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Influence of various nutrient sources on physic-chemical properties and nutrients status of loamy sand soil in Ber orchard

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Abstract
An experiment was carried out at SKN College of Agriculture, Jobner (Jaipur) Rajasthan to find out the Influence of Various Nutrient Sources on Physic-chemical Properties and Nutrients Status of Loamy Sand Soil in Randomized Block Design with three replications to balance the fertilizer requirement of ber orchard during 2015-16. The water retention at 1500 and 33 kPa, bulk density and organic carbon content in soil were significantly affected by application of FYM @ 20 kg per plant which was statistically at par with vermicompost @ 6 kg plant and poultry manure @ 8 kg plant than control. The application of vermicompost @ 6 kg per plant among the different organic manures proved significantly superior over rest of the treatments in respect to available N, P and K content in soil except poultry manure @ 8 kg per plant. Similarly, results also revealed that application of 125 per cent RDF (F_4) also significantly enhanced all the parameters except water retention at 1500 and 33 kPa, bulk density and organic carbon content in soil, however it was statistically at par with 100 per cent RDF (F_3).

Keywords: inorganic fertilizers, organic manures, physic-chemical properties, semi-arid conditions etc.

Introduction
Indian jujube (*Zizyphus mauritiana* Lamk.) is an important fruit crop of hot arid ecosystem due to less water requirement, wider adaptability, hardy nature and its ability to flourish well even in inferior soil. It is well documented that growth and yield of trees are greatly influenced by a wide range of nutrients. The intensively cultivated soils do have the problems of fast depletion of plant nutrients and become deficient not only in macro but also in micro nutrients (Singh *et al*., 1998) [13]. Integration of organic manures and chemical fertilizers is a system approach in nutrient management especially in semi arid regions emphasizes the need to increase the nutrient use efficiency and economise the use of costly mineral fertilizers by associating for the residual effects of the applied fertilizers. This approach is not only reliable way to obtain high fruit productivity with substantial fertilizer economy but also ensure concept of ecological soundness leading to sustainable Agriculture. The conclusions from long term experiments also support that a suitable combination of organic and inorganic sources will not only sustains soil fertility and crop productivity but also maintain higher levels of quality of produce (Pillai *et al*., 1985 and Nambair, 1994) [9, 7].
Keeping the above facts into consideration, an investigation on organic and inorganic sources of nutrients in Ber (*Zizyphus mauritiana* Lamk.) was carried out to identify the Influence of Various Nutrient Sources on Physic-chemical Properties and Nutrients Status of Loamy Sand Soil in Ber Orchard.

Materials and Methods
An experiment was conducted at Horticulture farm, S.K.N. College of Agriculture, Jobner (Jaipur) during July, 2015 to February, 2016 in the orchard of Ber under loamy sand soils. The plants of uniform size, vigorous and approximately three years age after budding, planted at 6 m x 6 m were selected.
The experiment consisted of 20 treatment combinations with four levels of organic manures (M_0-control, M_1-FYM @ 20 kg/plant, M_2-vermicompost @ 6 kg/plant and M_3-poultry manure @ 8 kg/plant) and five levels of RDF (F_0-control, F_1-50% RDF, F_2-75% RDF, F_3-100% RDF and F_4-125% RDF) in Randomized Block Design with three replications.

The full dose of organic manures was applied as soil application in July, 2015. The recommended doses of fertilizers as 1100 g urea, 1400 g SSP and 200 g MOP per tree were applied. Full dose of SSP, MoP and half dose of urea in various treatments were applied as basal dose in July, 2015. Remaining half dose of urea was applied before flowering. The fertilizers were applied to the top soil around the plant. The fertilizers uniformly mixed into the soil and then levelled. Irrigation was applied immediately after application of manures and fertilizers. The role of nutrient elements either alone or in combination with other sources (organic manures/fertilizers) has been well established in many fruit crops; while such studies are very meagrely available in ber (Katiyar *et al*., 2012) [5].

Soil analysis

The soil samples were collected from experimental site at 0-15 cm depth for analysis before application of treatments in the month of July, 2015 and after harvesting of the fruits in the month of February, 2016. The soil was analyzed for various physic-chemical properties *viz.*, water retention at 1500 and 33 kPa by pressure membrane apparatus (Singh, 1980), bulk density by RD bottle (Richards, 1954), organic carbon content by Walkely and Black rapid titration method (Piper, 1950) [10] and nutrient status such as available N through alkaline permanganate method (Subbiah and Asija, 1956) [16], available P_2O_5 through Olsen's method (Olsen *et al*., 1954) and available K_2O through Flame photometer method (Metson, 1956) [6].

The soil was characterized with low organic carbon (0.18%), available N (128.00 kg/ha) and medium available P_2O_5 (17.00 kg/ha) and K_2O (146.00 kg/ha). The initial values of Water retention at 1500 and 33 kPa (3.2 & 10.8%, respectively) and bulk density (1.52 Mg/m^3).

Statistical analysis

To test the significance of variation in the data obtained from analysis of various physic-chemical properties of plant and soil, the technique of statistical analysis of variance was suggested by Fisher (1950) [3] for Randomized Block Design. Significance of difference in the treatment effect was tested through 'F' tests at 5 per cent level of significance and CD (critical difference) was calculated, wherever the results were significant.

Results and Discussion

Effect of organic manures

Significant improvement in physic-chemical properties and nutrient status of soil were observed by use of organic manures (Table 1).

The application of treatment M_1 (FYM @ 20 kg/plant) which closely followed by treatment M_2 (Vermicompost @ 6 kg/plant) and M_3 (Poultry manure @ 8 kg/plant) gave significantly higher build up of water retention at 1500 kPa (6.90%) and 33 kPa (14.41%), organic carbon (0.332%) and decrease bulk density (1.43 Mg/m^3) of soil. The additive effect of FYM/ vermicompost/ poultry manure is beneficial for maintaining higher organic carbon level (Acharya *et al*., 1988) [1]. The addition of manures itself adds sufficient amount of organic matter to the soil and solubilizes plant nutrient and improve physical conditions of the soil by accelerating porosity, aeration and water holding capacity (Bhriguavanshi, 1988) [2].

Table 1: Effect of organic manures on physic-chemical properties and nutrient status of soil

Treatments	Water retention		Bulk density (Mg/m^3)	Organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
	At 1500 kPa (%)	At 33 kPa (%)					
M_0 Control	3.75	11.77	1.55	0.269	124.65	15.95	145.85
M_1 FYM 20 kg/p	6.90	14.41	1.43	0.332	136.54	17.65	148.91
M_2 VC 6 kg/p	6.76	13.88	1.49	0.319	147.11	19.11	160.00
M_3 PM 8 kg/p	6.70	13.61	1.49	0.311	145.61	18.88	156.81
SEm±	0.14	0.29	0.04	0.009	2.88	0.42	3.79
CD (P=0.05)	0.39	0.82	0.11	0.026	8.24	1.21	11.21

The application of treatment M_2 (Vermicompost @ 6 kg/plant) significantly increased the available status of NPK (147.11, 19.11 & 160.00 kg/ha respectively) in soil ascribed to the beneficial role of organic manures in mineralization of native as well as addition of own nutrient content which enhance the available nutrient pool of soil. The enhanced available nitrogen content of soil may also be due to favourable soil conditions under vermicompost treatment which helped in the mineralization of soil nitrogen leading to higher build up of available N (Tate, 1999) [18]. The organic manures, on decomposition, solubilize insoluble P and K fractions through release of various organic acids, which results in significant improvement in available P and K status of the soil and prevent the fixation of available nutrients by the chelation effect (Tandon, 1987) [17].

Effect of inorganic fertilizers

The results of the study of effect of various fertility levels on water retention, bulk density, organic carbon and N, P and K availability in the soil (Table 2).

The water retention, bulk density and organic carbon content in soil were not much influenced by treatment comprising the inorganic nutrient sources. Application of treatment F_4 (125% RDF) closely followed by F_3 (100% RDF) significantly increased the availability of nutrients *viz.*, N (156.21 kg/ha), P (19.95 kg/ha) and K (161.24 kg/ha) in soil (Table 2). Application of inorganic fertilizers (NPK) significantly influenced the physico-chemical properties of soil after harvesting of fruits. It can be understood in the light of differential solubility of nitrogen and readily availability of P and K fertilizers to the plants. The results obtained are also in close conformity with that of Shukla *et al.* (2014) [12] in guava.

Table 2: Effect of inorganic fertilizers on physic-chemical properties and nutrient status of soil

Treatments	Water retention		Bulk density (Mg/m^3)	Organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
	At 1500 kPa (%)	At 33 kPa (%)					
F_0 Control	5.88	13.25	1.51	0.293	116.14	14.82	142.82
F_1 50% RDF	5.90	13.31	1.50	0.302	129.48	16.69	146.73
F_2 75% RDF	6.02	13.36	1.49	0.305	140.30	18.30	147.52
F_3 100% RDF	6.15	13.40	1.49	0.305	150.26	19.73	157.91
F_4 125% RDF	6.19	13.77	1.48	0.333	156.21	19.95	161.24
SEm±	0.15	0.32	0.04	0.010	3.22	0.47	4.24
CD (P=0.05)	NS	NS	NS	NS	9.29	1.37	12.60

Conclusion

Results of the study demonstrated that vermicompost should be given priority over poultry manure and FYM along with 125 per cent RDF at farm level in ber orchards of Rajasthan (India) in loamy sand soil. Yield and quality parameters of fruits were positively correlated to the soil factors indicating that proper nutrient management systems has to be developed, in order to sustain the orchard productivity and fruit quality of ber. Soil restoration strategy with integration of organic manures with inorganic fertilizers under conditions of coarse-textured soils of low fertility and with high economic fruit crop of ber should find a place in decision support system.

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