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Soil Properties and Yield of Safflower as Influenced by different Fertilizers

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Abstract

The experiment was conducted at college of Agriculture, Nagpur, PDKV Akola research farm conducted in randomized block design (RBD) having three replication and eight treatment combinations of FYM in kharif season using soybean as test crop while biofertilizers and inorganic fertilizer at the time of sowing in rabi season for safflower crop var. AKS/S-41. Highest organic carbon (6.5 gm kg^{-1}), available NPK (112.02, 16.99 and 173.88 kg ha^{-1} respectively) and available Fe, Mn, Zn and Cu (7.26, 15.72 1.12 and 1.80 mg kg^{-1} respectively) were recorded in the treatment of 100 % RDF + Azospirillum + PSB. It was concluded that application of 100% RDF + Azospirillum + PSB improved the yield and significantly increased the uptake of NPK by safflower.

Keywords*:* Biofertilizers, NPK, Safflower, Soil Nutrients, Yield.

Introduction

Safflower (*Carthamus tinctorius* L.), comes under the Compositae family, is an annual oilseed crop[1]. It is native to parts of Asia, the Middle East, and Africa. It was earlier cultivated mainly for its flowers, which were used in preparation of dyes for clothing and food[2]. Today, it is grown mainly for its oil. Safflower evaluation in the U. S. started in 1925 in the Great Plains, but commercial production did not begin until the 1950s. Production is concentrated in the Western United States and the Canadian Prairie Provinces. California grows about 50 percent of U.S. safflower; North Dakota and Montana are the next major area of commercial production. South Dokota, Idaho, Colorado, Arizona, and Nebraska also produce the crop, but on small acreage.

In the world, India is the largest producer of safflower. This occupies 2788 ha area with 1689 metric tons production and having 606 kg ha^{-1} productivity[3]. In India it is mainly grown in Maharashtra, Karnataka and part of Andhra Pradesh, Orissa and Bihar[4]. In Maharashtra, Safflower is mainly grown in Marathwada region and occupies 9.5 thousand ha area with 6.8 metric tons production and having 710 kg ha^{-1} productivity, in Vidharbha region this occupies 2.5 thousand ha area with 1.7 metric tons production and having 657 kg ha^{-1} productivity. Buldhana occupy large area 1.7 thousand ha with 0.9 metric tons production and having 510 kg ha^{-1} productivity.

It is also grown in Akola, Amravati and Yeotmal districts, where it is now considered as an important oilseed crop in terms of production and trade. Since, the productivity of safflower in Maharashtra is quite low, there is need to study effect of nutrient levels to maximize productivity with minimum deterioration of soil[5].

Materials and Methods

The field investigation was conducted during *rabi* season 2013-14 at the farm College of Agriculture, Nagpur. Composite soil sample was prepared by collecting soil samples up to 0-15 cm depth from randomly selected spots over the experimental field before sowing. This composite soil sample was analyzed for initial fertility status of the soil. The physico-chemical characteristics were determined and the data are presented in Table-1.

The experiment was laid out in randomized block design with eight treatments *viz*., T_1–Control; T_2 – 75% RDF, T_3 – 75% RDF + *Azospirillum* + PSB,T_4 – 100% RDF,T_5 – 100% RDF + *Azospirillum* + PSB,T_6 – 125% RDF, T_7 – 125% RDF + *Azospirillum* + PSB and T_8 – 75% RDF +2 % DAP spray at 30 and 45 DAS, each was replicated thrice. Sowing of safflower (cv.AKS/S-41) was carried out in an experimental site on 16 October 2010 by dibbling and harvesting was done on 27 March 2011.

The fertilizers were applied as per treatment details. The doses of nitrogen and phosphorus were applied through Urea and SSP, respectively. Nitrogen was used in two split doses, 1st dose at the time of sowing and 2nd at 30 DAS. Seed treatment of biofertilizers, *Azospirillum* and PSB at 250g 10kg^{-1} of seed was given at the time of sowing. After harvesting safflower crop, treatment wise soil samples were taken for the determination of organic carbon. pH, EC, organic carbon, available N, P, K, Fe, Mn, Zn, and Cu. Available nitrogen was estimated by alkaline potassium permanganate method by Subbiah and Asija, 1956. Phosphorus was determined by Olsen's method by Jackson, 1967[6]. Available potassium in soil was extracted by neutral ammonium acetate solution and potassium was estimated using flame photometer.

Table-1
Fertility status of soil after harvest of safflower crop

Treatments		Organic carbon	Available nutrient (kg ha^{-1})			
		g kg^{-1}	N	P	K	S
T_1	Control	5.5	205.06	10.21	306.05	10.52
T_2	75% RDF	5.7	215.80	13.98	312.24	11.52
T_3	75% RDF + Azospirillum + PSB	5.8	225.08	15.01	316.37	12.53
T_4	100% RDF	6.0	228.76	16.10	330.71	15.55
T_5	100% RDF + Azospirillum + PSB	6.5	256.26	17.42	360.49	18.24
T_6	125% RDF	6.1	232.71	16.46	339.58	16.17
T_7	125% RDF + Azospirillum + PSB	6.3	248.17	17.09	355.95	17.62
T_8	75% RDF +2 % DAP spray at 30 and 45 DAS	5.7	217.25	13.73	309.54	11.73
SE (m) ±		0.040	1.109	0.230	1.070	0.180
CD at 5%		0.121	3.272	0.691	3.235	0.545

Results and Discussion

The data pertaining to Fertility status of soil after harvesting safflower are given in Table-1. The highest organic carbon content in soil was recorded with the application of 100% RDF + *Azospirillum* + PSB followed by 125% RDF + *Azospirillum* + PSB. Treatment receiving 100% RDF + *Azospirillum* + PSB was found to be significantly superior over all treatment. Lowest organic carbon content was recorded under control treatment. Similar findings were reported by Singh et al.[7].

Available N content in soil after harvesting safflower significantly increased with the increasing level of RDF, alone or in combination with *Azospirillum* + PSB. Application of 100 % RDF + *Azospirillum* + PSB showed highest values for available N content in soil, followed by 125 % RDF + *Azospirillum* + PSB. Treatment with 100% RDF + *Azospirillum* + PSB was found to be significantly superior over all treatment. The lowest available N content was observed under control treatment. Similar observations were recorded by Malewar and Hasanabade[8].

Available P content in soil may increase due to organic matter and PSB which makes P in the soil, available to the plant[7,9]. The beneficial effect of bio fertilizers on availability of K may be due to release of K due to the interaction of bio fertilizers with clay, besides the direct addition of K in the available pool of the soil. The available potassium status in the soil was significantly higher in the treatment receiving bio fertilizers (100 % RDF + *Azospirillum* + PSB). Available S content increased with the increasing levels of fertilizers application, as was also reported by Thakur and Sawarkar[10].

The data pertaining to grain and straw yields are given in Table-2. The yields were found statistically significant under different treatments during the year 2010-11. Significantly highest yield of grain (23.00 q ha^{-1}) and straw (84.68 q ha^{-1}) were recorded due to the treatment receiving 100% RDF + *Azospirillum* + PSB, which was followed by treatment with 125% RDF + *Azospirillum* + PSB i.e. (21.82 and 77.17 q ha^{-1} grain and straw yield, respectively). Both the treatments were at par and significantly superior over remaining treatments for straw yield. The treatment 125 % RDF was found to be at par with the treatment 125 % RDF + *Azospirillum*+ PSB with respect to the grain yield. Lowest yield was obtained in control (15.95 and 45.20 q ha^{-1}grain and straw, respectively).

Table-2
Yield of safflower as influenced by various treatments

Treatments		**Grain yield ($q\ ha^{-1}$)**	**Straw yield ($q\ ha^{-1}$)**
T_1	Control	15.95	45.20
T_2	75% RDF	19.97	68.18
T_3	75% RDF + Azospirillum + PSB	20.53	69.42
T_4	100% RDF	21.00	69.84
T_5	100% RDF + Azospirillum + PSB	23.00	84.68
T_6	125% RDF	21.68	76.24
T_7	125% RDF + Azospirillum + PSB	21.82	77.17
T_8	75% RDF +2 % DAP spray at 30 and 45 DAS	20.98	74.06
SE (m) ±		0.116	0.091
CD at 5%		0.343	0.271

Table-3
Total uptake of nutrients by safflower crop

Treatments		**uptake of nutrients ($kg\ ha^{-1}$)**		
		N	**P**	**K**
T_1	Control	55.88	7.62	71.32
T_2	75% RDF	81.70	11.70	125.66
T_3	75% RDF + Azospirillum + PSB	84.15	12.16	138.05
T_4	100% RDF	95.17	13.72	142.21
T_5	100% RDF + Azospirillum + PSB	112.02	16.99	173.88
T_6	125% RDF	100.60	14.67	156.50
T_7	125% RDF + Azospirillum + PSB	105.87	15.40	165.90
T_8	75% RDF +2 % DAP spray at 30 and 45 DAS	102.19	14.91	159.56
SE (m) ±		0.480	0.348	0.847
CD at 5%		1.440	1.045	2.541

Various levels of RDF showed linear and the grain and straw yield of safflower increased. Seed treatment with *Azospirillum* + PSB, along with the increasing levels of RDF, showed non - significant differences in yield of safflower. There was significant effect of application of biofertilizers over control. The yield increased in treatment receiving 100% RDF + *Azospirillum* + PSB, which might have been due to the application of inorganic fertilizers and biofertilizers. The findings were similar to those reported by Naseri Rahim et al.[11] and Vanjara *et al.*[12]. Increasing trend in uptake of NPK was observed with the increase in RDF level along with seed treatment with *Azospirillum* + PSB. The highest uptake of nutrient by safflower was recorded with 100%

Conclusion

From this study it is concluded that, RDF and seed treatment with *Azospirillum* + PSB, followed by 125% RDF and seed treatment with *Azospirillum* + PSB. The treatment 100% RDF + *Azospirillum* + PSB was significantly superior with respect to N, P and K uptake over other treatments. Treatment with 75% RDF +2 % DAP spray at 30 and 45 DAS and 125% RDF were found to be at par with treatment 125% RDF + *Azospirillum* + PSB in P uptake of safflower crop.

The increase in total uptake of nutrients might be due to the combined application of inorganic fertilizers and biofertilizers. Due to their combination treatments nitrogen, phosphorous and potassium might have been gained by plants through RDF and biofertilizers. These results are similar with observations of Sudhakar et al.[13] and Rather and Sharma[14]. Lowest uptake of NPK was found in control treatment.

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