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EFFECT OF LAND LAY OUT AND DEPTH OF IRRIGATION ON SAFFLOWER (*CARTHAMUS TINCTORIUS* L.) IN MARATHWADA REGION MAHARASHTRA

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ABSTRACT

An agronomic experiment was conducted to find out the effect of land layout and optimum water requirement of safflower. A field experiment was land layout in split-design with four replications. Among land layout in ridges and furrow method were recorded highest number of functional leaves, leaf area/plant, number of branches /plant, highest dry matter /plant and LAI, in paired row planting observed that significantly higher values of these growth attributes and among the depth of irrigation 60 cm depth recorded highest values for above growth attributes. In case of yield attributes and yield land layout in ridges and furrow method recorded highest number of capitula/plant, number of seeds/capitulum (20.40), number of seeds/plant (449.05), seeds weight /plant (20.45g), seeds yield (1579 kg/ha) and highest net return ₹14611/ha and among the depth of irrigation, 60 mm depth recorded highest yield attributes as well as net return (₹14332/ha). It can be inferred from above data that for obtaining the maximum seed and highest monetary net returns, safflower should be sown in ridges and furrow method at 60 ×15 cm spacing with 60 mm depth of irrigation.

Keywords:
Ridge,
Farrow,
Irrigation depth,
Safflower

INTRODUCTION

India is the largest producer of oilseeds in the world and the oilseed sector occupies an important position in the country's economy. The country accounts for 12-15 per cent of global oilseeds area, 6-7 per cent of vegetable oils production, and 9-10 per cent of the total edible oils consumption. In terms of acreage, production and economic value, oilseeds are second only to food grains. Besides the nine major oilseeds cultivated in India, a number of minor oilseeds of horticultural and forest origin, including coconut and oilpalm, are also grown. In addition, substantial quantities of vegetable oils are obtained from rice bran and cotton seed along with a small quantity from tobacco seed and corn. The area and production under the nine oilseeds was 26.11 million ha and 24.88 Mt, respectively in 2009-10, whereas the total edible oil production in the country stood at 6.17 MT in 2009-10. As per the fourth advance estimates for 2010-11, the production of total nine oilseed crops is 31.10 MT, which is a quantum jump over previous year's production. Oilseeds area and output are concentrated in the central and southern parts of India, mainly in the states of Madhya Pradesh, Gujarat, Rajasthan, Andhra Pradesh and Karnataka. Among different oilseeds, groundnut, rapeseed-mustard and soybean account for about 80 per cent of area and 87 per cent of production of oilseeds in the country (ASG, 2010-11).

Safflower (*Carthamus tinctorius* L.) is an important *rabi* oilseed crop of Maharashtra, apart from its superior adaptability to scanty moisture condition. It produce oil rich in polyunsaturated fatty acids (linoleic acid 78%), which play an important role in reducing the blood cholesterol level for centuries. It has been under cultivation in India either for its colored florets and much valued oil. Safflower acreage and production around the world has been witnessing wide fluctuations since last two decades .The crop is grown in an area of 691000 ha, with a production of about 615000 tones in more than 60 countries worldwide .India is the largest producer of safflower in the world, grown in an area of 295000 ha, with a production of 189000 tonnes (ISRO, 2012). Productivity of safflower needs to be increased, as this is a cash crop of medium and small holding farmers. It is hypothesized that this problem can be solved by introducing safflower in command areas with 2-3 protective irrigations. This will reflect in achieving the self sufficiency to some extent in oilseeds production of Maharashtra in general and Marathwada in particular. Farmers are using old method of irrigation i.e. flooding due to which wilting of plant occurs. The losses due to safflower wilt are more than 40%. To overcome this problem, modification in the land layout for scheduling of irrigation is the only one solution besides this growing of wilt tolerant variety should be preferred. The information on land layout, method of scheduling of irrigation and depth of irrigation

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required is meager. Hence, there is urgent need to know land layout for irrigation scheduling and depth of irrigation so as to make safflower cultivation a successful proposition under Jayakwadi and Purna command area of *vertisols* and salt prone area. In the view of this, experiment was conducted on land layout and depth of irrigation.

MATERIALS AND METHODS

The experiment was conducted during *rabi* season of 2005 at college farm, MAU, Parbhani which is situated at 409 m latitude and 19 º 16 North latitude and 76 º 47 E longitudes and has a sub-tropical climate. The Experiment field was laid out in spilt plot design after preparatory cultivation. It consisted of four replications with nine experiment units. The gross and net plot size 5.4 × 6.0 m and 4.5 ×5.0 m, respectively. Land layout and depth of irrigation treatment were randomly allotted to blocks in each replication. The distance between two plots was 1.0 m and in between two replication was 1.5 m. Irrigations were applied to safflower in ridge and furrow (60 × 15 cm), skip row furrow (45-90 × 13.33 cm) method and Paired row planting (30-60 × 20 cm). In Skip row method/ furrows were opened at 30 days after sowing. One row after every two crop rows was skipped and a furrow was opened in between skipped row. In paired row planting, every two crop rows were combined and a furrow was opened for giving irrigation. The soil sample were taken from 0 to 30 cm depth, covering experiment area and their composite representative soil samples were prepared by international pipette method (Piper, 1966), available nitrogen by Alkaline permanganate method (Subbiah and Asija, 1956), available phosphorus by Metavenadate method (Olsen *et al.*, 1954), available potassium by flame Photometer (Black, 1965) soil pH by Glass electrode pH meter and organic carbon by Walkey and Black's rapid titration method. Critical difference (CD) values at P=0.05 were used for determine the significance of differences between mean values of treatments.

RESULTS AND DISCUSSION

Effect of land lay out

The effect of land layout on plant height was found significant at all growth stages (Table 1). In ridges and furrow land layout recorded significantly higher plant height (15.96 cm) at 30 DAS, which was significantly superior over other land layout. Minimum plant height was recorded in paired raw planting. The mean plant height increased up to harvest, the rate of increase in plant height was gradual and steady upto 30 DAS, fast between 45 to 60 DAS and increased with increasing rate upto 90 DAS and there after slightly increased till harvest. The mean plant height recorded at harvest was 65.81 cm. The number of primary branches increased rapidly during 60 to 90 DAS after sowing (9.51 to 14.77) and increased with decreasing rate till the harvest. The mean primary branches recorded at harvest were 19.18. At 45 DAS, the highest number of branches (10.32) was recorded by ridges and furrow method, which was significantly superior over rest of the treatment. Second best land layout was skip row method, which was significantly superior over paired row planting method. Mean number of secondary branches /plant were significantly affected by different treatments. The number of secondary branches increased rapidly during 60 to 90 days after sowing and then increased slowly upto 105 DAS. The mean number of secondary branches per recorded at harvest were 19.93. At 60 DAS, among different land layout, ridges and furrow produced significantly higher secondary branches (10.81) as compared to other land layouts. The lowest secondary branches were produced in paired row planting method (7.07). The Mean leaf area (dm^2)/ plant was increased upto 90 DAS and decreased thereafter upto harvest (Table 2). The rate of increased very rapid during 45 and 75 DAS. The maximum mean leaf area/plant recorded at 90 DAS after sowing was 29.78 dm^2 and minimum leaf area of 17.60 dm^2 was recorded at harvest. At 30 DAS maximum dry matter per plant was accumulated in ridges and furrow method (3.07 g), which was significantly superior over other land layouts. Similar trends was found at 45, 60, 75, 90, 105 DAS and at harvest. The land layout played a conspicuous role in dry matter production. Ridge and furrow method produced higher dry matter/plant than skip row method and paired row planting. Characters viz. plant height, number of branches, number of leaves, leaf area were higher due to ridge and furrow method of lay out than other methods. Highest leaf area at ridge and furrow method was reflected in LAI leading to more photosynthetic surface area for tapping more assimilates, accumulating higher dry matter/ plant as compared to mother land lay outs. Similar findings were reported by Shelke *et al*. (2002); Lenssen *et al*. (2007); (Ejieji and Adeniran, 2010). The effect of land layout on plant height was found significant at all growth stages (Table 3). In ridges and furrow land layout recorded significantly Among land layout in ridges and furrow method were recorded significantly higher numbers of capitula/plant, weight of capitula /plant(g) number of seed/capitula, number of seed/plant, seed weight/plant(g), seed yield, biological yield and harvest index. Ridge and furrow method produced higher yield attributes than skip row method and paired row planting. Among land layout in ridges and furrow method were recorded significantly higher numbers of capitula/plant, weight of capitula /plant (g) number of seed/capitula, number of seed/plant, seed weight/plant (g), seed yield, biological yield and harvest index due to more photosynthetic surface area for tapping more assimilates, accumulating higher sink ratio as compared to other land lay outs. Similar findings were reported by Shelke *et al*. (2002); Lenssen *et al*. (2007); (Ejieji and Adeniran, 2010).

Table 1 Effect of land lay out and depth of irrigation on growth parameters of safflower

Treatment	Plant height (cm)							Primary branch						Secondary branch				
	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	At harvest	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	At harvest	60 DAS	75 DAS	90 DAS	105 DAS	At harvest
Land layout																		
Ridges and furrow	15.96	34.77	52.74	62.28	66.75	69.49	70.55	10.32	11.18	15.01	17.83	17.85	20.81	10.81	15.02	16.33	17.37	22.63
Skip row furrow method	13.18	32.13	49.97	55.09	63.22	63.88	65.90	8.42	9.55	13.11	14.54	15.68	18.87	8.98	12.70	14.38	15.68	20.81
Paired row planting	11.35	29.02	47.12	49.66	60.85	60.97	60.99	7.26	7.82	11.18	11.96	13.39	17.87	7.07	10.35	12.06	13.39	14.87
CD(*P*= 0.05)	0.31	0.48	1.65	0.64	1.74	1.39	1.39	0.56	0.58	0.61	1.04	1.61	0.20	0.81	0.78	0.28	1.23	0.41
Depth of irrigation (mm)																		
40mm	12.75	30.16	47.42	53.73	62.28	62.95	63.18	7.54	8.70	12.34	13.89	13.92	18.14	8.19	10.68	12.23	13.87	19.25
50mm	13.26	31.41	50.29	55.81	63.98	64.31	65.56	8.92	9.51	13.07	14.70	15.65	19.18	8.85	12.68	14.25	15.65	20.43
60mm	14.47	34.35	52.12	57.33	65.22	66.41	68.70	9.53	10.35	13.90	15.69	16.92	20.23	9.82	14.71	16.30	16.92	21.64
CD(P= 0.05)	0.56	0.65	1.25	0.55	0.43	0.95	0.95	0.42	0.52	0.54	0.57	0.82	0.36	0.35	0.13	0.17	0.80	0.45
Interaction																		
CD(*P*= 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Grand mean	13.39	31.97	49.94	55.65	63.71	64.66	65.81	8.66	9.51	13.10	14.77	15.49	19.18	8.95	12.69	14.25	15.48	19.93
Additional treatment(Flat bed)	12.11	30.65	48.51	55.15	62.46	64.17	64.20	8.10	9.25	12.15	16.20	16.50	17.81	8.21	12.10	14.15	15.21	19.21

Table 2 Effect of land lay out and depth of irrigation on growth parameters of safflower

Treatment	Leaf area (dm^2)							Dry matter per plant (g)						
	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	At harvest	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	105 DAS	At harvest
Land layout														
Ridges and furrow	7.37	14.67	22.95	31.04	32.56	21.12	20.07	3.07	5.38	9.20	19.93	30.29	39.68	40.70
Skip row furrow method	5.41	13.00	20.84	27.81	29.33	17.64	16.77	2.61	4.07	8.59	18.21	28.13	34.04	34.45
Paired row planting	4.39	9.80	18.70	25.54	27.43	16.09	14.24	2.35	3.41	7.54	17.47	25.83	28.50	28.60
CD(*P*= 0.05)	0.35	1.59	0.25	0.70	1.01	1.11	0.50	0.17	0.27	0.34	0.56	1.12	3.95	4.00
Depth of irrigation (mm)														
40mm	3.67	7.91	18.40	26.27	27.92	16.16	14.57	1.91	3.61	7.48	15.27	24.98	28.44	29.55
50mm	5.79	12.32	21.13	28.24	29.85	17.40	17.16	2.69	4.36	8.36	18.59	29.70	31.71	32.85
60mm	7.72	17.24	22.96	29.89	31.62	21.08	21.07	3.43	4.89	9.54	21.76	31.56	40.14	41.35
CD(*P*= 0.05)	0.34	0,83	0.53	0.79	0.46	0.94	0.82	0.18	0.18	0.22	0.41	1.05	1.87	1.92
Interaction														
CD(P= 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
grand mean	5.72	12.49	20.83	28.13	29.78	18.28	17.60	2.67	4.28	8.45	18.43	28.41	33.43	3.58
Additional treatment(Flatbed) bed)	5.10	11.45	17.35	25.47	29.33	16.50	14.25	2.56	3.35	8.40	17.21	25.27	30.27	30.30

Table 3 Effect of land lay out and depth of irrigation on yield parameters of safflower

Treatment	Yield attributes										Yield (kg)		
	Capitula / plant					Weight of capitula /plant (g)	No. of seed/capitula	No. of seed/plant	Seed weight /plant (g)	1000 seed weight (g)	Seed yield (kg),	Biological yield (kg)	Harvest index (%)
	60DAS	75DAS	90 DAS	105DAS	At harvest								
Land layout													
Ridges and furrow	16.33	18.23	23.85	25.36	25.40	58.43	22.81	449.05	20.45	45.91	1579	4155	38.53
Skip row furrow method	13.71	14.62	21.66	23.27	23.30	54.72	20.43	370.36	16.96	44.00	1430	3868	37.24
Paired row planting	12.15	12.37	19.80	22.42	22.45	52.45	18.48	342.10	13.40	41.66	1287	3576	35.79
CD(*P*=0.05)	1.20	0.72	0.68	1.01	1.01	0.99	1.46	26.42	2.52	1.36	103	276	0.84
Depth of irrigation (mm)													
40mm	12.49	12.93	19.93	21.74	21.80	53.36	18.50	304.60	11.53	42.08	1317	3555	36.40
50mm	14.03	14.37	21.66	23.67	23.69	55.30	20.74	359.80	14.74	43.83	1423	3843	37.03
60mm	15.68	17.91	23.73	25.63	25.65	57.14	22.48	505.10	24.55	46.66	1556	4201	37.99
CD(*P*= 0.05)	1.08	0.82	o.86	0.92	0.96	1.34	0.88	32.53	2.38	0.72	83	226	0.61
Interaction													
CD(*P*= 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
grand mean	14.06	15.07	21.77	23.68	23.71	55.20	20.57	388.50	16.93	43.85	1432.5	3067.0	37.16
Additional treatment(Flat bed)	12.75	15.00	20.48	23.6	23.65	65.43	20.43	450.27	22.37	53.15	1357.9	3850.50	37.0

Effect of irrigation depth

Effect of irrigation depth was found significant at all growth stages (Table 1 and 2). At 30 days, irrigation scheduled at 60 mm depth recorded highest plant height (14.47), which was significantly superior over depth of irrigation and followed by 50 and 40 mm and 45 DAS, among different irrigation depth, irrigating safflower at 60 mm depth recorded significantly highest number of primary branches (9.53) followed by 50 mm (8.92) and 40 mm depth (7.54). At 60 DAS, the highest number of secondary branches (9.82) was found in irrigation scheduled at 60 mm depth, which was significantly superior over all other treatments. The lowest numbers of secondary branches (8.19) were produced by 40 mm depth of irrigation. Similar results were recorded at 75, 90, 105 days and at harvest. Results clearly showed that 60 mm depth of irrigation recorded higher leaf area than 40 mm and 50 mm. At 30 days, the maximum dry matter accumulated/plant (3.43 g) was due to irrigation scheduling to safflower at 60 mm depth, which was significantly superior over 40 and 50 mm depth. The lowest dry matter/ plant (1.91g) was observed in 40 mm depth of irrigation. Similar type results were observed at 45, 60, 75, 90, 105 DAS and at harvest. Highest leaf area was reflected in LAI leading to higher photosynthetic surface area for tapping more assimilate, accumulating higher dry matter/ plant as compared to other depths of irrigation it is due to the availability of moisture in active root zone in abundant quantity which improves growth of crop. Similar findings were reported by Sharma *et al*. (2011); Allen *et al*. (2004).

The data presented in Table 3 indicated that the effect of depth of irrigations were recorded significantly higher numbers of capitula/plant, weight of capitula /plant (g) number of seed/capitula, number of seed/plant, seed weight/plant (g), seed yield, biological yield and harvest index were found significant at all stages of safflower. At 60 days the highest capitula per plant (15.68) were recorded due to 60 mm depth of irrigation, which was significantly superior over 50 and 40 mm depth. Similar type of results were observed at 75, 90, 105 days after sowing and at harvest. The depth of irrigation at 60 mm recorded highest weight of capitula/plant (57.14 g) and significantly superior over other treatments. Scheduling of irrigation at 60 mm depth recorded highest number of seeds/capitula (22.48) and followed by 50 and 40 mm depth. Irrigation scheduling at 60 mm depth recorded highest number of seeds per plant (505.10) and significantly superior over other treatments. The lowest seeds per plant were recorded at 40 mm depth of irrigation (304.60). Test weight of safflower was significantly more due to 60 mm irrigation depth (44.66) than 50 (43.83) and 40 mm (42.08). The effect of depth of irrigation on volume weight was found to be significant. Volume weight of safflower was significantly more due to 60 mm irrigation depth (472.75) than 50 and 40 mm. The effect of depth of irrigation on seed yield/ha was found significant. irrigating safflower at 60 mm depth recorded highest seed yield (1556 kg/ha) and was found significantly superior over 50 mm (1423 kg/ha) and mm (1317 kg/ha). Irrigating safflower at 60 mm depth was more effective and recorded significantly highest biological yield (4201 kg/ha) and followed by 50 and 40 mm depth and irrigating safflower at 60 mm depth (37.99) recorded significantly higher harvest index. Table 1clearly showed that 60 mm depth recorded higher leaf area than 50 mm and 40mm. highest leaf area by 60 mm depth was reflected in LAI leading to higher photosynthetic surface area for tapping more assailers, accumulating higher dry matter per plant as compared to other depths of irrigation it is due t the availability of moisture in active root zone in abundant quantity which improves growth and yield component of the crop. Similar findings were reported by Shelke *et al*. (2002); Lenssen *et al*. (2007); (Ejieji and Adeniran, 2010).

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