DOI : 10.5958/0974-0112.2016.00045.1

Indian J. Hort. 73(2), June 2016: 188-191

Conjunct use of organic manures, bio-fertilizers and inorganic fertilizers for improving plant health of plum cv. Santa Rosa

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ABSTRACT

A field trial was conducted on plum orchards during 2011 and 2012 under north Indian conditions. The treatments involved the application of inorganic fertilizers (urea, SSP and MOP), FYM, vermi-compost, bio-fertilizers and green manure in different combinations. The results showed highest annual shoot growth (55.27 cm), tree height (4.98 m), tree volume (18.62 m^3), leaf N (2.98%), K (3.44%) and Ca (2.86%) content with the treatment 'T_5' - 75% NPK + bio-fertilizers (60 g each/tree basin) + green manuring (sunhemp @ 25 g seeds/tree basin). Whereas, the highest trunk girth (71.47 cm), leaf area (13.12 cm^2), leaf Fe (265.16 ppm) and Zn (28.04 ppm) were observed with 'T_7' = 50% NPK + bio-fertilizers (60 g each/ tree basin) + green manuring (sunhemp @ 25 g seeds/tree basin) + FYM (40 kg) + vermicompost (11.5 kg). Thus, the combined application of nutrients in treatments T_5 and T_7 were found to be superior as compared to other treatments for enhancing the tree growth and leaf nutrients, which in turn lead to increase in fruit yield and quality.

Key words: Bio-fertilizer, growth, plum, integrated nutrient management.

INTRODUCTION

Plum (*Prunus salicina* Lindl.) is one of the important fruit crops of the temperate region. It has proved to be a money spinner for the people of mid hills. Proper nutrition to the plant is an important aspect to achieve higher production. The continuous use of chemical fertilizers has degraded the soil health in terms of fertility and has caused soil pollution. The reduction in soil fertility has resulted in low productivity of the crop. Besides, the increasing cost of fertilizers and their negative effect on soil health has led to intensified attempts to the use of organic matter and bio-fertilizers along with inorganic fertilizers through integrated nutrient management. Keeping in view the significance of judicious use of the organic minerals along with chemical fertilizers in regulating tree growth and leaf nutrient status, which directly affects the fruit yield and quality, the present investigation was conducted to find out the most efficient manuring schedule for plum.

MATERIALS AND METHODS

The present study was conducted during 2011-12 on plum orchards of Horticulture Research Station, Kandaghat, Dr YSPUH&F, Nauni, Solan. The experiment comprised of eight treatments, *viz.*, T_1 = bio-fertilizers (*Azotobacter*, AMF, PSB @ 60 g each/ tree basin) + FYM (40 kg/tree) + vermicompost (25 kg/tree), T_2 = Biofertilizers (60 g each/ tree basin) + green manuring (sunhemp @ 25 g seeds/ tree basin) + FYM (40 kg/tree) + vermicompost (24 kg/tree), T_3 = 75% NPK + bio-fertilizers (60 g each/ tree basin), T_4 = 50% NPK + bio-fertilizers (60 g each/tree basin), T_5 = 75% NPK + bio-fertilizers (60 g each/ tree basin) + green manuring (sunhemp @ 25 g seeds/tree basin), T_6 = 50% NPK + bio-fertilizers (60 g each/tree basin) + green manuring (sunhemp @ 25 g seeds/ tree basin) + FYM (40 kg/tree), T_7 = 50% NPK + bio-fertilizers (60 g each/tree basin) + green manuring (sunhemp @ 25 g seeds/ tree basin) + FYM (40 kg/ tree) + vermicompost (11.5 kg/tree) and T_8 = 500 g N + 250 g P + 700 g K + 40 kg/tree FYM. The trial was laid out in randomized block design with three replications. The required quantity of phosphorus (SSP) and potash (MOP) were applied during mid December along with FYM. The nitrogen (urea) was applied in split doses, half during spring before flowering and remaining half dose was applied one month after first application. Bio-fertilizers along with vermicompost were used one month after chemical fertilizers application. The seeds of sunhemp were sown during June. The tree growth parameters, *viz*., annual shoot growth, trunk girth, tree height and tree volume were recorded at the end of growing season. Leaf samples were collected from middle of current season's growth around the periphery of the trees in the last week of June as recommended by Kenworthy (8) during both the years. The leaf samples were kept in hot air oven for drying. After drying, the leaf samples were ground to pass a 0.5

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mm mesh and analysed for nutrient content. Nitrogen was estimated by using Kjeltech 2300 auto-analyzer unit. Phosphorus was determined by vandomolybdo phosphoric yellow colour method (Jackson, 7) in double beam UV-VIS spectrophotometer. Potassium and calcium were determined by flame photometer. Zinc, copper, iron and manganese were determined by atomic absorption method using Perkin Elmer Analyst 400 atomic absorption spectrophotometer.

RESULTS AND DISCUSSION

The results obtained on the effect of integrated nutrient management on the growth characteristics of plum (Table 1) exhibited the best performance with 75% NPK + bio-fertilizers (60 g each/ tree basin) + green manuring (sunhemp @ 25 g seeds/ tree basin), where highest annual shoot growth (55.27 cm), tree height (4.98 m) and tree volume (18.62 m^3) were observed, while the highest trunk girth (71.47 cm) and leaf area (13.12 cm^2) were observed with 50% NPK + bio-fertilizers (60 g each/tree basin) + green manuring (sunhemp @ 25 g seeds/ tree basin) + FYM (40 kg/ tree) + vermicompost (11.5 kg/tree). Similar results were obtained by Gautam *et al.* (4) who reported maximum vegetative growth with application of FYM and vermicompost along with chemical fertilizers. This might be due to the increased photosynthetic rate and carbohydrate accumulation as a result of multifarious role of FYM and vermicompost to allow most favourable conditions of soil with increased availability of plant nutrients responsible for better plant growth (Sharma and Bhutani, 12; Tiwari *et al.*, 14; Dutta *et al*., 3). Goswami (5) and Pathak and Ram (11) also observed improved vegetative growth in guava with the application of different fertilizers, organic manures and bio-fertilizers. This increase in tree height, spread, volume, shoot length and number of shoot emergence per branch might be attributed to the stimulative activity of microflora in the rhizosphere leading to increased nutrient availability and hence vigorous plant growth (Singh *et al*., 13; Aseri *et al.*, 2). The bio-fertilizers inoculation helps the plants to increase the dehydrogenase, alkaline phosphatase, nitrogenase and hydrolysis enzyme activities mainly due to increase in the rhizosphere microbial population as a consequence of the inoculation treatments (Aseri and Tarafdar, 1). The free living nitrogen fixer can affect plant growth not only by fixing nitrogen but also by altering microbial balance, solublizing fixed soil phosphorus, suppressing pathogenic micro organisms and by producing metabolites that stimulate plant development. This is an indication of the fact that bio-fertilizers and compost hasten the vegetative growth by virtue of their nutrient releasing properties.

Leaf nutrient status increased markedly with integrated application of inorganic fertilizers, FYM, vermicompost, bio-fertilizers and green manures (Tables 2 &3). The leaf nitrogen (2.98%), potassium (3.44%) and calcium (2.86%) content were maximum with the application of 75% NPK + bio-fertilizers (60 g each/ tree basin) + Green manuring (sunhemp @ 25 g seeds/ tree basin) while the application of 50% NPK + bio-fertilizers (60 g each/ tree basin) + Green manuring (sunhemp @ 25 g seeds/ tree basin) + FYM (40 kg/ tree) + vermicompost (11.5 kg/ tree) recorded maximum leaf iron (265.16 ppm) and zinc (28.04 ppm) content. However, the effect on leaf phosphorus, magnesium and copper was found to be non significant. Higher N might be attributed to the improvement in soil aeration, better soil moisture retention in root zone, increased microbial nitrogen fixation due to conjoint application and thus improved its availability to the plants. The addition

Table 1. Effect of organic manures, bio-fertilizers and inorganic fertilizers on growth of plum cv. Santa Rosa trees.

Treatment	Annual shoot growth (cm)	Trunk girth (cm)	Tree height (m)	Tree volume (cc)	Leaf area (cm^2)
T_1 (B + FYM + V_1)	37.72	66.06	4.00	11.72	8.63
T_2 (B + GM + FYM + V_2)	40.34	65.94	4.17	12.56	8.89
T_3 (75% NPK + B)	44.26	66.75	4.35	14.21	10.06
T_4 (50% NPK + B)	41.72	69.48	4.18	13.48	9.78
T_5 (75% NPK + B + GM)	55.27	69.74	4.98	18.62	12.30
T_6 (50% NPK + B + GM + FYM)	47.86	69.74	4.59	16.01	11.97
T_7 (50% NPK + B + GM + FYM + V_3)	50.94	71.47	4.78	17.51	13.12
T_8 (500 g N + 250 g P + 700 g K + FYM)	45.78	70.78	4.44	14.77	11.72
CD at 5%	0.52	3.02	0.34	0.50	1.60

V_1 = 25 kg vermicompost; V_2 = 24 kg vermicompost; V_3 = 11.5 kg vermicompost; B = Bio-fertilizers, GM = Green manure

Table 2. Effect of organic manures, bio-fertilizers and inorganic fertilizers on leaf nutrient status of plum cv. Santa Rosa trees.

Treatment	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Calcium (%)
T_1 (B + FYM + V_1)	1.61	0.20	2.38	1.92
T_2 (B + GM + FYM + V_2)	1.82	0.21	2.35	2.04
T_3 (75% NPK + B)	2.34	0.22	2.98	2.12
T_4 (50% NPK + B)	2.12	0.23	2.60	2.30
T_5 (75% NPK + B + GM)	2.98	0.27	3.44	2.86
T_6 (50% NPK + B + GM + FYM)	2.74	0.24	3.16	2.39
T_7 (50% NPK + B + GM + FYM + V_3)	2.85	0.25	3.31	2.65
T_8 (500 g N + 250 g P + 700 g K + FYM)	2.43	0.23	2.46	2.51
CD at 5%	0.67	NS	0.62	0.49

V_1 = 25 kg vermicompost; V_2 = 24 kg vermicompost; V_3 = 11.5 kg vermicompost; B = Bio-fertilizers, GM = Green manure

Table 3. Effect of organic manures, bio-fertilizers and inorganic fertilizers on leaf nutrient status of plum cv. Santa Rosa trees.

Treatment	Magnesium (%)	Iron (ppm)	Copper (ppm)	Zinc (ppm)
T_1 (B + FYM + V_1)	0.41	248.72	10.24	23.79
T_2 (B + GM + FYM + V_2)	0.45	251.4	12.28	24.24
T_3 (75% NPK + B)	0.52	256.05	12.54	26.25
T_4 (50% NPK + B)	0.58	257.13	12.20	25.15
T_5 (75% NPK + B + GM)	0.70	260.10	12.73	26.46
T_6 (50% NPK + B + GM + FYM)	0.62	261.39	11.22	27.32
T_7 (50% NPK + B + GM + FYM + V_3)	0.67	265.16	12.70	28.04
T_8 (500 g N + 250 g P + 700 g K + FYM)	0.64	253.74	12.01	22.46
CD at 5%	NS	0.64	NS	0.73

V_1 = 25 kg vermicompost; V_2 = 24 kg vermicompost; V_3 = 11.5 kg vermicompost; B = Bio-fertilizers, GM = Green manure

of vermicompost improved physical properties of soil, moisture retention in soil rhizosphere, improved root development by mycelia network of arbuscular mycorrhizal fungi, thus increased the water absorption and nutrients and thus improved the nutrient contents of leaf (Morselli *et al*., 10; Gupta *et al*., 6). Marathe *et al*. (9) observed the highest concentration of N, P, K, Mg, Zn and Cu in the leaves with the combined application of FYM along with 50% dose of inorganic fertilizers and Ca with green manuring with sunhemp along with 50% dose of inorganic fertilizers. Sole application of FYM recorded highest Mn and Fe contents followed by combined application of FYM along with *Azotobacter* and PSB. These observations clearly indicated that *Azotobacter* and PSB play key role in nitrogen fixation and phosphorus solubilization respectively and can compensate or save 25% dose of inorganic fertilizers supplied for N and P nutrition.

Hence, it can be concluded from the present investigation that combined application of nutrients through organic and inorganic sources was found to be superior as compared to other treatments for enhancing the tree growth and leaf nutrients which in turn lead to increase in fruit yield and quality.

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Received : November, 2013; Revised : April, 2016;
Accepted : May, 2016