Effect of Integrated Nutrient Management on Tree Growth, Yield and Quality of Walnut (*Juglans regia* L.)

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ABSTRACT

The study was conducted in 10 years old walnut orchard in Dr.Y. S. Parmar University of Horticulture and Forestry, Nauni-Solan(H.P.) to find out the effect of integrated nutrient management on tree growth, yield and nut quality of walnut (Juglans regia L.). There were 13 different treatments in combination of organic and inorganic fertilizers. Changes in tree-height, trunk-girth and protein and oil contents in nuts were recorded in percentage and shoot extension in meter. Statistical analysis of the data was carried out as per the method described by Cochran and Cox (1963). Recommended dose of NPK with 50 kg vermicompost produced highest increase in tree height, trunk girth and shoot extension. However, highest improvement in nut yield and quality were observed with three fourth of recommended NPK and 68.75 kg vermicompost.

Key words: Integrated-nutrient-management, NPK, neem-cake, vermicompost, walnut, Himachal Pradesh.

INTRODUCTION

Walnut (*Juglans regia* L.) is one of the important high value and suitable income generating crops to high mountain farmer of Nepal and India. The yield of walnut in the countries is very low as compared to USA, China, France and others developed countries (Chaudhary *et al.,* 2004). Due to lack of appropriate management practices, suitable varieties and market linkages, the mountain farmers are not encouraged to grow the tree crop in commercial scale despite a day-by-day increasing demand for walnut in market.

It has been reported that vermicompost and neem-cake are good sources of nutrients for excellent yield and quality of different crops (Arancon *et al.,* 2003; Kumari *et al.,* 1999). Likewise, various organic manures are excellent nutrients sources to increase yield and quality of coconut (Ram and Rajput, 2002). Integrated nutrient management is one of the most important technologies in walnut production. However, little information is available in this area. In view of which, this study was designed and conducted to identify the effect of integrated nutrient management on growth, yield and nut quality of walnut.

MATERIALS AND METHOD

The study was conducted during 2004-2005 at walnut orchard of the Department of Pomology in Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni-Solan (H.P.), India. Ten years old walnut trees were selected for the experiment. The experiment was laid out in randomized block design with three replications. There were 13 treatments as follows, all applied per tree basis in December 2004.

T_1= Recommended dose of NPK + 100kg FYM (750g :375g :750g)
T_2= Three fourths of the recommended NPK +137.5kg FYM
T_3= Half of the recommended NPK + 175kg FYM
T_4= Recommended dose of NPK+10kg Neem cake

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T_5= Three fourths of the recommended NPK + 13.75kg 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}=15kg neem cake
T_{11}= 75kg vermicompost
T_{12}= 150kg FYM
T_{13}= Recommended dose of NPK

Increment in trunk girth, tree volume, shoot extension, yield and nut-quality were recorded. Tree height of each experimental tree was measured above ground level with a graduated staff, and the trunk girth was measured 10cm above the graft union. Tree canopy volume was calculated using following formula as suggested by Westwood (1993).

$$\text{Tree canopy volume} = 4/3\ \pi(\text{tree height}) \times (\text{tree width})^2$$

For shoot extension, ten annual shoots were randomly selected from all over the periphery of each experimental tree, and length of the shoots was measured with a measuring tape at the end of growing season (November). The per tree basis yield was recorded after crop harvesting and sun-drying of nuts for five days. Kernel protein was assessed by the method given by Khanizadeh *et al*. (1995) and the percentage oil content on weight basis by Soxhlet apparatus method (Ranganna, 1997). The data were analyzed by using the statistical techniques describe by Cochran and Cox (1963). The treatment effects were tested at five percent level of significance.

RESULTS AND DISCUSSIONS

Growth

The **o**rganic manures applied in combination with the inorganic fertilizers (NPK) significantly increased the growth of walnut tree measured in terms of tree height, trunk girth, cross sectional area, tree volume and shoot extension. A combination of full dose of NPK and 50kg of vermicompost was found superior to the rest of the treatments (Table 1). Marimuthu *et al.* (2001) and Murarkar *et al.* (1998) also reported similar results in tree growth due to application of organic manures in combination with fertilizers respectively on coconut and mulberry.

Better efficiency of organic manures in combination with inorganic fertilizers in increasing tree growth and yield could be due to various micronutrients provided to the trees in optimum range. Application of organic manures would have helped in the nourishment of the trees with the supplemental micronutrients contained in the organic manures. As reported by Nandhakumar (1997), the organic manures would enhance metabolic activity in the trees during early growth phase through the supply of such micronutrients, which in turn could have encouraged overall tree growth in the later stage also.

Yield and nut quality

The maximum fruit yield was recorded with the application of three fourths of the recommended NPK and 68.75kg of vermicompost, which was statistically superior to other treatments. The minimum yield was in the trees treated with three fourths of the recommended NPK and 137.5kg FYM (Table 2). The increased yield with application of three fourths of the recommended NPK and 68.75kg of vermicompost might be attributed to the possible effect of vermicompost on transforming plant nutrients into soluble forms

and chelating them to increase the uptake by the trees. Vermicompost is also a rich source of micro flora such as *Azosprillium*, *Actinomycetes* and *Phosphobacillus*, which multiplies faster through digestive system of earthworms. Beyond helping in nutrients transformation, these microbes also released hormone like substances to help in the tree metabolism, growth, development and yield (Tomati *et al*., 1988).

Table 1: Effect of integrated nutrient management on the growth of walnut (*J. regia* L.)

Treatment	Increment in tree height (%)	Increment in trunk girth (%)	Tree volume (m^3)	Shoot extension growth(m)
T_1=Rec. NPK + 100kg FYM	15.22	0.75	34.97	0.67
T_2=3/4th rec. NPK +137.5kg FYM	13.7	0.8	26.02	0.58
T_3= 1/2 rec. NPK + 175 kg FYM	8.48	0.68	22.36	0.27
T_4= Rec. NPK+10kg Neem cake	14.54	0.91	29.97	0.61
T_5= 3/4t^{h} rec. NPK+ 13.75 kg Neem cake	13.86	0.8	29.3	0.58
T_6= 1/2 rec. NPK + 17.5kg Neem cake	9.17	0.7	23.13	0.28
T_7= Rec. NPK +50kgvermicompost	15.9	0.96	36.36	0.77
T_8=3/4th rec. NPK+68.75kgvermi-compost	15.48	0.86	32.51	0.75
T_9= 1/2 rec. NPK + 87.50kg vermicompost	12.36	0.75	23.7	0.57
T_{10}= 15 kg Neem cake	11.37	0.75	22.99	0.46
T_{11}= 75kg vermicompost	12.74	0.87	24.13	0.57
T_{12}= 150kg FYM	9.72	0.7	23.01	0.38
T_{13}= Rec. NPK	9.47	0.7	23.19	0.48
$CD_{0.05}$	0.50	0.06	NS	0.29

Table 2: Effect of integrated nutrient management on the yield and nut quality of walnut (*J. regia* L.)

Treatment	Yield (kg/tree)	Kernel protein (%)	Kernel oil (%)
T_1=Rec. NPK + 100kg FYM	0.87	11.02	53.31
T_2=3/4th rec. NPK +137.5kg FYM	0.72	10.96	57.76
T_3= 1/2 rec. NPK + 175 kg FYM	0.9	14.12	57.86
T_4= Rec. NPK+10kg Neem cake	0.97	11.99	57.18
T_5= 3/4t^{h} rec. NPK+ 13.75 kg Neem cake	1.02	11.93	60.63
T_6= 1/2 rec. NPK + 17.5kg Neem cake	1.93	11.08	61
T_7= Rec. NPK +50kgvermicompost	1.43	14.21	62.35
T_8=3/4th rec. NPK+68.75kgvermi-compost	2.68	13.75	58.17
T_9= 1/2 rec. NPK + 87.50kg vermicompost	1.15	12.53	61.66
T_{10}= 15 kg Neem cake	1.28	10.94	59.51
T_{11}= 75kg vermicompost	1.2	11.24	59.18
T_{12}= 150kg FYM	0.97	13.6	59.94
T_{13}= Rec. NPK	1.05	10.88	52.15
$CD_{0.05}$	0.82	0.58	2.06

The kernel protein was registered maximum in the treatment with recommended dose of NPK and 50kg vermicompost and minimum with recommended dose of NPK (control). Treatment with full NPK and 50kg vermicompost should have enhanced the uptake of nitrogen and its assimilation into amino acids and finally into protein in conformity to the findings of Sharma *et al*. (2002).

The treatments significantly affected the oil content in walnut kernels. The lowest oil content was recorded in the treatment with recommended dose of NPK. The highest oil percentage was recorded in the treatment with recommended dose of NPK and 50kg vermicompost, which was statistically at par with half of the recommended NPK and 17.5kg Neem cake and half of the recommended NPK and 87.50kg vermicompost. This might be due to higher contents of nitrogen, phosphorus, potash and cupper in the treatment with recommended dose of NPK and 50kg vermicompost, which might have triggered metabolic pathways synthesizing fats in the kernels (Randhawa, 2004).

CONCLUSIONS

Walnut is one of the important high value cash crops, and high mountains of Nepal and India are potential for its commercial production. According to this research, use of recommended dose of NPK (750g: 375g: 750g) with 50kg vermicompost increased the growth of walnut tree significantly. However, kernel yield and quality were improved by application of vermicompost in the walnut trees combined with three fourths of recommended dose of NPK. Moreover, use of the organic fertilizer in soil would reduce mining of soil tilth, maintain adequate level of plant nutrients in the soil pool and improve soil aeration, drainage and water-holding capacity in walnut orchard.

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