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Influence of application of various levels of organic and inorganic nutrients sources on soil quality parameters

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Abstract
A field experiment was conducted at Experimental Farm of Department of Soil Science and Agricultural Chemistry, Marathwada Krishi Vidyapeeth, Parbhani during *rabi* season with eleven treatments and four replications in randomized block design in Vertisols. The results indicated maximum increase in soil pH with an application of (T_8) 100% RDF + FYM @ 10 t ha^{-1} throughout the growing period of crops. The EC and organic carbon in soil was not significantly influenced by different treatments. The maximum decrease in bulk density, and increase in porosity of soil was observed with addition of FYM @ 10 t ha^{-1}. Significantly higher availability of N, P, K, was noticed with (T_3) 150% RDF, followed by (T_8) 100% RDF + FYM @ throughout growing period of crop. Highest moisture content of soil at 30 days, 60 days and 90 days noticed in treatment (T_8) 100% RDF + FYM @ followed by (T_{10}) only FYM @ 10 t ha^{-1}. This indicates that balance use of inorganic source of nutrients along with organic sources improve the physical characteristics of soil and also increases the availability of nutrients.

Keywords: Various levels, organic, inorganic nutrients sources, soil quality parameters

Introduction
Safflower (*Carthamus tinctorius*) is grown in both tropical and temperate regions. India ranks first in the word in the production of Safflower. Among oilseed crops, safflower has assumed much prominence. Safflower contains about 26-32% proteins, Safflower oil contains about 75% polyunsaturated fatty acid, linoleic acid which helps in lowering cholesterol level in human blood.

Soil is one of the most important natural resource for agricultural production. Sustainable productivity is possible only when best nutrient management practices are adopted. Application of inorganic along with organic sources of nutrients to crop is one of the judicious management practices. Keeping these view if we partially substitute some amount of chemical fertilizer through organic and bio-fertilizer sources, it will not only save cost on fertilizer input, but also sustain soil productivity and improve soil environment for maximum crop production (Dutta *et al*., 2003) [4].

With these understanding the present investigation was undertaken to evaluate the effect of chemical fertilizers alone, in combination with FYM or micronutrients on soil parameters under soybean-safflower cropping sequence.

Materials and Methods
A field experiment was conducted at farm of Department of Soil Science and Agricultural Chemistry, MKV, Parbhani. The experimental soil was Typic Haplusterts with almost flat topography, dominated by montmorillonitic clay with high coefficient of swelling and shrinkage, which leads to deep cracking in summer. The experiment was laid out in Randomized Block Design (RBD) with eleven treatments and four replications. The safflower (PBNS-12) were sown at the rate of 12 to 15 kg/ha. The sowing was done with dibbling the seed in row to row spacing 45 cm and plant to plant spacing of 15 cm. The details of treatments are given below.

Table 1: Details of treatment

Treatment	Rabi	Kharif
T_1	50% RDF	50% RDF
T_2	100% RDF	100% RDF
T_3	150% RDF	150% RDF
T_4	100% RDF + HW	100% RDF + HW
T_5	100% RDF + $ZnSO_4$ @ 25 kg ha^{-1}	100% RDF + $ZnSO_4$@ 25 kg ha^{-1}
T_6	100% NP	100% NP
T_7	100% N	100% N
T_8	100% RDF + FYM @ 10 t ha^{-1}	100% RDF + FYM @ 10 t ha^{-1}
T_9	100% RDF – Sulphur	100% RDF – Sulphur
T_{10}	Only FYM @ 10 t ha^{-1}	Only FYM @ 10 t ha^{-1}
T_{11}	Absolute control	Absolute control

HW - Hand weeding
RDF - Recommended dose of fertilizer

The soil samples collected from 0-15 cm depth with the help of screw augar at initial, flowering and after harvest from each plot at inter row spacing of safflower were analyzed for different physico-chemical properties using standard methods. Results obtained were statistically analysed as per the method described by Panse and Sukhatme (1985) [11]. Approximate standard crosses (SE) were worked out and critical differences (CD) at 5 per cent level were given whenever necessary for interpretation.

Result and Discussion

It is observed from the data that the initial value of soil pH was not changed significantly due to different treatments. The soil pH recorded before safflower crop indicated that there was slight increase in initial value of soil pH under all the treatments except application of FYM and control. More or less increase in soil pH was noticed with an application of 150% RDF (8.26), followed by 100% RDF (HW) (8.24) and 100% RDF (-S) (8.23) after harvest of safflower. Further, the data (Table 2) showed that addition of FYM @ 10 t ha^{-1} decreases the pH by 0.29 unit, while in treatment absolute control it was reduced by 0.28 units.

Similarly, the soil pH after harvest of safflower crop indicated maximum raise in pH upto 8.30 with an addition 150% RDF. The increased in soil pH recorded in other treatments did not show significant variation. However, the addition of FYM, absolute control decreased the initial value of pH upto 7.75 and 7.4, respectively.

The significant changes in soil pH due to different treatments were recorded in this study. However, the slight increased in pH due to addition of 100% RDF + FYM and higher dose of fertilizer observed is in line with the results reported by Tayade *et al*. (2002) [5]. Balagurvaiah *et al*. (2005) [2] and Mann *et al*. (2006) [6] also reported increased in initial value of soil pH due to addition of FYM in combination with inorganic fertilizers. The decrease in soil pH recorded with addition of FYM may be due to production of organic acid during process of decomposition of organic matter supplied through FYM.

Electrical conductivity of soil

The data presented in Table 2 revealed that the EC of soil under different manure treatments varied from 0.213 to 0.237 dSm^{-1} before sowing and 0.211 to 0.242 after harvest of safflower crop and did not show significant variation before sowing and after harvest stage.

Maximum increased in EC was recorded in the present study with the addition of (T_3) 150% RDF at both stages of crop growth. Maximum change in EC in surface layer may be attributed to the long term addition of RDF fertilizer. This may be due to the fact that by addition of fertilizers in the soil, the salt content of soil increased as compared to other treatments, thereby showed an increased in EC of soil. Similar findings were reported by Tayade *et al*. (2002) [5].

Organic carbon content in soil

The data presented in Table 2 indicated that the organic carbon content in soil influenced by various treatments but did not show significant variation throughout the growing period of crop.

Bulk density of soil

The application of FYM @ 10 t ha^{-1} showed maximum decreased in initial value of bulk density before sowing and after harvest of crop. This decreased in bulk density may be ascribed to increased the total porosity of soil which leads to improvement in soil aggregation and thereby decreased in bulk density and increased water holding capacity to maintaining soil health Padole *et al*., (1998) [9] and Pathak *et al*. (2005) [10] also reported reduction in bulk density of soil due to application of inorganic fertilizers in combination of FYM. Selvi *et al*. (2005) [14] and Bajpai *et al*. (2006) [1] also indicated a significant reduction in bulk density of soil.

Porosity

The porosity of soil recorded at before sowing indicated maximum increased porosity with addition of (T_8) 100% RDF + FYM (56.12%) followed by (T_{10}) only FYM @ 10 t ha^{-1} (56.03%). However decreased in initial soil porosity upto 52.10% recorded in (T_{11}) control.

Moisture Content

At lower soil depth (15-30 cm) comparatively high moisture content per cent noticed than surface soil layer (0-15 cm). Soil moisture status studied at 30 days interval indicated that highest soil moisture content noticed in treatment (T_8) 100% RDF + FYM i.e. 21.30% at 15 cm and 22.36% at 30 cm, respectively. Further, it decrease in treatment (T_1) 50% RDF, (T_4) 100% RDF (HW), (T_5) 100% RDF + Zn, (T_6) 100% NP and (T_9) 100% RDF (-S) at par with each other.

Available Nitrogen

The initial value of available nitrogen (216 kg ha^{-1}) content in soil was found to increased under all the treatments except under control. Among, the different treatments addition of treatment (T_3) 150% RDF showed maximum increased in available N upto 284.5 kg ha^{-1} followed by (T_8) 100% RDF + FYM (284.1 kg ha^{-1}). Further, the increased in available N

recorded with the addition of (T_6) 100% NP (273.6.9 kg ha^{-1}), (T_2) 100% RDF (264.9 kg ha^{-1}) and (T_7) 100% N (261.0 kg ha^{-1}) was at par.

Thus, highest available N is recorded with application of (T_3) 150% RDF and (T_8) 100% RDF + FYM throughout the growing period of safflower. The long term experiments have revealed the favourable effects of FYM on soil properties and availability of nutrient which are released on mineralization and become available to growing crops. Similarly, applied fertilizers can supply essential nutrients as needed for the crops in adequate amounts.

Available phosphorus

The data (Table 4) indicated that the initial value of available phosphorus 16 kg ha^{-1} was increased slightly upto 18.27 and 17.63 kg ha^{-1} due to addition of (T_3) 150% RDF and (T_8) 100% RDF + FYM, respectively before sowing of safflower crop.

Among the all treatments, (T_3) 150% RDF showed significantly higher availability of P followed by (T_8) 100% RDF + FYM. Further, the (T_2) addition of 100% RDF, (T_4) 100% RDF (HW), (T_6) 100% NP and (T_9) 100% RDF (-S) showed slight decreased in available P upto 17.17, 17.19, 17.14 and 16.83 kg ha^{-1}, respectively.

Available potassium

The data presented in Table 4 at before sowing showed that the initial value (766.0 kg ha^{-1}) of available potassium was found to increase maximum upto 831.58 kg ha^{-1} with an addition of (T_3) 150% RDF followed by 822.48 kg ha^{-1} due to application of (T_8) 100% RDF + FYM. Further, the decreased upto 754.00, 767.00, 763.40 in treatment (T_7) 100% NP (T_6) 100% N and (T_{10}) only FYM @ (10 t ha^{-1}), respectively while lower value of available K was noticed in (T_{11}) absolute control.

Table 2: Effect of continuous manuring and fertilization on Physico-chemical properties of soil

Treatments	pH of soil		Electrical conductivity (dSm^{-1})		Organic carbon (g kg^{-1})		Bulk density of soil (Mgm^{-3})		Porosity (%)	
	Before sowing	After harvest	Before sowing	After harvest	Before sowing	After harvest	Before sowing	After harvest	Before sowing	After harvest
T_1-50% RDF	8.11	8.21	0.221	0.222	5.11	5.15	1.16	1.16	55.75	53.95
T_2-100% RDF	8.17	8.21	0.237	0.232	5.32	5.44	1.18	1.16	55.65	55.31
T_3-150% RDF	8.26	8.30	0.235	0.242	5.43	5.62	1.22	1.24	54.05	53.48
T_4-100% RDF (HW)	8.24	8.26	0.231	0.231	5.37	5.44	1.23	1.22	54.05	53.29
T_5-100% RDF + $ZnSO_4$@ 25 kg ha^{-1}	8.22	8.22	0.230	0.239	5.42	5.58	1.21	1.21	54.05	52.82
T_6-100% NP	8.18	8.23	0.232	0.231	5.05	5.43	1.20	1.17	54.42	53.95
T_7-100% N	8.14	8.20	0.221	0.224	4.93	5.22	1.16	1.16	55.46	54.14
T_8-100% RDF + FYM @ 10 t ha^{-1}	8.26	8.23	0.224	0.216	5.93	6.17	1.17	1.14	56.12	56.12
T_9-100% RDF (-S)	8.23	8.26	0.231	0.234	5.82	5.88	1.23	1.22	53.76	53.29
T_{10}-FYM @ 10 t ha^{-1}	8.06	7.75	0.213	0.211	5.86	5.88	1.18	1.16	56.03	55.92
T_{11}-Absolute control	7.82	7.74	0.227	0.222	4.73	4.91	1.21	1.18	52.10	53.20
SE $\pm$	0.017	0.015	0.0007	0.0007	0.04	0.02	0.010	0.010	0.95	1.68
CD at 5%	0.050	0.043	0.0020	0.0022	0.14	0.07	0.029	0.029	NS	NS

Table 3: Effect of organic and inorganic nutrient sources on moisture content of soil

Treatments	30 days		60 days		90 days	
	15 cm	30 cm	15 cm	30 cm	15 cm	30 cm
T_1-50% RDF	19.55	21.11	21.75	23.25	15.11	16.15
T_2-100% RDF	20.18	21.29	23.18	23.75	15.68	17.60
T_3-150% RDF	18.89	20.66	20.78	22.15	14.83	15.46
T_4-100% RDF (HW)	20.74	21.30	23.22	20.64	16.58	17.74
T_5-100% RDF + $ZnSO_4$ @ 25 kg ha^{-1}	20.14	21.28	23.15	23.63	15.61	16.81
T_6-100% NP	20.08	21.22	23.02	23.41	15.11	16.72
T_7-100% N	19.02	20.69	21.22	22.52	15.08	15.46
T_8-100% RDF + FYM @ 10 t ha^{-1}	21.30	22.36	24.06	25.37	18.45	19.19
T_9-100% RDF (-S)	20.09	21.23	23.05	23.61	15.16	16.74
T_{10}-FYM @ 10 t ha^{-1}	20.84	21.83	23.72	24.70	16.91	18.45
T_{11}-Absolute control	18.77	19.50	20.22	22.05	14.50	15.18
SE $\pm$	0.011	0.011	0.011	0.008	0.036	0.02
CD at 5%	0.033	0.034	0.033	0.023	0.10	0.08

Table 4: Effect of organic and inorganic nutrient sources on available Nitrogen, Phosphorus and Potassium

Treatments	Available nitrogen (kg ha^{-1})		Available phosphorus (kg ha^{-1})		Available potassium (kg ha^{-1})	
	Before sowing	After harvest	Before sowing	After harvest	Before sowing	After harvest
T_1-50% RDF	226.0	221.8	16.14	15.54	774.62	770.72
T_2-100% RDF	264.9	247.7	17.17	16.99	818.78	790.32
T_3-150% RDF	284.5	275.1	18.27	17.45	831.58	821.51
T_4-100% RDF (HW)	257.1	228.9	17.19	16.29	795.90	783.55
T_5-100% RDF + $ZnSO_4$ @ 25 kg ha^{-1}	259.4	239.9	16.03	16.81	786.15	782.49
T_6-100% NP	273.6	254.0	17.14	15.99	754.00	746.48
T_7-100% N	261.0	246.1	16.08	15.70	767.00	760.52
T_8-100% RDF + FYM @ 10 t ha^{-1}	284.1	257.9	17.63	17.22	822.48	812.95
T_9-100% RDF (-S)	255.5	228.1	16.83	16.11	786.05	782.05
T_{10}-FYM @ 10 t ha^{-1}	251.6	231.2	16.03	15.96	763.40	748.36
T_{11}-Absolute control	198.3	172.65	15.67	15.34	736.77	732.00
SE $\pm$	15.48	5.47	0.15	0.15	2.62	0.15
CD at 5%	44.65	15.77	0.43	0.43	7.55	0.43

Conclusion

Inclusion of organic manures (at 10 t ha^{-1} along with 100% RDF) in nutrient management system proved better to improve physico-chemical properties particularly organic carbon of soil. Inorganic nutrients when applied along with organic manures and micronutrient found (at 10 t ha^{-1} along with 100% RDF) beneficial to enhance the availability of nutrients as well as increase the residual value of nutrients in soil.

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