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Impact of Land Configurations and Nutrient Levels on Growth and Yield of Sunflower under Rainfed Condition

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A B S T R A C T

The field investigation was carried out at the Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *Kharif* season of 2015-16 on clay loam soil. The experiment was laid out in split plot design with three replications. The main plot treatments comprised of four land configuration treatments viz., flat bed sowing, ridges and furrow, paired row planting and broad bed furrow while the sub plot treatments consisted of three nutrient levels viz., 75 % RDF, 100 % RDF and 125 % RDF. The treatment ridges and furrow significantly improved these growth parameters as compared to flatbed sowing and paired row planting but was found to be at par with broad bed furrow. Significantly highest seed yield (1316 kg ha^{-1}) and straw yield (3289 kg ha^{-1}) were recorded with ridges and furrow as compared to paired row planting and flatbed but was at par with broad bed furrow. The land configuration treatment ridges and furrow recorded significantly higher GMR (Rs.42999 ha^{-1}), NMR (Rs.24032 ha^{-1}) and B: C ratio (2.26). As far as nutrient levels are concerned it was noted that the growth attribute viz., plant height, number of functional leaves, leaf area, stem girth and dry matter were significantly improved with the application of 125 % RDF but was at par with 100 % RDF. Similarly yield attributes such as diameter of disc, weight of disc, number of filled seed, seed weight per plant and 100 seed weight were also significantly higher with the application of 125 % RDF. Application of 125 % RDF recorded higher seed yield per ha. GMR, NMR and B: C ratio than 100 % and 75 % RDF.

Introduction

Sunflower (*Helianthus annuus* L.) oil is preferred among the consumers in India for its health benefits and sunflower oil is the largest selling oil in the branded oil segment. It is also a crop of choice for farmers due to its wider adaptability, high yield potential, shorter duration and profitability. Presently in India sunflower is grown over an area of 5.51 lakh hectares with a production of about 4.15 lakh tonnes and average productivity of 752 kg per hectare. In Maharashtra it is grown over an area of 0.46 lakh hectares with a production of about 0.19 lakh tonnes and the productivity is 425 kg per hectare (Anonymous, 2016). 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.

The crops grown under rainfed condition are either subjected to excess water or water deficit condition. Intermittent dry spell of 10 to 15 days or even more are commonly observed affecting growth of the crop. Therefore it is necessary to reduce water loss from soil. Under rainfed conditions, response to the applied fertilizers varies with the available soil moisture. Hence, efficient soil moisture conservation is the key for successful crop production under this situation. Application of fertilizers having nutrients viz., nitrogen, phosphorous and potash can increase sunflower growth and yield substantially (Reddy *et al.,* 2007). Intensive agriculture with fertilizer use is highly skewed towards nitrogen, has deprived the soil of other essential nutrients, especially P and K. Hence, balanced fertilizer application is important for high seed and oil yield. Appropriate combination of land configuration along with nutrient levels not only meets the crop nutrient requirements and sustain productivity but also improve soil health. Considering these facts the present study has been undertaken to study the effect of land configurations and nutrient levels to improve the productivity of sunflower.

Materials and Methods

The present experiment on sunflower was conducted during *kharif* 2015 at Oilseed Research Unit farm, Dr. PDKV, Akola. The soil of experimental site was clay loam with pH of 8.1, electrical conductivity 0.32 dSm^{-1}, low in organic carbon (0.38 %), low in available nitrogen (181.17 kg ha^{-1}) and phosphorus (14.12 kg ha^{-1}) and marginally high in available potassium (323.33 kg ha^{-1}). The experiment was laid out in split plot design consisting of twelve treatments combinations and replicated thrice. The main plots consisted of : L_1- Flat bed, L_2- Ridges and furrow, L_3- Paired row planting and L_4- Broad bed and furrow and N_1- 75 % RDF, N_2- 100 % RDF (80:60:30 N, P_2O_5 and K_2O kg ha^{-1}) and N_3- 125 % RDF were the sub plot treatments. The sunflower hybrid (DRSH-1) was sown on 7th August and harvested on 6th November, 2015. Full dose of P_2O_5 and K_2O along with half of the nitrogen in all the treatments was applied as basal. Remaining nitrogen was applied at 30 DAS as per the treatments. Need based plant protection measures were taken. The crop was grown completely under rainfed conditions. A total of 258.4 mm rainfall was received in 12 rainy days during the crop growth period.

Results and Discussion

Growth and growth attributes

The data from Table 1 indicated that the land configuration technique of ridges and furrow recorded maximum plant height which was at par with broad bed furrow, both these treatments were significantly superior over paired row planting and flatbed which were also statistically similar in respect of plant height. Application of 125 % RDF remains at par with 100 % RDF and recorded significantly higher plant height over 75 % RDF. Application of 100 % RDF and 75 % RDF were similar in respect of plant height. The increase in plant height with increase in nutrient management might have attributed to greater availability of nutrients with increase in application rate which might have favourable effect on plant growth. Similar results were observed by Byomkesh *et al.,* (2014).

The data in respect of functional leaves indicated that ridges and furrow and broad bed furrow both being at par and recorded

significantly more number of functional leaves than the paired row planting and flatbed which were also remain at par with each other in respect of functional leaves. Application of 125 % RDF and 100 % RDF both treatments being at par produced significantly higher number of functional leaves than the 75 % RDF level.

Treatment ridges and furrow, broad bed furrow and paired row planting were statistically equal in effect and recorded significantly more stem girth than the flat bed.

Application of 125 % RDF being at par with 100 % RDF recorded significantly higher stem girth than the 75 % RDF, which was at par with 100 % RDF level. Similar results were also reported by Solangi *et al.*, (1999)

Significant increased in growth attributes with ridges and furrow and broad bed furrow as compared to paired row planting and flatbed indicated adequate moisture conservation in soil, resulting in good supply of required moisture, available nutrients, soil aeration which has benefited to the crop during growth period, resulted in optimum cell division and their elongation which resulted in enhanced plant height, number of functional leaves and stem girth. The results were in conformity with those reported by Ahmad *et al.*, (2000)

The dry matter production per plant was significantly higher with ridges and furrow than the paired row planting and flatbed but was at par with broad bed furrow which was significantly superior over flat bed and at par with paired row planting. Increased moisture availability in root zone due to ridges and furrows increases the availability of nutrients as well as nutrient uptake which led to increase in the overall growth of crop and the resultant increase in dry matter accumulation. Elevated moisture content (%) in ridges and furrows might have helped the sunflower crop to record higher dry matter. These results were supported with the findings of Kalegore and Girme (2009).

Table.1 Effect of land configurations and nutrient levels on growth and growth attributes

Treatments	Plant height	No. of functional leaves	Stem Diameter	Dry matter accumulation
1. Main plot (Land configuration)				
L_1 -Flat bed	167.52	26.02	1.72	154.56
L_2 -Ridges and furrows	175.56	29.50	1.84	168.54
L_3 -Paired row planting	168.11	27.80	1.78	159.33
L_4 - Broad bed furrow	174.07	29.02	1.82	162.66
SE(m)±	1.64	0.71	0.03	1.95
CD at 5%	5.66	2.44	0.09	6.75
2. Sub-plot (Nutrient levels)				
N_1 -75% RDF	167.67	26.02	1.75	156.33
N_2 -100% RDF	171.19	29.50	1.78	162.66
N_3 -125% RDF	175.08	27.80	1.84	165.67
SE(m)±	1.31	29.02	0.02	1.74
CD at 5%	3.96	0.71	0.07	5.21
3. Interaction (L x N)				
SE(m)±	2.63	0.78	0.05	3.48
CD at 5%	NS	NS	NS	NS

Table.2 Yield attributes, yield and economics of sunflower as influenced by land configuration and nutrient levels

Treatment	Diameter of disc	Filled seed	Seed yield plant^{-1}(g)	100 seed weight(g)	Seed yield (kg ha^{-1})	NMR (Rs. ha^{-1})	B:C Ratio
Main plot (Land configuration)							
L_1 -Flat bed	14.82	599	28.83	3.66	1081	17943	2.00
L_2 -Ridges and furrows	15.44	758	35.14	3.95	1316	24032	2.26
L_3 -Paired row planting	15.21	685	29.44	3.78	1209	21188	2.13
L_4 - Broad bed furrow	15.37	729	S32.00	3.87	1268	22206	2.14
SE(m)±	0.35	18	1.00	0.17	28	-	-
CD at 5%	NS	64	3.46	NS	97	-	-
Sub-plot (fertilizer levels)							
N_1 -75% RDF	14.68	625	28.60	3.70	1103	18647	2.06
N_2 -100% RDF	15.06	705	31.30	3.56	1186	20235	2.07
N_3 -125% RDF	15.89	749	34.17	4.18	1367	25145	2.27
SE(m)±	0.31	13	0.62	0.15	21	-	-
CD at 5%	0.93	41	1.87	0.44	63	-	-
Interaction (L x N)							
SE(m)±	0.062	28	1.27	0.29	42	-	-
CD at 5%	NS	NS	NS	NS	NS	-	-

Each increment in nutrient levels significantly increased dry matter accumulation per plant. At harvest, application of 125 % RDF and 100 % RDF remain at par and produced significantly higher dry matter than the 75 % RDF. Increased application of nutrients which increased leaf photosynthetic rate which might have resulted in higher accumulation of metabolites in both vegetative and reproductive fractions thus resulted significant gain in total dry matter per plant in response to increased rate of nutrients application. These results were supported with the findings of Byomkesh *et al.*, (2014)

Yield and yield attributes

The data in the Table 2 indicated that, land configurations had no significant effect on diameter of disc. Application of 125 % RDF remain at par with 100 % RDF and registered significantly higher diameter of disc than the 75 % RDF level, which was at par with 100 % RDF.

Number of filled seeds disc^{-1} differed significantly due to land configurations. The ridges and furrow, broad bed furrow, and paired row planting treatment remain at par and recorded significantly higher number of filled seeds per disc than the flat bed treatments. Higher filled seed disc^{-1} under ridges and furrow, broad bed furrow and paired row planting could be attributed to the adequate availability of soil moisture over other treatments. These findings are in close accordance with Byomkesh *et al.*, (2014).

Among the fertilizer levels application of 125 % RDF and 100 % RDF both remain at par and recorded significantly more number of filled seeds than 75 % RDF treatment.

Cumulative effect of improved growth parameters (plant height and dry matter accumulation) through efficient metabolic activity, increased photosynthetic rate and supply of photosynthates from source to sink had accommodated more number of filled seeds Disc^{-1} under 125 % RDF. These results are in line with those of Thorat *et al.*, (2007).

The seed yield plant^{-1} differed significantly due to land configurations. The treatment ridges and furrow remain at par with broad bed furrow and recorded significantly higher seed yield plant^{-1} than the paired row planting and flat bed, which were also statistically comparable with paired row planting. The seed yield plant^{-1} significantly increased with every increased fertilizer level. Application of 125 % RDF recorded highest seed yield plant^{-1} followed by 100 % RDF and 75 % RDF. Maximum seed yield plant^{-1} with application of 125 percent RDF is due to maximum head diameter, more number of seed plant^{-1} and the highest test weight in this treatment. This finding is in close proximity with that of Thorat *et al.*, (2007) in sunflower.

The hundred seed weight was found to be non-significant due to different land configuration treatment. While the Application of 125 % RDF registered significantly higher hundred seed weight than 100 % RDF and 75 % RDF, which were at par with each other.

Treatment ridges and furrow (1316 kg ha^{-1}) recorded significantly higher seed yield than the paired row planting (1209 kg ha^{-1}) and flatbed (1081 kg ha^{-1}), whereas it remain at par with broad bed furrow (1268 kg ha^{-1}) and paired row planting were also significant over flat bed in respect of seed yield. The significant increase in weight of disc, number of filled seed, seed yield per plant under ridges and furrow, broad bed furrow and paired row planting ultimately resulted into higher seed yield per hectare over flat bed. Similar type of results was reported by Malik *et al.*, (2001). Among the nutrient levels, application of 125 % RDF (1367 kg ha^{-1}) recorded significantly higher seed yield of sunflower over 100 % RDF (1186 kg ha^{-1}) and 75 % RDF (1103 kg ha^{-1}) level, which were statistically equal in seed yield. These findings corroborate with those of Nandhagopal *et al.*, (2003).

Economics

Higher net monetary returns and B:C ratio were obtained in ridges and furrow. The net monetary returns and B:C ratio were found higher under 125 % RDF level than the100 % and 75 % RDF level. Profound influence of land configuration for better crop growth and yield could result in improving the net returns and benefit cost ratio underridges and furrow and broad bed furrow over paired row planting and flat bed methods. These findings are in close accordance with Somasundaram *et al.*, (2000).

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