



## Effect of top working to improve pollination in apple (*Malus x domestica* Borkh.) orchards under mid hill conditions of Kullu district

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### Abstract

A study was carried out at village Seobagh of Kullu block located at 5000 feet altitude on eighteen years old Royal Delicious apple orchard raised on seedling rootstock spaced at 6m x 6m apart. Seven pollinizer cultivars viz. Golden Delicious, Granny Smith, Spartan, Commercial, Mollis Delicious, Gloster and Black Ban Davis were used in various combinations [viz. T<sub>1</sub>: Top working with Golden Delicious + Granny Smith, T<sub>2</sub>: Top working with Golden Delicious + Spartan, T<sub>3</sub>: Top working with Commercial + Mollis Delicious + Gloster, T<sub>4</sub>: Top working with Commercial + Black Ban Davis + Spartan and T<sub>5</sub>: Farmers' practice (Golden Delicious or Red Gold)] to top work the Royal Delicious branches in three different directions during the spring season. Top working with pollinizer cultivars Commercial + Black Ban Davis + Spartan (T<sub>4</sub>) gave highest average fruit set (30.19%) and yield (13.85 t/ha) followed by T<sub>3</sub>. However, minimum fruit set and yield (16.51%, 9.71 t/ha respectively) of Royal Delicious apple were recorded under farmers practice (Control) i.e. Golden Delicious.

**Key words:** Top working, pollinizers, apple, fruit set, yield

Apple (*Malus x domestica* Borkh.) is the predominant temperate fruit crop of India which accounts for about 2.8% of total fruit production of the country. India has 5th ranking in the world production of apple (Anonymous 2015). However, the decreasing trend in its productivity in the last decade due to changing climate scenario has caused a serious concern to the fruit growers and planners of the country. In Himachal Pradesh, the productivity of apple varies between 6-7 t/ha as compared to 25-30 t/ha in the developed countries like USA, UK, Australia and Canada. The causes of low productivity of apple are many, but pollination is the major factor which becomes serious especially under adverse climatic conditions. Nearly 75% old Delicious apple orchards have inadequate pollinizer proportion (less than 20%) and suffer with pollination problems (Gautam *et al.* 2004). Such orchards having fruit set problems with inadequate pollinizers can be managed effectively by providing various supplementary techniques such as branch top working of

pollinizer scions, pollinizers bouquet, hand pollination, spraying and dusting with pollen particularly under adverse weather conditions. Supplementary pollination arrangements are also necessary because there is lack of diversity in pollinizing cultivars. Mainly Golden Delicious and Red Gold are being predominantly used which have attained biennial bearing tendency. Their bloom seldom coincides with the flowering period of Delicious cultivars. Also bloom of Red Gold is damaged by spring frost. Keeping in view the importance of pollinizer's diversity in enhancing productivity, the present investigation was conducted to investigate the effectiveness of different combinations of pollinizers for increasing production in orchards lacking adequate pollinizers and to select suitable pollinizers with better fruit set responses.

The present investigation was carried out at village Seobagh of Kullu block located at 5000 feet above mean sea level on eighteen - year - old Royal Delicious apple orchard having low proportion of pollinizing trees raised

on seedling rootstock spaced at 6 m x 6 m apart. Seven pollinizer cultivars viz. Golden Delicious, Granny Smith, Spartan, Commercial, Mollis Delicious, Gloster and Black Ban Davis were used in various combinations [viz. T<sub>1</sub>: Top working with Golden Delicious + Granny Smith, T<sub>2</sub>: Top working with Golden Delicious + Spartan, T<sub>3</sub>: Top working with Commercial + Mollis Delicious + Gloster, T<sub>4</sub>: Top working with Commercial + Black Ban Davis + Spartan and T<sub>5</sub>: Farmers' practice (Golden Delicious or Red Gold)] to top work (by cleft grafting) six branches of each tree in different directions during the Spring season of 2008. The trial was conducted in randomized block design with three replications. Each treatment was constituted of having five trees.

Fruit set was recorded three weeks after petal fall and percent fruit set was calculated by following formula given by Westwood (1993).

$$\text{Fruit set (\%)} = \frac{\text{Number of fruit set}}{\text{Number of flowers cluster}} \times 100$$

Fruit yield was recorded by removal of crop load during harvesting season as kg/tree based on 20 kg standard apple box and later converted to t/ha. The weight of fruit was taken with the help of a top pan balance. The unit sample consisted of ten fruits and the results were expressed as weight in g/fruit. Fruit size (length and

breadth) was recorded with the help of Vernier calliper and expressed as cm. Total soluble solids were determined using a hand refractometer.

The top worked branches of main cultivars with pollinizers scion take at least three years to change the vegetative shoots into flower buds, therefore, data were recorded during 2012 and 2013.

Very less number of pollinizer trees have been planted in existing Delicious apple orchards because the predominant pollinizers like Red Gold and Golden Delicious are of low market value. Nearly 70-80% orchards have minimum proportion. The existing pollinizer proportion is given in Table 1. At present 33% pollinizer proportion is recommended for optimum cropping of Delicious but hardly 5% orchards contain this much number.

In all existing grown up apple plantations of Delicious, Golden Delicious and Red Gold were the major pollinizing cultivars (Table 2). Only very few orchards (about 5.0-7.0%) have adequate diversity of pollinizing cultivars and their placement. Moreover these pollinizers have been planted in groups. These arrangements have aggravated the gravity of pollination problem thereby affecting fruit set in Delicious. With the change in climate scenario, most of these pollinizing cultivars have attained the biennial bearing tendency.

**Table 1.** Existing pollinizer proportion in Delicious apple plantations

Pollinizer proportion (%)	Himachal Pradesh (% orchard)	Uttarakhand (% orchard)	Jammu and Kashmir (% orchard)	Average yield (20 kg boxes)
< 10	42.4	70.0	40.0	1.3
10-20	31.5	20.0	30.0	2.1
20-30	18.5	10.0	20.0	3.3
> 30	7.6	Nil	10.0	5.2

Source: Gautam *et al.* 2004

**Table 2.** Relative proportion of pollinizing cultivars in Delicious orchards

Pollinizer	Relative proportion (%)
Golden Delicious	30.4
Red Gold	42.4
Tydemans' Early Worcester	20.0
Pippin group ( King Pippin, Yellow Newton, Black Ban Davis, Summer Queen, Red June, Early Royal )	7.0

Source: Gautam *et al.* 2004

The data presented in Table 3 showed significant differences among different treatments. Different pollinizer combinations resulted in significantly higher fruit set and yield. Top working of trees with Commercial + Black Ban Davis + Spartan gave significantly higher average fruit set (30.19%) compared to control (16.51%). Commercial + Mollis Delicious + Gloster (28.67%), Golden Delicious + Spartan (23.50%) and Golden Delicious + Granny Smith (19.73%) also resulted in significantly higher fruit set. Similar trend was noticed in case of fruit yield of apple. Commercial + Black Ban Davis + Spartan, Commercial + Mollis Delicious + Gloster, Golden Delicious + Spartan and Golden Delicious + Granny Smith gave 42.63%, 31.82%, 22.55% and 15.24%, respectively, higher yield over control. Effectiveness of supplementary pollination method in apple has also been reported by Jindal *et al.* (1993) and Chauhan *et al.* (2004).

Data pertaining to the quality parameters of apple after top working with pollinizers are given in Table 4. All the quality parameters *viz.* fruit weight, fruit length, fruit breadth and total soluble solids were significantly affected due to pollinizer's combinations. Maximum fruit weight (120.25 g), fruit length (6.54 cm), fruit breadth (6.60 cm) and total soluble solids (13.56 °B) were recorded from the trees top worked with Commercial + Black Ban Davis + Spartan (T<sub>4</sub>) closely followed by the treatments T<sub>3</sub> and T<sub>1</sub> but superior to control.

On the basis of present study, it was concluded that Commercial + Black Ban Davis + Spartan followed by Commercial + Mollis Delicious + Gloster, Golden Delicious + Spartan and Golden Delicious + Granny Smith are the best pollinizers combinations for apple under mid hill conditions of Kullu district.

**Table 3.** Fruit set and yield of apple top worked with different pollinizers

Treatment (Top working with)	Fruit set (%)		Pooled	Yield (t/ha)		Pooled
	2012	2013		2012	2013	
T <sub>1</sub> : Golden Delicious + Granny Smith	18.25	21.22	19.73	11.14	11.25	11.19
T <sub>2</sub> : Golden Delicious + Spartan	22.00	25.00	23.50	11.77	12.04	11.90
T <sub>3</sub> : Commercial + Mollis Delicious + Gloster	27.52	29.82	28.67	12.74	12.86	12.80
T <sub>4</sub> : Commercial + Black Ban Davis + Spartan	29.54	30.84	30.19	13.64	14.06	13.85
T <sub>5</sub> : Control (Golden Delicious or Red Gold)	16.00	17.02	16.51	9.69	9.73	9.71
LSD ( P=0.05)	0.14	0.16	0.19	0.09	0.10	0.12

**Table 4.** Fruit quality of apple (mean of both years) top worked with different pollinizers

Treatment (Top working with)	Fruit weight (g)	Fruit length (cm)	Fruit breadth (cm)	Total soluble solids (°B)
T <sub>1</sub> : Golden Delicious + Granny Smith	116.00	6.44	6.50	12.70
T <sub>2</sub> : Golden Delicious + Spartan	114.25	6.40	6.42	12.30
T <sub>3</sub> : Commercial + Mollis Delicious + Gloster	118.30	6.48	6.52	13.00
T <sub>4</sub> : Commercial + Black Ban Davis + Spartan	120.25	6.54	6.60	13.56
T <sub>5</sub> : Control (Golden Delicious or Red Gold)	105.00	6.18	6.25	12.20
LSD ( P=0.05)	5.72	0.10	0.09	0.22

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