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Partitioning Dry Matter and Growth Functions of Finger Millet (*Eleusine coracana* (L) Gaertn) as influenced by different Land Situations, various Planting Geometry and Levels of Fertilizer under Lateritic Soil of Konkan Region

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Abstract

The partitioning of dry matter and growth functions of finger millet (*Eleusine coracana* (L) Gaertn) as influenced by different land situations, various planting geometry and levels of fertilizer under lateritic soil of Konkan region was investigated at Agronomy Farm, College of Agriculture, Dapoli, in Maharashtra during kharif seasons of 2017 and 2018. The field experiment was laid out in a split-split plot design. Main plot treatments consisted of three land situations, *viz*. upland situation (LS_1), midland situation (LS_2) and gently sloping (*Varkas*) land (LS_3). The sub plot treatments consisted of five planting geometries, viz. 15 cm x 10 cm (PG_1), 20 cm x 10 cm (PG_2), 25 cm x 10 cm (PG_3), 30 cm x 10 cm (PG_4) and 20 cm x 15 cm (PG_5). While sub-sub plot treatment comprised of five fertilizer levels, *viz*. 80: 40:0 NPK kg ha^{-1} (RDF) without FYM (F_1), 80:40: 0 NPK kg ha^{-1} (RDF) with FYM 5 t ha^{-1} (F_2), 80:40:40 NPK kg ha^{-1} with FYM 5 t ha^{-1} (F_3), 100:50:50 NPK kg ha^{-1} with FYM 5 t ha^{-1} (F_4) and 120:60:60 NPK kg ha^{-1} with FYM 5 t ha^{-1} (F_5). Thus, there were 25 treatment combinations replicated three times. On the basis of investigation, it can be concluded that the finger millet crop should be grown during kharif season on upland situation (well drained) followed by gentle sloping land with 25 cm x 10 cm planting geometry along with application of fertilizer dose @ 120:60:60 NPK kg ha^{-1} with FYM 5 t ha^{-1} for obtaining maximum dry matter accumulation (g) $hill^{-1}$ partitioning and growth functions under south Konkan condition.

Key words: Dry matter partitioning, Finger millet, Growth analysis, Land situations, Levels of fertilizer, Planting geometry**.**

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Introduction

Finger millet (*Eleusine coracana* G.) is staple food of tribles and lower income class. Finger millet has some unique qualities, which makes it potentially valuable product. It has low glycemic index. This makes it a boon for the people suffering from diabetes and obesity (Arora and Srivastava 2000). It has excellent malting qualities with considerable industrial potential for producing malt extract and beverages. The grains are malted and fed to infants due to its high nutritious value and suggested as the best weaning food which is popularly known as '*Nachani Satva*'. It is usually converted into flour, which is used for preparation of cake / puddings / porridge.

Finger millet is an important food grain crop of semi-arid tropics particularly of India, East Africa and Srilanka. In India, finger millet is cultivated over wide range of agro-climatic conditions almost in all the states. Finger millet contributes nearly 40 per cent of small millets in India. Finger millet contributes an area of 1.27 m ha with average annual production 1.89 million tonnes with productivity 1490 kg ha^{-1} (Anonymous 2011). In Maharashtra, finger millet occupies an area of about 166.8 thousand hectare ha with an annual grain production of 170.2 thousand tonnes. It is mainly cultivated in Thane, Raigad, Ratnagiri, Sindhudurg, Dhule, Jalgaon, Nashik, Ahmednagar, Pune, Satara and Kolhapur districts.

The largest acreage of *ragi* is in *Konkan* region. In *Konkan* region, finger millet plays an important role in agriculture with an area of 38488 ha of Maharashtra comprising with an annual production 41136 t. However, the productivity in Thane, Palghar, Raigad, Ratnagiri and Sindhudurg is very low 1167 kg ha^{-1}.

The productivity is low due to delay in nursery sowing and late transplanting, faulty methods of cultivation and little or no use of fertilizers. The secret of boosting its yields mainly lies in timely transplanting and properly fertilizing the crop. It is well known that there is direct positive correlation between fertilizer consumption and food grain production. Major finger millet growing areas in the region are highly eroded sandy clay loams. Poor fertility and low moisture holding capacity are the characteristics of these soils. Fertilizer use efficiency is low in the region due to heavy rainfall and it is revealed from the studies that integration of nutrient sources improves fertilizer use efficiency (Tondon 1992). Hence, integrated nutrient management is one of the key components of intensive agriculture.

The finger millet crop has given secondary importance and generally the crop grown on hill slope and *varkas* land and hence the productivity of finger millet is low due to delay in nursery sowing and late transplanting, faulty methods of cultivation and little or no use of fertilizers. It is nutritionally high value crop and to maintain human health, the demand of fingermillet has been increased day by day and hence it is necessary to test land suitability for yield maximization of nagli. Finger millet is a premium crop as compared to other millets. Finger millet put forth luxuriant growth during *kharif* season, therefore to find out suitable land situation, planting geometry and optimum fertilizer dose for the maximization of partitioning dry matter, growth functions and yield. Keeping these points in views, it is proposed to conduct a field experiment on, "partitioning dry matter and growth functions of finger millet (*Eleusine coracana* (L) Gaertn) as influenced by different land situations, various planting geometry and levels of fertilizer under lateritic soil of *konkan* region" was conducted.

Materials and Methods

The investigation "partitioning dry matter and growth functions of finger millet (*Eleusine coracana* (L) Gaertn) as influenced by different land situations, various planting geometry and levels of fertilizer under lateritic soil of *konkan* region" was conducted at Agronomy Farm, College of Agriculture, Dapoli, Dist. Ratnagiri (M.S.) during *kharif* season of 2017 and 2018. The site was selected on the basis of suitability of soil for the cultivation of finger millet on various land situations. The topography of the experimental plot was fairly uniform level, water saturated and gently sloppy land (*Varkas*). The plot was well drained and provided drainage for removal excess rain water during both years of *kharif* season.

The field experiment was laid out in a split-split plot design. Main plot treatment consisted of three land situations *viz*., upland situation (LS_1), midland situation (LS_2) and gently sloping (*Varkas*) land (LS_3), the sub plot treatment consisted of five planting geometry, viz.15 cm x 10 cm (PG_1), 20 cm x 10 cm (PG_2), 25 cm x 10 cm (PG_3), 30 cm x 10 cm (PG_4) and 20 cm x 15 cm (PG_5),while, sub-sub plot treatment comprised of five fertilizer levels viz., 80:40:0 NPK kg ha^{-1} (RDF) without FYM (F_1), 80:40:0 NPK kg ha^{-1} (RDF) with FYM 5 t ha^{-1} (F_2), 80:40:40 NPK kg ha^{-1} with FYM 5 t ha^{-1} (F_3), 100:50:50 NPK kg ha^{-1} with FYM 5 t ha^{-1} (F_4) and 120: 60:60 NPK kg ha^{-1} with FYM 5 t ha^{-1} (F_5). Thus, there were 25 treatment combinations replicated three times. The variety *Dapoli 2* (Somaclonal variation developed through tissue culture technique) of finger millet was used in the investigation. Seeds were treated with thiram @ 3 g kg^{-1} of seed, before sowing in order to protect the crop against seed and soil borne fungal diseases.

The finger millet nursery was manured with FYM @ 100 kg R^{-1} and it was mixed thoroughly into soil at the time of seedbed preparation. Then, nursery beds of 3 m x 1 m size were prepared in a well tilled plot. Fertilizers, *viz.* urea @ 1 kg and single super phosphate @ 3 kg were applied for 100 m^{-2}. nursery area at the time of sowing of finger millet seed. The transplanting of the seedlings was done at different land situations. Application of full dose of FYM and basal dose of N, P_2O_5, K_2O as per the treatments were done at the time of transplanting. The basal dose of N, P_2O_5, K_2O included half dose of nitrogen and full dose of phosphorus and potassium. Remaining half dose of nitrogen (urea) was applied at 30 DAT. Seeds were treated with thiram @ 3 g kg^{-1} of seeds, before sowing in order to protect the crop against seed and soil borne fungal diseases. Poison bait of phorate @ 10 kg ha^{-1} was placed in crab holes in the field and on bund area of experimental plots to control crab attack. Spraying of trycyclozole 75 WP and propiconazole @ 0.05 per cent for control of foot rot and one spraying of carbendanzim @ 0.1 per cent for controlling of leaf spot disease. All biometric and other observations recorded during the course of investigation.

Growth analysis

Data on growth characters *viz*. height, dry matter per hill, were further subjected for the competition of growth function which absolute growth rate, mean relative growth rate. Data on these growth functions were reported and inferences are drawn on the basis of mean value.

Absolute growth rate (AGR):

The rate of increase of growth variables dry matter (W) or height of plant (H) at time (t) is called as absolute growth rate. It was measured as differentiation coefficient with respect of time. Absolute growth rate of two growth variables *viz.* height of plant and total dry matter hill^{-1}, were worked out by formula given by Richards (1669).

$$\text{AGR for plant height (cm day}^{-1}) = \frac{H_2 - H_1}{t_2 - t_1}$$

$$\text{AGR for plant height (gm day}^{-1}) = \frac{W_2 - W_1}{t_2 - t_1}$$

Where,

H_1, H_2 and W_1, W_2 refers to plant height (cm) and total dry matter weight (gm) at the time t_1 and t_2, respectively. It is expressed in cm per day in case of plant height and gm day^{-1} in case of dry matter production hill^{-1}.

Relative growth rate (RGR):

The increase in dry matter of plant per hill is a process of continuous compound interest, where in, the increment in any interval adds to the capital for subsequent growth. This rate of increment is known as RGR, which was worked out as per the formula given by Fisher (1921).

$$\text{RGR (mg g}^{-1}\text{ day}^{-1}) = \frac{\text{Log}_e W_2 - \text{Log}_e W_1}{t_2 - t_1}$$

Where,

W_1 and W_2 are the weight of dry matter in g per hill at times t_1 and t_2, respectively and t_2 - t_1 is time interval in days.

Log_e = natural logarithm to the base 'e' = 2.3026.

Results and Discussion

The data regarding the partitioning of dry matter hill^{-1} (g) of finger millet as influenced by different treatments during both the years are presented in Table 1.

Growth functions are the measures of growth rates in different growth parameters of plant. The data calculated on these aspects were not subjected to 'F' test of variance and results are interpreted on the basis mean values. Mean values of AGR for plant height recorded at various growth stages during both the years of study presented in Table 4 revealed that, mean AGR based on plant height increased up to 90 days during *kharif* 2017 and up to 60 days in *kharif* 2018 thereafter drastic reduction in AGR values were observed during both the years.

Mean values of AGR for dry matter accumulation (g) hill^{-1} calculated at various growth stages in both the years. The data presented in Table 4 revealed that, mean AGR based on dry matter accumulation (g hill^{-1}) increased up to 90 DAT and thereafter declined up to the harvest during both the years of study.

The mean values of RGR for dry matter accumulation of finger millet crop (mg g^{-1} day^{-1}) calculated at various growth stages during both the years are presented in Table 5. The data revealed that the mean values of AGR increased up to 60 DAT during both the years of study i.e. *kharif* 2017 and *kharif* 2018.

Effect of land situations

The data presented in Table 1 showed that mean dry matter accumulation hill^{-1} (g) partitioning was be significant. The upland situation (LS_1) recorded significantly higher mean dry matter accumulation hill^{-1} (g) in stem, leaves and earhead over rest of land situations during both the years. However, mean dry matter accumulation hill^{-1} (g) partitioning in respect of leaves and earhead during 2017 remained at par with the gently sloppy land situation (LS_3). The reason of high dry matter accumulation in upland situation (LS_1) followed by gently sloppy land (LS_3) may be due to the significant increase in morphological parameters which are responsible for the photosynthetic capacity of the plant thereby increasing the straw yield. These results are in conformity with the results reported by Modak (1979), Bhatkar (1980), Nevse et. al. (2013).

Absolute Growth Rate (AGR) for plant height of finger millet showed increasing trend up to 90 DAT during *kharif* 2017 and up to 60 DAT during *kharif* 2018 under upland (LS_1) followed by gently sloppy land (LS_3) situations, while under midland (LS_2) situation AGR for plant height of finger millet did not show any trend during both the years of study. Numerically, higher values of AGR for plant height of finger millet was recorded under upland (LS_1) situation up to 90 DAT (1.175 cm day^{-1}) during *kharif* 2017 and up to 60 DAT (2.246 cm day^{-1}) during *kharif* 2018. However, numerically higher value of AGR for plant height of finger millet was recorded under midland (LS_2) situation up to 90 DAT during both the years.

AGR for dry matter accumulation (g day^{-1}) of finger millet showed increasing trend up to 90 DAT during both years of study i.e. *kharif* 2017 and *kharif* 2018, under upland situation (0.546 and 1.122 g day^{-1} respectively) followed by gently sloppy land (LS_3) situations, while under midland (LS_2) situation AGR for dry matter accumulation (g day^{-1}) of finger millet recorded increasing trend till harvest of crop during

Table 1. Mean partitioning of dry matter accumulation hill^{-1} of fingermillet at harvest as influenced by different treatments during kharif 2017 and 2018

Treatments	Partitioning dry matter accumulation hill^{-1} (g)					
	Stem		Leaves		Earhead	
	2017	2018	2017	2018	2017	2018
A) Main plot: Land situations (LS)						
LS_1: Upland	15.87	23.51	12.09	14.77	13.93	26.64
LS_2: Mid land (Drainage facility provided)	5.40	4.78	4.55	4.38	4.17	2.76
LS_3: Gently sloppy land	13.81	15.05	10.73	10.33	13.57	23.94
S.Em. ±	0.42	1.14	0.36	0.54	0.74	0.47
C.D. at 5 %	1.66	4.48	1.43	2.11	2.91	1.84
B) Sub plot: Planting geometry (PG)						
PG_1: 15 cm x 10 cm	10.51	11.96	8.51	9.16	8.73	15.51
PG_2: 20 cm x 10 cm	11.02	14.34	8.78	9.40	8.73	16.63
PG_3: 25 cm x 10 cm	14.36	16.37	9.82	10.51	12.87	19.91
PG_4: 30 cm x 10 cm	11.09	14.63	8.82	9.60	10.49	17.91
PG_5: 20 cm x 15 cm	11.49	14.93	9.69	10.47	11.98	18.93
S.Em. ±	0.65	0.64	0.48	0.46	0.62	0.74
C.D. at 5 %	1.90	1.87	1.40	1.34	1.82	2.15
C) Sub-sub plot : Fertilizers levels (F)						
F_1: 80: 40: 00 NPK kg ha^{-1} (RDF) without FYM	6.60	8.80	5.47	6.44	5.22	10.09
F_2: 80: 40: 00 NPK kg ha^{-1} (RDF) with FYM	8.84	11.08	7.24	7.58	6.96	14.00
F_3: 80: 40: 40 NPK kg ha^{-1} with FYM	10.49	13.14	8.93	8.94	9.64	16.61
F_4: 100: 50: 50 NPK kg ha^{-1} with FYM	15.82	19.07	11.67	12.79	15.04	23.56
F_5: 120: 60: 60 NPK kg ha^{-1} with FYM	16.71	20.12	12.31	13.38	15.93	24.64
S.Em. ±	0.35	0.46	0.23	0.26	0.36	0.57
C.D. at 5 %	0.98	1.29	0.65	0.73	1.01	1.60
Interaction effect						
LS x PG	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
LS x F	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
PG x F	Sig.	N.S.	Sig.	Sig.	Sig.	Sig.
LS x PG x F	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
General mean	11.69	14.44	9.12	9.83	10.56	17.78

kharif 2017 and did not show any trend during *kharif* 2018. Numerically higher values of AGR for dry matter accumulation (g day^{-1}) of finger millet was recorded under upland (LS_1) situation up to 90 DAT during *kharif* 2017 and up to 60 DAT during *kharif* 2018. Numerically, higher value of AGR for dry matter accumulation (g day^{-1}) of finger millet during *kharif* 2018 was recorded under upland (LS_1) situation up to 90 DAT during both years.

RGR for dry matter accumulation of finger millet crop (g g^{-1} day^{-1}) recorded increasing trend for all land situation under study, up to 60 DAT during both years of study i.e. *kharif* 2017 and *kharif* 2018. Numerically higher value of RGR for dry matter accumulation of finger millet crop (g g^{-1} day^{-1}) was recorded under gently sloppy land (LS_3) situation during 31 to 60 DAT and under gentle sloppy land (LS_3) situation during both years. There after values of RGR for dry matter accumulation of finger millet crop (g g^{-1} day^{-1}) decreased till harvest.

Effect of planting geometry

Among the different planting geometries 25 cm x 10 cm (PG_3) recorded significantly higher dry matter accumulation (g $hill^{-1}$) over rest of the planting geometry. The dry matter accumulation (g $hill^{-1}$) in stem was at par with PG_4 and PG_5 during 2018, in leaves PG_2, PG_4 and PG_5 during both the years and earhead PG_5 during 2017 and PG_4 and PG_5 during 2018. The results are in confirmation with the results reported by Roy *et al*. (2001), Andrew *et al*. (2018).

AGR for plant height showed increasing trend up to 90 DAT during *kharif* 2017 and up to 60 DAT during *kharif* 2018. The planting geometry of 30 cm x 10 cm (PG_4) recorded numerically higher AGR for plant height of finger millet up to 90 DAT (1.294 cm day^{-1}) during *kharif* 2017 and planting geometry of 25 cm x 10 cm (PG_3) recorded numerically higher AGR for plant height of finger millet up to 60 DAT (1.390 cm day^{-1}) during *kharif* 2018. Numerically, lower AGR for plant height was recorded by crop transplanted at 30 cm x 10 cm (PG_2) during initial growth period up to 60 DAT during both the years of study.

Among the different planting geometry under study, AGR based on dry matter accumulation (g day^{-1}) recorded increasing trend up to 90 DAT during *kharif* 2017 and *kharif* 2018 except AGR based on dry matter accumulation (g day^{-1}) for finger millet crop transplanted at spacing of 15 cm x 10 cm (PG_1), showed less AGR during *kharif* 2018. The planting geometry 25 cm x 10 cm (PG_3) recorded numerically higher AGR based on dry matter accumulation (g day^{-1}) of finger millet up to harvest during *kharif* 2017 and up to 90 DAT *kharif* 2018.

RGR for dry matter accumulation of finger millet crop (g g^{-1} day^{-1}) recorded increasing trend up to 60 DAT during both years of study i.e. *kharif* 2017 and *kharif* 2018. While, during 31- 60 DAT, numerically higher values of RGR for dry matter accumulation (g g^{-1} day^{-1}) for finger millet was recorded under planting geometry of 20 cm x 15 cm (PG_5) during *kharif* 2017 (0.021 mg g^{-1} day^{-1}) and planting geometry of 15 cm x 10 cm (PG_1) during *kharif* 2018 (0.030 g g^{-1} day^{-1}). There after no specific trend was noticed in case of RGR for dry matter accumulation of finger millet crop (g g^{-1} day^{-1}) till harvest.

Effect of fertilizer levels

Among the various fertilizer levels mean dry matter accumulation (g $hill^{-1}$) partitioning was found to be significant. The fertilizer level 120:60:60 NPK kg ha^{-1} with FYM (F_5) recorded significantly higher mean dry matter accumulation (g $hill^{-1}$) in stem and leaves over rest of treatments and on par with 100:50:50 NPK kg ha^{-1} with FYM (F_4) during both the years and remaining fertilizer levels in that descending order of significance. However, more number of functional leaves showed better agronomic potential to produce significantly higher dry matter accumulation $hill^{-1}$ during both the years of investigation. Similar results were reported by Chavan et al. (2018a), Chavan et al. (2018b), Mahapatra and Sunitha (2018).

AGR for plant height of finger millet recorded increasing trend up to 90 DAT when crop was supplied with 120: 60:60 NPK kg ha^{-1} with FYM (F_5), followed by 100: 50:50 NPK kg ha^{-1} with FYM 5 t ha^{-1} (F_4) during *kharif* 2017 and *kharif* 2018. Finger millet crop recorded numerically lower value of AGR for plant height up to 90 DAT and 60 DAT during *kharif* 2017 and *kharif* 2018, respectively when crop was supplied with 80:40:00 NPK kg ha^{-1} (RDF) without FYM (F_1).

AGR for dry matter accumulation (g day^{-1}) of finger millet showed increasing trend when crop was grown under different fertilizer levels under study, up to 90 DAT during both the years of study. The treatment 120: 60:60 NPK kg ha^{-1} with FYM (F_5) recorded numerically higher AGR for dry matter accumulation (g day^{-1}) up to 90 DAT during *kharif* 2017. During *kharif* 2018 treatment F_4 (100:50:50 NPK kg ha^{-1} with FYM 5 t ha^{-1}) recorded numerically higher value of AGR based on dry matter accumulation (g day^{-1}) up to 90 DAT.

RGR for dry matter accumulation (g g^{-1} day^{-1}) of finger millet showed increasing trend when crop was grown under different fertilizer levels under study, up to 60 DAT during both the years of study. While, the treatment 80:40:00 NPK kg ha^{-1} (RDF) with FYM 5 t ha^{-1} (F_2) recorded numerically higher RGR for dry matter accumulation (g g^{-1} day^{-1}) in initial growth i.e. 30- 60 DAT during *kharif* 2017 and 80:40:00 NPK kg ha^{-1} (RDF) without FYM (F_1) during *kharif* 2018, respectively. There after no specific trend was noticed in case of RGR for dry matter accumulation of finger millet crop (g g^{-1} day^{-1}) till harvest.

Interaction effect

Table 2. Interaction effect of land situations & planting geometry, land situations & fertilizer levels and land situations, planting geometry and fertilizer levels on dry matter accumulation hill^{-1} (partitioning) at harvest during kharif 2017 and 2018.

Treatments	Stem										Leaves									
	2017					2018					2017					2018				
LS X PG	PG_1	PG_2	PG_3	PG_4	PG_5	PG_1	PG_2	PG_3	PG_4	PG_5	PG_1	PG_2	PG_3	PG_4	PG_5	PG_1	PG_2	PG_3	PG_4	PG_5
LS_1	15.53	16.33	19.67	14.60	13.20	17.17	25.13	27.60	22.10	25.53	9.73	11.47	14.07	11.67	13.53	13.20	13.07	19.13	13.53	14.93
LS_2	4.73	4.73	5.87	4.93	6.73	3.83	4.07	6.08	4.90	5.00	4.53	4.07	5.13	4.60	4.40	3.87	3.87	5.27	4.33	4.57
LS_3	11.27	12.00	17.53	13.73	14.53	13.70	13.80	18.67	12.47	16.60	11.27	8.73	12.67	10.40	10.60	8.53	9.87	10.40	9.53	13.30
	S.E.±	1.13	C.D. at 5%		3.29	S.E.±	1.51	C.D. at 5%		4.77	S.E.±	0.83	C.D. at 5%		2.43	S.E.±	0.89	C.D. at 5%		2.52
LS x F	F_1	F_2	F_3	F_4	F_5	F_1	F_2	F_3	F_4	F_5	F_1	F_2	F_3	F_4	F_5	F_1	F_2	F_3	F_4	F_5
LS_1	8.93	11.67	14.87	21.93	21.93	13.73	17.57	21.60	30.93	33.70	7.07	9.47	12.27	15.73	15.93	9.13	10.80	13.00	20.27	20.67
LS_2	3.47	4.20	5.07	6.87	7.40	2.80	3.67	4.47	6.35	6.60	3.33	3.87	4.07	5.40	6.07	3.00	3.33	4.17	5.40	6.00
LS_3	7.40	10.67	11.53	18.67	20.80	9.87	12.00	13.37	19.93	20.07	6.00	8.40	10.47	13.87	14.93	7.20	8.60	9.67	12.70	13.47
	S.E.±	0.69	C.D. at 5%		2.22	S.E.±	0.80	C.D. at 5%		2.23	S.E.±	0.51	C.D. at 5%		1.73	S.E.±	0.67	C.D. at 5%		2.36
PG X F	F_1	F_2	F_3	F_4	F_5	F_1	F_2	F_3	F_4	F_5	F_1	F_2	F_3	F_4	F_5	F_1	F_2	F_3	F_4	F_5
PG_1	6.33	8.11	9.56	14.11	14.44	-	-	-	-	-	5.78	6.56	7.89	11.78	10.56	5.56	7.56	8.22	11.56	12.89
PG_2	6.00	9.56	9.67	13.67	16.22	-	-	-	-	-	5.56	7.00	9.22	9.89	12.22	6.22	7.33	8.78	11.44	13.22
PG_3	6.89	10.67	13.33	18.78	22.11	-	-	-	-	-	5.89	7.11	8.78	13.44	13.89	6.67	7.22	8.78	14.78	15.11
PG_4	6.78	8.11	9.89	17.33	13.33	-	-	-	-	-	5.67	7.33	8.78	11.33	11.00	5.67	7.11	8.89	13.22	13.11
PG_5	7.00	7.78	10.00	15.22	17.44	-	-	-	-	-	4.44	8.22	10.00	11.89	13.89	8.11	8.67	10.06	12.94	12.56
	S.E.±	0.96	C.D. at 5%		2.73	S.E.±	-	C.D. at 5%		-	S.E.±	0.67	C.D. at 5%		1.91	S.E.±	0.70	C.D. at 5%		1.98
LS X PG X F	F_1	F_2	F_3	F_4	F_5	F_1	F_2	F_3	F_4	F_5	F_1	F_2	F_3	F_4	F_5	F_1	F_2	F_3	F_4	F_5
LS_1 PG_1	7.67	10.67	13.67	21.67	24.00	9.33	12.33	15.67	25.33	23.17	5.67	7.00	8.67	14.00	12.67	6.67	11.00	12.00	17.67	18.67
LS_1 PG_2	9.00	13.67	14.00	20.67	24.33	16.00	19.33	22.33	32.00	36.00	8.00	10.67	14.67	14.33	14.67	9.00	9.67	12.67	16.00	18.00
LS_1 PG_3	9.00	16.33	21.33	23.00	28.67	17.67	22.00	24.33	38.00	46.67	7.67	8.00	11.67	17.00	20.00	10.67	11.67	15.00	28.67	29.67
LS_1 PG_4	8.33	9.67	11.67	27.67	15.67	14.33	17.00	22.00	31.67	32.00	7.00	9.33	11.67	16.00	13.33	9.33	10.33	12.00	21.33	21.67
LS_1 PG_5	10.67	8.00	13.67	16.67	17.00	11.33	17.17	23.67	27.67	30.67	7.00	12.33	14.67	16.67	19.67	10.00	11.33	13.33	17.67	15.33
LS_2 PG_1	3.67	4.00	4.00	6.33	5.67	3.00	4.00	4.67	6.33	7.00	4.00	3.67	4.00	5.00	6.00	2.33	3.00	3.33	4.33	6.33
LS_2 PG_2	3.33	3.33	4.67	5.67	6.67	2.83	2.87	4.00	6.00	4.67	3.67	3.67	4.00	4.00	5.00	3.67	4.33	5.00	5.67	4.67
LS_2 PG_3	4.00	5.00	5.00	6.67	8.67	2.50	3.33	4.33	6.67	7.67	3.33	4.00	4.00	6.67	7.67	2.67	2.67	3.67	6.00	7.33
LS_2 PG_4	2.67	4.00	6.00	6.00	6.00	2.00	3.50	4.33	4.33	5.00	3.00	4.00	4.00	5.33	6.67	3.00	3.33	5.00	5.33	5.00
LS_2 PG_5	3.67	4.67	5.67	9.67	10.00	3.67	4.67	5.00	8.40	8.67	2.67	4.00	4.33	6.00	5.00	3.33	3.33	3.83	5.67	6.67
LS_3 PG_1	7.67	9.67	11.00	14.33	13.67	10.33	11.33	12.50	17.00	17.33	7.67	9.00	11.00	15.67	13.00	7.67	8.67	9.33	12.67	13.67
LS_3 PG_2	5.67	11.67	10.33	14.67	17.67	7.33	10.67	14.00	18.33	18.67	5.00	6.67	9.00	11.33	11.67	6.00	8.00	8.67	12.33	12.67
LS_3 PG_3	7.67	10.67	13.67	26.67	29.00	14.67	18.00	18.00	26.67	26.33	6.67	9.33	10.67	16.67	20.00	6.67	7.33	7.67	15.50	15.67
LS_3 PG_4	9.33	10.67	12.00	18.33	18.33	8.67	10.00	10.67	16.33	16.67	7.00	8.67	10.67	12.67	13.00	4.67	7.67	9.67	10.00	11.00
LS_3 PG_5	6.67	10.67	10.67	19.33	25.33	8.33	10.00	11.67	21.33	21.33	3.67	8.33	11.00	13.00	17.00	11.00	11.33	13.00	13.00	14.33
	S.E.±	1.36	C.D. at 5%		3.80	S.E.±	1.78	C.D. at 5%		4.98	S.E.±	0.90	C.D. at 5%		2.51	S.E.±	1.02	C.D. at 5%		2.84

Table 3. Interaction effect of land situations & planting geometry, land situations & fertilizer levels and Land situations, planting geometry and fertilizer levels on dry matter accumulation hill^{-1} (partitioning) g at harvest during kharif 2017 and 2018

Treatments	Earhead									
	2017					2018				
LS X PG	PG_1	PG_2	PG_3	PG_4	PG_5	PG_1	PG_2	PG_3	PG_4	PG_5
LS_1	11.33	11.87	19.13	12.67	14.67	13.47	23.73	30.07	21.33	27.93
LS_2	3.73	3.80	4.87	4.67	3.80	2.00	2.80	2.53	2.60	3.07
LS_3	11.13	10.53	19.07	13.00	14.13	23.20	23.37	29.27	21.07	13.00
	S.E.±	1.22	C.D. at 5%		3.46	S.E.±	1.28	C.D. at 5%		3.73
LS x F	F_1	F_2	F_3	F_4	F_5	F_1	F_2	F_3	F_4	F_5
LS_1	6.67	9.20	12.33	19.20	22.27	15.00	20.87	24.20	35.80	37.33
LS_2	2.40	3.33	3.73	5.53	5.87	1.47	1.93	2.73	3.87	3.80
LS_3	6.60	8.33	12.87	20.40	19.67	13.80	19.20	22.90	31.00	32.80
	S.E.±	0.93	C.D. at 5%		3.27	S.E.±	1.00	C.D. at 5%		3.06
PG X F	F_1	F_2	F_3	F_4	F_5	F_1	F_2	F_3	F_4	F_5
PG_1	4.33	5.78	8.00	10.78	14.78	-	-	-	-	-
PG_2	5.33	6.44	8.00	12.22	11.67	-	-	-	-	-
PG_3	5.33	8.00	13.00	16.33	21.67	-	-	-	-	-
PG_4	5.33	6.00	8.56	17.44	15.11	-	-	-	-	-
PG_5	5.78	8.56	10.67	18.44	16.44	-	-	-	-	-
	S.E.±	0.96	C.D. at 5%		2.73	S.E.±	-	C.D. at 5%		-
LS X PG X F	F_1	F_2	F_3	F_4	F_5	F_1	F_2	F_3	F_4	F_5
LS_1 PG_1	5.00	6.67	9.67	13.00	22.33	10.00	17.00	20.33	31.00	28.33
LS_1 PG_2	7.67	8.00	10.00	16.00	17.67	10.67	19.33	23.00	31.00	34.67
LS_1 PG_3	5.67	11.67	13.67	16.00	26.33	17.67	22.67	26.67	43.00	47.67
LS_1 PG_4	7.00	7.00	11.00	19.67	18.67	21.00	25.33	26.67	37.33	40.00
LS_1 PG_5	8.00	12.67	17.33	31.33	26.33	15.67	20.00	24.33	34.00	38.67
LS_2 PG_1	2.33	2.67	4.00	4.00	5.67	1.00	1.33	2.00	2.67	3.00
LS_2 PG_2	2.33	4.00	3.33	4.33	5.00	2.00	2.00	2.67	3.67	3.67
LS_2 PG_3	2.67	3.33	4.00	7.67	8.00	1.00	2.33	2.33	5.00	5.33
LS_2 PG_4	2.33	3.33	4.00	5.67	6.67	1.33	1.33	2.33	4.00	4.00
LS_2 PG_5	2.33	3.33	3.33	6.00	4.00	2.00	2.67	3.00	4.00	4.33
LS_3 PG_1	5.67	8.00	10.33	15.33	16.33	13.00	21.00	21.67	28.00	32.33
LS_3 PG_2	6.00	7.33	10.67	16.33	12.33	13.00	16.00	20.17	31.33	36.33
LS_3 PG_3	7.67	9.00	21.33	25.33	32.00	19.33	25.33	29.33	35.33	37.00
LS_3 PG_4	6.67	7.67	10.67	27.00	18.67	10.67	16.00	18.67	31.00	29.00
LS_3 PG_5	7.00	9.67	11.33	18.00	19.00	13.00	17.67	24.67	27.67	31.00
	S.E.±	1.40	C.D. at 5%		3.93	S.E.±	2.22	C.D. at 5%		6.22

The data presented in Table 2 and 3 indicated that, interaction effect between land situations and planting geometry in mean dry matter accumulation hill^{-1}(g) in stem, leaves and earhead was found to be significant. The upland situation (LS_1) with planting geometry 25 cm x 10 cm (PG_3) recorded significantly higher mean dry matter accumulation partitioning over rest of treatment combinations and on par with LS_1PG_2, LS_3PG_3 and LS_1PG_2, LS_1PG_5, LS_3PG_3 in stem and LS_1PG_4, LS_1PG_5, LS_3PG_3 in leaves and LS_3PG_3 in respect of earhead during 2017 and 2018, respectively.

The interaction effect between land situations and

Table 4. Mean absolute growth rate (cm day^{-1}) and mean absolute growth rate (g day^{-1}) of finger millet as influenced by different treatments during kharif 2017 and 2018

Treatments	Time interval (Days after transplanting)															
	kharif 2017				kharif 2018				kharif 2017				kharif 2018			
	Mean absolute growth rate (cm day^{-1})								Mean absolute growth rate (g day^{-1})							
	0–30	31-60	61-90	91-At harvest	0–30	31-60	61-90	91-At harvest	0–30	31-60	61-90	91- At harvest	0–30	31-60	61-90	91- At harvest
A) Main plot: Land situations (LS)																
LS_1: Upland	0.788	0.846	1.175	0.071	0.551	2.246	0.396	0.030	0.096	0.272	0.546	0.473	0.114	0.715	1.122	0.280
LS_2: Mid land	0.370	0.275	0.967	0.330	0.425	0.269	0.920	0.118	0.040	0.048	0.106	0.276	0.050	0.173	0.072	0.101
LS_3: Gentle	0.570	0.627	1.549	0.089	0.447	1.485	0.586	0.053	0.046	0.189	0.604	0.413	0.078	0.646	0.635	0.276
B) Sub plot: Planting geometry (PG)																
PG_1: 15 cm x	0.529	0.709	1.168	0.167	0.482	1.379	0.617	0.084	0.060	0.130	0.425	0.312	0.071	0.483	0.441	0.256
PG_2: 20 cm x	0.523	0.635	1.242	0.143	0.481	1.351	0.619	0.033	0.055	0.151	0.417	0.319	0.076	0.493	0.641	0.179
PG_3: 25 cm x	0.552	0.729	1.189	0.170	0.491	1.390	0.659	0.093	0.070	0.194	0.432	0.524	0.091	0.572	0.659	0.235
PG_4: 30 cm x	0.507	0.503	1.294	0.194	0.441	1.208	0.701	0.046	0.056	0.173	0.425	0.390	0.077	0.511	0.652	0.228
PG_5: 20 cm x	0.526	0.579	1.261	0.141	0.477	1.338	0.575	0.079	0.064	0.200	0.395	0.390	0.090	0.499	0.655	0.198
C) Sub-sub plot: Fertilizers levels (F)																
F_1:80:40:00 NPK kg	0.534	0.365	1.194	0.301	0.420	1.120	0.635	0.076	0.036	0.108	0.273	0.161	0.049	0.371	0.396	0.028
F_2:80:40:00 N P K	0.546	0.506	1.224	0.215	0.448	1.234	0.646	0.075	0.043	0.143	0.306	0.277	0.064	0.436	0.438	0.151
F_3: 80 : 40 : 40 NPK kg	0.568	0.576	1.237	0.170	0.475	1.318	0.656	0.052	0.055	0.157	0.373	0.380	0.079	0.523	0.537	0.152
F_4:100:50:50 NPK kg	0.609	0.713	1.235	0.088	0.508	1.464	0.628	0.078	0.084	0.218	0.562	0.540	0.107	0.714	0.842	0.363
F_5:120:60:60 NPK kg	0.622	0.753	1.263	0.043	0.522	1.529	0.606	0.054	0.086	0.222	0.579	0.563	0.107	0.618	0.835	0.402
General mean	0.557	0.601	1.231	0.163	0.474	1.333	0.634	0.067	0.061	0.170	0.419	0.387	0.081	0.511	0.610	0.219

Table 5. Mean relative growth rate (g g^{-1} day^{-1}) of finger millet as influenced by different treatments during kharif 2017 and 2018

Treatments	Relative growth rate (g g^{-1} day^{-1})							
	Kharif 2017				Kharif 2018			
	0-30 DAT	31-60 DAT	61-90 DAT	91- At harvest	0-30 DAT	31-60 DAT	61-90 DAT	91- At harvest
A) Main plot : Land situations (LS)								
LS_1: Upland	0.015	0.019	0.013	0.006	0.018	0.029	0.012	0.002
LS_2: Mid land	0.003	0.011	0.011	0.013	0.006	0.022	0.004	0.004
LS_3: Gently sloppy land	0.005	0.024	0.018	0.006	0.012	0.032	0.009	0.003
B) Sub plot : Planting geometry (PG)								
PG_1: 15cm x10 cm	0.009	0.017	0.017	0.006	0.011	0.030	0.008	0.003
PG_2: 20cm x 10 cm	0.007	0.019	0.016	0.006	0.012	0.029	0.011	0.002
PG_3: 25cm x 10 cm	0.011	0.019	0.014	0.008	0.014	0.029	0.010	0.002
PG_4: 30cm x 10 cm	0.007	0.020	0.015	0.007	0.012	0.029	0.011	0.002
PG_5: 2cm x 15 cm	0.009	0.021	0.013	0.007	0.014	0.027	0.011	0.002
C) Sub-sub plot : Fertilizers levels (F)								
F_1: 80: 40: 00 NPK kg ha^{-1} (RDF) without FYM	0.001	0.020	0.015	0.005	0.006	0.031	0.010	0.0005
F_2: 80: 40: 00 NPK kg ha^{-1} (RDF)with FYM	0.004	0.021	0.014	0.006	0.009	0.030	0.009	0.002
F_3: 80: 40: 40 NPK kg ha^{-1} with FYM	0.007	0.019	0.015	0.007	0.012	0.029	0.009	0.002
F_4:100: 50: 50 NPK kg ha^{-1} with FYM	0.013	0.018	0.015	0.007	0.017	0.028	0.011	0.003
F_5:120: 60: 60 NPK kg ha^{-1} with FYM	0.014	0.018	0.015	0.007	0.017	0.028	0.011	0.003
General mean	0.008	0.019	0.015	0.007	0.012	0.029	0.010	0.002

fertilizer levels in mean dry matter accumulation $hill^{-1}$ (g) partitioning was found to be significant. The upland situations (LS_1) along with the application of 120: 60: 60 NPK kg ha^{-1} with FYM (F_5) recorded significantly higher mean dry matter accumulation over rest of treatment combination and remains at par with LS_1F_4 and LS_3F_5 in stem and leaves during 2017 and earhead LS_1F_4 ,LS_3F_4 and LS_3F_5 during 2017 and LS_1F_4 during 2018.

The interaction effect between planting geometry and fertilizer levels in stem, leaves and earhead mean dry matter accumulation was found significant. The planting geometry 25 cm x 10 cm (PG_3) along with fertilizer level 120: 60: 60 NPK kg ha^{-1} with FYM (F_5) i.e. PG_3 F_5 recorded significantly higher mean dry matter accumulation $hill^{-1}$ (g) over rest of the treatment combinations. However, PG_3F_5 which was at par with

PG_3F_4, PG_5F_5 and PG_2F_5, PG_3F_4, PG_4F_4 in terms of leaves during *kharif* 2017 and *kharif* 2018, respectively.

The interaction effect between land situations, planting geometry and fertilizer levels in mean dry matter accumulation (g) hill^{-1} partitioning was found to be significant. The gently sloppy land (LS_3) with 25 cm x 10 cm (PG_3) and application of 120: 60: 60 NPK kg ha^{-1} with FYM (F_5) i.e. LS_3 PG_3 F_5 recorded significantly higher mean dry matter accumulation hill^{-1} (g) over rest of the combinations in respect of stem and leaves during 2017 and which was at par in stem dry matter accumulation hill^{-1} (g) with $LS_3PG_2F_5$ and $LS_3PG_3F_4$ in stem and in leaves and earhead $LS_1PG_3F_5$, $LS_1PG_4F_4$ and $LS_1PG_3F_4$, $LS_3PG_5F_5$ during *kharif* 2017.The treatment combination of LS_1 PG_3F_5 recorded significantly higher mean dry matter accumulation hill^{-1} (g) over rest of combinations in respect of stem and leaves during both the years.

Conclusion

On the basis of investigation, it can be concluded that the finger millet crop should be grown during *kharif* season on upland situation (well drained) followed by gently sloppy land (*Varkas*) with 25 cm x 10 cm planting geometry along with application of fertilizer dose @ 120: 60: 60 NPK kg ha^{-1} with FYM 5 t ha^{-1} for obtaining maximum dry matter accumulation (g) hill^{-1} partitioning and growth functions under south *Konkan* condition.

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