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Effect of pruning intensities on growth, nut quality, yield and leaf nutrient status of pecan

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ABSTRACT

Pecan trees (25-year-old) were pruned to pruning intensities where height to spread ratio was kept at four different levels *viz.*, 1 : 1.50, 1 : 1.25, 1 : 1.00 and 1 : 0.75 and their influence on growth, nut quality, yield and leaf nutrient status was studied over unprunned trees (control). Pruning was done in the month of February during dormancy. All the pruning intensities recorded better results for growth, nut quality and leaf nutrient content in pecan nut than control but the yield was significantly reduced with the pruning intensities where height to spread ratio was kept as 1 : 1.00 and 1: 0 .75. Maximum yield (2.95 kg/tree) was obtained in control trees, which was statistically at par with pruned trees where height to spread ratio was 1 : 1.50 (2.84 kg/tree) without affecting the nut quality. The nut length (4.00cm), nut weight (5.03g), kernel weight (3.26g), kernel percentage (63.15), protein (12.44%) and oil content (61.96%) recorded in trees with 1 : 1.50 pruning intensity were observed to be non-significant over control. The data revealed that 1 : 1.50 height to spread ratio proved to be the optimum pruning intensity as it did not reduce the yield significantly and also improved growth, nut quality and leaf nutrient status compared to unprunned trees.

Key words: Pecan, *Carya illinoensis*, pruning, yield, nut quality, leaf nutrient.

INTRODUCTION

Pecan nut (*Carya illinoensis* Wang K. Koch) is an introduced nut crop, which has adapted well in the mid hills of the Himachal Pradesh and can be grown in the areas where walnut cultivation cannot be undertaken due to warmer climate. Various factors like climate, soil, topography, sunlight, cultural practices etc. influence growth, production and nut quality of pecan. It can be improved by adopting proper and adequate cultural practices like fertilization, irrigation, training and pruning. Unpruned pecan trees tend to be oversized and become overcrowded, which cause hindrance in the harvesting of nuts, sunlight penetration, spray operations etc. Low photosynthesis rate due to less sunlight and high incidence of pests and diseases reduce pecan nut size and quality as well as result in poor filling of nuts or formation of blank nuts. Pruning is one of the most important cultural practices affecting the vigour, productivity and fruit quality and also the regulation of bearing. Optimum pruning practices can be employed to achieve these objectives. It has beneficial effect on growth, size and quality of pecan.

Pruning resulted in enhanced fruit set, increases growth of remaining branches and reduced fruit drop in pecan (Sparks, 6). Pruning has been reported to increase tree vigour, terminal shoot growth, nut size and quality (Worley and Mullinix, 10). They have also observed an increase in leaf N, P and Mg. However, pruning is rarely done scientifically in pecan orchards and no work has been reported on the pruning of pecans in India so far. Therefore, present investigations were carried out to standardize the optimum pruning intensity and to study the effect of different pruning intensities on growth, yield nut quality, and leaf nutrient status.

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MATERIALS AND METHODS

The studies were undertaken in pecan cv. Western Schley, 25-year-old plants spaced at 8m × 8m in the orchard of the Department of Horticulture, CSKHPKV, Palampur during 2005-07. In order to get homogeneity of trees under each treatment, the replication were selected on the basis of their trunk girth. Uniform cultural practices, *i.e.*, fertilization, irrigation etc. were followed for all the trees under experiment. The soil samples were analyzed and the pH of the orchard soil was 5.6, whereas; organic carbon, phosphorus and potash were found in the higher range and nitrogen in medium range. The experiment was laid out in a randomized block design with four levels of pruning intensities; where, height to spread ratio was kept at 1 : 0.75, 1 : 1.00, 1 : 1.25 and 1 : 1.50 along with control (no pruning) replicated four times. Height was kept constant, *i.e.* 5.3 m and spread was maintained by pruning to 4.0, 5.3, 6.6 and 8.0 m in order to get 0.75,

1.00, 1.25 and 1.50 times of plant height respectively. Pruning was done in the month of February every year, when the plants were in dormant stage. Tree characters like plant height, spread and trunk circumference were measured after the completion of one growing season. Annual shoot growth was measured during October and leaf area was taken in the month of July. Nut characters were recorded after harvesting and four replicates (10 nuts / replicate). Digital Vernier callipers was used for measuring nut length and breadth. Nut and kernel weight were taken on top pan balance. Crude protein was determined by multiplying the total nitrogen estimated by Kjeldahl method with 5.3 factor. Fat content was estimated by distillation method using petroleum ether as solvent (AOAC, 1). Total nitrogen was determined by Micro-Kjeldahl's method and phosphorous by vanadomolybdophosphoric yellow colour method. The determination of potassium, calcium, magnesium, manganese, iron and zinc were carried out on atomic absorption spectrophotometer. Pooled analysis has been done for the data recorded during the years three and pooled means were presented.

RESULTS AND DISCUSSION

All the growth characters except yield were increased with increasing pruning intensities over control (Table 1). Significantly, higher percent increase in height, spread and circumference was obtained with 1.75 pruning intensity. However, percent increase in spread and circumference had very little differences among pruning intensities and were at par with each other. Leaf area and annual shoot growth increased with the increase in pruning intensity though this increase was non-significant over control, *i.e.*, only up to the treatment where height to spread ratio was 1: 1.50. The maximum leaf area and shoot growth were obtained in the 1: 0.75 pruning intensity, which was statistically at par with the treatment where height to spread ratio was 1: 1.00. Improvement in tree vigour, increased trunk circumference and terminal shoot growth with pruned are in conformity with the findings of Worley (9). Highest increase in tree height and highest values of shoot girth were recorded in severely pruning treatments in mango (Lal and Mishra, 4). The increase in growth characters may also be due to the redistribution of carbohydrate reserves to the remaining leaves, branches and trunk.

With the increasing pruning intensity, reduction in yield was noticed (Fig. 1). The maximum yield was obtained in control trees, which was statistically at par with pruned trees where height to spread ratio was 1:1.50 without affecting the nut quality. In the present studies, reduction in yield may be due to the reason that severe pruning reduced bearing area; since pecan bears laterally on one-year-old shoots. These findings are also in agreement with the results of Worley (8), and Worley and Mullinix (10), who also observed reduction in yield due to pruning. Similarly, loss of fruiting for initial two years was also recorded in severely pruning treatments in mango by Lal and Mishra (4).

An increase in nut length, nut breadth, nut weight, kernel weight, kernel percentage, protein and oil

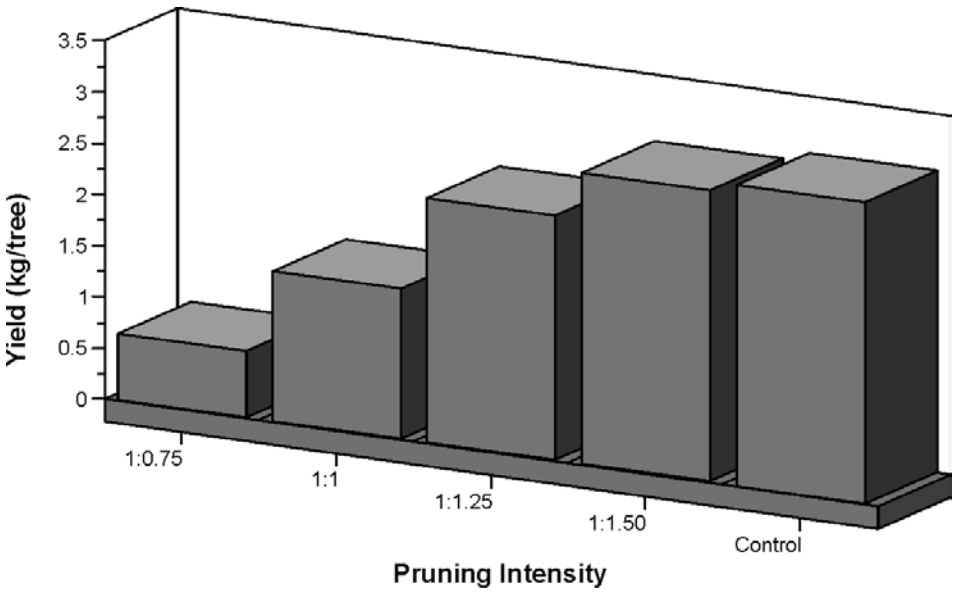

Fig. 1. Effect of pruning intensities on pecan yield.

Table 1. Effect of pruning intensities on vegetative growth of pecan.

Parameter / Pruning intensity	Increase in height (%)	Increase in spread (%)	Increase in circumference (%)	Leaf area (cm^2)	Annual shoot growth (cm)
1:0.75	12.10	11.21	10.26	26.5	20.9
1:1.00	11.29	10.21	9.44	25.2	19.7
1:1.25	10.61	9.66	8.79	21.9	18.0
1:1.50	10.14	9.03	7.75	18.8	16.8
Control	8.49	8.92	5.81	18.2	14.9
$CD_{0.05}$	0.60	0.82	1.15	2.1	2.5

Table 2. Effect of pruning intensities on nut quality of pecan.

Parameter / Pruning intensity	Nut length (cm)	Nut breadth (cm)	Nut weight (g)	Kernel weight (g)	Kernel (%)	Protein (%)	Oil (%)
1:0.75	4.19	2.23	5.57	3.94	67.2	13.9	70.1
1:1.00	4.11	2.19	5.17	3.49	65.8	13.4	69.7
1:1.25	4.04	2.20	5.08	3.35	63.7	12.9	68.5
1:1.50	4.00	2.17	5.03	3.26	63.2	12.4	61.9
Control	3.86	2.10	4.86	3.06	61.4	11.6	60.2
$CD_{0.05}$	0.15	NS	0.20	0.36	2.9	0.9	5.2

content was observed with the increasing pruning intensity over control (Table 2). The increase in nut length, nut and kernel weight, kernel percentage, protein and oil content of trees with 1:1.50 pruning intensity was non-significant over control. The increase in nut breadth was non-significant. Lowest values for all the nut characters were recorded under control. Improvement in nut size may be due to the reason that increased pruning intensity decreased number of flower buds and produced less number of nuts which ultimately increased the nut size. Higher protein and oil content with increased pruning intensity may be attributed to the enhanced leaf area which caused more synthesis of carbohydrates and metabolites and their translocation to fruit tissues. The present findings are in conformity with the results of Tarango and Ojeda (7), who also observed that pruning improved nut quality significantly through an increase in nut size and kernel percentage. Increasing the intensity of pruning tended to increase the nut size but there was little difference in total kernel percentage among pruning treatments and control (Worley, 8, 9; Worley and Mullinix, 10). Similarly, Lal and Mishra (3) reported higher values for fruit weight and TSS from pruning treatments in mango and lowest values in control. Though, severe pruning where height to spread ratio was 1:0.75 recorded significantly higher values for all the nut traits; but it reduces the yield significantly, which is not economical.

Levels of all leaf nutrients increased with increased levels of pruning intensity (Fig. 2). The maximum values for all the nutrients were obtained in the treatment in which height to spread ratio was 1:0.75 The least values were recorded in the control which was statistically at par with treatment in which height to spread ratio was 1:1.50 for N, P, Ca and Mg. These results are in conformity with the findings of Tarango and Ojeda (7) who observed that pruning significantly increased foliar concentration of N, P, Ca, Zn, Fe, Mn and slightly K, whereas, an increase in Mg leaf levels of Mg with pruning was also reported by Worley (9). Similarly, significant differences in leaf N, P, Ca, Mg, and S due to different pruning levels in mango were also reported by Singh *et al*. (5). Pruning is also known to increase the synthesis of auxins and gibberellins in the above ground parts of tree which may promote the development of vascular system and activate nutrient transport in the remaining leaves and branches (Grochowska *et al*., 2). Higher levels of leaf nutrients in pruned trees may be due to the redistribution of the elements of the pruned parts to the remaining branches and foliage.

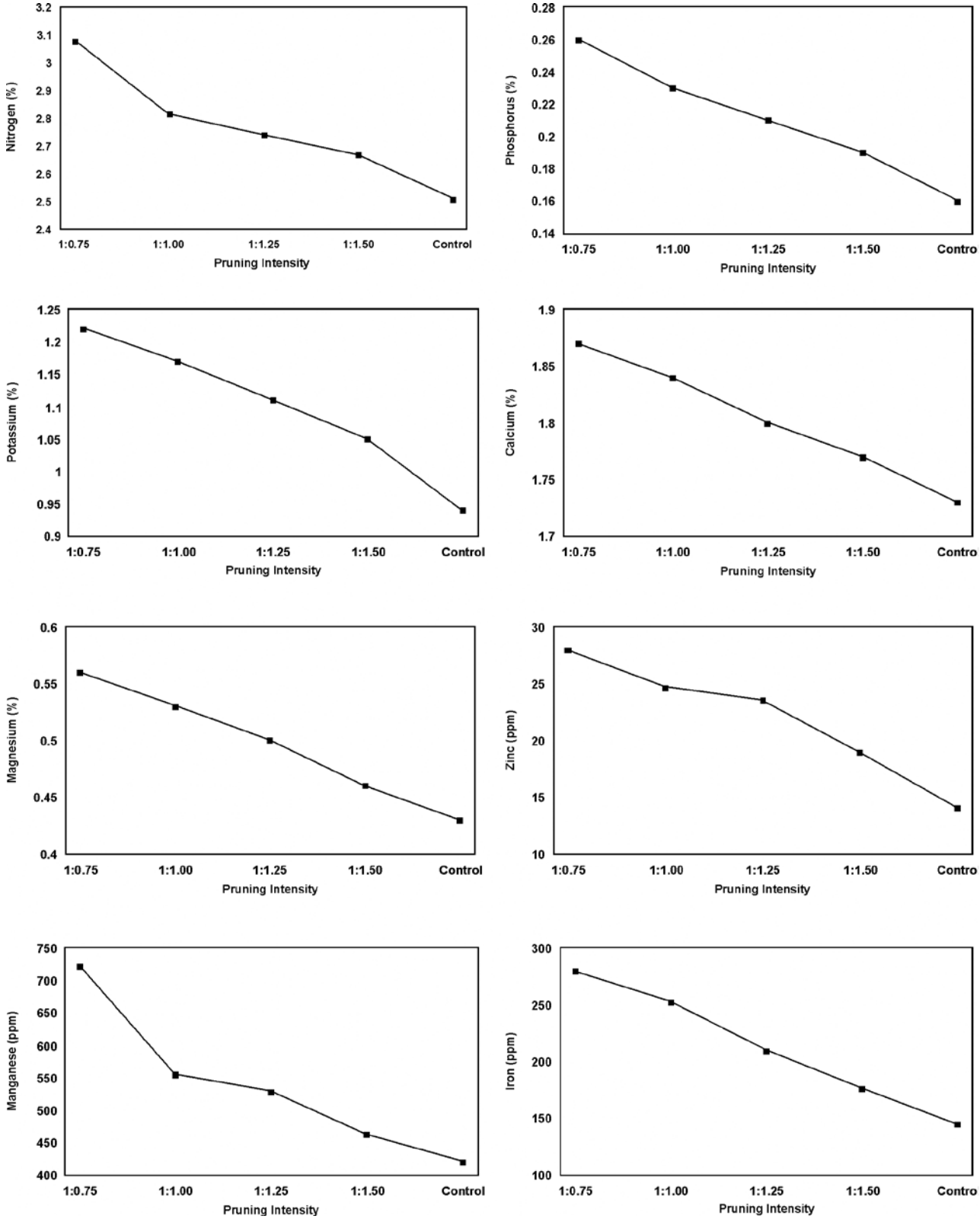

Fig. 2. Effect of pruning intensities on leaf nutrient content of pecan.

From the present investigations, it is concluded that pecan trees should be pruned at the pruning intensity of 1:1.50 height to spread ratio for getting higher yields of quality nuts besides better growth and leaf nutrient status.

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