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Effect of Method of Establishment, Planting Geometry and Nutrient Source on Growth and Yield of Finger Millet (*Eleusine coracana* L.)

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ABSTRACT

Field experiment was conducted during *Kharif*-2015 at AICRP on dryland agriculture, GKVK, UAS, Bengaluru to assess the effect of planting geometry, method of establishment and nutrient sources on growth and yield of finger millet. Significantly higher growth parameters *viz*., number of tillers hill^{-1} (11.28), leaf area (1961.59 cm^2), total dry matter production hill^{-1} (41.17 g hill^{-1}), number of productive tillers hill^{-1} (10.84), grain (3240 kg ha^{-1}) and straw (5592 kg ha^{-1}) yield were recorded in transplanting method. The wider spacing (45 x 30cm and 30 x 30 cm) has recorded higher number of tillers (14.31 and 10.81, respectively), leaf area (2280.16 and 1906. 64 cm^2, respectively), total dry matter production (41.43 and 39.16 g hill^{-1}, respectively) and number of productive tillers hill^{-1} (14.19 and 9.81, respectively). Whereas, grain and straw yield was non-significant with respect to planting geometry. Significantly higher growth parameters *viz.,* plant height (77.5cm), number of tillers hill^{-1} (11.33), leaf area (2005.09 cm^2), SPAD meter observation (43.30), total dry matter production (40.37 g hill^{-1}), number of productive tiller hill^{-1} (10.75) grain (3051 kg ha^{-1}) and straw yield (5381 kg ha^{-1}) were recorded with the application of recommended dose of FYM 7.5 t ha^{-1} + RDF (50:40:37.5 kg N, P_2O_5 and K_2O ha^{-1}).

Keywords: Methods of establishment, planting geometry, nutrient source, growth, yield parameters

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 one of the important cereal which occupies the highest area under cultivation among the small millets and a predominant food crop of Southern Karnataka, mainly grown under rainfed conditions. In India it is grown in an area of 1.19 m ha with a production of 1.98 m t with an average productivity of 1661 kg ha^{-1}. Karnataka is the largest producer of finger millet grown in an area of 1.05 m ha with a production of 1.57 m t with an average productivity of 1889 kg ha^{-1} (Anon., 2015).

For realizing higher yield of finger millet there is a need for the adoption of new high yielding, fertilizer responsive varieties with proper rain water conservation and nutrient management practices. The productivity is low due to late transplanting, faulty methods of cultivation and little or no use of fertilizers. The secret of boosting its yields mainly lies with suitable planting method with proper nutrient management practices. Hence this field study was undertaken.

MATERIAL AND METHODS

The experiment was conducted during *Kharif*-2015 at AICRP on dryland agriculture, 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 laterite derived from gneiss under subtropical semiarid climate. The soil of experimental site was red sandy clay loam in texture.

The study was undertaken in factorial RCBD with three factors which are replicated thrice. The first factor was Method of establishment (M_1: Direct sowing, M_2: Transplanting) second factor was planting geometry (S_1: Recommended spacing (30 cm×10 cm),

S_2: 30 cm × 30 cm and S_3: 45 cm × 30 cm) and the third factor was nutrient source (N_1: Recommended dose of FYM 7.5 t ha^{-1} + RDF (50:40:37.5 kg N, P_2O_5 and K_2O ha^{-1}) and N_2: FYM on N equivalent basis + FYM 7.5 t ha^{-1}).

The observations on growth parameters like plant height, number of tillers per m^2, number of leaves $hill^{-1}$, leaf area $hill^{-1}$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

Methods of establishment, planting geometry and nutrient source have significantly influenced the growth parameters of finger millet (Table I). With respect to method of establishment, transplanting has significantly influenced the number of tillers $hill^{-1}$ (11.28), leaf area (1961.59 cm^2) and total dry matter production $hill^{-1}$ (41.17 g $hill^{-1}$) at 90 DAS. Whereas, direct sowing has recorded significantly lower growth parameters (number of tillers $hill^{-1}$ (10.26), leaf area (1928.35cm^2) and total dry matter production $hill^{-1}$ (37.95 g). Non-significant results were obtained with respect to plant height and SPAD meter reading. Higher growth parameters in transplanting method of establishment had an opportunity to get better moisture, nutrient supply and optimum growth conditions during nursery.

The higher plant height was recorded in the recommended spacing (80.0 cm during 90 DAS). Whereas, significantly lower plant height was recorded with the 45 x 30 cm and 30 x 30 cm spacing (72.3 and 76.4 cm, respectively). Higher plant density brings morphological changes such as increase in plant height, which denotes the competition between plants for light, moisture and nutrients, favouring light interception and increases the dry matter production per unit area. Wider spacing (45 x 30cm and 30 x 30 cm) has recorded higher number of tillers (14.31 and 10.81, respectively), leaf area (2280.16 and 1906. 64 cm^2, respectively) and total dry matter production (41.43 and 39.16 g $hill^{-1}$, respectively). 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. This was in conformity with Kalaraju (2007). The planting geometry did not influence much on chlorophyll content at 90 DAS.

Different nutrient sources have profoundly influenced the growth parameters of finger millet at different crop growth stages. Significantly higher growth parameters *viz*. plant height (77.5cm), number of tillers $hill^{-1}$ (11.33), leaf area (2005.09 cm^2), SPAD meter observation (43.30) and total dry matter production (40.37 g $hill^{-1}$) were recorded due to the application of recommended dose of FYM 7.5 t ha^{-1}+ RDF (50:40:37.5 kg N, P_2O_5 and K_2O ha^{-1}). Higher growth parameters were attributed to integrated nutrient management that helped to supply the nutrients based on the crop demand. Whereas, significantly lower plant height (75.0 cm), number of tillers $hill^{-1}$, (10.21), leaf area (1884.85 cm^2), SPAD meter reading (39.49) and total dry matter production (38.75 g $hill^{-1}$) were noticed mainly due to lower availability of nutrients in FYM on N equivalent basis + FYM 7.5 t ha^{-1} was mainly due to lesser mineralization of organics which resulted in the lesser growth parameters of finger millet. These findings are in line with Vijayamahantesh (2012) and Pavan Kumar (2014).

None of the interaction effects were found to be significant with respect to growth parameters of finger millet.

Yield parameters and yield of finger millet

Methods of establishment, planting geometry and nutrient source have significantly influenced the yield

TABLE I

Growth parameters of finger millet as influenced by planting geometry, method of establishment and nutrient source at 90 DAS

Treatments	Plant hieght (cm)	No. of tillers hill^{-1}	Leaf area hill^{-1} (cm^2)	SPAD meter observation	Total dry matter production (g hill^{-1})
Method of establishment (M)					
M_1: Direct sowing	76.1	10.26	1928.35	41.47	37.95
M_2: Transplanting	76.4	11.28	1961.59	41.33	41.17
S. Em. (±)	0.8	0.22	6.71	0.94	0.41
C. D. @ 5 %	NS	0.65	19.68	NS	1.20
Planting geometry (S)					
S_1: Recommended spacing 30 cm × 10 cm	80.0	7.20	1648.12	40.78	38.09
S_2: 30 cm × 30 cm	76.4	10.81	1906.64	41.93	39.16
S_3: 45 cm × 30 cm	72.3	14.31	2280.16	41.48	41.43
S. Em. (±)	1.0	0.27	8.22	1.15	0.50
C. D. @ 5 %	3.0	0.79	24.11	NS	1.47
Nutrient source (N)					
N_1: Recommended dose of FYM 7.5 t + RDF (50:40:37.5 kg N, P_2O_5 and K_2O ha^{-1})	77.5	11.33	2005.09	43.30	40.37h a^{-1}
N_2: FYM on N equivalent basis + FYM 7.5 t ha^{-1}	75.0	10.21	1884.85	39.49	38.75
S. Em. (±)	0.8	0.22	6.71	0.94	0.41
C. D. @ 5 %	2.5	0.65	19.68	2.74	1.20
Method of establishment x Planting geometry (M x S)					
S. Em. (±)	1.4	0.38	11.62	1.62	0.71
C. D. @ 5 %	NS	NS	NS	NS	NS
Method of establishment x Nutrient source (M x N)					
S. Em. (±)	1.2	0.31	9.49	1.32	0.58
C. D. @ 5 %	NS	NS	NS	NS	NS
Planting geometry x Nutrient source (S x N)					
S. Em. (±)	1.4	0.38	11.62	1.62	0.71
C. D. @ 5 %	NS	NS	NS	NS	NS
Method of establishment x Planting geometry x Nutrient source (M x S x N)					
S. Em. (±)	2.1	0.54	16.44	2.29	1.00
C. D. @ 5 %	NS	NS	NS	NS	NS

NS-Non-significant, DAS: Days after sowing

parameters of finger millet (Table II). With respect to method of establishment, the transplanting method has significantly influenced the number productive tillers hill^{-1} (10.84) compared to direct sowing (9.51). Among different planting geometry, 45 x 30 cm spacing recorded significantly higher number of productive tillers (14.19) compared to 30 x 30 cm (9.81) and 30 x 10 cm (6.53). With respect to nutrient sources, application of recommended dose of fertilizer (50:40:37.5 kg N, P_2O_5 and K_2O ha^{-1})+FYM 7.5 t ha^{-1} recorded significantly higher number of productive tillers hill^{-1} (10.75) compared to application of FYM on N equivalent basis + FYM 7.5 t ha^{-1} (9.60).

Effect of methods of establishment and planting geometry on finger number ear^{-1} and ear length were found to be non-significant. Whereas, application of recommended dose of fertilizer (50:40:37.5 kg N, P_2O_5

TABLE II

Yield and yield parameters of finger millet as influenced by planting geometry, method of establishment and nutrient source

Treatments	No. of Productive tillers hill^{-1}	Finger No. / ear	Ear length (cm)	Test weight (g)	Grain yield (kgha^{-1})	Straw yield (Kg ha^{-1})
Method of establishment (M)						
M_1: Direct sowing	9.51	7.39	5.89	3.53	3034	5369
M_2: Transplanting	10.84	7.24	5.93	3.57	3240	5592
S. Em. (±)	0.22	0.16	0.07	0.07	45.47	65.12
C. D. @ 5 %	0.63	NS	NS	NS	133.35	191.00
Planting geometry (S)						
S_1: Recommended spacing 30 cm × 10 cm	6.53	7.12	5.80	3.51	3250	5543
S_2: 30 cm × 30 cm	9.81	7.45	5.83	3.55	3111	5462
S_3: 45 cm × 30 cm	14.19	7.39	6.09	3.58	3051	5436
S. Em. (±)	0.26	0.19	0.09	0.09	55.69	79.76
C. D. @ 5 %	0.77	NS	NS	NS	NS	NS
Nutrient source (N)						
N_1: Recommended dose of FYM 7.5 t ha^{-1} + RDF (50:40:37.5 kg N, P_2O_5 and K_2O ha^{-1})	10.75	7.57	6.01	3.54	3223	5581
N_2: FYM on N equivalent basis + FYM 7.5 t ha^{-1}	9.60	7.07	5.80	3.56	3051	5381
S. Em. (±)	0.22	0.16	0.07	0.07	45.47	65.12
C. D. @ 5 %	0.63	0.46	0.21	NS	133.35	191.00
Method of establishment x Planting geometry (M x S)						
S. Em. (±)	0.37	0.27	0.12	0.13	78.75	112.80
C. D. @ 5 %	NS	NS	NS	NS	NS	NS
Method of establishment x Nutrient source (M x N)						
S. Em. (±)	0.31	0.22	0.10	0.10	64.30	92.10
C. D. @ 5 %	NS	NS	NS	NS	NS	NS
Planting geometry x Nutrient source (S x N)						
S. Em. (±)	0.37	0.27	0.12	0.13	78.75	112.80
C. D. @ 5 %	NS	NS	NS	NS	NS	NS
Method of establishment x Planting geometry x Nutrient source (M x S x N)						
S. Em. (±)	0.53	0.39	0.17	0.18	111.37	159.52
C. D. @ 5 %	NS	NS	NS	NS	NS	NS

NS : Non-significant, DAS: Days after sowing

and K_2O ha^{-1}) + FYM 7.5 t ha^{-1} recorded higher finger number ear^{-1}(7.57) and ear length (6.01 cm) compared to application of FYM on N equivalent basis + FYM 7.5 t ha^{-1} (7.07 and 5.80 cm, finger number ear^{-1} and ear length, respectively). Test weight of finger millet did not differ significantly due to methods of establishment, planting geometry and nutrient sources.

Among different methods of establishment, significantly higher grain and straw yield (3240 and 5592 kg ha^{-1}, respectively) was recorded with transplanting when compared to direct sowing (3034

and 5369 kg ha^{-1}, respectively). The lower growth attributes in direct sowing were due to poor root length which failed to take up optimum quantity of nutrients and water which ultimately resulted in less productive tillers, grain and straw yield. This is also in line with Ahiwale *et al*. (2011).

No significant difference in grain and straw yield was observed with the planting geometry but higher grain and straw yield was recorded with recommended spacing of 30x10 cm (3250 and 5543 kg ha^{-1}, respectively) which was on par with 30 x 30 cm (3111 and 5462 kg ha^{-1}, respectively) and 45 x 30 cm spacing (3051 and 5436 kg ha^{-1}, respectively), Higher dry matter production per unit area which ultimately resulted in the higher grain and straw yield. The higher grain and straw yield was obtained in recommended spacing (30 x 10 cm) of finger millet was mainly due to higher population per unit area compared to 45 x 30 cm and 30 x 30 cm spacing. This is in conformity with the findings of Bitew and Asargew, (2014).

Among nutrient sources added, significantly higher grain and straw yield (3223and 5587 kg ha^{-1}, respectively) was recorded with application of recommended dose of FYM 7.5 t ha^{-1} + RDF (50:40:37.5 kg N, P_2O_5 and K_2O ha^{-1}) compared to application of FYM on N equivalent basis + FYM 7.5 t ha^{-1}(3051 and 5381 kg ha^{-1}, respectively). Similar results were reported by Veeresh Hatti. (2016). None of the interaction effects were found to be significant with respect to yield parameters and yield of finger millet.

From the study, it can be concluded that higher growth parameters, grain and straw yield of finger millet was recorded in transplanting method with recommended spacing (30 x 10 cm) along with the application of recommended dose of FYM 7.5 t ha^{-1} + RDF (50:40:37.5 kg N, P_2O_5 and K_2O ha^{-1}).

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