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Growth and Yield of Finger Millet as Influenced by Planting Geometry, Age of Seedlings and Manure Levels

Shiva Kumar H.D.[1*], Kalyana Murthy K.N.[2], Anand M.R.[3], Boraiah B.[4], Nanjareddy Y.A.[5] and Prakasha H.C.[6]

[1]Ph.D Research Scholar, Department of Agronomy,
College of Agriculture, University of Agricultural Sciences (UAS), GKVK, Bengaluru (Karnataka), India.
[2]Professor and University Head (Agronomy), Department of Agronomy,
UAS, GKVK, Bengaluru (Karnataka), India.
[3]Associate Professor (Agronomy), AINP on Arid Legumes, UAS, GKVK, Bengaluru (Karnataka), India.
[4]Senior Farm Superintendent, ZARS, UAS, GKVK, Bengaluru (Karnataka), India.
[5]Professor of Crop physiology and Dean, College of Horticulture,
Munirabad,University of Horticultural Sciences, Bagalkot (Karnataka), India.
[6]Dean (Post Graduate Studies), UAS, GKVK, Bengaluru (Karnataka), India.

(Corresponding author: Shiva Kumar H.D.)*
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ABSTRACT: A field experiment was undertaken during *Rabi* 2017 and 2018 to assess the effect of planting geometry, method of establishment and nutrient sources on growth and yield of finger milletat ZARS, UAS, GKVK, Bengaluru located in eastern dry zone of Karnataka. Among the planting geometry significantly higher growth parameters *viz.*, plant height (82.59 cm) and leaf area index (4.06) were recorded in 30 cm × 10 cm, the total dry matter production (53.30 g hill^{-1}), number of productive tillers hill^{-1} (10.38) and grain yield hill^{-1} (37.25 g) were recorded in 30 cm × 30 cm. Whereas, higher grain yield (4336 kg ha^{-1}) was recorded in 25 cm × 25 cm and higher straw yield (8687 kg ha^{-1}) was recorded with 30 cm × 10 cm and it was on par with 25 cm × 25 cm (7915 kg ha^{-1}). Significantly higher growth parameters *viz.*, plant height (79.73 cm), leaf area index (2.73), total dry matter production (52.06 g hill^{-1}), number of productive tillers hill^{-1} (8.21), grain yield hill^{-1} (26.76 g) and grain yield (4316 kg ha^{-1}) were recorded with 15 days old seedlings. Significantly higher growth parameters *viz.*, plant height (78.75cm), leaf area index (2.68), total dry matter production (51.39 g hill^{-1}), number of productive tiller hill^{-1} (8.10), ear length (7.15 cm), grain yield hill^{-1} (26.35 g) and grain (4250 kg ha^{-1}) and straw yield (7865kg ha^{-1}) were recorded with application of 100% RDN through FYM + 25% through inorganic fertilizers.

Keywords: Finger Millet, SRI, Plant Geometry, Age of Seedlings, Manure Levels.

INTRODUCTION

FINGER MILLET (*Eleusine coracana* L.) is a staple food for working class and also an ideal food for people suffering from diabetes, cardiac and blood pressure issues since it contains higher dietary fiber. It is an annual plant belonging to family Poaceae widely grown as millet in the arid areas of Africa and Asia. It is an important cereal crop occupying the highest area under cultivation in Karnataka under rainfed conditions of *Alfisols.* Finger millet plays an important role in both dietary needs and income of many rural households. In Karnataka, the average productivity of finger millet is 1800 kg ha^{-1} but the potential yield is more than 4000 kgha^{-1} as recorded under on station experiments (AICSMIP, 2013).

One of the problems faced by the farmers in the production of finger millet is the plant geometry, age of seedlings and manure level. Optimum spacing with young seedlings generally ensures sufficient time for root development and vegetative growth for optimum harvesting of available soil nutrient and solar energy. Plant geometry can also influence weed growth in the crop. In square or wider spacing method with the reduced seed rate, the inter-cultivation can be imposed in both the directions to manage the weeds. This technology needs the scientific validation through intensive and in depth study to enhance the productivity. Hence, the present investigation is undertaken to evaluate the effect of plant geometry, age of seedlings and manure levels on the growth and yield of finger millet at ZARS, GKVK, Bengaluru.

MATERIAL AND METHODS

The experiment was conducted during *Rabi*-2017 and *Rabi*-2018 at ZARS, GKVK, UAS, Bengaluru. The center is situated in the eastern dry zone of Karnataka at 12^{o} 58 North latitude and 77^{o} 35 East longitude with an altitude of 930 m above the mean sea level. The soils of GKVK farm belong to Vijayapura series and are classified as *Oxichaplustalf.* Soils are reddish brown lateritederived from gneiss under subtropical semiarid

climate. The soil of experimental site was red sandy clay loam in texture.

The study was undertaken in double split plot design with three factors which are replicated thrice. The first factor was planting geometry (S_1: 25 cm × 25 cm, S_2: 30 cm × 30 cm, S_3: 30 cm × 10 cm), second factor was age of seedlings(A_1: 12 days, A_2: 15 days, A_3: 18 days) and the third factor was manure levels (M_1: 100% Recommended Dose of Nitrogen (RDN) through Farm Yard Manure (FYM) + 25% through inorganic fertilizers, M_2: 75% RDN through FYM + 25% through inorganic fertilizers).

The observations on growth parameters like plant height, number of tillers per hill, leaf area index and dry matter production were recorded at 30, 60, 90 DAS and at harvest. Grain and straw yield was calculated based on the yield obtained from each net plot and converted to kg ha^{-1}. The data was statistically analyzed by following the method of Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Plant growth is dependent on the rate of accumulation of dry matter and the dry matter accumulation may reflect on the economic yield. The fact is that vegetative part of the plants serve as source, whereas, grains are the sink. The need for the increased crop productivity is an outcome of a series of intermediate interaction of various biological events involving biochemical, physiological and morphological change which takes place during its development in accordance with the supply of light, water, temperature and nutrients.

Growth parameters of finger millet. Crop geometry, age of seedling and manure levels has significantly influenced the growth parameters of finger millet (Table 1). With respect to plant geometry, 30 cm × 10 cm has significantly influenced the plant height (82.59 cm) and leaf area index (4.06), whereas, total dry matter production $hill^{-1}$ (53.30 g) was influenced by 30 cm × 30 cm at 90 DAS. Significantly lower growth parameters like plant height (70.74 cm) and LAI (1.74) were recorded in 30 cm × 30 cm and lower total dry matter production $hill^{-1}$ (45.95 g $hill^{-1}$) was recorded in 30 cm × 10 cm.

Higher growth parameters in 30 cm × 10 cm is due to higher plant density brings morphological changes such as increase in plant height, which denotes the competition between plants for light, moisture and nutrients, favoring light interception and increases the dry matter production per unit area. Wider spacing of finger millet also recorded higher growth parameters $hill^{-1}$ due to availability of more space and nutrients to particular hill, which has resulted in lesser competition for growth resources, ultimately resulted in the higher growth parameters per hill. These findings are in line with Narayan and Ramachandrappa (2017); Prakasha, *et al.* (2018).

Different aged seedlings have profoundly influenced the growth parameters of finger millet at different crop growth stages. Significantly higher growth parameters *viz.* plant height (79.73 cm), leaf area Index (2.73) and total dry matter production (52.06 g $hill^{-1}$) were recorded in 15 days old seedling. Higher growth parameters were attributed to reduced transplanting shock and better establishment of the seedlings. Whereas, significantly lower growth parameters of finger millet [plant height (74.72cm), LAI(2.53),total dry matter production (48.83 g$hill^{-1}$)] were noticed in 12 days old seedlings. These findings are in line with (AICSMIP, 2011); Anitha, *et al.*, (2016).

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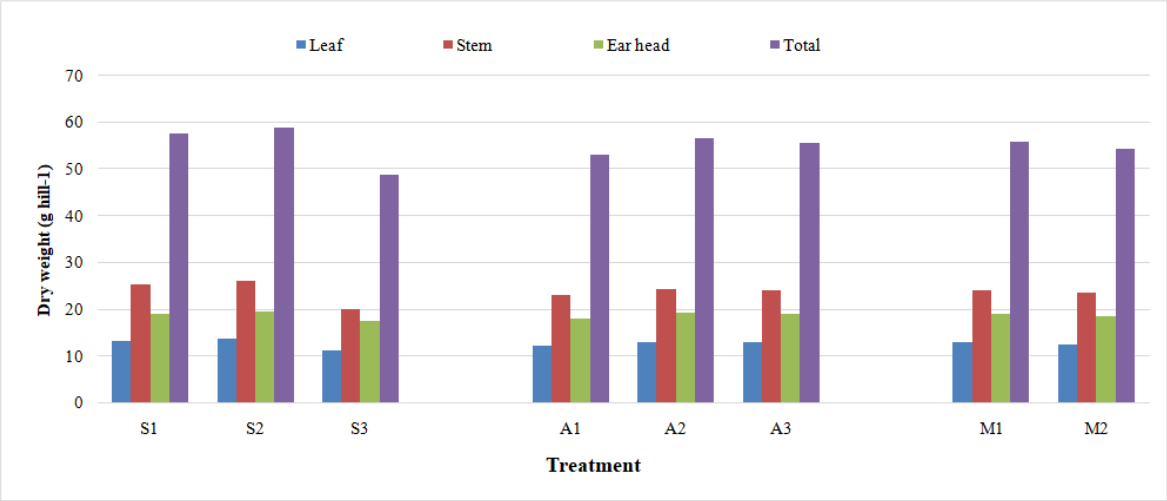


Legend:
Planting geometry: **S_1:** 25 cm × 25 cm **S_2:** 30 cm × 30 cm **S_3:** 30 cm × 10 cm
Age of seedlings: **A_1:** 12 days **A_2:** 15 days **A_3:** 18 days
Manure levels: **M_1:**100% RDN through FYM + 25% through Inorganic fertilizers
M_2: 75% RDN through FYM + 25% through Inorganic fertilizers.

Fig 1. Dry matter accumulation and distribution at harvest as influenced by planting geometry, age of seedlings and manure levels in finger millet.

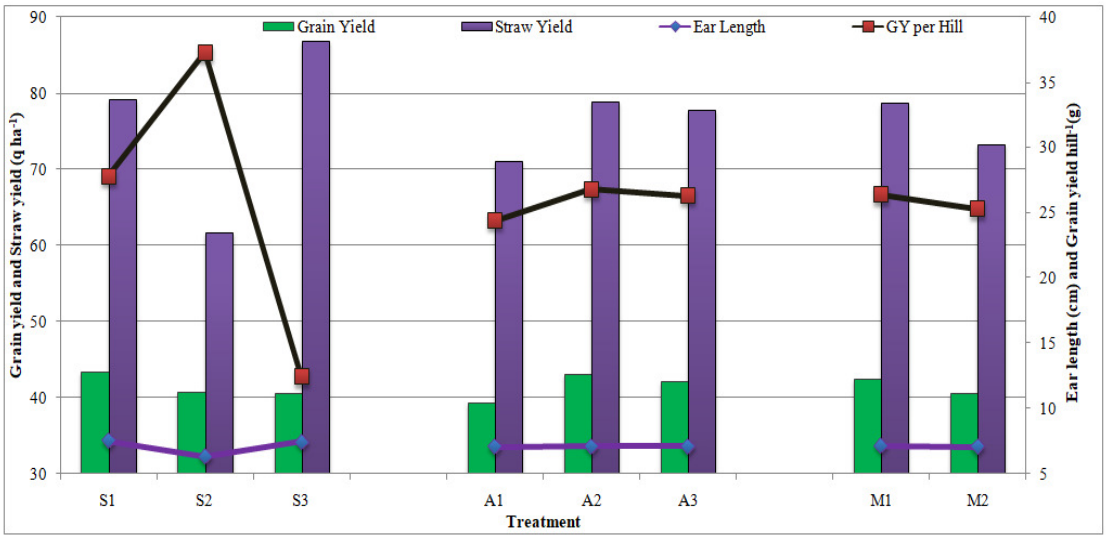
Different manure levels have significantly influenced the growth parameters of finger millet at different crop growth stages. Significantly higher growth parameters *viz.,* plant height (78.75 cm), leaf area index (2.68) and total dry matter production (51.39g hill^{-1}) were recorded due to the application of 100% RDN through FYM + 25% through inorganic fertilizers (Fig. 1). Higher growth parameters were attributed to nutrient management that helped to supply the nutrients based on the crop demand and organic matter helps in reducing the bulk density and improve the establishment and growth of plants. Whereas, significantly lower plant height (76.48 cm), leaf area index (2.61) and total dry matter production (50.00g hill^{-1}) were noticed in 75% RDN through FYM + 25% through inorganic fertilizers, mainly due to lower availability of nutrients. These findings are in line with Vijayamahantesh (2012); Pavan Kumar (2014). There was a significant interaction was observed between spacing and age of seedlings in the growth parameters.

Yield parameters and yield of finger millet. Crop geometry, age of seedlings and manure levelhave significantly influenced the yield parameters of finger millet (Table 2). With respect to plant geometry, the 30 cm × 30 cmhas significantly influenced the number productive tillers hill^{-1} (10.38) as compared to 25 cm × 25cm and 30 cm × 10 cm. Among different age of seedlings, 15 days old seedling recorded significantly higher number of productive tillers hill^{-1}(8.21) compared to 12 and 18 days old seedlings (7.08 and 7.63, respectively). With respect to manure levels, application of 100% RDN through FYM + 25% through inorganic fertilizers recorded significantly higher number of productive tillers hill^{-1} (8.10) compared to 75% RDN through FYM + 25% through inorganic fertilizers (7.18). Effect of age of seedlings on earhead length found to be non-significant. Whereas, application of 100% RDN through FYM + 25% through inorganic fertilizersrecorded higher earhead length (7.15cm) compared to application of 75% RDN through FYM + 25% through inorganic fertilizers (7.04cm earhead length). Test weight of finger millet did not differ significantly due to crop geometry, age of seedlings and manure level.

Among different planting geometry (Table 3), significantly higher grain yield (4336 kg ha^{-1}) was recorded with 25 cm × 25 cm and higher straw yield (8687 kg ha^{-1}) was recorded with 30 cm × 10 cm and it was on par with 25 cm × 25 cm (7915 kg ha^{-1}).

Significant difference in grain yield was observed with the age of seedlings which was on par with 15 days (4316 kg ha^{-1}) and 18 days old seedlings (4223 kg ha^{-1}) (Fig. 2). These findings are in line with AICSMIP, (2011). Higher dry matter production per unit area which ultimately resulted in the higher grain yield. The higher grain yield was obtained was mainly due to higher number of productive tillers.

Among manure levels, significantly higher grain yield (4250 kg ha^{-1}) was recorded with application of 100% RDN through FYM + 25% through inorganic fertilizers compared to application of 75% RDN through FYM + 25% through inorganic fertilizers. Similar results were reported by Saravanane *et al.* (2011); Veeresh Hatti (2016). None of the interaction effects were found to be significant with respect to yield parameters and yield of finger millet.



Legend:
Planting geometry: S_1: 25 cm × 25 cm **S_2:** 30 cm × 30 cm **S_3:** 30 cm × 10 cm
Age of seedlings: **A_1:** 12 days **A_2:** 15 days **A_3:** 18 days
Manure levels: M_1:100% RDN through FYM + 25% through Inorganic fertilizers
M_2: 75% RDN through FYM + 25% through Inorganic fertilizers

Fig. 2. Ear length, grain yield per plant, grain and straw yield of finger millet as influenced by planting geometry, age of seedlings and manure levels.

Table 1: Growth parameters of finger millet as influenced by planting geometry, age of seedlings and manure levels at 90 DAS.

Treatments	Plant height (cm)	Leaf area Index	Total dry matter production (g hill^{-1})
Planting geometry			
S_1: 25 cm × 25 cm	79.52	2.14	53.07
S_2: 30 cm × 30 cm	70.74	1.74	53.30
S_3: 30 cm × 10 cm	82.59	4.06	45.71
S.Em±	0.64	0.03	0.84
CD @ 5%	2.53	0.12	3.30
Age of seedlings			
A_1: 12 days.	74.72	2.53	48.83
A_2: 15 days.	79.73	2.73	52.06
A_3: 18 days.	78.40	2.68	51.19
S.Em±	0.08	0.00	0.05
CD @ 5%	0.25	0.01	0.15
Manure levels			
M_1:100% RDN through FYM + 25% through Inorganic fertilizers	78.75	2.68	51.39
M_2:75% RDN through FYM + 25% through Inorganic fertilizers	76.48	2.61	50.00
S.Em±	0.21	0.01	0.16
CD @ 5%	0.63	0.03	0.46
Planting geometry × Age of seedlings			
S.Em±	0.17	0.01	0.10
CD @ 5%	NS	NS	NS
Planting geometry × Manure levels			
S.Em±	0.37	0.02	0.27
CD @ 5%	NS	NS	NS
Age of seedlings × Manure levels			
S.Em±	0.37	0.02	0.27
CD @ 5%	NS	NS	NS
Planting geometry × Age of seedlings × Manure levels			
S.Em±	0.63	0.03	0.47
CD @ 5%	NS	NS	NS

NS-Non-significant, DAS: Days after sowing

Table 2: Yield parameters as influenced by planting geometry, age of seedlings and manure levels in finger millet.

Treatments	Productive tillers hill^{-1}	Ear length (cm)	Grain yield hill^{-1} (g)
Planting geometry			
S_1: 25 cm × 25 cm	8.51	7.52	27.75
S_2: 30 cm × 30 cm	10.38	6.31	37.25
S_3: 30 cm × 10 cm	4.03	7.46	12.41
S.Em±	0.09	0.05	0.31
CD @ 5%	0.34	0.18	1.24
Age of seedlings.			
A_1: 12 days.	7.08	7.05	24.38
A_2: 15 days.	8.21	7.11	26.76
A_3: 18 days.	7.63	7.12	26.28
S.Em±	0.11	0.03	0.19
CD @ 5%	0.32	NS	0.59
Manure levels			
M_1:100% RDN through FYM + 25% through Inorganic fertilizers.	8.10	7.15	26.35
M_2:75% RDN through FYM +25% through Inorganic fertilizers.	7.18	7.04	25.26
S.Em±	0.10	0.03	0.30
CD @ 5%	0.28	0.10	0.88
Planting geometry × Age of seedlings.			
S.Em±	0.22	0.06	0.41
CD @ 5%	NS	NS	NS
Planting geometry × Manure levels			
S.Em±	0.16	0.06	0.51
CD @ 5%	NS	NS	NS
Age of seedlings × Manure levels			
S.Em±	0.16	0.06	0.51
CD @ 5%	NS	NS	NS
Planting geometry × Age of seedlings × Manure levels			
S.Em±	0.28	0.10	0.89
CD @ 5%	NS	NS	NS

NS-Non-significant, DAS: Days after sowing

Table 3: Grain yield, straw yield and harvest index as influenced by planting geometry, age of seedling and manure level in finger millet.

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index
Planting geometry			
S_1: 25 cm × 25 cm	4336	7915	0.355
S_2: 30 cm × 30 cm	4080	6166	0.399
S_3: 30 cm × 10 cm	4056	8687	0.319
S.Em±	41	262	0.008
CD @ 5%	159	1027	0.033
Age of seedlings.			
A_1: 12 days.	3933	7096	0.360
A_2: 15 days.	4316	7892	0.357
A_3: 18 days.	4223	7781	0.356
S.Em±	31	183	0.005
CD @ 5%	96	563	NS
Manure levels			
M_1:100% RDN through FYM + 25% through Inorganic fertilizers.	4250	7865	0.354
M_2:75% RDN through FYM + 25% through Inorganic fertilizers.	4065	7314	0.361
S.Em±	44	47	0.003
CD @ 5%	131	140	NS
Planting geometry × Age of seedlings			
S.Em±	66	387	0.012
CD @ 5%	NS	NS	NS
Planting geometry × Manure levels			
S.Em±	77	82	0.006
CD @ 5%	NS	NS	NS
Age of seedlings × Manure levels			
S.Em±	77	82	0.006
CD @ 5%	NS	NS	NS
Planting geometry × Age of seedlings × Manure levels			
S.Em±	133	141	0.010
CD @ 5%	NS	NS	NS

NS-Non-significant, DAS: Days after sowing

CONCLUSION

From this study, it can be concluded that planting of 15 days old seedlings with a spacing of 25 cm × 25 cm with the application of 100% RDN through FYM + 25% through inorganic fertilizers recorded significantly higher growth and yield components, grain and straw yield.

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Conflicts of Interest. None.

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