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# Effects of pesticides on agricultural and horticulture production

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### Abstract
Pesticides are used in all agricultural and horticulture systems and plays a key role to diminish environmental threats and also health perils. To diminish pesticide uses is a stimulating in an orchards where recurrently pesticides are used so as to control abundant pests and also diseases, but it may be vital to increase a fruit production and its sustainability. Agronomic researches had provided changes to control chemical for the organization for a single pest or disease, but had been seldom addressed for the design of an overall justifiable policies for aiming to reduce pesticide uses. New insights are permitted by the system are now developing. Here, we are reporting the level of pesticide use and also the agro-environmental performances of the three protection systems to an apple orchards gaged from 2005 to 2008: (i) unoriginal, (ii) low input and (iii) biological farming. To measure the significances of the cultivator in order to decreasing pesticide uses, these safeguard systems were combining with three cultivars different in scab susceptibility: 'Ariane' (Vf-resistant), 'Melrose' (low-susceptibility) and 'Golden Delicious' (susceptible). Thus, nine 'management x cultivar' apple plantation systems are to be assessed. The level of pesticide uses are now highest in conservative 'Golden Delicious' and in 'Golden Delicious' plots for their protection system. A 43-56% decline in pesticide uses were observed in 'Ariane' and 'Melrose' in both for low input and also organic framings defense system as compared to conventional 'Golden Delicious' as orientation. Only with low input 'Melrose' and also low input 'ARIANE herbicide' achieved a Good level of production and less fruit damages similar to the matching conventional cultivators under reduced pesticide uses, also allowing reduced on environmental impacts. But even with the low input 'Melrose' and least pesticide-dependent systems were far from being pesticide-free, suggesting that the current straight-designed mono-clone plantations are to be hardly appropriate to drastically reduce pesticide use and that the range of commercial apple cultivators should be renewed to offer more robust cultivators.

**Keywords:** Plantation system, pesticide use, pest and disease management, longitudinal survey, decision rule, agronomic evaluation, environmental evaluation, drastically

### Introduction
Horticulture forming is the backbone of the Indian economy of the Jammu and Kashmir state. Utmost of the peoples especially those are living in Kashmir are openly or incidentally dependent on it. Amongst all the fruit crops in Jammu and Kashmir only apple production that constitutes about 86% per cent of the total horticultural production (Dar *et al*., 2010) [16]. Throughout the whole Kashmir valley especially the South Kashmir is famous for in producing good quality temperate fruits especially well known for their apple, almond and walnut production. However, an apple production is inclined to a number of diseases that are causing by fungi, bacteria and multiple viruses, etc. these are as scab, Alternaria, leaf blotch, cankers, root/collarrot, etc. and are severely attacked by many insect pests like San Jose Scale, woolly apple aphid, borers etc. which causes a severe economic losses and also sometimes leads to a partial or whole plant death in distress. Now, therefore, various approaches are to be necessarily followed by all the farmers on their management which include hygiene, removal of all infested and diseased branches, etc. and they particularly start spraying with different pesticides like fungicides, insecticides and Acaricide. The farmers now following a calendar based spraying schedule spraying comprehensively different pesticides for management of their diseases and also insect pests without taking into consideration for their adverse effects. This necessitates them to conducting of survey programmes for generating data with regards to the current pesticide usage among all the farmers and other related aspects for their judicious use and for efficient management.

Therefore, this whole study was to be conducted to investigate the pesticide use and their application behavior of the farmers in apple production system. The main objective for this study was to investigate farmers' perception and the factors that can influence their intention to apply pesticide to their crops for pest management with the purpose for improving the IPM extension program.

**Improving productivity**

Tremendous benefits had been derived from the use of pesticides in forestry, public health and in the domestic spheres, especially in an agriculture sector upon which the whole Indian economy is fully dependent. Food grain production, which stood at a mere 50 million tons in 1948–49, had increased almost fourfold to 198 million tons by the end of 1996–97 from an estimated 169 million hectares of permanently cropped land. This result has been achieved by the use of high-yield varieties of seeds, advanced irrigation technologies and agricultural chemicals (Employment Information: Indian Labour Statistics, 1994). Similarly outputs and productivity have increased dramatically in most countries, for example wheat yields in the United Kingdom, corn yields in the USA. Increases in productivity have been due to several factors including use of fertilizer, better varieties and use of machinery. Pesticides have been an integral part of the process by reducing losses from the weeds, diseases and insect pests that can markedly reduce the amount of harvestable produce. Warren (1998) [17] also drew attention to the spectacular increases in crop yields in the United States in the twentieth century. Webster *et al.* (1999) [18] stated that "considerable economic losses" would be suffered without pesticide use and quantified the significant increases in yield and economic margin that result from pesticide use. Moreover, in the environment most pesticides undergo photochemical transformation to produce metabolites which are relatively non-toxic to both human beings and the environment (Kole *et al.*, 1999) [19].

**Pests and Diseases Encountered by Farmers in Apple Growing**

As for all agricultural crops, plant protection problems such as pests and diseases are the major factors decreasing apple production. Codling moth, mites, aphids, scale insects, leaf rollers, jewel beetles and bark beetles are the main pests and apple scab, powdery mildew, cedar apple rust, brown blight, collar rot and apple mosaic virus are the main diseases of apple trees (Blommers 1994; Ohlendorf 1999) [20-21]. These pests and diseases, mainly codling moth and apple scab, cause economical losses in some orchards in the study area, time to time, according to the location, varieties and cultural practices. Chemical control is the primary method in use to suppress apple pests and diseases, due to its easy application and rapid effect (Karaca *et al*. 2010) [22]. Table 1.1 shows that the major pests and diseases encountered by farmers in apple growing in the study area. The research results showed that the majority of these farmers faced pests and diseases include; codling moth, apple scab, bark beetles, red spider mite and mites, respectively. Among the pests and diseases, the most commonly encountered in apple growing in the study area are codling moth and apple scab. These two pests and diseases accounted for over 77.19% in apple growing in the study area.

**Table 1:** The major pests and diseases encountered by farmers in apple growing in research area.

| Pests and diseases | $N^2$ | % | Rank |
|---|---|---|---|
| Codling moth | 49 | 42.98 | I |
| Apple scab | 39 | 34.21 | II |
| Bark beetles | 37 | 32.46 | III |
| Red spider mite | 28 | 24.56 | IV |
| Mites | 25 | 21.93 | V |

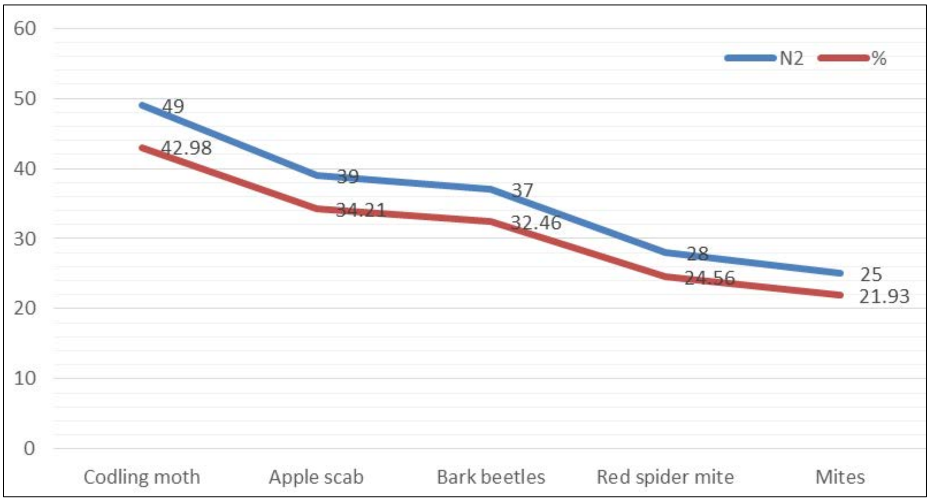


**Fig 1:** Showing the graphical representation on the major pests and diseases encountered by farmers in apple growing in research area

**Indiscriminate pesticide use and technological gaps**

Since apple constitutes more than 85 per cent of area under all fruits in the valley, it receives considerably high quantity of pesticides. The scientific spray schedule, developed by SKUAST-Kashmir in collaboration with concerned Development Department of Government of Jammu & Kashmir, for apple recommends only 6 essential fungicides to be sprayed at various stages of fruit development. Contrary to this, farmers had adopted diverse spraying system and the majority of them had sprayed their crops8 or 9 times, 6 per cent of them had even treated apple crop with more than 12 sprays (Table 1.2). Despite the fact that the season under reference was a normal one, their crops received on average 01 spray of insecticides, 07 sprays of fungicides and 01 dormant spray. Only one farmer was found to have sprayed summer spray oil. Further, pesticides were applied on apple without the consideration of stages of fruit development and even a good proportion of farmers were found repeating same chemicals up to 3 or 4 sprays.

**Table 2:** Average number of pesticide application in the study area

| Sprays (no.) | No. farmers | % of total farmers |
|---|---|---|
| Up to 5 | 0 | 0.0 |
| 6 | 13 | 6.5 |
| 7 | 27 | 13.5 |
| 8 | 40 | 20.0 |
| 9 | 49 | 24.5 |
| 10 | 31 | 15.5 |
| 11 | 17 | 8.5 |
| 12 | 11 | 5.5 |
| ›12 | 12 | 6.0 |
| Total farmers | 200 | 100.0 |

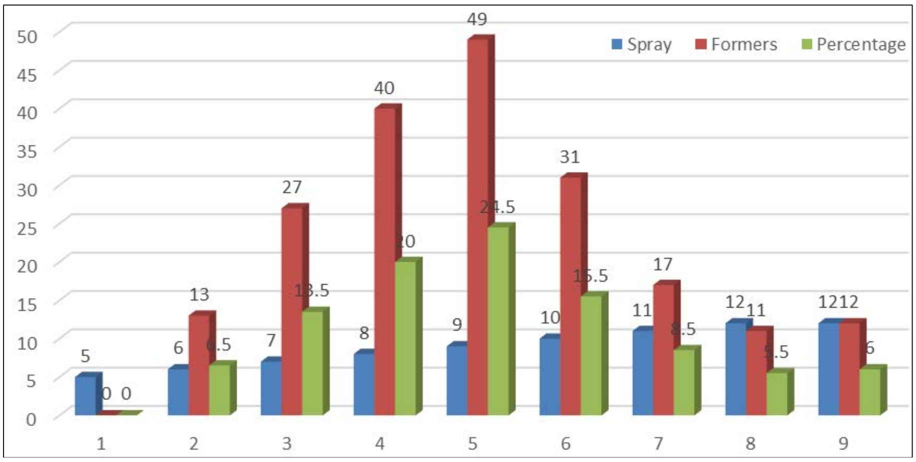


**Fig 2:** Average number of pesticide application in the study area

Accordingly, Duratek dormant spray oil has been recommended as the first choice to the farmer sowing to its less cost, however, only 2.5 per cent of the farmers had used this oil despite its availability in the markets (Table 3). About 9 per cent of the farmers had used diesel oil which was estimated to be almost double in cost than Duratek or Mac. Few farmers (1.5%) had been sprayed their orchards with some unidentified oil.

**Table 3:** Choice of chemicals for dormant spray (1st spray) by farmers

| Chemicals | No of farmers | % of total farmers | Technological gap (%) |
|---|---|---|---|
| Diesel | 17 | 8.5 | - |
| Duratek | 5 | 2.5 | 80.0 |
| HP | 101 | 50.5 | 50.0 |
| Mac | 71 | 35.5 | 40.0 |
| Others* | 3 | 1.5 | 60.0-75.0 |
| Unidentified | 3 | 1.5 | - |
| Total | 200 | 100.0 | - |

**Note:** * include Arbofine, ASTO, etc. Source: computed by authors based on information collected through field survey, 2015-16

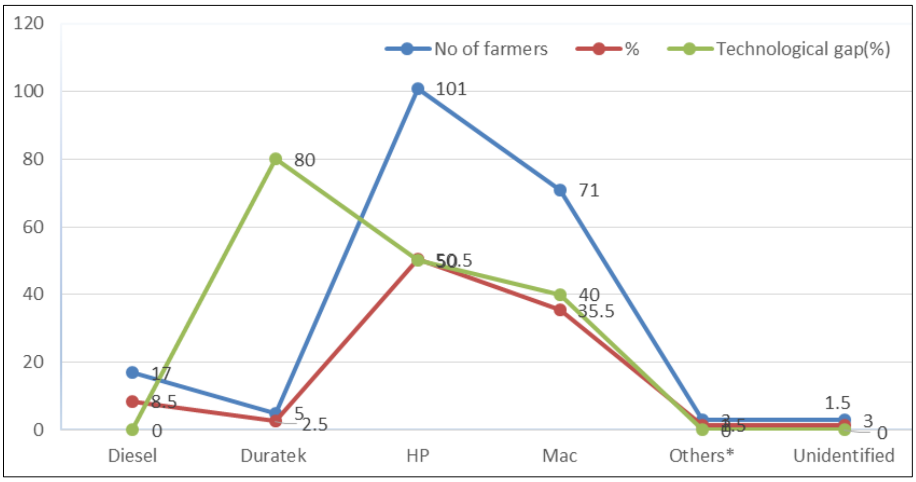


**Fig 3:** Showing graphical representation on choice of chemicals for dormant spray (1st spray) by farmers

Similarly, there was no uniformity among different orchards with respect to the spray of fungicides and insecticides in the study area. About 17 per cent and10per cent of orchardists had sprayed their apple orchards ten times and more than 10 times, respectively (Table 4). Scientific plant protection schedule for apple recommends spray of Mencozeb with alternative choice 'Captan' as second spray at green tip stage. In practice, only 29 per cent farmers had applied these two chemicals at this stage and the rest used other 7chemicals which are even not mentioned in schedule for this stage. As third spray only 1 per cent of farmers had treated their crop with Captan + Hexoconazole, almost cost-effective recommended fungicide and 99 percent had chosen other fungicides. At this stage, no insecticidal spray was made by the sample respondents which are contradictory to the scientific recommendation which has advised an essential spray of Dimethoate insecticide. Even the use of unlabeled chemical by few of the farmers was seen in the apple growing belt of the valley. Moreover, there was a repeated application of same chemicals at different stages of fruit development and this scenario has put a question mark at the performance of extension agencies serving the valley. If a new pesticide is found efficacious at evaluation, SKUAST-Kashmir recommends it for application on apple in Kashmir at specific concentration beyond which its negative externality (ies) would supposedly multiply. It is worth to note that none of the pesticides used in the study area was applied at the recommended concentrations. Among dormant sprays, technological gap in the use of Duratek was estimated at 80 per cent as farmers had put this oil and water in the ratio of3.6:100 litres, respectively, instead of recommended level of 2:100 litres. On average, dormant oils were used 61 per cent more than scientific recommendations though gap was relatively lower in the application of Mac dormant spray oil (Table 3). In fungicidal sprays, the technological gap ranged from 5.5 per cent in Metirum + Pyroclostrobin to as high as 87 per cent in Hexaconazole (Table 4). In the case of insecticides, the maximum gap was observed in application of Fenzaquin, though the average gap among all the insecticides was estimated at 36 per cent. It was observed that the technological gap in the formulation/concentration of newly released pesticides was relatively lower. It is suspected that once the newly introduced pesticides make their markets, a reasonable proportion of sub-standard/spurious chemicals of the mare also pumped into the distribution system, particularly through unauthorized traders. The poor performance of pesticides and availability of substandard/spurious pesticides was found one of the reasons farmers use chemicals in more concentrations.

**Table 4:** Choice of chemicals for fungicidal/acaricidal sprays by farmers

| **Chemicals spray Tech Gaps%** | **2nd** | **3rd** | **4th** | **5th** | **6th** | **7th** | **8th** | **9th** | **10th** | | **›10th** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Captan | 9.0 | 2.0 | 11.0 | 7.0 | 10.0 | 10.0 | 3.0 | 3.0 | - | - | 14.3 |
| Dodine | 31.0 | 15.0 | 6.0 | 7.0 | - | 1.0 | 8.0 | 1.0 | - | - | 21.7 |
| Mencozeb | 25.0 | 19.0 | 10.0 | 19.0 | 2.0 | 3.0 | 2.0 | - | 1.0 | 1.0 | 13.3 |
| Difenconazole | 1.0 | 11.0 | 13.0 | 19.0 | 4.0 | 13.0 | 3.0 | 2.0 | - | 1.0 | 78.5 |
| Carbondazime+ mancozab | - | 1.0 | - | - | 9.0 | 3.0 | - | - | - | 0.5 | 7.0 |
| Propeneb | - | 6.0 | 5.0 | 6.0 | 6.0 | - | 5.0 | - | - | - | 10.7 |
| Captan+ hexaconazole | - | 1.0 | 5.0 | 1.0 | 3.0 | - | - | - | - | - | 71.2 |
| Trifloxystrobin+ tebuconcazole | - | 1.0 | 0.0 | 3.0 | 2.0 | - | - | - | - | 2.0 | 17.8 |
| Ziram | - | - | - | 4.0 | - | 1.0 | 7.0 | 1.0 | 1.0 | 1.0 | 21.8 |

***Source***: computed by authors based on information collected through field survey, 2015-16

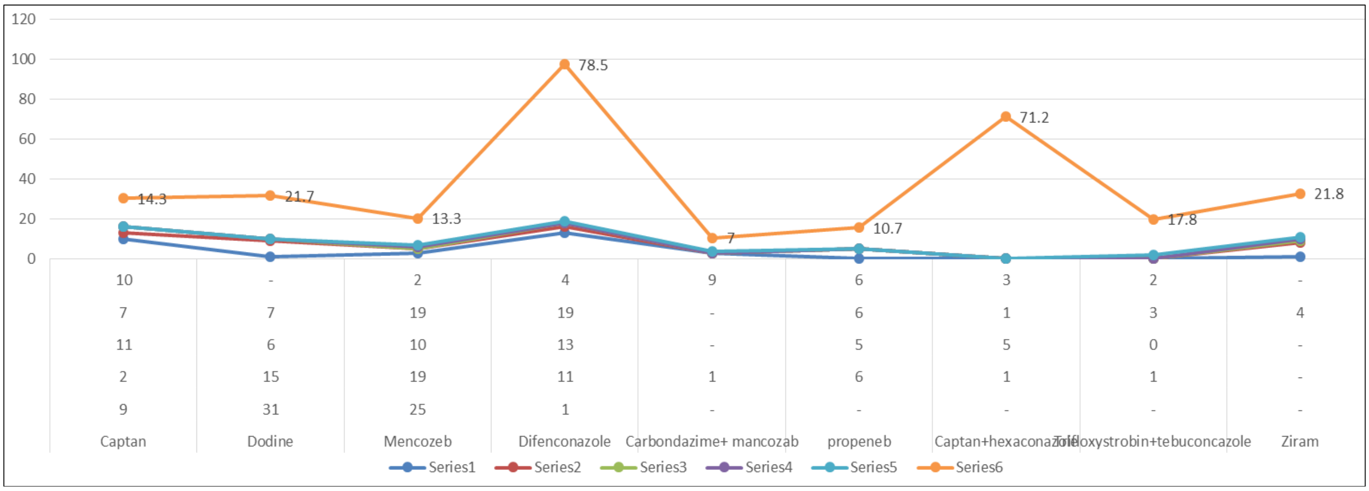


**Fig 3:** Showing graphical representation on choice of chemicals for dormant spray (1st spray) by farmers

## Impact on environment

Pesticides can contaminate soil, water, turf, and other vegetation. In addition to killing insects or weeds, pesticides can be toxic to a host of other organisms including birds, fish, beneficial insects, and non-target plants. Insecticides are generally the most acutely toxic class of pesticides, but herbicides can also pose risks to non-target organisms.

## Direct impact on humans

If the credits of pesticides include enhanced economic potential in terms of increased production of food and fibre, and amelioration of vector-borne diseases, then their debits have resulted in serious health implications to man and his environment. There is now overwhelming evidence that some of these chemicals do pose a potential risk to humans and other life forms and unwanted side effects to the environment. No segment of the population is completely protected against exposure to pesticides and the potentially serious health effects, though a disproportionate burden, is shouldered by the people of developing countries and by high-risk groups in each country (WHO, 1990). The world-wide deaths and chronic diseases due to pesticide poisoning number about 1 million per year (Environews Forum, 1999). The high-risk groups exposed to pesticides include production workers, formulators, sprayers, mixers, loaders and agricultural farm workers. During manufacture and formulation, the possibility of hazards may be higher because the processes involved are not risk free. In industrial settings, workers are at increased risk since they handle various toxic chemicals including pesticides, raw materials, toxic solvents and inert carriers.

**Advantages and disadvantages of pesticides**

A pesticide is any substance or mixture of substances whose purpose is to prevent, extinguish, or repel pests or to regulate plants. There are considerable benefits to pesticide use. Cooper & Hans summarize these benefits as primary and secondary. Primary benefits include improved crop and livestock quality and increased crop and livestock yields. Secondary benefits are less immediate, and they include food security, increased export revenues, and reduced international spread of disease. In the short-range, pesticides reduce waste of crops, land, water, time, and other valuable resources. In fact, it has been estimated that investing around $10 billion in pesticides every year saves about $40 billion in crops. On the other hand, the disadvantages to widespread pesticide use are significant. They include domestic animal contaminations and deaths, loss of natural antagonists to pests, pesticide resistance, Honeybee and pollination decline, losses to adjacent crops, fishery and bird losses, and contamination of groundwater. The fertility of soil is affected by the death or damage to microorganisms caused by pesticides. Further, some pesticides induce immunotoxicity in humans which may lead to immunosuppression, hypersensitivity (allergies), autoimmune diseases, and inflammation; children may be especially susceptible to the adverse effects of being exposed to pesticides. People who work regularly with pesticides, such as farmers, are at greater risk of cancer. Thousands of non-lethal poisonings and cancer cases each year are attributable to pesticides.

**Benefits and problems associated with pesticides**

The benefits of pesticides include increased food production, increased profits of farmers and the prevention of diseases. Although pests consume or harm a large portion of agricultural crops, without the use of pesticides, it is likely that they would consume a higher percentage. Due to the is of pesticides, it is possible to combat pests and produce larger quantities of food. By producing major crops, farmers are also able to increase profits by having more produce to sell. Using pesticides reduces the amount of time required to manually remove weeds and pests from fields. In addition to saving crops and livestock, pesticides have also had direct benefits to human health. Although there are benefits to the use of pesticides there have also been many problems associated with there use. When pesticides are used, they don’t always stay in the location where they are applied. They are mobile in the environment and often move through water, air and soil. The problem with pesticide mobility is that when they travel the pesticides come in contact with other organisms and can cause harm. Pesticides have also been shown to disrupt the balance of an ecosystem. In many situations, when a pesticide is used, it also kills non pest organisms this can drastically alter the natural balance of the ecosystem.

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