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Performance of Varieties and Row Spacing on Yield, Quality and Economics of Safflower (*Carthamus tinctorius* L.)

Mirza I.A.B.*, Gokhale D.N., Pawar S.U. and Shaikh Wasim Chand
Department of Agronomy, College of Agriculture, VNMKV, Parbhani.
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ABSTRACT

A field experiment was conducted during the rabi season of 2015 at AICRP on safflower, V.N.M.K.V., Parbhani with a view to find out the suitable row spacing for safflower on seed yield, oil content, oil yield and economics of safflower. The experiment was laid out in factorial randomized block design with five spacing S_1-30 cm x 20 cm, S_2-45 cm x 20 cm, S_3-60 cm x 20 cm, S_4- 75 cm x 20cm, S_5- 90 cm x 20 cm. and two varieties Annegeri -1 (V_1) and NARI- 38 (V_2) in three replications. Each experimental unite was repeated three times 5.4 x 4.0 m^2 size in gross plot and it was of 4.5 x 3.6 m^2 size in net plot. From the result of experiment can be concluded that among different varieties of safflower Annegeri -1 produced significantly higher yield attributes, higher gross monetory returns, net monetory returns and B: C ratio followed by NARI-38 (V_2). The variety Annegeri-1 (V_1) produced significantly higher yield and yield attributes, higher gross monetory returns, net monetory returns and B: C ratio when sown with S_2-45 cm x 20 cm. Sowing of safflower at S_2-45 cm x 20 cm spacing was found better for higher yield and economics was followed by S_1-30 cm x 20 cm. The interaction effects of varieties x spacings were found to be non- significant.

Key words: *Safflower, Oilseeds, Cereals, Agricultural*

INTRODUCTION

India is among the largest economy in the world with 21 per cent of the world's agricultural area but accounts for less than 10 per cent of the world's agricultural production to meet the need of about 16 per cent of the world's population. Oilseeds is the second largest agricultural commodity after cereals sharing 13 per cent of the country's gross cropped area and accounting for nearly 6 per cent of gross national production and 10 per cent of the value of all agricultural commodities. Safflower (*Carthamus tinctorius* L.) is an important *Rabi* oilseed crop of Maharashtra. Apart from its superior adaptability to scanty moisture conditions, it produces 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 for its coloured florets and much valued oil.

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Safflower is the only one native to Iran. Safflower (*Carthamus tinctorius* L.) belongs to the family of Asteraceae. The vegetable oil of oilseed crop is an integral part of diet human.

The involvement of oil and oil products as the major constituents of all balanced dietary patterns emphasis their importance. So our annual per capita consumption of oils and fats remained only 14.8 kg as against 41 kg in developed countries and 26 kg world average. Besides the dietary needs, the vegetable edible oils have numerous mechanical, industrial, medicinal and therapeutic uses too.

Safflower contains a small amount of oleic acid, linoleic acid, linolenic acid, flavonoids, amino acids and polysaccharides[10]. India ranks first in area (51 %) and production (37 %) in the world. The safflower production in the country during 2014-15 was 90.12 lakh tonnes with a productivity of 515 Kg ha^{-1} and Area was 174.95 lakh ha. In Maharashtra the production was 1.13 lakh tonnes a productivity of 645 kg ha^{-1} and Area 1.76 lakh ha.[1]. Since a majority of safflower varieties grown in India were spiny, collecting flowers from them was tedious, time-consuming and labour-intensive. However, with the national releases of non-spiny varieties, it is now possible in India to collect flowers economically by hand without the help of a machine.

India occupies premier position in safflower in the world as it was cultivated over an area of 364 thousand hectares (50% of world area) and had a production of 229 thousand tons (27% of world production) during 2005-06. However, after attainment of the peak area in 1988 (69% of world area) and peak production in 1994 (69% of world production), the area and production of safflower is continuously declining. This decline has been attributed due to many different reasons.

The important factor which plays an important role in assessing the performance of the plant type is the morphological structure of the plant contributing towards the growth and yield of crop under prevailing soil moisture nutrient regimes and management level of the crop owing to xerophytic characteristics. And as such plant population per unit area becomes important factor for realization of higher productivity.

MATERIAL AND METHODS

The field experiment was conducted during *rabi* season of 2015-16 at research farm of All India Coordinated Research Project on Safflower, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra). The soil of experimental field was clayey in texture. It was low in nitrogen, medium in phosphorus and high in potash, while medium in organic carbon and slightly alkaline in nature. Field experiment was laid out in Factorial Randomized Block Design having three replications each containing total 10 treatments. Main plot contain five spacings as, S_1-30 cm x 20 cm, S_2-45 cm x 20 cm, S_3-60 cm x 20 cm, S_4-75 cm x 20 cm, S_5-90 cm x 20 cm and two varieties Annegeri-1 (V_1) and NARI- 38 (V_2). Recommended dose of fertilizer was applied at the time of sowing and top dressing through Urea, Diamononium phosphate (DAP), Single super phosphate (SSP) and Murat of potash (MOP) a 60:40:00 NPK kg/ha. Recorded various post-harvest observations, quality parameters and economics of the given experiment.

RESULT AND DISCUSSION

In table 1. The results of yield attributes and quality are mentioned. The spacing S_5-90 cm × 20 cm (28.00) was maximum number of capitula $plant^{-1}$. The spacing S_5-90 cm × 20 cm which was found to be at par with spacing, S_3-60 cm × 20 cm (24.00) and S_4-75 cm × 20 cm (25.00). The variety Annegeri-1 (25.33) recorded maximum number of capitula $plant^{-1}$ which was significantly superior over other variety NARI-38 (21.07). The spacing S_5-90 cm × 20 cm (15.20) recorded maximum number of seeds $capitula^{-1}$ was found to be significantly superior over the spacing S_1-30 cm × 20 cm, S_2-45 cm × 20 cm, S_3-60 cm × 20 cm and S_4-75 cm × 20 cm. The spacing S_1-30 cm × 20 cm recorded minimum number of seeds $capitula^{-1}$. The variety Annegeri-1

(14.82) recorded maximum number of seeds capitula^{-1} which was significantly superior over other variety NARI-38 (12.03). Highest seed yield plant^{-1} observed with the spacing S_5-90 cm × 20 cm (16.00 g) was significantly superior over spacing S_1-30 cm × 20 cm, S_2-45 cm × 20 cm, S_3-60 cm × 20 cm and S_4-75 cm × 20 cm however, it was on par with S_4-75 cm × 20 cm in recording seed yield ha^{-1}. The variety Annegeri-1 (12.60 g) recorded maximum seed yield plant^{-1} which was significantly superior over other variety NARI-38 (11.40 g). The oil yield was influenced significantly by row spacing. Oil yield increase in application of narrow row spacing, due to higher seed yield. The similar results were reported by Mahale[4], Tahereh *et al*.[8], and Mohtasham Mohammadi *et al*.[5].

Effect of spacings and varieties on oil content was not found significant. The similar results were reported by Daltalab *et al*.[3], Unal *et al*.[9]. Oil yield of safflower was increased significantly due to spacings and varieties. The effect of spacings on oil yield (kg ha^{-1}) was found to be significant. The maximum seed yield (kg ha^{-1}) was given spacing of S_2-45 cm × 20 cm (334 kg ha^{-1}) and followed by spacings S_4-75 cm × 20 cm, S_1-30 cm × 20 cm, S_3-60 cm × 20 cm and S_5-90 cm × 20 cm respectively. The effect of oil yield was found to be significant. Annegeri-1 (330.32 kg ha^{-1}) recorded highest seed yield over other variety NARI-38 (251.86 kg ha^{-1}). Oil yield increase in application of narrow row spacing, due to higher seed yield.

In table 2. The results of yield and economics are mentioned. The effect of spacings on seed yield, straw yield and biological yield was found to be significant. The maximum seed yield (1149 kg ha^{-1}), straw yield (3562 kg ha^{-1}) and biological yield (4711 kg ha^{-1}) was recorded with the spacing of S_2-45 cm × 20 cm followed by spacing of S_1-30 cm × 20 cm. Sowing of safflower at S_5-90 cm × 20 cm recorded significantly lowest seed yield, straw yield and biological yield. The effect of varieties on yield, straw yield and biological yield was found to be significant. Annegeri-1 recorded highest seed yield (1099 kg ha^{-1}), straw yield (3122 kg ha^{-1}) and biological yield (4221 kg ha^{-1}) over other variety NARI-38. The interaction on effect between spacing and varieties on straw yield and Biological yield was found to be non-significant. The seed yield plant^{-1} and other attributes were higher at closer row spacing and wide plant spacing. The highest seed yield (kg ha^{-1}) rows were obtained for narrow row spacing. The similar trend was observed in case of straw yield (kg ha^{-1}) and biological yield (kg ha^{-1}). In the spacing increasing the grain yield, straw yield and biological yield of safflower was observed by Oad *et al*.[6], Ozel *et al*[7].

Harvest index was found to be highest in spacing of S_1-30 cm × 20 cm (26.00%) over other treatments. Effect of spacings was not found significant. Harvest index was found to be highest in variety Annegeri-1 (25.00%) over other variety NARI-38 (24.67%). Effect of varieties was not found significant. The interaction on effect between spacing and varieties on harvest index was found to be non-significant. Similar results were also showed by Asim Muhammod *et al*.[2].

The effect of spacings on gross monetary returns, net monetary returns (Rs ha^{-1}) and benefit: cost ratio was found to be significant. The maximum gross monetary returns (37917 Rs ha^{-1}), net monetary returns (16917 Rs ha^{-1}) and benefit: cost ratio (1.81) was reported with spacing of S_2-45 cm × 20 cm is which was found to be at par with S_1-30 cm × 20 cm. However, the spacing S_1-30 cm × 20 cm which was more S_3-60 cm × 20 cm, S_4-75 cm × 20 cm and S_5-90 cm × 20 cm. The effect of varieties on gross monetary returns, net monetary returns (Rs ha^{-1}) and benefit: cost ratio was found to be significant. The maximum gross monetary returns (36267 Rs ha^{-1}), net monetary returns (15567 Rs ha^{-1}) and benefit: cost ratio (1.75) was resulted with Annigeri-1 over other variety NARI-38.

Table 1: Number of capitula plant^{-1}, number of seeds capitula^{-1}, seed yield plant^{-1}, Oil content (%) and oil yield (kg ha^{-1}) as influenced by treatments of spacings and varieties

Treatment	Number of capitula plant^{-1}	Number of seeds capitula^{-1}	Seed yield plant^{-1} (g)	Oil content (%)	Oil yield (kg ha^{-1})
Spacings (S)					
S_1- (30 cm × 20 cm)	18.00	12.00	7.00	26.73	280.10
S_2- (45 cm × 20 cm)	21.00	13.00	11.00	28.20	334.91
S_3- (60 cm × 20 cm)	24.00	13.00	12.00	28.48	279.81
S_4- (75 cm × 20 cm)	25.00	14.00	14.00	30.22	290.71
S_5- (90 cm × 20 cm)	28.00	15.20	16.00	31.38	269.91
S.E.±	2.09	0.69	0.62	1.30	14.580
C.D.at 5%	6.21	2.07	1.85	NS	43.314
Varieties (V)					
V_1- (Annigeri-1)	25.33	14.85	12.60	30.22	330.32
V_2- (NARI-38)	21.07	12.03	11.40	27.79	251.86
S.E.±	1.32	0.44	0.39	0.82	9.22
C.D.at 5%	3.93	1.31	1.17	NS	27.39
Interaction (S×V)					
S.E.±	2.95	0.98	0.88	1.84	20.61
C.D.at 5%	NS	NS	NS	NS	NS

Table 2: Yield and economics as influenced by treatments of spacings and varieties

Treatment	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index (%)	Gross monetary returns (GMR) (Rs. ha^{-1})	Net monetary returns (NMR) (Rs. ha^{-1})	Benefit : cost ratio (B:C)
Spacings (S)							
S_1- (30 cm × 20 cm)	1082	3244	4326	26.00	35690	14390	1.62
S_2- (45 cm × 20 cm)	1149	3562	4711	24.67	37917	16917	1.81
S_3- (60 cm × 20 cm)	950	2660	3610	24.17	31350	10650	1.52
S_4- (75 cm × 20 cm)	922	2489	3394	24.33	30426	10026	1.49
S_5- (90 cm × 20 cm)	830	2075	2905	22.50	27390	7290	1.36
S.E.±	32.19	319.83	309.39	0.93	1062.50	1062.50	0.05
C.D.at 5%	95.52	950.15	919.16	NS	3152.20	3152.20	0.15
Varieties (V)							
V_1- (Annegeri-1)	1099	3122	4221	25.00	36267	15567	1.75
V_2- (NARI-38)	874	2490	3357	24.67	28842	8142	1.40
S.E.±	20.36	202.27	195.68	0.59	671.98	671.98	0.03
C.D.at 5%	60.41	600.93	81.33	NS	1993.50	1993.50	0.10
Interaction (S×V)							
S.E.±	45.53	452.28	437.55	1.31	1502.6	1502.6	0.07
C.D.at 5%	NS	NS	NS	NS	NS	NS	NS

CONCLUSION

It can be concluded from the studies on that, variety Annegeri-1 was found to be better in yield attributes, quality parameters, seed yield and net monetary return compared to NARI-38. The gross monetary returns was influenced by spacings and varieties. The spacing S_2-45 cm x 20 cm, S_1-30 cm x 20 cm and variety Annegeri -1 recorded significantly higher gross monetary returns respectively, the similar trend was observed in case of net monetary returns and benefit: cost ratio. Sowing of safflower at S_2-45 cm x 20 cm spacing was found better for yield attributes, quality parameters, higher yield and economics followed by S_1-30 cm x 20 cm.

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