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Response of Sunflower to Fertiliser Levels under Different Planting Geometry and Land Configurations

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ABSTRACT

An experiment was carried out during *kharif*, 2013 at College farm, P.J.T.S.A.U, Hyderabad, to find out appropriate planting geometry, land configuration and optimum nutrient level for rainfed sunflower. The results revealed that planting geometry and land configurations could not exert significant influence on growth, yield attributes and yield of sunflower. Among the fertilizer levels, 125% RDF recorded significantly higher growth parameters, yield attributes, seed (2221 kg ha^{-1}), oil yield (902 kg ha^{-1}), stalk yield (3889 kg ha^{-1}) and harvest index (36%) over 75 % RDF but 125% RDF was comparable with 100% RDF. Highest gross, net returns and B: C ratio were accrued with flat bed and paired row planting along with the application of 125% RDF over rest of the treatments.

Key words : Land Configurations, Planting geometry, Sunflower and Yield.

Sunflower (*Helianthus annuus* L.), by virtue of its short duration, wider adaptability to different soil types, photo- insensivity and availability of promising hybrids and varieties, has stabilized its area and production in India. It is also a crop of choice for farmers due to its wider adaptability, high yield potential, shorter duration and profitability.

The productivity of sunflower in India is low (692 kg ha^{-1}) as compared to other sunflower growing nations and one of the major reason for low productivity is due to its cultivation mainly under rainfed conditions with sub optimal crop stand, imbalanced nutrition and lack of soil moisture conservation techniques, thus leading to poor seed set and high per cent of chaffy seed, low oil content and yield. Under rainfed conditions the response to the applied fertilisers depends on the soil moisture. Hence, efficient soil moisture conservation is the key for successful crop production under this situation. Proper land configuration helps to conserve soil moisture at the time of low rainfall or drought condition and it also helps to dispose water at the time of excess rainfall from the field.

Plant spacing effects are highly pronounced in sunflower because there is no possibility of covering gaps between plants by branching or tillering. Thus an optimum plant stand help in harnessing the renewable resources in efficient manner towards achieving high crop yields. Considering the importance of land configuration, planting geometry and nutrient management the present study was conducted to evaluate the interactive effects of planting geometry and different land configurations under fertiliser levels on growth, yield attributes and yield of rainfed sunflower.

MATERIAL AND METHODS

The experiment was conducted on medium Vertisol at college farm, College of Agriculture, Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad during *kharif* 2013. The soil of experimental site was sandy clay with pH of 7.54, electrical conductivity 0.32 dSm^{-1}, low in organic carbon (0.36 %), low in available nitrogen (267 kg ha^{-1}), phosphorus (31 kg ha^{-1}) and high in potassium (352 kg ha^{-1}). The experiment was laid out in split plot design with twelve treatment combinations *viz*; (Four main and three sub plots) and replicated thrice. The main plot treatments consisted of : M_1- Flat bed sowing at 60 cm x 30 cm, M_2- Ridge and furrow sowing at 60 cm x 30 cm, M_3- Flat bed with paired row planting at 45 cm x 40 cm (90/40 cm) and M_4- Broad bed and furrow with paired row planting at 45 cm x 40 cm (90/40cm) and sub plot treatments consisted of S_1- 75 % RDF, S_2- 100 % RDF (60:60:30 N, P_2O_5 and K_2O kg ha^{-1}) and S_3- 125% RDF.

Table 1. Growth and yield parameters of rainfed sunflower as influenced by different treatments.

Treatment	Plant height (cm)	Leaf area (cm^2)	SPAD chlorophyll meter readings	Leaf area duration (days)	Dry matter accumulation (g $plant^{-1}$)	Stem girth (cm)	Head diameter (cm)	Filled seed $head^{-1}$
Planting geometry and land configuration (M)								
M_1- Flat bed (60 cm x 30 cm)	175.4	4619	34.1	21.47	92.78	7.6	15.8	771
M_2- Ridge and furrow (60 cm x 30 cm)	176.0	4980	34.4	23.15	88.28	8.0	16.8	785
M_3- Flat bed with paired row 45 cm x 40 cm (90/40 cm)	175.7	4434	33.5	20.61	82.57	7.8	15.4	897
M_4- Broad bed and furrow with paired row 45 cm x 40cm (90/40cm)	183.7	4947	35.2	23.00	92.92	8.0	16.7	913
SEm ±	7.4	316	0.56	1.47	4.18	0.3	0.4	33
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	113
Fertilizer levels (S)								
S_1- 75 % RDF	174.0	4416	33.7	20.52	83.19	7.6	15.4	821
S_2- 100 % RDF	177.6	4621	34.1	21.48	87.81	8.0	16.3	831
S_3- 125% RDF	181.6	5197	35.2	24.15	96.41	8.0	16.8	873
SEm ±	1.8	209	0.32	0.97	1.82	0.1	0.4	14
CD (p=0.05)	5.4	626	0.96	2.91	5.46	0.3	1.1	42
Interaction (M x S) : N.S								

The sunflower crop (DRSH-1 hybrid) was sown on 9th July and harvested on 18th october, 2013. Full dose of P_2O_5 and K_2O along with half of the nitrogen in all the treatments was applied as basal and remaining nitrogen was applied in two equal splits i.e. 1/4th at 30 DAS and 1/4th at flowering as per the treatments. Need based plant protection measures were taken. The crop was grown completely under rainfed conditions. A total of 442.05 mm rainfall was received in 30 rainy days during the crop growth period. The growth parameters and yield attributes were taken on five representative plants and the mean values were computed for statistical analysis.

RESULTS AND DISCUSSION

Effect of planting geometry and land configurations:

Perusal of the data (Table.1) indicated that planting geometry and land configurations could not exert significant influence on growth parameters (plant height, leaf area, SPAD chlorophyll meter readings, leaf area duration, stem girth and dry matter accumulation).

Similarly the effect of planting geometry and land configurations on yield attributes (head diameter and yield per plant) except filled seeds per head and on yield (seed, stalk and oil) and harvest index was found to be non- significant.

Number of filled seeds $head^{-1}$ differed significantly among planting geometry and land configurations. Among the treatments, M_4 recorded higher number of filled seeds $head^{-1}$ (913) over M_1 (771) and M_2 (785) but (M_4) was comparable with M_3 (897) which in turn was comparable with M_2. The crop sown under M_1 (771) and M_2 (785) recorded significantly lower number of filled seeds $head^{-1}$ and were comparable with each other. While higher seeds $head^{-1}$ under M_4 and M_3 could be attributed to the adequate availability of soil moisture over other treatments.

A well distributed rainfall of 442.05 mm was received in 30 rainy days during the crop growth period. Thus the moisture availability to the

Table 2. Yield and economics of rainfed sunflower as influenced by different treatments.

Treatment	Seed yield plant^{-1} (g)	Seed yield (kg ha^{-1})	Oil yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Harvest index (%)	Cost of cultivation (₹ ha^{-1})	Gross returns (₹ ha^{-1})	Net returns (₹ ha^{-1})	B:C ratio
Planting geometry and land configuration (M)									
M_1- Flat bed (60 cm x 30 cm)	35.60	1960	802	3780	34	27210	66623	39413	2.43
M_2- Ridge and furrow (60 cm x 30 cm)	39.33	1994	832	3689	35	28210	67805	39596	2.40
M_3- Flat bed with paired row 45 cm x 40 cm (90/40 cm)	40.64	2079	847	3689	36	27210	70696	43485	2.60
M_4- Broad bed and furrow with paired row 45 cm x 40cm (90/40cm)	40.12	2052	854	3905	34	28510	69783	41273	2.43
SEm ±	0.86	168	67	182	1	-	-	-	-
CD (p=0.05)	2.97	NS	NS	NS	NS	-		-	-
Fertilizer levels (S)									
S_1- 75 % RDF	36.67	1763	739	3668	32	26694	59940	33246	2.25
S_2- 100 % RDF	38.18	2080	860	3748	36	27786	70713	42927	2.53
S_3- 125% RDF	41.93	2221	902	3889	36	28877	75527	46650	2.61
SEm ±	0.89	105	44	46	1	-	-	-	-
CD (p=0.05)	2.67	316	131	138	3	-	-	-	-
Interaction (M x S) : N.S									

crop under different planting geometry and land configurations was adequate and uniformly distributed without any moisture stress during crop growth period and hence resulted in non significant growth parameters, yield attributes and thus finally reflected in non significant yields.

Among the planting geometry and land configurations flatbed and paired row planting accrued higher net returns and B: C ratio over rest of the treatments.

Effect of fertiliser levels:

Graded levels of fertiliser had significantly influenced growth parameters, yield attributes and yield.

Crop fertilised with 125% RDF recorded tallest plants and maximum leaf area (181.6 cm and 5197 cm^2) over 75% RDF (174.0 cm and 4416 cm^2) and 125 % RDF was comparable 100% RDF (177.6 cm and 4621cm^2). The increase in plant height and leaf area with increasing fertilizer level was probably due to its beneficial effect on cell elongation and production of more number of leaves. An increase in number of leaves per plant signifies that there was a substantial improvement in the source of photosynthates that could be translocated to the sink. Similar results with respect to improved plant height and leaf area under higher level of fertilizer in sunflower were reported by Kadasiddappa *et al*. 2007 and Sarkar and Mallick (2009).

Perusal of SPAD chlorophyll meter readings indicated significantly higher value under 125% RDF (35.2) over 75 (33.7) and 100 % (34.1) RDF which could be probably due to the higher photosynthetic area coupled with the persistence of the leaf area for relatively longer time as evident from the higher leaf area duration values (Table.1).These results are in line with those of Pavani *et al.* (2012). Similarly dry matter production and stem girth were significantly higher with 125 % RDF (162.97 g and 8.0 cm) over 75 % RDF (148.42 g and 7.6 cm) but it was comparable with 100 % RDF (153.44 g and 8.0 cm). This could be ascribed to the adequate supply of nutrients under 125 % RDF that resulted in greater plant height

and higher production of photosynthates (leaf area) as evident from the respective data (Table 1).These results are in line with those of Sardana and Bajaj (2007) and Pavani *et al*. (2013).

Yield attributes (head diameter and number of filled seeds head^{-1}) were significantly higher with application of 125% RDF (16.8 cm and 873) over 75% RDF (15.4 cm and 821) however, 125 % RDF was comparable with 100% RDF (16.3 cm and 831) which in turn was comparable with 75% RDF. The yield (seed, oil and stalk) and harvest index were significantly higher with 125% RDF (2221, 902, 3889 kg ha^{-1} and 39 %) over 75% RDF (1763, 739, 3668 kg ha^{-1} and 32 %) but 125 % RDF was comparable with 100% RDF (2080, 860, 3748 kg ha^{-1} and 32 %) in terms of yield and harvest index

Seed yield in sunflower is the function of several growth parameters (plant height, leaf area and dry matter accumulation) yield attributing characters viz., head diameter, number of filled seeds, test weight and yield plant^{-1}. Cumulative effect of improved growth parameters and yield attributes due to adequate supply of fertilizers under 125% RDF had also positively reflected in higher seed, stalk yield and harvest index. Among the yield attributes, head diameter is the most important character, which improves the seed yield by providing maximum number of florets for higher seed set. Harvest index basically depends on the economic yield (seed). Thus higher seed yield under 125% RDF and 100 % RDF resulted in higher harvest index values over 75 % RDF.

Higher seed yield under in flat bed and paired row planting and application of 125 % RDF accrued higher gross returns, net returns and benefit cost ratio. These findings corroborate with those of Pavani *et al.* (2012) and Byomkesh Let *et al.* (2014).

From the foregoing results, it can be concluded that under Southern Telangana region during a normal year of rainfall, flat bed with paired row planting and application of 125% RDF could be recommended for improved growth parameters, yield attributes, higher seed and oil yield of sunflower besides higher monetary returns.

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