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Pollination Problems in Apple of Kashmir Himalaya

G. H. Rather[1], M. A. Paray[1], Rehana Javid[2*], Rizwana Khursheed[1], Munazah Yaqoob[1], M. U. Rehman[2] and Farhana Majid[1]

[1]Research and Training Centre for Pollinators, Pollinizers and Pollination Management, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir

[2]Division of Fruit Science, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir

*Corresponding Author E-mail: 786bazila@gmail.com

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ABSTRACT

Apple is the predominant temperate fruit crop in India which accounts for about 10% of total fruit production of the Country. Although India ranks 10th in world production of apple, yet the decreasing trend in productivity of its orchards has caused a serious concern to the fruit growers and planners of the Country. The horticulture being an important sector in the overall economy of Jammu and Kashmir. Pollination is an essential ecosystem service which involves symbiosis between cultivar, pollinizer and the pollinator. Effective pollination results in increased quality fruit production. Apples are highly dependent on bee pollination like other fruit crops. Throughout the world there is a serious deficit of pollinators worldwide and its foot prints are also seen in our valley. Low percentage of people in Kashmir understands the process of pollination and its importance. It is essential to up scale the capacity of various stakeholders concerned with crop production in Kashmir.

Key words: *Apple production, Pollination, Kashmir Valley, Insect pollinators.*

INTRODUCTION

Apple is the predominant temperate fruit crop in India which accounts for about 10% of total fruit production of the Country. At present the Delicious group of cvs mainly Red Delicious, Red Chief, Starkrimson constitute nearly 80% of apple trees. Although India ranks 10th in world production of apple, yet the decreasing trend in productivity of its orchadrs, in the last decade has caused a serious concern to the fruit growers and planners of the Country[2].

India is known for producing different varieties and variabilities among fruit crops. However, it has been ranked at sixth position in apple producing countries in the world[4]. Apple is an important temperate fruit crop in India in terms of acreage, production, economic value and popularity among the society as it is the most important deciduous fruit tree with regard to the production. In India its cultivation is mainly confined in the states of Jammu and Kashmir, Himachal Pradesh and Uttarakhand.

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Jammu and Kashmir has the highest average yield and accounts 67% of total apple production and 50% of its export in the country, hence a substantial foreign exchange earner and important for economic growth. Productivity of apple in J&K is much higher (10.85mt/ha) than national average of 6.86 tons/ha. India annually exports apple worth Rs 400 million out of which Rs. 200 million of apples comes from Jammu and Kashmir. It provides job opportunity to 1.2 million people directly or indirectly[3]. This apple crop has been a main source of income of 2.85 lakh farming community of the valley which earns about 2500 to 3000 crore rupees annually to the state exchequer (Indian Horticulture Database, 2014).

Although the agro climatic conditions of the state are congenial for apple production yet the productivity of quality fruit is substantially low. There is a large gap between actual and potential yields of our apple orchard which could be reduced by adaption of proper and appropriate cultural practices, inputs and pollination which needs a quick attention.

This has become a particular source of interest as it has been regarded as hub of apple industry in whole India. Apple has been cultivated in almost all the ten districts of Kashmir valley with an average area of 125615.6 ha and production of about 1134637 metric tonnes with a productivity of 10.85MT ha^{-1}. Although its annual production is higher than other states but from last few years it is decreasing, irrespective of the fact that average land under apple cultivation has explicitly increased without rapid increase in production. A lot of reasons are responsible for its decline but lack of pollination in the apple orchards is considered as one of the main reasons.

Pollination is considered as one of the important keys for profitable apple production. Pollination is a process in which pollen is transferred to the female reproductive organs of seed plants, thereby enabling fertilization and reproduction through growth of the pollen tube and eventual release of sperm. Insects play a vital role in pollination of various crops particularly in apple orchards. Indiscriminate use of pesticides in modern agriculture has disturbed the ecological inter-relationship by massive killing of farmer friendly insects along with detrimental insects[5]. The culling of the pollinizer varieties and monoculturing of only Red Delicious cultivators further adds to the pollination problem in the state. The main objective of this study was to assess the knowledge of the farmers towards pollination and its consequences in apple orchard system of Kashmir.

MATERIALS AND METHODS

Research and training centre for pollinators, pollenizers and pollination management SKUAST-K, Shalimar conducted an extensive survey during 2014-15 and 2015-16 in ten apple growing districts of Kashmir valley viz Baramulla, Kupwara, Shopian, Budgam, Anantnag, Kulgam, Ganderbal, Bandipora, Pulwama and Srinagar. The main objective of the study was to assess the knowledge regarding the awareness among apple growers in relation to apple production and crop pollination. For this purpose two hundred progressive apple growers were interviewed with ten to twenty orchardists per district for the purpose of collection of primary data. Studies were carried out on the primary data collected through sample survey based on a pre-tested, well structured questionnaire framed in advance. The blocks in the district were taken as primary stage unit, villages as secondary stage unit and orchardists as ultimate unit of sampling. Number of villages was allocated to different blocks in proportion to the area under the fruit. Orchardists in the identified villages were selected with simple random sampling without replacement.

RESULT AND DISCUSSION

Apple Production: Apple is cultivated in almost all the ten districts *viz;* Baramulla, Kupwara, Bandipora, Ganderbal, Budgam, Pulwama, Shopian, Srinagar, Kulgam and Anantnag which ranges from an altitude of 4,000-11,000 feet amsl. As per the estimate of Horticulture Department of Kashmir Division, the productivity in the year 2005-06 was about

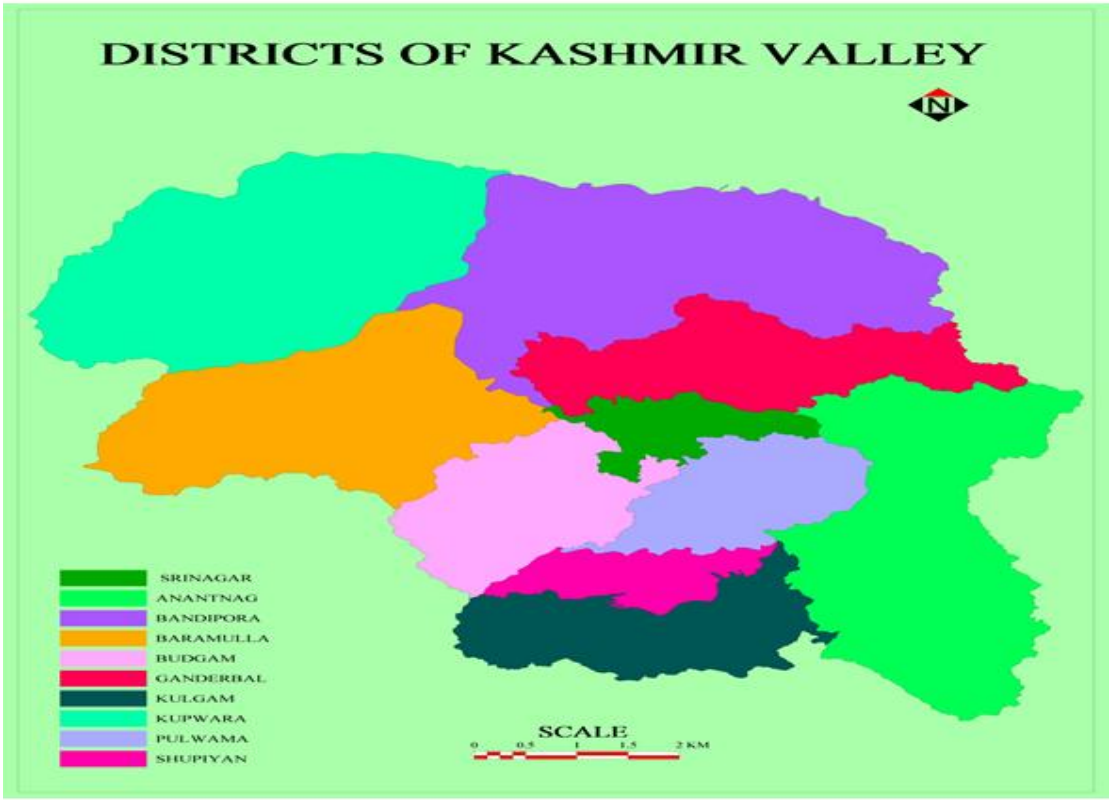
10.29 metric tonnes, which declined to 7.91 ha^{-1} in 2014-15. Majority of the people consider weather as mainly responsible for low apple productivity which hinders in pollination and in pollinator movement. The farmers blame it to the cold weather especially during flowering and fruit set period irrespective of the fact that it hinders in pollination and pollinators movement.

It is pertinent to mention here that land under apple cultivation has increased three folds but the production is decling or stagnant which is attributed to monoculturing of one variety (Red Delicious). People are unaware about the compatible pollinizer varieties (Table-I).

Table I: Area and production of apple in Kashmir valley

S.No.	Year	Production(MTs)	Area (ha)	Productivity (MT/ha)
1.	2005-06	1151341	111879	10.29
2.	2006-07	1222176	119041	10.26
3.	2007-08	1152350	115235	10.00
4.	2008-09	1294158	120542	10.73
5.	2009-10	1161536	107275	10.82
6.	2010-11	1822058	125788	14.48
7.	2011-12	1730619	130874	13.22
8.	2012-13	1321317	139017	09.50
9.	2013-14	1618673	143035	11.31
10.	2014-15	1134637	143470	7.90
Average mean	2015-16		125615.6	10.85

Annonymous 2015



LAND HOLDING OF SAMPLE APPLE FARMERS

Out of the total farm land apple orchards constituted nearly 58.58% (133101 ha). Average land holding of sample farmers was (12.03 *kanals*) and their land under apple cultivation is 17.67 *kanals*. The maximum farm size of sampled farmers was relatively large in district Baramulla (120.25 *kanals*) followed by Shopian (70.46 *kanals*), Pulwama

(69.05 *kanals*) and Budgam (67.04 *kanals*) (Table- II). The actual density in local orchards varies from 180 to 200 trees ha^{-1} as against 260 trees ha^{-1} on seedling rootstock. Faulty pruning and training was noticed in all the districts with large number of unfruitful branches which hinder light penetration in the interiors of the trees resulting in poor fruit quality. The leaf fruit ratio was not maintained in the sample orchards which recorded only 1: 15-20 as against 1: 32-40. Application of high doses of fertilizers like DAP @ 2-5 kgs/tree and 1-3 kgs of urea was noticed in these orchards. Poor Potassium fertilizer was noticed in the orchard of sampled farmers because of the fact that its benefits were not known by the farmers. It was noticed that the farmers did not use potassium. Young and juvenile orchards and they thought it beneficial only for development of colour in the fruit.

Table II: Land holding of sample apple farmers

District		Average size of Land holding (*Kanals*)	Area under apple cultivation (*Kanals*)	Percentage of area under apple cultivation	Average percentage of area under apple
Baramulla	Max.	120.25	80.35	67.81	
	Min.	8.12	6.25	76.35	50.62
	Avg.	27.94	23.15	7.69	
Kupwara	Max.	45.65	34.92	76.49	
	Min.	2.51	1.11	44.22	54.85
	Avg.	7.41	3.25	43.85	
Bandipora	Max.	40.15	27.32	68.04	
	Min.	5.05	1.15	22.77	43.61
	Avg.	8.12	3.25	40.02	
Ganderbal	Max.	30.45	21.62	71.00	
	Min.	2.15	1.00	46.51	48.78
	Avg.	4.16	1.20	28.84	
Budgam	Max.	67.14	26.35	39.24	
	Min.	7.11	5.00	70.32	57.64
	Avg.	6.50	4.12	63.38	
Srinagar	Max.	20.18	8.40	41.63	
	Min.	2.51	0.50	19.92	27.32
	Avg.	2.45	0.50	20.40	
Pulwama	Max.	69.15	61.40	88.00	
	Min.	1.02	1.02	100.00	87.84
	Avg.	17.61	13.30	75.52	
Shopian	Max.	70.46	63.32	89.87	
	Min.	5.14	4.42	85.99	89.02
	Avg.	19.21	17.52	91.20	
Kulgam	Max.	40.11	32.67	81.45	
	Min.	1.26	0.50	39.68	57.28
	Avg.	12.05	6.11	50.70	
Anantnag	Max.	45.26	31.71	70.06	
	Min.	2.10	1.21	57.61	68.86
	Avg.	18.25	14.40	78.90	
Average mean		**12.03**	**8.68**	**50.05**	**58.58**

VARIETAL SPECTRUM IN APPLE ORCHARDS:

In Kashmir the term apple usually refers to Delicious apple (*Malus domestica*) because this is widely grown variety in the orchards. Although there are numerous other varieties like Fuji, Gala must, Silver spur, Ambri, wall's spur, White Dotted Red, Golden Delicious, American Apirouge, Cox's orange pippin available but their proportion is very small and negligible in these orchards. Red Delicious is the most popular variety in whole Kashmir valley orchards. The results revealed that more than 80 per cent of farmers have only Red Delicious variety or its mutants in their orchards and the other strains like Golden Delicious, Red Gold etc are less than 2 per cent. Thus monoculturing was found to be the main reason for low production and productivity. In past, large number of varieties of apple were present in the orchards which cross pollinated with each other and improves the quality of fruit with the result most of the apple fruit was exported to other countries. But, the farmers have destroyed these varieties and maintained only Red Delicious in their orchards as it has a good market value and premium price in the market. The orchardists were ignorant of pollination value which ultimately resulted in poor fruit quality. The

rootstocks used are usually local which are non-precocious and come into bearing after 7 to 8 years and economic yields are obtained at the age of 15 to 18 years.

AWARENESS AMONG THE FARMERS REGARDING APPLE POLLINATION

As per the survey, the sampled farmers show least apple requisite knowledge with regard to the pollination and its impact on fruit quality throughout the valley. 86.5 per cent of apple orchardists are unaware of compatible pollenizer variety in apple orchards. 13.93 per cent farmers are to some extent aware about using a pollinizer orchards but without any knowledge of synchronization which accounts only 0.8–2.6%, with Red Delicious. In these orchards Golden Delicious is the main pollinizing variety but it blooms 4-5 days late after main variety i-e Red Delicious. Thus the king flower, which has the inherent capacity to develop as 'A' grade fruit doesn't get pollinated and with the result, it mostly falls during fruit development. Similarly American apirange flowers about 8-10 days after Red delicious and does not help in pollination. Majority of people think that wind and the natural insects that are present in the vicinity of orchard are acting as pollinating agents in their orchards.

Table III: Farmers knowledge about apple pollination

District	Knowledge about pollination			Pollinizer proportion (%)	Prominent Pollinizers in the orchards
	Good	Poor	Don't know		
Baramulla	16.65	37.18	46.17	1-3	Golden Delicious, Red Gold, American apirouge
Kupwara	10.24	31.28	58.48	0-1	Wild apple, Maharaji
Bandipora	12.69	34.07	53.24	0-1	Maharaji, American apirouge
Ganderbal	13.25	35.14	51.61	0-1	Golden Delicious, Red Gold, Maharaji
Budgam	15.70	32.10	52.20	0-1	Scarlet Siberian, American apirouge
Srinagar	10.16	30.65	59.19	1-3	Golden Delicious, American apirouge
Pulwama	15.37	34.74	49.89	2-5	Golden Delicious, Red Gold, American apirouge, Maharaji
Shopian	18.56	40.16	41.28	2-5	Golden Delicious, Red Gold, American apirouge, Maharaji
Kulgam	14.10	30.45	55.45	1-3	Red Gold, Maharaji, American apirouge
Anantnag	12.67	35.75	51.58	1-3	Red Gold, Maharaji, American apirouge
Mean	13.93	34.15	51.90	0.8-2.6	

FARMER'S PERCEPTION ABOUT INSECT POLLINATORS

All commercial varieties of apple require cross pollination to set good quality of fruit production. It is regarded as partially self-incompatible and needs cross pollination for fruit development. The pollen of apple fruit is sticky in nature and is mostly transferred by insects. More than ninety per cent farmers interviewed during survey observe various types of insects foraging on apple flowers during bloom in orchards and among them honey bees were probably seen by each. *Lassioglossum* spp., *Andrena* spp., *Apis mellifera, Apis cerana,* Syrphids etc has been found in the vicinity of orchards of Kashmir. *Apis cerana* is a native species and has been recommended as potential pollinator in orchards, and can withstand the abnormalities in weather condition. The sampled farmers having their orchards near forest lands observe higher frequencies of natural pollinators like *Lassioglossum* spp., *Andrena* spp. etc. However lower frequencies were observed by the respondents in the orchards much away from the forest cover.

Decrease in population of insects in the orchards has been recorded by farmers. Multiple factors are responsible for it. Indiscriminate use of pesticides in orchards

has been regarded as major cause of decline in population, while few of them are in favor of climate change as responsible for decline. The loss of habitat due to frequent adds further the problem.

FARMER'S PERCEPTION ABOUT HONEY BEES AS POLLINATORS:

Only 30-40 per cent of respondents say that honey bees play an important role in apple pollination, and are of the perception that honey bee colonies are the best and ideal. While as 60-70 per cent doesn't know about its role in apple production. The information solicited reveals that > 90% farmers don't place honey bee colonies in their orchards. The interviewed farmers' feel that honey bees are only for honey production and are unaware of the pollination services.

PESTICIDE USAGE IN APPLE ORCHARDS

The data on percentage response of orchardists on pesticide usage in orchards of ten districts is presented in Table IV. The surveyed farmers used both insecticides (chlorpyriphos, propargite, fenazaquin, dimethoate and ethion) and fungicides (mancozeb, difenaconazole, myclobutanil, and dodine). Mostly 7-12 pesticide sprays were carried out in a season with 2-3 sprays before bloom and rest after petal fall. 5.31 per cent pesticides were applied during bloom. Majority of farmers of all the districts believed that pesticide usage has resulted in decline of pollinator diversity and destruction of pollinator habitats.

Table IV. Pesticide use in different districts of Kashmir Valley

Percentage response of orchardists											Mean
No. of sprays	**Baramulla**	**Pulwama**	**Shopian**	**Kulgam**	**Budgam**	**Kupwara**	**Ganderbal**	**Anantnag**	**Bandipora**	**Srinagar**	
4-6	4.0	6.0	6.0	4.0	2.0	4.0	5.0	6.0	3.0	4.0	4.4
7-9	41.0	47.0	48.0	43.0	55.0	49.0	48.0	54.0	45.0	51.0	48.1
10-12	50.0	44.0	42.0	51.0	38.0	41.0	43.0	37.0	46.0	40.0	43.2
>12	5.0	3.0	4.0	2.0	5.0	6.0	4.0	3.0	6.0	5.0	4.3

CONCLUSION

Apples are highly dependent on bee pollination like other fruit crops. Throughout the world there is a serious deficit of pollinators worldwide and its foot prints are also seen in our valley. Less percentage of orchardists in Kashmir understands the process of pollination and its importance. It is essential to up scale the capacity of various stakeholders concerned with crop production in Kashmir. Many steps have been taken by the central and state govt. in this regard for awareness among masses by the way of engaging different departments *viz.*, horticulture departments, universities, media, etc but farmers still lack the confidence to opt for the pollinizer varieties as they feel it does not create the desired result and will waste the land. There are so many pollinizers available whose bloom synchronizes with the spectrum of varieties. Pollination being an important dimension in the fruit quality and production requisite information should be known. The Govt. of J&K is trying its best to utilize the services of insects (honey bees) but due to non-seriousness of the farmers, the industry is lagging behind to harness the full potential of the industry.

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