



POLLINATION STUDIES IN SOME LOW CHILL AND STANDARD APPLE CULTIVARS

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ABSTRACT

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An experiment was conducted at apple orchard of Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Himachal Pradesh. Major factors contributing to this effect are very old cultivars in cultivation, change in climate in adequate pollination, monoculture of delicious of delicious varieties, prevalence of disease and pest. Due to change in climatic conditions low and mid hill areas are now not suitable for apple cultivation therefore low chill cultivars need to be tested under these vacant areas along with testing of suitable, compatible pollinizer to sustain the declining apple productivity. Pollination was studied through different modes by selfing by bagging, hand pollination, open pollination, Fruit retention under each mode in both low chill and standard apple cultivars. 'Red Baron' was fertilised with all the seven pollinizers tested and fruit set ranged from 86.2 to 92.4 % and retention from 58.5 to 86.2 %. Cultivars 'Top Red' 'Hardeman', 'Nema Red', 'Skyline Supreme' failed to set any fruit when crossed with 'Hardeman Top Red', 'Royal Red', and 'Skyline Supreme'. Fruit set was higher under open pollination and ranged from 25.8– 49.4 % while 'Hardeman', 'Royal Red', 'Top Red' and 'Skyline Supreme' failed to set any fruit when flowers were bagged. The present investigation on pollination studies is carried out at apple block of the department of Fruit Science, University of Horticulture and Forestry, Nauni, Solan.

INTRODUCTION

Apple is an important temperate fruit crop in India in term of acreage, production, economic value and popular among the society as it is the most important deciduous fruit tree with regard to the production (Westwood, 1978). The cultivation of apple in India was initiated by the Britishers in 1870, when the European missionaries introduced apple cultivars. These acidic varieties were for the first times were planted in kullu. Introduction was successful and plantations performed well but due to high acidity hr consumers did not like the taste and new plantation could come up. Later delicious apple cultivars were introduced from California and were planted in Kotgarh area of district Shimla in Himachal Pradesh. The sweet tasting bright red in colour delicious cultivars was readily accepted by the orchardist and consumers. With passage of time apple industry was established and its cultivation has proved very ruminative. The production and consumer preference trends are fast changing and the orchardist are currently interested in growing spur types, early and intensively coloured strains and from diversification to the marginal area, low chill cultivars are the option. Keeping these changed condition, new introduction were made and planted at the main campus of

the university of Horticulture and Forestry, Nauni, Solan and have been fruiting for the last 8-9 years. Although fruiting regularly but yield are inconsistent, as there is no information pertaining to their pollination requirements. Apple cultivars are predominantly self incompatible and they need cross pollination for fruit set. Incompatibility is caused by a gametophyte self incompatibility system (Keulemans *et al.*, 1996). Therefore the pollination requirement of these cultivars with different modes of pollination was undertaken to find out the effectiveness of the selected pollinizers to pollinate effectively these new introduction with the aim to have regular and increased fruit production.

MATERIALS AND METHODS

The present study on pollination requirement of new introduction was carried out for three years during 2011, 2012, 2013 in the department orchard of Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Himachal Pradesh. This site represents the mid hill conditions of the state. The different modes of pollination i.e. selfing by bagging, open or natural pollination, hand self pollination and cross pollination was tried. Apart from this the suitability of

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the commonly recommended pollinizers like Tydemann's with objective overlapping of their flowering time with the other cultivars. The cultivars taken for study were Hardeman, Maayan, Michal Schlomit, Mollie's Delicious, Nemared, Red Baron, Royal Red, Skyline Supreme, Top Red were taken for the pollination studies.

RESULTS AND DISCUSSION

In the present investigation, out of 10 cultivars taken for pollination studies, five set fruit with selfing by bagging viz. Schlomit, Michal, Maayan, Red Baron and Mollies Delicious. The set percentage ranges from 8.8 (Red Baron) to 18.2 (Michal). Other cultivars failed to set any fruit. Fruit retention in selfing was highest in Maayan (12.2%), Michal (11.4 %) and least Red Baron (6.0%). In hand self pollination cultivars Hardeman, Royal Red, Top Red and Skyline Supreme set no fruits with its own pollen when pollinated by hand. In the other cultivars fruit set ranges from 8.5 (Nemared) to 36.5 % (Michal). Cultivars showed statistical differences among themselves (Dashad and Sharma 1993, Chauhan *et al* 2009, Bashir 210). Fruit retention after hand pollination was least in Schlomit (8.2%), Michal had maximum (30.0%) and cultivars revealed significant statistical differences (Table-1). The fruit set under open pollination was much higher compared to selfing and hand pollination. Cultivars Red, Michal and Maayan registered maximum set of 52.5, 49.4 and 48.8 %, respectively while Royal Red, Top Red and Skyline Supreme had lower set i.e. 27.5, 25.8 and 28.5 %. Under same mode of pollination fruit retention varied from 20.4 (Top Red) to 43.4 (Michal) percent. Retention was almost two times higher in Maayan and least was in standard cultivars Royal Red, Top Red, Skyline Supreme and Hardeman (Sharma *et al.*, 2006; Sharma and Bashir 2007).

In cross pollination studies the crosses were made based upon synchronization of flowering period of cultivars. All the ten cultivars were crossed with each other (Table-2). Amongst the low chilling cultivars, Schlomit as male crossed with Maayan resulted in highest fruit set (91.6 %) followed by Michal × Schlomit (77.5%) and least set was in Michal × Maayan (15.4%). Michal pollen failed to set fruit in Maayan. Fruit retention in low chill cultivars ranged from 12.3 to 84.4%. Being low chill in nature their flowering time was over by the time other cultivars attained full bloom stage hence pollination could not be attempted. Hardeman was successfully crossed by pollinizers Tydeman's Early, Red Baron and Golden Delicious with fruit set of 31.2, 18.6, and 68.3%, respectively. Cultivars Nemared, Top Red, Skyline Supreme, Royal Red pollen set no fruit with Hardeman. Three pollinizers Golden Delicious, Red Baron and Tydeman's Early pollen was compatible with Top Red and

Early Worcester and Golden Delicious was also studied set ranged from 21.4 to 27.4 %, while pollen of Royal Red, Hardemen, Nemared, Skyline Supreme failed to set fruit. All the pollinizer were highly compatible with Red Baron and fruit set too was very high, ranged from 63.3 to 92.4, Tydeman's Early Worcester being highly compatible and Golden Delicious least compatible as fruit set was lowest (63.3%). In the other three standard cultivars Royal Red, Skyline Supreme and Nemared, pollinizer Red Baron, Tydeman's Early Worcester and Golden Delicious did set fruit whereas Top Red, Hardeman, Nemared and Skyline Supreme failed to set any fruit (Fisher, 2002; Sharma and Bashir, 2007; Bahir *et al.*, 2010).

Table 1 Fruit set and retention under different modes of pollination in low chill and apple cultivars.

Cultivars	Selling by Bagging (%)	Retention (%)	Hand self Pollination (%)	Retention (%)	Open Pollination (%)	Retention (%)
Hardeman	0.0	0.0	0.0	0.0	32.6	26.3
Schlomit	15.6	10.8	19.6	8.2	35.2	28.6
Michal	18.2	11.4	36.5	30.2	49.4	33.4
Maayan	16.0	12.2	28.3	22.0	48.8	42.7
Red Baron	8.8	6.0	24.0	17.5	52.5	40.0
Nemared	0.0	0.0	8.5	0.0	35.8	29.3
Mollies delicious	10.3	7.1	15.6	10.0	36.4	28.2
Royal Red	0.0	0.0	0.0	0.0	27.5	21.5
Top Red	0.0	0.0	0.0	0.0	25.8	20.4
Skyline supreme	0.0	0.0	0.0	0.0	28.5	22.5
CD (P=0.05)	2.10	1.68	3.65	2.45	3.21	2.41

Apple is a highly cross pollinated fruit and selection of suitable compatible pollinizer is an integral part for successful fruiting and consistent production. In the present study cultivars Schlomit, Maayan, Michal, Red Baron and Mollies Delicious set fruit under selfing by bagging, though fruit set was much less compared to that under open pollination. With hand self pollination the fruit set was slightly increased in the above cultivars, but in Hardeman, Royal Red, Top Red, Skyline Supreme no set was observed (Nautiyal and Dimri 2009). The cultivars which set fruit under selfing by bagging show their self fruitfulness while with hand pollination their self-compatibility nature is proved. The variation in fruit set observed is due to genetic makeup of the cultivars and prevailing environmental conditions, further some injury caused in hand self pollinated flowers at the time of emasculation and pollination (Chauhan *et al.*, 2009).

Table 2 Fruit set in apple as affected by pollinizers (Pooled data).

Cultivars pollinated	Pollinizer	Fruit set percentage	Fruit Retention	Pollinizer those set no fruit
Mayaan	Schomit	91.6	84.4	Michal
Michal	Maayan	15.4	12.3	---
	Schomit	77.5	68.6	---
Schlomit	Maayan	70.4	62.2	
	Michal	64.8	58.5	
Hardemann	Tydemann's EarlyWorcestor	31.2	25.3	Nemared, Top Red, Skyline, Royal Red
	Red Baron	18.6	15.3	
	Golden Delicious	68.3	62.8	
Mollies Delicious	Tydemann's EarlyWorcestor	57.8	53.6	
	Golden Delicious	52.4	47.2	
Top Red	Golden Delicious	24.6	21.4	Royal Red, Hardimann, Nemared, Skyline Supreme
	Red Baron	21.5	18.5	
	Tydemann's EarlyWorcestor	27.4	23.6	
Red Baron	Tydemann's EarlyWorcestor	92.4	86.2	
	Mollis Delicious	87.2	81.6	
	Golden Delicious	63.3	58.5	
	Hardeman	88.4	82.2	
	Top Red	86.2	81.5	
	Skyline Supreme	89.5	82.7	
	Nemared	92.2	81.2	
Royal Red	Red Baron	53.6	48.4	Top Red, Hardiman, Nemared, Skyline Supreme
	Golden Delicious	52.4	49.3	
	Tydemann's EarlyWorcestor	35.6	32.6	
Skyline Supreme	Tydemann's EarlyWorcestor	23.7	20.6	Nemared, Top Red, Hardeman, Royal Red
	Red Baron	43.8	38.7	
	Golden Delicious	35.5	31.7	
Nemared	Tydemann's EarlyWorcestor	38.6	33.8	Skyline Supreme, Hardimann, Royal Red
	Red Baron	18.5	14.3	
	Golden Delicious	16.2	12.8	

Although variation in fruit set was recorded especially with selfing by bagging and hand self pollination it would be too early to say that these cultivars totally self fruitful as factors like locality, year and more importantly cultivar are responsible for fruit set and variation in self-incompatibility varies from season to season. The percent fruit set in different cultivars under open pollination in the present study ranges from 15.4 to 91.6 %. This wide difference in fruit set is mainly due to the prevailing weather conditions at blooming time of a cultivar. Inclement weather during flowering time significantly restricts bee activity, stigma receptivity, pollen and ultimately the fruit set. Cross pollination is the most effective method especially in apple to have higher and

consistent yield even under adverse climatic conditions provided appropriate compatible and inadequate number the pollinizing cultivar is present in the orchard.

CONCLUSION

The Magnitude of fruit set with selfing by bagging in the present study ranged from 0.0 to 18.2 while with hand self pollination variation extended from 0.0 to 36.5 %. Cultivars namely Schlomit, Michal, Maayan, Red Baron and Mollies Delicious were self fruitful and set fruit under selfing by bagging. These five cultivars with hand pollination had more fruit set compared to selfing by bagging. The fruit set under open pollination varied from 25.8 to 52.5 per cent.

Maayan, Michal and Schlomit being low chill flowered earlier and hence their crossing with other cultivars was not possible. One cultivar Red Baron was cross-compatible with the seven pollinizers tested and their flowering period also synchronized with the main cultivar.

REFERENCES

- Bahir, R., Sharma, G. and Sharma, N. 2010. Studies on fruit set and fruit characteristics as affected by different pollinizers in apple (*Malus × domestica* Borkh.). *Advances in Horticultural Sciences*. **24** (2): 1-11.
- Chauhan, A., Sharma, G. and Chauhan, P.S. 2009. Pollination as an essential function in regular apple (*Malus x domestica* Borkh.) production. *Indian Journal of Agricultural Sciences*. **79** (1): 58-60.
- Dashad, S.S. and Sharma, J.K. 1993. Comparison of fruit set under various modes of pollination in seven cultivars of apple (*Malus x domestica* Borkh.). *International Journal of Tropical Agriculture*. **11**(2): 134-137.
- Fisher, C. 2002. Crossing fertility of apple varieties. *Erwerb Sobstbau*. **44** (2):33-39.
- Keulemans, J., Brusselle, A., Eysen, R., Vercammen, J, and Van Daele, G. 1996. Fruit weight in apple as influenced by seed number and pollinizer. *Acta Horticulturae*. 481: 201-209
- Nautiyal, P, and Dimri, D,C. 2009. Pollination studies in apple (*Malus domestica* Borkh.) cv. Red Delicious. *Progressive Horticulture*. **41**(2): 157-163
- Sharma ,G., Anand, R, and Sharma, O,C. 2006. Flower biology and effect of pollination in apple (*Malus x domestica* Borkh.). *Indian Journal of Agricultural Sciences*. **75** (10): 667-669.
- Sharma, G, and Bashir, R. 2007. Effect of different mode of pollination on fruit set and retention in apple (*Malus x domestica* Borkh.) cultivars. *Indian Journal of Agricultural Sciences*. **77** (8): 33-35.
- Westwood, M.N. 1978. Temperate Zone Pomology. Timber Press, Portland, Oregon,pp. 428.