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Effect of Integrated Nutrient Management on Leaf Nutrient Status of Walnut (*Juglans regia* L.)

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Abstract

The study was conducted at 10 – years- old walnut orchard at Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni-Solan(H.P.) to find out the effect of integrated nutrient management on leaf nutrient status of walnut (*Juglans regia* L.). There were 13 different treatment combinations of organic and inorganic fertilizers. Treatments were applied on per tree basis. Among the treatments recommended dose of NPK +50kg vermicompost and three fourth recommended dose of NPK+68.75kg vermicompost were effective for improvement of leaf nutrient status.

Key words: NPK, neem cake, vermicompost, leaf nutrient

Introduction

Walnut (*Juglans regia* L.) is one of the most important income generating high value nut crops and suitable for poor farmers in high hills of Nepal and India (Chaudhary *et al.* 2004). However, the production of walnut is very low as compared to USA, China, France and others developed countries. The annual production of walnut in USA is 290300 , China 503000 and France 34228 , but in Nepal its production is 4521 (FAO 2007). Although the demands of walnut have been increasing day by day in national and international market, farmers are not encouraged to grow this high value crop in a commercial scale. Due to lack to appropriate management practices, suitable varieties and market linkage Nepali and Indian farmers are not motivated to grow this crop.

Fertilizers and organic manures constitute important inputs in the production of fruit crops. Plants require essential mineral nutrients to complete their life cycle and the quantities required for optimum growth and production vary with species.

Increased chemical fertilizer cost and awareness of environmental pollution have necessitated the use of organic fertilizers for the development of more efficient fertility management program. Organic fertilizers are apparently environment and farmer friendly renewable source of non-bulky, low cost organic agricultural inputs for improving soil fertility status in sloppy and denuded areas. Organic manures are fairly good source of nutrients which has direct influence on plant growth like other commercial fertilizers. Mukherjee *et al.* (1991) and Prasad and Singhania (1989) also reported that application of organic manures with NPK increased the leaf nutrient status of Khasi mandarin. Jambhekar (1992) and Shivputra *et al.* (2004) also reported similar result. However, few information are available in this area; therefore this study was designed and conducted to identify the effect of INM on leaf status of walnut.

Materials and Methods

The study was conducted during 2004-2005 at the walnut orchard of the Department of Pomology at Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni-Solan (H.P.) India. Ten - years - old walnut trees having uniform size and vigour were selected. An experiment was laid out in a randomized block design with three replications. There were 13 treatments T_1= Recommended dose of NPK + FYM (750 g: 375 g: 750g +100kg) ,T_2=Three fourths of the recommended NPK

+137.5kg FYM, T_3= Half of the recommended NPK + 175 kg FYM, T_4= Recommended dose of NPK+10kg neem cake, T_5= Three fourths of the recommended NPK + 13.75 kg neem cake, T_6= Half of the recommended NPK + 17.5kg neem cake, T_7= Recommended dose of NPK +50kg vermicompost, T_8=Three fourths of the recommended NPK+68.75kg vermi-compost, T_9= Half of the recommended NPK + 87.50kg vermicompost , T_{10}=15 kg neem cake , T_{11}= 75 kg vermicompost, T_{12}= 150 kg FYM, T_{13}= Recommended dose of NPK .

All the treatments were applied in December 2004. The required amounts of each fertilizer and manure were weighed by weighing balance separately .Fertilizers and manures were applied 30 cm away from tree trunk by broadcasting in the tree basin area then mixing with the soil and mulching properly . The leaf samples were collected during the first week of August 2005.

Determination of leaf nutrient status

Collection and preparation of leaf samples

Leaf samples from walnut trees were collected and analysed as per standard sampling method. The samples were washed first under tap water followed by 0.1 N HCl, distilled water and finally with double distilled water. They were then dried by spreading on clean blotting papers and final drying was accomplished in an oven at 68 ^{o}C (Chapman 1964). The samples were sequentially ground by electrical grinder for further analysis.

Digestion of the leaf samples

The digestion of the samples for the estimation of nitrogen was carried out in concentration sulphuric acid (AR grade) by adding digestion mixture . For the estimation of leaf P, K, Ca, Mg, Zn, Fe, Cu and Mn, digestion was done in diacid mixture prepared by mixing nitric acid and perchloric acid (AR grade) in the ratio of 4:1.

Determination of nutrient elements

a) Total nitrogen content was determined by Microkjeldahl's method (AOAC 1980) and results were expressed in percentage on dry weight basis.

b) Total phosphorus content was determined by Vanadomolybdophosphoric yellow colour method (Jackson 1975) and the results were expressed in percentage on dry weight basis.

c) Total potassium content was determined by flame photometer (Toshniwal, TMF 45) and the result was expressed in percentage on dry weight basis.

d) The estimation of Ca and Mg was done by attomic absorption spectrophotometer.

e) The micronutrients zinc, iron, copper and manganese were also determined with the help of atomic absoption spectrophotometer and the results were expressed in parts per million (ppm) on dry weight basis.

Result and Discussion

Leaf nitrogen

The highest leaf N content was recorded in treatment recommended dose of NPK +50 kg vermicompost and lowest in treatment 150 kg FYM (Table 1) . This might be due to the fact that application of 50 kg vermicompost along with full dose of NPK must have enhanced mineralization of organic nitrogen thus making more nitrogen available to the plant. These results are in conformity with the findings of Prasad and Singhania (1989) and Mukherjee *et al.* (1991) who also reported similar results in Khasi mandarin. Similar results were also reported by Reddy *et al.* (2001) in coconut seedlings and Shivputra *et al.*(2004) in papaya.

Leaf phosphorus content

Leaf P content was affected significantly by different treatments. Maximum leaf P content was recorded in treatment full NPK + 50 kg vermicompost and minimum in treatment 15 kg neem cake (Table 1). Highest leaf P content in treatment T_7 may be attributed to the fact that vermicompost is a rich source of soil micro-organisms which must have helped in the solublization of fixed P to soluble form thus making it easily available to the plant. These results are in agreement with the findings of Jambhekar *et al. (*1992) and Shivputra *et al. (*2004).

Leaf potassium content

Effect of different treatments of organic, inorganic and their combinations on leaf K content of walnut was found statistically non-significant.

Leaf calcium content

Leaf Ca content was affected significantly by different treatments. Highest leaf Ca content was in treatment half of the recommended NPK + 87.50 kg vermicompost and lowest in control recommended dose of NPK (750g: 375g: 750 g) (Table 1). Similar results were also reported by Rodrignez *et al.*(2000) in Gerbera. This response could have been due to the fact that vermicompost is a rich source of Ca and with the application of higher quantity of it, availability of Ca would have increased hence more leaf Ca content. These results are in confirmation with the findings of Anitha and Prema (2003) who reported more Ca in vermicompost.

Leaf magnesium content

The present investigation results clearly indicate that leaf Mg was affected significantly by different treatments. Treatment half of the recommended NPK + 17.5kg neem cake was found superior in increasing leaf Mg than all other treatments (Table 1). Results also showed that with the increase in neem cake , leaf Mg content increased , while with the increase in vermicompost leaf Mg showed declining trend. This reflects that neem cake might be rich source of Mg content as compared to vermicompost and FYM. These results are in line with the findings of Huchce *et al.* (2001) who also reported similar results in mandarin.

Table 1. Effect of integrated nutrient management on the macro-nutrient status of walnut leaves.

Treatment	N (%)	P (%)	K (%)	Ca (%)	Mg (%)
T_1=Recommended dose of NPK + FYM(750g :375 g: 750g +100kg)	2.77	0.25	1.42	2.58	0.53
T_2=Three fourths of the recommended NPK +137.5kg FYM	2.68	0.28	1.34	2.46	0.54
T_3= Half of the recommended NPK + 175 kg FYM	2.69	0.27	1.38	2.46	0.54
T_4= Recommended dose of NPK+10kg neem cake	2.63	0.25	1.35	2.58	0.52
T_5= Three fourths of the recommended NPK+ 13.75 kg neem cake	2.67	0.26	1.39	2.49	0.59
T_6= Half of the recommended NPK + 17.5kg neem cake	2.69	0.24	1.40	2.50	0.62
T_7= Recommended dose of NPK +50kg vermicompost	2.78	0.31	1.38	2.57	0.61
T_8=Three fourths of the recommended NPK+68.75kg vermi-compost	2.76	0.28	1.44	2.37	0.60
T_9= Half of the recommended NPK + 87.50kg vermicompost	2.71	0.31	1.41	2.60	0.53
T_{10}=15 kg neem cake	2.53	0.24	1.29	2.36	0.56
T_{11}= 75 kg vermicompost	2.48	0.26	1.29	2.33	0.60
T_{12}= 150kg FYM	2.27	0.27	1.27	2.39	0.57
T_{13}= Recommended dose of NPK	2.67	0.25	1.31	2.22	0.53
CD 0.05	0.24	0.04	NS	0.10	0.03

Leaf zinc content

Maximum leaf Zn content was recorded in treatment, three fourths of the recommended NPK+68.75kg vermicompost (Table 2). This might be due to the reason that vermicompost in combination with NPK must have improved soil properties like microbial population, enzymatic activities especially dehydrogenase and hydrolase (Chaudhary *et al.* 2004). With the improvement of these soil characteristics the higher availability of micronutrients especially Zn and Mn in vermicompost treated soils may be attributed to the release of organically bound micronutrients present in vermicompost (Lee 1985).

Leaf manganese content

Leaf Mn content was also recorded maximum in treatment three fourths of the recommended NPK+68.75kg vermicompost (Table 2). This may be attributed due to the improved fertilizer use efficiency with the application of vermicompost (Chaudhary *et al.* 2004) apart from the nutrient supply and availability.

Table 2. Effect of integrated nutrient management on the micro-nutrient status of walnut leaves

Treatment	Zn(ppm)	Mn(ppm)	Fe(ppm)	Cu(ppm)
T_1=Recommended dose of NPK + FYM(750g :375 g: 750g +100kg)	23.85	36.50	135.12	3.60
T_2=Three fourths of the recommended NPK +137.5kg FYM	26.70	51.65	112.42	4.08
T_3= Half of the recommended NPK + 175 kg FYM	28.67	35.82	106.53	3.55
T_4= Recommended dose of NPK+10kg neem cake	25.17	33.31	133.62	3.38
T_5= Three fourths of the recommended NPK+ 13.75 kg neem cake	23.72	42.98	103.72	2.60
T_6= Half of the recommended NPK + 17.5kg neem cake	22.57	46.55	113.13	2.75
T_7= Recommended dose of NPK +50kg vermicompost	27.53	33.52	109.93	4.53
T_8=Three fourths of the recommended NPK+68.75kgvermi-compost	29.18	53.50	120.65	4.23
T_9= Half of the recommended NPK + 87.50kg vermicompost	27.53	42.52	116.82	2.54
T_{10}=15 kg neem cake	19.50	39.53	105.82	2.83
T_{11}= 75 kg vermicompost	16.50	52.25	155.67	3.43
T_{12}= 150kg FYM	23.88	34.58	124.12	3.03
T_{13}= Recommended dose of NPK	23.16	32.52	119.73	2.72
$CD_{0.05}$	2.71	2.67	22.20	0.90

Leaf iron content

Leaf Fe content was affected significantly by different treatments. Highest leaf Fe content was in treatment 75 kg vermicompost and lowest in three fourths of the recommended NPK+ 13.75 kg neem cake (Table 2). Highest Fe content in 75kg vermicompost might be due to the positive effect of vermicompost on soil properties thus releasing Fe to the plant. Addition of vermicompost in the soil increases the availability of micronutrient to plant (Sainz *et al.* 1998, Vasanthi & Kumaraswamy, 1999). Venkatesh *et al.* (1997) in grape field found that application of vermicompost @ 5t ha^{-1} Increased Fe availability to 122.6 percent.

Leaf copper content

Leaf Cu content was maximum in treatment recommended dose of NPK +50kg vermicompost (Table 2). This again might be due to the improved soil properties, increased microbial population and more solublization of bound nutrients thus making them available freely to the plant. Results are in close confirmity with the findings of Venkatesh *et al.* (1997) who also reported in grape field that application of 5 t/ha^{-1}. vermicompost increased available Cu to 194 percent.

Walnut is a most important high value nut crop and has potential in some hills of India and Nepal. According to this research application of recommended dose of NPK +50kg vermicompost and three fourth of the recommended dose of NPK + 68.75 kg vermicompost were effective in improving the leaf nutrient status.

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