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An evaluation of extent and gap in adoption in recommended apple spray schedule of the apple growers

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Abstract
The present study was carried out to evaluate the extent and gap in adoption in recommended apple spray schedule of the apple growers in district Ganderbal of Jammu and Kashmir in 2014. By following the simple random sampling, 100 respondents were selected from 25 villages of four blocks. The data was elicited through personal interview method. The district Ganderbal was purposively selected, because of the potentiality for the development of horticulture, and most of area of the district was under apple plantation. An overall 73.66 per cent of technological gap was observed. The total adoption of the recommended apple spray schedule was found to be only 26.34 percent. Farmers adoption pertaining to recommended chemical, dose and time of spray was high for petal fall stage (46.67%), fruit let stage (42%), dormant stage (36.67%) and pre-harvest stage (29.34%). Overall extent of adoption of the recommended apple spray schedule by the respondents, majority of the respondents (63%) belonged to medium category extent of adoption of the recommended apple spray schedule followed by high 19.00 and low with 18.00 per cent of the respondents.

Keywords: apple growers, adoption, gap, ganderbal, Kashmir, spray schedule

1. Introduction
Apple (*Malus domestica* Borkh) is commercially the most important temperate fruit and is fourth among the most widely produced fruits in the world after banana, orange and grape [1]. Out of all the deciduous fruits in India apple is the most important in terms of production and area. It is mostly grown in the states of Jammu & Kashmir, Himachal Pradesh, Uttaranchal, Arunachal Pradesh and Nagaland [2]. It is grown over an area of 2.89 lakh ha, with a production of 28.91 lakh tons, contributing 3.9 per cent share in total fruit production [3].
In Jammu and Kashmir, production constraints of apple in the state, among others, include a complex of key and secondary insect pests and diseases. Because of their impact upon the tree and fruit, ecological diversity and demand for almost blemish free crop the pests of pome fruits have received extensive study. Under Kashmir conditions, the most important pests attacking apple are: European red mite *Pannonychus ulmi* (Koch), two spotted mite, *Tetranychus urtica* (Koch), Sanjose scale, *Quadraspidiotus perniciosus* (Cmstk), Woolly apple aphid, *Eriosoma lanigerum* (Hausmann), etc. Not only insect pests but also many diseases cause huge economic losses to apple. Principle diseases attacking are: Scab *Venturia inequalis* (Cke) Wint, Brown rot *Sclerotinia fructigina*, Sooty blotch *Gloedes pomigena* (Schw) Cloby & Leaf spot *Alternaria mali* (Str) etc., [4]. A variety of pesticides have been employed to minimise the losses due to insect pests and diseases all over the world. Fungicides such as Carbendazim, Mancozeb, Myclobutanil and Fenarimol etc have been recommended against scab [5]. Similarly Dimethoate, Phosphamidon, Ethion, Endosulphon, Quinolphos, Oxydemeton methyl, Malation and Carbaryl etc., has been recommended on apples against the key arthropod pests [6, 7].
During the past two decades, there has been a substantial increase in the use of pesticides in terms of both volume and value. The demand for agrochemicals depends upon the type of crops grown, farmer's knowledge about technologies and their profitability and also upon the availability, affordability and ease in accessing the input and output markets [8]. Among different crops grown in Jammu & Kashmir, apple cultivation is highly capital-intensive in terms of pest control measures. In the apple-growing belt of the valley, chemicals are being

used indiscriminately without considering scientific recommendations. The choice of chemicals/brand preferences is steered by traders and market functionaries [9]. The excessive/ indiscriminate use of pesticides not only increases the cost of apple cultivation but also results in many problems viz., problems related to human health, environmental contaminations, problems of pest resurgence, pesticide resistance etc. Moreover these problems are accentuated with the use of spurious chemicals and the existence of a chain of functionaries/unlicensed dealers between firms and farmers. The judicious application of pesticides, adoption of recommended commercial products, with other recommended technological interventions in apple should, therefore, be the concern of all stakeholders, researchers, and policy and decision makers [10].

The common pest and disease problems, point towards some alternative control strategies that have been effective. Not all the methods are appropriate for every orchard or every region. Geographical/climatic considerations, cultivar selection, the local pest-complex, market prices, production costs, and other factors will all influence the selection of pesticides. [11]. Reducing chemical input and adopting need based sprays requires the growers to develop an understanding of the orchard agro-ecosystem. In this regard, there is no substitute for direct observation and experience, along with a willingness to experiment. Other factors are also needed to be taken into consideration that are; Cultural guidelines for controlling one pest may create conditions that favour another pest; Many ecological pest control tactics tend to give highly variable results from location to location and year to year; Traditional local support services are often unable to provide much information or guidance; and available ecological practices may be labour/capital-intensive [12].

The management of insect pest and diseases involve frequent pesticide intervention throughout the world; in Kashmir valley however a need based spray schedule for the management of the various apple pest comprises 6-8 essential sprays of pesticides [13]. But for adoption the recommended spray schedule for apple efforts should be made for its popularization and timely updating amongst the farmers.

"Key to agricultural development lies in the mind, heart and hands of farmers". Farmers are ultimate decision makers about an innovation introduced into their systems. They are heterogeneous and differ in various characteristics like education, experience in cultivation, farm size, annual income, media participation, extension contact, participation in extension activities; economic motivation, scientific orientation, etc. [14].Their receptivity to different agricultural innovativeness will vary depending on their personal, socioeconomic and psychological attributes. Hence, an insight in to these factors is essential. Large scale adoption of innovation is essential feature of agricultural development. However, some farmers adopt all the recommended practices while some others don't. The personal, social and economic aspects of the farmers play a major role in their adoption process. Further, inadequate extension services, high illiteracy among farmers, socio-cultural background, low paying-capacity, lack of skill, etc. may be the barriers for non-adoption or low adoption of various improved technologies [15].

There is no more distinctive feature of agriculture than its dynamism. Farming practices change continually. Farmers build on their own experience and that of their neighbours to refine the way they manage their crops. Changes in natural conditions, resource availability, and market development also present challenges and opportunities to which farmers respond. In addition, farmers learn about new technologies from various organizations, programs, and projects dedicated to research, extension, or rural development [16]. These organizations develop and promote new varieties, inputs, and management practices. It is essential that such organizations be able to follow the results of their efforts and understand how the technologies they promote fit into the complex pattern of agricultural change in which all farmers participate. There are several reasons to invest in studying the adoption of agricultural technology. These include improving the efficiency of technology generation; assessing the effectiveness of technology transfer, understanding the role of policy in the adoption of new technology, and demonstrating the impact of investing in technology generation [17]. The present study was carried out to evaluate the extent and gap in adoption in recommended apple spray schedule of the apple growers in district Ganderbal of Jammu and Kashmir

2. Materials and Methods

The present study was carried out in district Ganderbal of Jammu and Kashmir, and by following simple random sampling, 100 respondents were selected from 25 villages of four blocks. The data was elicited through personal interview method. The district Ganderbal was purposively selected, because of the potentiality for the development of horticulture, and most of area of the district was under apple plantation. Out of the four blocks of the district, village clusters were identified with higher areas under apple cultivation and out of those clusters a total of 25 villages were purposively selected for the study. Comprehensive lists of farmers engaged in apple cultivation from each village were framed in consultation with office of chief horticulture officer and HDOs'of the district. Respondents were selected using proportionate sampling (taking area as auxiliary information) and ultimate unit of sampling (farmer) were selected randomly taking the sample size of 100 respondents, from whom data was collected. To measure the extent of adoption the recommendations were divided into three categories; Fully adopted, Partially adopted and Not adopted and were quantified by giving scores to each viz-2 score to full adoption, '1' score to partial adoption and '0'score to no adoption. Therefore maximum score obtainable was 22 for each respondent. Based on the responses the adoption level was quantified by using frequency and percentage. Finally respondents were divided into three categories using mean and standard deviation.

Table 1: Categories of apple growers (n=100)

S. No.	Category	Score
1.	Low	*Low (<Mean - SD)*
2.	Medium	*Medium (Between Mean ± SD)*
3.	High	*High (> Mean + SD)*

The measurement was applied to the time of application of the recommended pesticides and with recommended concentrations according to recommended schedule. All the important recommendations were listed. A total number of 11 recommended sprays were selected based on the recommended apple spray schedule by the SKUAST (K) as listed below. Table-1 reveals that the categories of farmer about the adoption of spray schedule to control the diseases and pests as recommended by the state agricultural university.

Table 2: Recommended apple spray schedule

S. No.	Tree stage	Recommended Chemicals
1.	Dormant	Diesel oil + Fish oil soap (Potash based)
2.	Green tip	Mancozeb 75 WP (300g) or Zineb 75 WP(300g) or Propineb 75WP(300g)
3.	Pink bud	Dimethoate 30EC (100ml) or Clothionidin 50 WDG (14g), Myclobutanil 10WP (30g) or Dodine 65WP (60g) or Dodine 40SC (70ml) OR Flusilazole 40EC (20ml) or Bitertanol 25WP (50g) or Fenarimol 12EC (40ml)
4.	Petal fall	(need based for SJS) Methyl-o-demeton 25EC (80ml) or Quinalphos 25EC (100ml) (need based ERM) Milibectin 1EC (100ml) or Abemectin 1.8EC (55ml)or Fenpyroximate 5SC (100ml), 14-18 days after III spray Hexaconazole 5EC (50ml)or Difenaconazolen 25EC (30ml) or Triadimefon 25WP (50g) or Diniconazole 25WP (40g)
5.	Fruit let stage	Cholrpyriphos 20EC (100ml)or Dimethoate 30EC (1ooml) or Thiocloprid 240SC (40ml) (need based ERM) Dicofol 18.5EC (108ml) or Hexythaizox 5EC (40ml) or Fenazaquin 10EC (40ml), 14-18 days after IV spray Ziram 80WP (200g) or Mancozeb 75WP (300g) or Ziram 27W/V (600ml) or Captan 50WP (300ml)or Propineb 75WP (300g) or Mancozeb flowable 35 SL (300ml) or Zineb75WP (300g) or Captan (70%)+ Hexaconazole (5%) 75 WP (50g) or Metiram (55%) + Pyraclostrobin (5%) 60WG (100g)
6.	Fruit development I	(Need based for Bark and June beetles) Clothianidin 50WDG (14g) or Quinalphos 25EC (100ml), (need based ERM) Propargite 57EC (88ml)or Fenpyroximate 5SC (100ml), 14-18 days after V spray Bitertanol 25WP (50g) or Dithionon 75 WP (75g) or Triadimefon 50WP (50g)or Penconazole 10EC (50g) or Fenarimol 12EC (40ml) or *Dodine 65WP (60g)
7.	Fruit Development II	Chlorpyriphos 20EC (100ml) or Methyl-o-demeton 25EC (80ml) (For ERM) Fenazaquin 10EC (40ml) or Spiromesifen 240SC (40ml), 14-18 days after VI spray Hexaconazole 5EC 50ml) or Flusilazole 40EC(20ml) or Diniconazole 25WP (40g)
8.	Fruit Development III	(Need based for SJS, WAA) Dimethoate 30EC (100ml), (need based ERM) Clothianidin 50WDG (14g) or Milbemectin 1EC (100ml), 14-18 days after VII spray Dithionon 75WP (75g) or Penconazole 10EC (50ml)or Myclobutanil 10WP (30g) or Triadimefon 25WP (50g) or Metiram (55%) + Pyraclostrobin (5%) 60WG (100g)
9.	Fruit Development IV	**14-18 days after VII spray Difenaconazole 25EC (30ml) or Bitertanol 25WP (50g) or Fenarimol 12EC (40ml)or ***Ziram 80WP (200g) or ***Propineb 75WP (300g)
10.	Pre-harvest	****25 days before harvest Ziram 80WP (200g) or Mancozeb 75WP (300g) or Ziram 27W/V (600ml) or Captan 50WP (300g) or Mancozeb flowable 35 SL (300ml) or Zineb 75WP (300g) or Captan (70%)+ Hexaconazole (5%) 75 WP (50g)
11.	Post-harvest	(Need based for SJS, WAA) Phosalone 35 EC (140ml) or Ethion 50 EC (100ml), (need based ERM) Herbal (200ml) or Fenzaquin 10 EC (40ml)

Adoption of recommended apple spray schedule is a process that has several dimensions; it can be studied under few aspects including the extent of adoption and gap in the adoption of recommended spray schedule by apple growers. Table-2 is the recommended spray schedule for effective control of diseases and pests.

3. Technological gap in adoption

Gap in adoption has been defined as the proportion of gap in the adoption of practices recommended and it is expressed in percentage [18]. In the present study technological gap was operationalized on the adoption of 11 recommended practices in the apple spray schedule by the each respondent farmer and then expressed in percentage.

The gap in adoption of a particular practice expressed in percentage was:

$$\text{Technological gap} = \frac{\text{Standard score-Actual score}}{\text{Standard score}} \times 100$$

4. Statistical analysis

Different statistical tools and formulae were used to draw logical inferences.

4.1 Frequency

This measure was used to know the distribution pattern of apple grower's variable wise.

4.2 Percentage

Percentage is a number or ratio expressed as a fraction of 100. This measure was used for simple comparisons and to know the adoption level of apple growers regarding apple cultivation.

4.3 Arithmetic mean (X)

It is defined as the sum of all values of the observations divided by the total number of observation (n), symbolically it is represented as;

$$x = \frac{\sum x}{n}$$

Where,
X: Arithmetic mean
Σx : Sum of the item
n: Total number of item

4.4 Standard deviation (σ)

It is positive square root of the mean of the sum of square of the deviation taken from the mean of the distribution.

$$\sigma = \frac{\sqrt{\frac{1}{n}\{\sum x^2 - (\sum x)^2\}}}{n}$$

Where,
σ : Standard deviation.
Σx^2 : Sum of squares of each individual.
$(\Sigma x)^2$: Square of sum of all items.
n : Number of items.

Mean and standard deviation were used to categorise the respondents into different categories.

5. Result and Discussion

5.1 Extent of adoption of recommended apple spray schedule

Results indicated that the overall adoption of the recommended apple spray schedule was 26.34 per cent, and it was found that grower's extent of adoption, pertaining to name of chemical, its dose and time of spray was high petal fall stage (46.67%), fruit let stage (42%), dormant stage (36.67%) and pre- harvest stage (29.34) (Table-3 and Fig. 1). Moreover regarding other recommended pesticide sprays, the adoption of green tip and fruit development I was found to be 25.67 and 25.34 per cent respectively by the respondents, followed fruit development III (23.33%), pink bud stage (23.00%), fruit development II (21.67%), fruit development IV (16%) and post-harvest stage (zero%). A perusal of the data in Table - 4 and Fig. 2 indicated the, overall extent of adoption of the recommended apple spray schedule by the respondents. Majority 63.00 per cent of the respondents had medium extent of adoption of the recommended apple spray schedule followed by high 19.00 per cent and low with 18.00 per cent.

5.2 Technological gap in adoption of the recommended apple spray schedule

Table -5 and Fig. 3 show the technological gap in adoption of recommended apple spray schedule. There is a 100 per cent gap in the recommended post harvest sprays, a gap of 84.00 per cent in sprays for fruit development IV, in addition a technological gap of 78.33, 77.00, 76.67, 74.66 and 74.33 per cent in fruit development II, pink bud, fruit development III, fruit development I and green tip stages respectively. Moreover a gap of 70.66 was found in pre-harvest spray. The gap in dormant sprays and fruit let stage was found 63.34 and 58.00 per cent respectively.

Table -6 and Fig. 4 shows that majority (67%) of the respondents belonged to medium category of overall technological gap in adoption of the recommended apple spray schedule, followed by low with 19.00 and high 14.00 per cent.

5.3 Extent of adoption of the recommended apple spray schedule

The adoption of any technology in general and that of apple spray schedule in particular depends on various factors such as awareness about practices, complexity of practices, timely availability of inputs, characteristics of farmers etc. However, it is true that all the recommended practices will not be adapted to some degree by all the members in a given social system.

A perusal of Table -3 indicated that the total adoption of the recommended apple spray schedule was only 26.34 per cent. The table revealed the adoption of the recommended apple spray schedule by the respondents, and it was found that majority of the respondents adopted recommended schedule for the petal fall stage (46.67%), followed by spray schedule for fruit let stage (42%), the possible reason for this trend may awareness of these particular sprays that are easy to remember. Adoption of recommended dormant sprays was only 36.67 per cent may because of complexity in the use of diesel oil spray especially for large land holdings as compared of readymade horticulture mineral oils. And adoption of 29.34 per cent for that of pre harvest spray schedule. Moreover regarding other recommended pesticide sprays, the adoption of green tip and fruit development I was found to be 25.67 and 25.34 per cent respectively by the respondents, followed fruit development III (23.33%), pink bud stage (23.00%), fruit development II (21.67%), fruit development IV (16%) and post-harvest stage (zero%). Such low adoption of recommended pesticide sprays for green tip, pink bud and for fruit let stage may be attributed to the asynchronous developmental stages of different apple varieties in the same orchards, thus making it complex and laborious for farmers to follow the recommended apple spray schedule.

A perusal of the data in Table -4 indicated that, overall extent of adoption of the recommended apple spray schedule by the respondents. Majority of the respondents (63%) had medium extent of adoption of the recommended apple spray schedule followed by high 19.00 and low with 18.00 per cent of the respondents. the possible reason for such low adoption may be because of less awareness of the recommendations because of low efforts of change agencies, impact of progressive farmers, pesticide and input dealers, trader cum- contractors or unlicensed dealers. These findings are in line with the research findings of Baba *et al.* [19] and Beigh [20].

5.4 Technological gap in adoption of the recommended apple spray schedule

Table -5 shows the technological gap in adoption of the recommended apple spray schedule. There is a 100 per cent gap in the recommended post harvest sprays, a gap of 84.00 per cent in sprays for fruit development IV, in addition a technological gap of 78.33, 77.00. 76.67, 74.66 and 74.33 per cent in fruit development II, pink bud, fruit development III, fruit development I and green tip stages respectively. Moreover a gap of 70.66 was found in pre-harvest spray. The gap in dormant sprays and fruit let stage was found 63.34 and 58.00 per cent respectively. The above mentioned findings brings to inference that high per cent of technological gap was found in some practices that may be attributed to many factors like lack of knowledge and guidance, unawareness, complexity, technical know-how and also non-availability of chemicals and other inputs.

5.5 Distribution of the respondents based on overall technological gap in adoption of the recommended apple spray schedule

Table -6 shows that majority (67%) of the respondents belonged to medium category of overall technological gap in adoption of the recommended apple spray schedule, followed by low with 19.00 and 14.00 per cent belong to high category. In addition to above mentioned factors, the adoption was noticed only in those orchards which were managed and maintained by the owners of the orchards rather than those orchards that were leased out to contractors and dealers. These findings are also in line of the findings of Baba *et, al.* [21].

Table 3: Extent of adoption of recommended apple spray schedule (n=100)

S. No.	Tree stage	Full Adoption	Partial Adoption	No Adoption	Total	
					Score	Per cent
1.	Dormant	55	0	45	110	36.67
2.	Green tip	35	7	58	77	25.67
3.	Pink bud	14	41	45	69	23.00
4.	Petal fall	56	28	16	140	46.67
5.	Fruit let stage	39	48	13	126	42.00
6.	Fruit Development I	12	52	36	76	25.34
7.	Fruit Development II	7	51	42	65	21.67
8.	Fruit Development III	15	40	45	70	23.33
9.	Fruit Development IV	22	4	74	48	16.00
10.	Pre-harvest	39	10	51	88	29.34
11.	Post-harvest	0	0	100	0.00	0.00
	Total	588	281	0.00	869	26.34

#Score = 2(FA) + PA

Table 4: Overall Extent of adoption (n=100)

S. No.	Category	Per cent
1.	Low (< Mean – SD = less than 4)	18
2.	Medium (Between Mean ± SD= 4-13)	63
3.	High (> Mean + SD = 14 and above)	19
Total		100

Mean = 8.72, SD = 4.66

Table 5: Technological gap in adoption of the recommended apple spray schedule. (n=100)

S. No.	Stage	Technological gap (Per cent)
1.	Dormant	63.34
2.	Green tip	74.33
3.	Pink bud	77.00
4.	Petal fall	53.33
5.	Fruit let stage	58.00
6.	Fruit Development I	74.66
7.	Fruit Development II	78.33
8.	Fruit Development III	76.67
9.	Fruit Development IV	84.00
10.	Pre-harvest	70.66
11.	post Harvest	100
Total		73.66

Table 6: Distribution of the respondents based on overall technological gap in adoption of the recommended apple spray schedule (n = 100)

S. No.	Category	Per cent
1.	Low (<Mean+SD)= less than 9	19
2.	Medium (Between Mean ± SD)= 9-17	67
3.	High (> Mean + SD) =18 and above	14
Total		100

Mean = 13.31, SD = 4.69

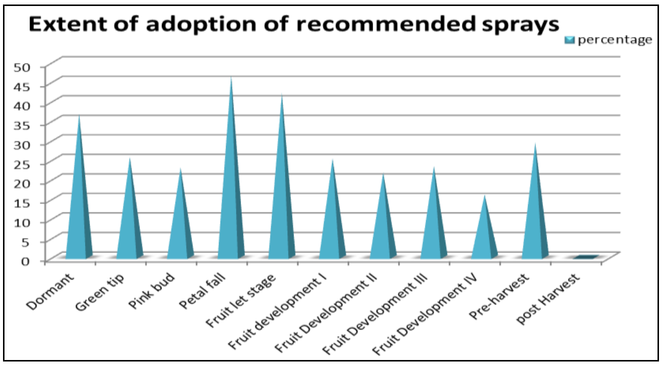

Fig 1: Extent of adoption of recommended apple spray schedule

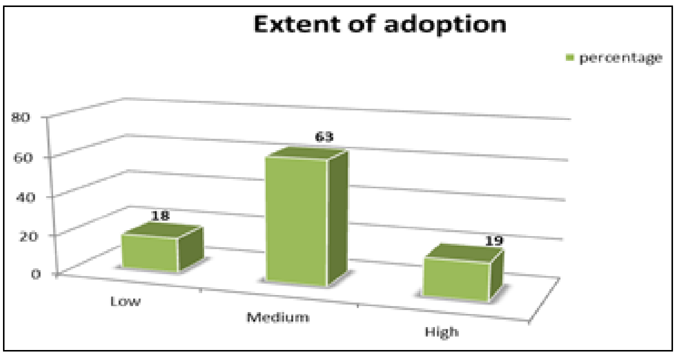

Fig 2: Overall Extent of adoption of recommended apple spray schedule by the apple growers

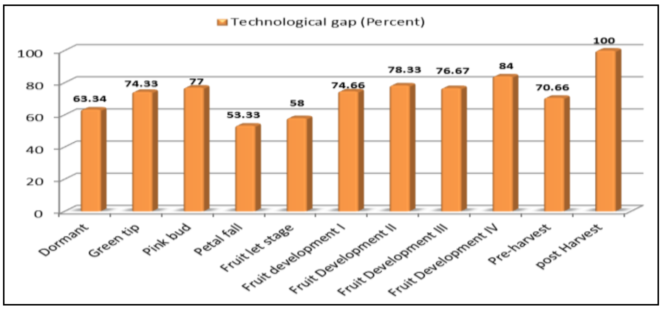

Fig 3: Technological gaps in adoption of the recommended apple spray schedule

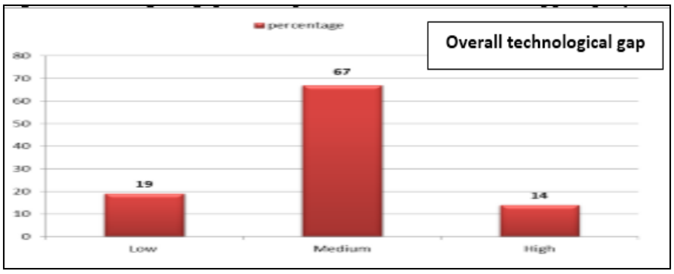

Fig 4: Overall Technological gap in adoption of the recommended apple spray schedule

6. Conclusion

A wide technological gap observed; warrants the attention of extension workers and scientists to intensify their efforts in these areas where wide gap observed and appropriate educational activities like organising trainings, demonstrations, exhibitions and field days should be undertaken to reduce the technological gap. More educational efforts are necessary on the part of extension agency to increase the knowledge of farmers about recommended apple spray schedule Special attention should be given to illiterate farmers and farmers having low income, small land holdings while educating through demonstrations and trainings.

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