Himachal Journal of Agricultural Research 36 (1): 124-127, 2010

Short Note

Effect of pruning intensities and nitrogen levels on growth, yield and fruit qualities of Starking Delicious apple under wet temperate high hills of Himachal Pradesh

N.S. Kaith, D.K. Mehta* and L.K. Sharma**
Dr YS Parmar University of Horticulture and Forestry
Krishi Vigyan Kendra Rohru, District Shimla -171207,HP, India.

Abstract

A field experiment on the effect of different pruning intensities and nitrogen levels on apple cultivar Starking Delicious was conducted in a private orchard at Rohru in Shimla district. Four pruning intensities and different nitrogen levels ranging from ranging from 300 to 900 g tree^{-1} were used as treatments. The plant growth increases with the increase in severity of pruning, conversely the fruit set and yield decreases with the increase in pruning severity. Similarly, with the increase in nitrogen application, plant growth and yield increases. Maximum fruit yield was observed at 700 g N tree^{-1}. Fruit size also increased with the increase in pruning intensities and nitrogen levels.

Key words: Nitrogen level, fruit yield, pruning intensities, quality parameters and growth characters.

In apple pruning/ thinning out and heading back is must for maintaining the balance between vegetative and reproductive growth. It helps in giving regular good crops of quality fruits without any effect on the tree growth. Growth responses in terms of trunk diameter and shoot growth have also been observed by Hou *et al.* (2004). In order to keep the balance between vegetative and reproductive growth a regular application of nitrogen and other nutrients are also required to be applied depending upon the growth and yield of a tree. Sharma *et al.* (2003) found that increase in the nitrogen levels and pruning intensities increases the vegetative growth of plants. Kanwar (1979) observed that higher foliar nitrogen in heavily pruned trees may be due to lower yield and more vegetative growth. Keeping in view the importance of nitrogen fertilizer and pruning intensities in maintaining balance between vegetative growth and fruit production, the present study was undertaken in a private orchard at Rohru in district Shimla, HP.

The experiment was conducted during 2007-08 in a private orchard at Dalgaon in Rohru tehsil on twenty five year old Starking Delicious apple, raised on seeding root- stocks in sandy loam soil, spaced at 5 x 5 m apart. A split plot design was followed with three replications. The treatments in main plot were four pruning intensities, as given below:

T1 No heading back only thinning out
T2 ¼ heading back and thinning out
T3 ½ heading back and thinning out
T4 ¾ heading back and thinning out

Pruning was done in the first week of January every year. Seven levels of nitrogen (300, 400, 500, 600, 700, 800 and 900 g N tree^{-1}) were assigned to sub-plots. All the trees also received uniform dose of 700 g K_2O tree^{-1} as muriate of potash and 350 g P_2O_5 tree^{-1} as single super phosphate. Nitrogen was applied as CAN in all the trees under treatment. The total dose of P_2O_5 and K_2O were applied annually during January. Nitrogen in different levels was applied in the first fortnight of March. The physical characters of the tree and yield were recorded as follows:

Trunk girth of the tree was measured at 20 cm above the graft union with the help of a measuring tape at the beginning and end of growing season.

Extension shoot growth was measured by randomly selecting shoots of current season's growth from the periphery of the tree and their lengths were measured to find out an average increase in extension shoot growth.

$$\text{Fruit set} = \frac{\text{Number of fruit set}}{\text{Number of flower cluster}} \times 100$$

Fruit yield

The crop load removed from the trees during the harvesting season was recorded as Kg tree^{-1} based on 20 kg standard apple box and later converted in to t/ ha.

Physico-chemical analysis of fruits

The weight of fruit was taken with the help

* Seed Technology & Production Centre, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan 173230 HP
** Krishi Vigyan Kendra, Bajaura, Distt- Kullu 175125 HP

of a top pan balance. The unit sample consisted of ten fruits and the results were expressed as weight in grams per fruit. Total soluble solid contents were determined with the refractometer up to the range of 0-032^0 Brix. The titratable acidity was estimated in term of per cent malic acid by titrating the juice against N/ 10 NaOH by using phenolphthalein indicator. The fruit firmness was measured with the help of Magness and Taylor pressure tester and expressed as lbs per square inch.

The data on shoot length, fruit set, yield and quality parameters of Starking Delicious apple as influenced by pruning intensities and nitrogen levels are presented in Table-1. However, results of effect of pruning intensities and nitrogen levels on trunk girth, fruit firmness and acidity were non significant. Cumings (1980) found that different levels of nitrogen and pruning intensities had no significant effect on the acid content of the fruits.

Table 1. Effect of pruning intensity and nitrogen levels on growth, fruit set yield and quality of Starking Delicious apple

Pruning intensity	Extension growth (cm)		Fruit Set (%)		Yield (t / ha)		TSS (^{0}Brix)		Fruit wt. (g)	
	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
T_1	17.5	19.3	21.6	28.4	9.6	24.5	13.2	13.6	140	144
T_2	19.6	20.2	21.2	27.5	9.0	23.6	13.8	14.0	150	160
T_3	24.5	26.2	20.3	24.6	8.5	21.8	14.2	14.6	165	172
T_4	29.4	31.9	19.5	20.8	7.6	20.5	14.5	14.7	180	195
CD (P=0.05)	4.7	5.3	1.2	1.8	1.4	2.9	0.8	0.9	13.6	15.2
N rates (g/tree)										
300	21.5	22.2	20.3	23.7	8.0	24.2	14.2	14.3	145	150
400	22.5	22.8	21.2	26.6	7.5	22.3	14.0	14.6	153	155
500	23.2	23.5	19.8	24.4	7.8	23.8	12.6	13.7	156	157
600	23.6	23.8	20.5	28.6	9.0	25.2	13.4	13.2	159	164
700	23.9	24.0	21.1	31.4	9.6	25.8	13.1	12.9	170	164
800	24.5	24.7	22.2	30.6	8.9	24.6	12.1	12.4	165	163
900	25.0	25.5	21.5	27.8	7.6	21.8	11.3	12.2	169	165
CD (P=0.05)	2.1	2.8	NS	NS	1.2	1.8	1.2	1.8	11.2	11.8

Shoot length

The effect of different level of nitrogen and pruning intensities on extension shoot growth was found to be significant during both the years under study. Maximum shoot growth 29.4 and 31.9 cm was found at T_4 treatment with¾ heading back and thinning cuts and maximum 25.0 and 25.5 cm shoot growth was recorded at 900 g N tree^{-1} during both the years. Maximum extension shoot growth observed under treatment 900 g N tree^{-1} was found to be statistically at par with 500 g, 600 g, 700 g and 800 g N tree^{-1} whereas, found to be significantly higher than the lower levels of nitrogen. Similarly, in different pruning intensities shoot growth increases as the severity of pruning increases.

Growth is generally considered to include linear increase, gain in weight, increase in dimension, gain in organic mass and cell multiplication. In general nitrogen application influences the tree growth, which might be due to better root development and nutrient uptake. Growth response as expressed in term of trunk diameter and shoot growth has been observed by Hou *et al.* 2004; Guak *et al. 2003.* Sharma *et al* (2003) found that increase in the nitrogen levels and pruning intensities increases the vegetative growth of the plants. Kanwar (1979) found that

higher foliar nitrogen in heavily pruned trees may be due to lower yield and more vegetative growth.

Fruit set and yield

Different levels of nitrogen had no significant effect on fruit set. However, maximum fruit set 22.2 percent was observed with 800 g N tree^{-1} during the year 2007, whereas, during the year 2008 maximum fruit set 31.4 percent was observed with 700 g N tree^{-1} . The minimum fruit set 22.2 and 20.3 percent was observed with 300 g N tree^{-1} in both the years. In different pruning intensities fruit set was found to be significant during both the years. With the increase in pruning intensities the level of fruit set decreases, which may be due to more vegetative growth. The effect of pruning intensities and N rates on fruit yield was observed to be significant during both the years under study. The maximum yield 9.6 and 25.8 t ha^{-1} was observed with 700 g N tree^{-1} during both the years, followed by 600 and 800 g N tree^{-1}. Similarly, the effect on fruit yield under different pruning intensities was also found to be significant, but it was observed that with the increase in pruning severity the fruit yield decreases, which may be due to more vegetative growth lesser number of fruiting spurs. Singh *et al* (2009) observed that nitrogen levels increases the fruit yield up to a certain level. Sharma *et al.* (2003) earlier demonstrated that N, K and Ca are utilized almost in the same magnitude in the production of flowers and therefore, more yield due to nitrogen levels in the present case may be the cumulative effect of balanced nutrition. Due to the antagonistic effect of nitrogen on potassium uptake, the effect on fruit yield was not significant at higher nitrogen levels. Lower yield recorded during the year 2007 might be attributed partly due to the alternate bearing tendency of the cultivar Starking Delicious and partly to the inclement weather condition.

Fruit quality

The effect of different pruning intensities and nitrogen rates on Total Soluble Solid (TSS) content of fruit was found to be significant during both the years. In the year 2007, maximum TSS content 14.2 ^{0}B was recorded with 300 g nitrogen tree^{-1}, followed by 400 g nitrogen tree^{-1} where it was 14.0 ^{0}B. The maximum TSS contents 14.6 ^{0}B observed at 400 g nitrogen tree^{-1} in the year 2008 was significantly higher than higher nitrogen levels. Under different pruning intensities, maximum TSS contents 14.5 ^{0}B and 14.7 ^{0}B was observed with T_4 treatment with¾ heading back and thinning cuts, which was found statistically higher to the lower pruning intensities. It is clear here that TSS contents decreased with the increase in nitrogen levels. The level of leaf and soil nitrogen content increased with the increase in nitrogen levels, which assisted in the accumulation of CO_2 and protein synthesis. Singh *et al.* (2009) observed that TSS con tents of fruits increased favorably with the increase in K application and reduce with more nitrogen application.

The effect of different levels of nitrogen and pruning intensities had significant effect on the fruit weight during both the years under study. In the year, 2007 maximum fruit weight 170 g was observed with 700 g nitrogen tree^{-1} which was statistically at par with 600 g, 800 g and 900 g nitrogen. Similarly, during the year, 2008 maximum fruit weight was observed at 900 g nitrogen tree^{-1} which was found to be statistically at par with all other treatments except 300 g nitrogen tree^{-1}. The increase in fruit weight might be due to higher cell division and photosynthetic activities. Photosynthates are supplied to the fruits by leaves and fruit act as a metabolic sink, which was probably higher on account of nitrogen fertilizers. Jozsef *et al.* (2005) observed that nitrogen application in combination with different pruning intensities decreased the firmness of fruits, but increased the fruit size. Singh *et al* (2009) found that fruit size increases with proper combination of mineral nutrients, especially with N levels. Under different pruning intensities, maximum fruit weight 180 and 195 g was observed with T_4 treatment with¾ heading back and thinning cuts, which was found statistically higher to the lower pruning intensities, which may be due to lower fruit yield, helping in increasing the fruit size.

References

Cuming GA 1980 Potassium fertilization increases yield and quality of fruits. Better crop with Plant Food **64**: 20- 21.

Guak S, Neilson DP, Millard R and Neilsen GH 2003. Determining the role of nitrogen remobilization for growth of apple trees. J.Exp. Bot. **54**: 2121- 31.

Hou, L., Szwonek, E. and Shu, H. 2004. Effect of nitrogen fertilization on growth and nitrogen in Red Fuji apple tree. J. Fruit Ornamental Pl. Res. **12**: 191- 99.

Jozsef R, Zoltan S and Jozsef N 2005. Effect of nutrient supply on fruit quality in apple. J. Central European Agri.. **6**:35- 42.

Kanwar JS 1979. Investigation on pruning and fertilization requirement on peach cv. Flordasun. Ph D Thesis, Punjab Agricultural University Ludhiana (unpublished).

Sharma U, Bhandari AR, Shylla B 2003. Nutrient composition and growth performance of apple under varying productivity status. Indian J. Hort. **60**: 227-31.

Singh SR, Sharma AK and Sharma MK 2009. Influence of NPK combination at different altitude and aspect on fruit yield, quality and leaf nutrient status of apple cvs Red Delicious. Indian J. Hort. **66**:175-82.

Westwood MN 1978. *Temperate Zone Pomology* Ed WH Freeman and Company, San Francisco, USA pp. 119-20.

VIR SOFTECH