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# Blossom Performance and Fruit Yield of Red Delicious Apple in Relation to Pruning and Fertilizer Application

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**Abstract**

Flowering bloom density and maturity period of 20 year old apple cv Red Delicious on seedling were observed in response to pruning and fertilizer application treatments. Strong pruning delayed flowering by 6—9 days. However, no significant difference was recorded in bloom period. Fruit maturity gets delayed by 2—18 days with every increase in primary severity. With increase in nitrogen rates flowering were delayed by 1—2 days and fruit maturity by 2—3 days increase. Potassium application caused early flowering and early fruit maturity.

**Key words : Apple, Fertilizer, Blossom performance, Fruit yield.**

Pruning is essential in almost all fruit crops deciduous in nature to improve production, quality, to control irregular bearing and to maintain the vigor of the trees. Modern apple plantings require growth of roots which ultimately reduces tree canopy but growth is stimulated near pruning cuts. The objective of this experiment was to associate the flowering responses of the apple tree as influenced by pruning and fertilizers application treatments.

## Methods

The experiment was conducted during 2004 and 2005 in a private orchard near Ganderbal area of district Srinager in Kashmir. The soil of the experimental field was classified as with a pH of trees on seedling rootstock. The 20 year old Red Delicious in excellent vigor were trained to a modified leader system and adequately speed. A randomized block design was used four intensities of pruning and three treatments of nitrogen potassium each were given.

Control pruning was administered the treatment except the removal of dead, diseased in $Pr_1$, $Pr_2$ and $Pr_3$ consisted of removing 1/3rd, 1/2 and 2/3rd of the one year shoot in addition to $Pr_0$ treatment and proper thinning. There were three rates of nitrogen as urea per tree viz. $N_1$=795 g, $N_2$=1,060 g/tree and $N_3$=1,325 g and potassium as MOP per tree viz. $K_1$=1,125 g, $K_2$=1,500 g and $K_3$=1,325 g in alone or in combination phosphorus application as DAP was same for all trees as 650 g. Nitrogen was applied in two split doses. First half of nitrogen along with full MOP and DAP were applied three weeks before expected bloom in a ring in the outer canopy area. Second dose of nitrogen was applied three weeks after fruit set.

Observations on flowering, fruit setting, yield were recorded on eight branches selected at random around the tree.

Bloom percent was recorded by the formulae and expressed as percent $= \frac{\text{Flower buds}}{\text{Flower buds + leaf buds}} \times 100$

$$\text{Fruit set} = \frac{\text{Number of fast lets}}{\text{Number of flowers}} \times 100$$

$$\text{And expressed as per cent yield efficacy} = \frac{\text{Yield (kg/tree)}}{\text{TCSA (cm}^2\text{)}}$$

$$\text{Where TCSA} = \frac{\text{Girth}}{4}$$

**Table 1.** Effect of different pruning (Pr) regimes, levels of nitrogen (N) and potassium (K) on initial bloom (DARD) of apple cv Red Delicious. DARD : Days after reference date; Reference date: 1 March.

| Treatment | 2004 | | | | | 2005 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Pr_0$ | $Pr_1$ | $Pr_2$ | $Pr_3$ | Mean | $Pr_0$ | $Pr_1$ | $Pr_2$ | $Pr_3$ | Mean |
| $N_1$ | 29.67 | 34.56 | 37.15 | 41.58 | 35.74 | 32.29 | 37.95 | 42.56 | 46.38 | 39.79 |
| $N_2$ | 31.18 | 34.77 | 38.23 | 42.05 | 36.56 | 33.97 | 35.59 | 41.72 | 47.92 | 39.81 |
| $N_3$ | 31.23 | 35.89 | 40.01 | 41.87 | 37.25 | 35.68 | 37.87 | 41.79 | 46.60 | 40.48 |
| $K_1$ | 31.95 | 34.90 | 38.83 | 42.25 | 36.99 | 34.13 | 37.84 | 42.86 | 48.35 | 40.79 |
| $K_2$ | 29.91 | 35.68 | 38.65 | 41.81 | 36.51 | 33.94 | 37.39 | 41.82 | 46.73 | 39.97 |
| $K_3$ | 30.24 | 34.64 | 37.80 | 41.44 | 36.04 | 33.87 | 36.18 | 41.39 | 45.82 | 39.31 |
| $N_1K_1$ | 30.64 | 33.30 | 37.67 | 42.42 | 36.01 | 32.67 | 38.21 | 43.25 | 47.32 | 40.36 |
| $N_1K_2$ | 29.33 | 35.38 | 37.67 | 40.79 | 35.79 | 32.15 | 38.04 | 42.45 | 46.17 | 39.70 |
| $N_1K_3$ | 29.09 | 35.00 | 36.11 | 41.53 | 35.43 | 32.04 | 37.60 | 41.99 | 45.64 | 39.32 |
| $N_2K_1$ | 32.11 | 34.94 | 39.03 | 41.62 | 36.93 | 34.25 | 37.03 | 42.61 | 46.38 | 40.82 |
| $N_2K_2$ | 30.40 | 34.40 | 37.37 | 42.71 | 36.22 | 34.62 | 36.11 | 41.44 | 47.76 | 39.98 |
| $N_2K_3$ | 31.02 | 34.97 | 38.28 | 41.52 | 36.45 | 33.04 | 33.63 | 41.12 | 46.61 | 38.60 |
| $N_3K_1$ | 33.09 | 36.45 | 39.95 | 43.02 | 38.12 | 35.47 | 38.26 | 42.72 | 48.35 | 41.20 |
| $N_3K_2$ | 30.00 | 37.25 | 40.90 | 41.63 | 37.45 | 35.04 | 38.03 | 41.60 | 46.26 | 40.23 |
| $N_3K_3$ | 30.60 | 33.95 | 39.18 | 41.83 | 36.25 | 36.53 | 37.31 | 41.06 | 45.19 | 40.02 |
| Mean | 30.70 | 35.07 | 38.46 | 41.83 | | 33.98 | 37.14 | 42.02 | 46.97 | |
| CD ($P$=0.05) : | | | | | | | | | | |
| Pruning (Pr) = | | 0.57 | | | | | 0.53 | | | |
| Nitrogen (N) = | | 0.50 | | | | | 0.46 | | | |
| Potassium (K) = | | 0.50 | | | | | 0.46 | | | |
| Pr × N = | | 0.99 | | | | | 0.92 | | | |
| Pr × K = | | NS | | | | | NS | | | |
| N × K = | | NS | | | | | NS | | | |
| Pr × N × K = | | NS | | | | | NS | | | |

$$\text{Return bloom} = \frac{\text{Number of flowers in the current season}}{\text{Number of flowers in the previous season}} \times 100$$

## Results and Discussion

Table 1 indicates that all treatments had a significant influence on flowering of Red Delicious cv of apple. With the increase in the severity of pruning, averaged over various levels of nitrogen and potassium, flowering was delayed during both the years. Early flowering was recorded in control and light pruning intensity. Trees receiving strong pruning took 41.83 and 46.97 days to reach initial bloom stage as compared to conventional pruning (30.70 and 33.98

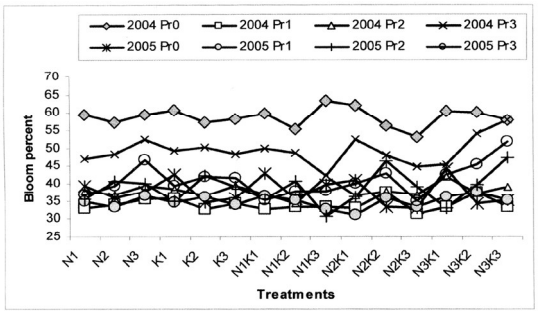


**Figure 1.** Effect of different pruning (Pr) regimes, levels of nitrogen (N) and potassium (K) on bloom (%) of apple cv Red Delicious.

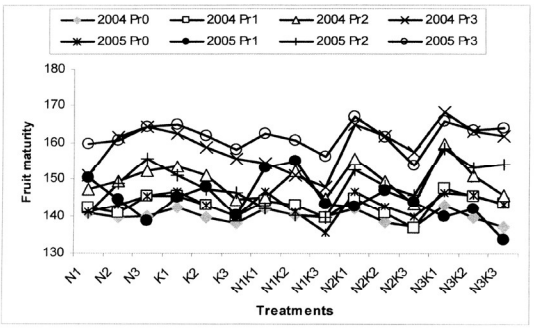


**Figure 2.** Effect of different pruning (Pr) regimes, levels of nitrogen (N) and potassium (K) on fruit maturity (DAFB)* of apple cv Red Delicious.

**Table 2.** Effect of different pruning (Pr) regimes, levels of nitrogen (N) and potassium (K) on full bloom (DARD) of apple cv Red Delicious. DARD : Days after reference date; Reference date : 1 March.

| Treatment | 2004 | | | | | 2005 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Pr_0$ | $Pr_1$ | $Pr_2$ | $Pr_3$ | Mean | $Pr_0$ | $Pr_1$ | $Pr_2$ | $Pr_3$ | Mean |
| $N_1$ | 35.12 | 38.71 | 41.97 | 46.16 | 40.49 | 36.90 | 42.66 | 46.87 | 48.24 | 43.67 |
| $N_2$ | 36.52 | 39.58 | 40.01 | 45.71 | 40.46 | 38.70 | 40.69 | 44.88 | 51.71 | 43.99 |
| $N_3$ | 37.42 | 41.67 | 44.84 | 47.81 | 42.93 | 39.24 | 42.68 | 46.71 | 49.00 | 44.41 |
| $K_1$ | 36.76 | 41.79 | 41.55 | 47.29 | 41.85 | 40.51 | 42.01 | 46.63 | 51.21 | 45.09 |
| $K_2$ | 36.47 | 39.54 | 42.69 | 46.60 | 41.33 | 38.46 | 42.84 | 46.42 | 49.46 | 44.30 |
| $K_3$ | 35.82 | 38.63 | 42.59 | 45.80 | 40.71 | 37.94 | 41.18 | 45.42 | 48.28 | 43.21 |
| $N_1K_1$ | 35.02 | 40.20 | 41.00 | 46.90 | 40.77 | 38.73 | 41.80 | 46.57 | 50.29 | 44.35 |
| $N_1K_2$ | 35.48 | 38.24 | 42.06 | 45.76 | 40.39 | 37.43 | 43.97 | 47.68 | 48.37 | 44.36 |
| $N_1K_3$ | 34.85 | 37.69 | 42.85 | 45.83 | 40.31 | 38.76 | 42.22 | 46.37 | 46.06 | 43.35 |
| $N_2K_1$ | 37.63 | 41.51 | 38.36 | 46.11 | 40.90 | 40.07 | 41.64 | 45.56 | 53.46 | 45.18 |
| $N_2K_2$ | 35.79 | 40.07 | 40.87 | 46.83 | 40.89 | 38.66 | 41.35 | 45.52 | 51.47 | 44.25 |
| $N_2K_3$ | 36.12 | 37.16 | 40.80 | 44.21 | 39.57 | 37.36 | 39.08 | 43.55 | 50.19 | 42.55 |
| $N_3K_1$ | 37.64 | 43.67 | 45.28 | 48.87 | 43.86 | 40.74 | 42.60 | 47.72 | 49.87 | 45.23 |
| $N_3K_2$ | 38.13 | 40.33 | 45.12 | 47.20 | 42.69 | 39.28 | 43.21 | 46.06 | 48.55 | 44.27 |
| $N_3K_3$ | 36.48 | 41.02 | 44.12 | 47.36 | 42.24 | 37.70 | 42.25 | 46.34 | 48.59 | 43.72 |
| Mean | 36.35 | 39.99 | 42.27 | 46.56 | | 38.62 | 42.01 | 46.16 | 49.65 | |
| CD ($P$=0.05) : | | | | | | | | | | |
| Pruning (Pr) = | | 0.60 | | | | | 0.40 | | | |
| Nitrogen (N) = | | 0.52 | | | | | 0.34 | | | |
| Potassium (K) = | | 0.52 | | | | | 0.34 | | | |
| Pr × N = | | 1.04 | | | | | 0.69 | | | |
| Pr × K = | | 1.04 | | | | | 0.69 | | | |
| N × K = | | 0.89 | | | | | 0.60 | | | |
| Pr × N × K = | | 1.79 | | | | | 1.19 | | | |

days) in 2004 and 2005, respectively. This may be due to the reason that in severe pruning was giving less number of cuts as compared to light pruning where numerous cuts are made which render high production of ethylene and cytokining (i.e. 4 times more than unpruned) which causes early flowering in light pruning intensity. Gough (1) also observed that the reason for pruning affecting date of bloom may be related to the autumnal migration of carbohydrates or nitrogenous compounds. As in light pruning, we are removing less wood which means we are removing less carbohydrates stored in those branches. Pruning increases the auxin, gibberellin and cytokinin synthesis and their activity. The increase in auxin and gibberellin synthesis promotes development of vascular system and activates nutrient transport and the intensifying the initiated growth (2).

Similarly, the trees receiving high nitrogen dose significantly reach flowering stage late (37.25 and 40.48 DARD) as compared to lower doses of nitrogen (35.74 and 39.79 DARD) in both the years respectively. This is due to the reason excess N always delays flowering but causes early vegetative growth. These results are in conformity with Singh (3) and Hassan (4). Significantly less number of days (36.04 and 39.31 DARD) were registered by trees receiving higher doses of potassium in 2004 and 2005, respectively which may be due more absorption of water and other nutrients and their translocation to the spurs. Fertilizer treatment combination recorded no significant effect in both the years with respect to flowering. All the main and interaction effects a non-significant effect on bloom period in both the years of study.

*Bloom Per Cent.* Pruning, nitrogen and potassium applications were highly significant with regard to bloom per cent during 2004 and 2005 (Tables 2 to 4, Fig. 1). In 2004 significant maximum bloom per cent (58.67) was observed in control followed by light pruning regime (49.26%) and the minimum bloom per cent (34.18%) was noticed in strong pruning intensity in both the years. In 2005, maximum bloom per cent was noticed in strong pruning intensity (40.92) followed by medium pruning intensity (38.74%) and the mini-

**Table 3.** Effect of different pruning (Pr) regimes, levels of nitrogen (N) and potassium (K) on petal fall (DARD) of apple cv Red Delicious. DARD : Days after reference date; Reference date : 1 March.

| Treatment | 2004 | | | | | 2005 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Pr_0$ | $Pr_1$ | $P_2$ | $Pr_3$ | Mean | $Pr_0$ | $Pr_1$ | $Pr_2$ | $Pr_3$ | Mean |
| $N_1$ | 40.19 | 45.40 | 50.31 | 54.19 | 47.52 | 43.75 | 49.36 | 55.42 | 56.07 | 51.15 |
| $N_2$ | 42.88 | 48.16 | 48.62 | 55.18 | 48.71 | 44.19 | 48.46 | 53.80 | 59.26 | 51.41 |
| $N_3$ | 44.48 | 47.89 | 52.83 | 54.91 | 50.03 | 44.97 | 51.06 | 53.71 | 58.13 | 51.97 |
| $K_1$ | 43.77 | 48.18 | 50.45 | 55.75 | 49.54 | 44.00 | 51.12 | 55.48 | 59.89 | 52.60 |
| $K_2$ | 41.92 | 46.77 | 50.83 | 55.55 | 48.77 | 45.57 | 49.77 | 54.10 | 57.48 | 51.73 |
| $K_3$ | 41.86 | 46.49 | 50.48 | 52.97 | 47.95 | 43.36 | 47.99 | 53.37 | 56.08 | 50.20 |
| $N_1K_1$ | 40.66 | 46.34 | 50.58 | 54.13 | 47.93 | 42.14 | 50.94 | 56.82 | 59.55 | 52.36 |
| $N_1K_2$ | 40.11 | 44.17 | 50.42 | 55.27 | 47.49 | 45.78 | 50.10 | 55.26 | 55.64 | 51.70 |
| $N_1K_3$ | 39.81 | 45.69 | 49.92 | 53.15 | 47.15 | 43.35 | 47.04 | 54.20 | 53.02 | 49.40 |
| $N_2K_1$ | 44.98 | 49.72 | 47.56 | 56.18 | 49.61 | 45.23 | 50.20 | 55.66 | 60.05 | 52.77 |
| $N_2K_2$ | 41.79 | 48.17 | 49.23 | 56.02 | 48.80 | 44.48 | 47.85 | 53.96 | 60.01 | 51.59 |
| $N_2K_3$ | 41.87 | 46.57 | 49.07 | 53.34 | 47.72 | 42.88 | 47.34 | 51.79 | 57.72 | 49.93 |
| $N_3K_1$ | 45.69 | 48.49 | 53.20 | 56.93 | 51.08 | 44.63 | 52.24 | 53.97 | 60.12 | 52.74 |
| $N_3K_2$ | 43.87 | 47.98 | 52.84 | 55.36 | 50.01 | 46.46 | 51.37 | 53.05 | 56.76 | 51.91 |
| $N_3K_3$ | 43.89 | 47.20 | 52.44 | 52.43 | 48.99 | 43.83 | 49.58 | 54.13 | 57.51 | 51.26 |
| Mean | 42.52 | 47.15 | 50.59 | 54.76 | | 44.31 | 49.62 | 54.31 | 57.82 | |
| CD ($P$=0.05) : | | | | | | | | | | |
| Pruning (Pr) = | | 0.50 | | | | | 0.83 | | | |
| Nitrogen (N) = | | 0.43 | | | | | 0.71 | | | |
| Potassium (K) = | | 0.43 | | | | | 0.71 | | | |
| Pr × N = | | 0.86 | | | | | 1.42 | | | |
| Pr × K = | | 0.86 | | | | | 1.42 | | | |
| N × K = | | NS | | | | | NS | | | |
| Pr × N × K = | | NS | | | | | NS | | | |

mum bloom per cent was exhibited by light pruning intensity (34.05) in 2004 and 2005 respectively. In growing shoots, terminal apices and young leaves inhibit the development of auxillary buds. Top most buds dominate and from long shoots, while the other buds develop into the spurs or remain dormants (5). Increased levels of nitrogen has also significantly increased the bloom per cent (46.69 and 40.19) as compared to lower doses of nitrogen (44.27 and 36.69%) in 2004 and 2005, respectively.

Potassium levels exerted significant influence only in 2004; however, in 2005 different potassium levels were at par with each other as far as bloom per cent is concerned. Maximum bloom per cent (46.00 and 37.89) was observed in $K_1$ potassium application. With further increase in potassium levels bloom per cent decreased in both the years. Significantly varied responses were noted during two years. In 2004 highest bloom per cent of 59.46 was noted in $Pr_0 N_3$ and the minimum (33.00%) in $Pr_1N_1$. In 2005 maximum bloom per cent was exhibited by $Pr_3N_3$ (45.55) followed by $Pr_0N_2$ (40.50%) and the minimum in $Pr_1N_2$ (33.44%).

Figure 2 reveals that with increase in the severity of pruning, fruit maturity delayed significantly. Maximum number of days (158.93 and 161.59 DAFB) were taken by trees receiving strong pruning and the minimum in control (14.02 and 143.22 DAFB) in 2004 and 2005 respectively. With every increase in nitrogen and potassium application rates, fruit maturity was enhanced.

Prunning and nitrogen interaction and pruning and potassium interactions also had a significant influence on fruit maturity. Early fruit maturity (139.44 and 138.56 DAFB) was recorded in $Pr_0N_2$ and $Pr_1N_3$ treatment followed by $Pr_0N_3$ (139.89 DAFB) in 2004 and $Pr_0N_1$ (141.11 DAFB) in 2005. In pruning and potassium interactions effects, early fruit maturity was noticed in $Pr_0K_3$ treatment which reach to maturity stage at 138.88 and 140.00 DAFB and delayed maturity was noticed in $Pr_3K_1$ (162.56 and 165.00 DAFB) in 2004 and 2005, respectively. The interaction effect of pruning and fertilizer treatment combinations had a non-significant influence on fruit maturity during both

**Table 4.** Effect of different pruning (Pr) regimes, levels of nitrogen (N) and potassium (K) on bloom period (days) of apple cv Red Delicious.

| Treatment | 2004 | | | | | 2005 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Pr_0$ | $Pr_1$ | $Pr_2$ | $Pr_3$ | Mean | $Pr_0$ | $Pr_1$ | $Pr_2$ | $Pr_3$ | Mean |
| $N_1$ | 10.52 | 10.84 | 13.16 | 12.61 | 11.78 | 11.46 | 11.41 | 12.86 | 9.69 | 11.36 |
| $N_2$ | 11.70 | 13.39 | 10.39 | 13.13 | 12.15 | 10.22 | 12.87 | 12.08 | 11.34 | 11.06 |
| $N_3$ | 13.25 | 12.00 | 12.82 | 13.04 | 12.77 | 9.29 | 13.19 | 11.92 | 11.53 | 11.49 |
| $K_1$ | 11.82 | 13.28 | 11.62 | 13.50 | 12.55 | 9.87 | 13.28 | 12.62 | 11.54 | 11.81 |
| $K_3$ | 12.01 | 11.09 | 12.18 | 13.74 | 12.25 | 11.63 | 12.38 | 12.28 | 10.75 | 11.76 |
| $K_3$ | 11.62 | 11.85 | 12.63 | 11.53 | 11.92 | 9.49 | 11.81 | 11.98 | 10.26 | 10.88 |
| $N_1K_1$ | 10.52 | 13.04 | 12.91 | 11.71 | 11.92 | 9.47 | 12.73 | 13.57 | 12.23 | 12.00 |
| $N_1K_2$ | 10.78 | 8.79 | 12.75 | 14.48 | 11.70 | 13.63 | 12.06 | 12.81 | 9.47 | 9.24 |
| $N_1K_3$ | 10.72 | 10.69 | 13.81 | 11.62 | 11.71 | 11.31 | 9.44 | 12.21 | 7.38 | 7.33 |
| $N_2K_1$ | 12.87 | 14.78 | 8.53 | 14.56 | 12.68 | 10.98 | 13.17 | 13.05 | 13.67 | 12.71 |
| $N_2K_2$ | 11.39 | 13.77 | 11.86 | 13.31 | 12.58 | 9.86 | 11074 | 12.52 | 12.25 | 11.59 |
| $N_2K_3$ | 10.85 | 11.60 | 10.79 | 11.82 | 11.26 | 9.84 | 13.71 | 10.67 | 11.11 | 11.33 |
| $N_3K_1$ | 12.59 | 12.04 | 13.25 | 13.91 | 12.94 | 9.16 | 13.98 | 11.25 | 11.77 | 11.54 |
| $N_3K_2$ | 13.87 | 10.73 | 11.94 | 13.73 | 12.56 | 11.42 | 13.34 | 11.45 | 10.50 | 11.69 |
| $N_3K_3$ | 13.29 | 13.25 | 13.26 | 11.18 | 12.74 | 7.30 | 12.27 | 13.07 | 12.32 | 11.19 |
| Mean | 11.82 | 12.07 | 12.14 | 12.92 | | 10.33 | 12.48 | 12.29 | 10.87 | |
| CD ($P$=0.05) : | | | | | | | | | | |
| Pruning (Pr) = | | NS | | | | | NS | | | |
| Nitrogen (N) = | | NS | | | | | NS | | | |
| Potassium (K) = | | NS | | | | | NS | | | |
| Pr × N = | | NS | | | | | NS | | | |
| Pr × K = | | NS | | | | | NS | | | |
| N × K = | | NS | | | | | NS | | | |
| Pr × N × K = | | NS | | | | | NS | | | |

the years.

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