONCLUSION

The present investigation of the study concluded that, SRI method of planting with application of 75% RDF + Poultry manure @ 3 t ha^{-1}, realizing the higher number of grains per head^{-1} (1508), ear head weight (7.1g), grain yield (2496 kg ha^{-1}) and straw yield (3542 kg ha^{-1} in fingermillet.

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Received on 03.09.2023 and Accepted on 05.11.2023