

**Awareness Among the Vegetable and Fruit Growers about Adverse
Effect of Pesticides**

A thesis submitted to the

**MAHATMA PHULE KRISHI VIDYAPEETH
RAHURI-413 722, DIST. AHMEDNAGAR,
MAHARASHTRA (INDIA)**

*In partial fulfilment of the requirements for the degree
of*

MASTER OF SCIENCE (AGRICULTURE)

In

AGRICULTURAL EXTENSION

By

Mr. Wayal Vikas Mohan

Reg. No. 013/246

**DIVISION OF EXTENSION EDUCATION
COLLEGE OF AGRICULTURE,
PUNE – 411005 (MAHARASHTRA)**

2015

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ABSTRACT

Awareness Among the Vegetable and Fruit Growers about Adverse Effect of Pesticides

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Research Guide

: Dr. H. P. Sonawane

India has a mixed economy largely dependent on agriculture and its allied sectors. Therefore, agricultural development is one of the prime focuses of Indian planning and policy. After Independence, agriculture in India underwent significant transformation and production has increased tremendously due to the introduction of high yielding varieties and the large scale use of synthetic pesticides and fertilizers. However, there is a trade-off between agricultural production and increasing soil, air and water pollution and associated health hazards. Currently, India is the largest producer of pesticides in Asia and ranks twelfth in the world for the use of pesticides. Although the average consumption of pesticides is far lower than many other

countries, the problem of pesticide pollution is serious in India. Therefore, the present discourse aims to review the technology of application of pesticides in India and recommend future strategies for the rational use of pesticides and minimizing the problems related to health and environment due to inappropriate application of pesticides.

The present study was conducted in Pune district of Maharashtra state. Pune district was purposively selected for the study because it is having large area under vegetable and fruit cultivation. From Pune district Ambegaon, Junnar and Khed tahsils were selected on the basis of area under vegetable and fruit cultivation as the area of present research study. There were 13 villages from 3 tahsil selected. The findings of the study are based on the data collected by interviewing 115 selected vegetable and fruit growers. The data collected were processed and statistically analyzed. The data are discussed and presented by using the mean, frequencies, percentage and standard deviation.

Majority of the respondents belonged to the middle age group (62.61 per cent). About 60.87 per cent number of respondents had received secondary education (8th to 10th std). A large number (62.61 per cent) of respondents had medium level of annual income. About 46.09 per cent of respondents had marginal (Up to 1.00 ha.) land holding. More than half (53.91 per cent) of respondent were having medium (1.01 to 2.00 ha) area under vegetable and fruit cultivation. About 61.74 per cent of respondents had medium experience in vegetable and fruit cultivation. Majority (68.70 per cent) of the respondents had medium extension contact. About 59.13 per cent of the respondents had medium sources of information.

Majority (74.78 per cent) of the respondents belonged to medium risk preference category, while economic motivation was noticed among 71.30 per cent of respondents. Around 61.74 per cent of the respondents had medium awareness about adverse effects of pesticides.

Out of 110 vegetable and fruit growers who used 'Fipronil', vast majority (80.00 per cent) were using it 'more than recommended dose', while in case of 'Dimethoate', majority (90.00 per cent) of the respondents were using 'more than recommended dose' and of those who were using 'Thiamethoxam', 52.00 per cent were using it 'as per recommended dose'. Majority (94.78 per cent) of the respondents were aware about adverse effects namely, 'Headache'(94.78 per cent), 'Irritation in eyes' (93.91 percent), 'Itching on skin'(90.43 per cent), 'Nausea' (84.35 per cent), 'pesticide causes death of valuable pollinators like honey bee' (72.17per cent), 'persistent chemicals contaminate soil for longer period'(59.13 per cent) and 'developed pesticide resistant in pest due to constant use' (53.91 per cent).

'Pesticides should be kept away from reach of children and animals' (98.26 per cent), 'pesticides should be stored in cool, dry, safe and locked room' (85.22 per cent), 'washing of spray pumps near the river and wells should be avoided' (70.43 per cent), 'the clogged nozzle and other parts should not be blowed by mouth' (64.35 per cent) and 'empty tins of pesticides should not be used' (53.91 per cent) were the major suggestions given by them.

The study implies the need to provide all technical knowledge to the respondents about adverse effect of pesticides through frequent training.

1. INTRODUCTION

Agriculture is the important occupation of rural people and it is the backbone of the economy of many countries. Naturally, the practices and procedures of cultivating different crops have been changing from time to time. India is an agricultural country with near about 40 million hectares of land under cultivation. Over 70 per cent of country's population lives in rural areas where majority of the people belongs to farming communities. Obviously, the soil, climate and topography vary from region to region and within a region, but all types of crops can be grown successfully. Intensive and multiple cropping systems are practised wherever irrigation facilities are provided. Still today, about 60% net sown area is under rainfed land.

Our forefathers followed the methods of organic farming. But researches on the use of fertilizers and chemicals got impetus and it was considered a boom for production. In India, after green revolution, use of agricultural chemicals got momentum and it raised manifold. As these were used more unscientifically, they started showing negative impact on the soil, water and air, and as a whole, on the environment which otherwise could be termed as pollution. After green revolution, agriculture also started adding its part to this pollution and it is named as agricultural pollution.

'Agriculture pollution' is defined as the liquid and solid wastes from all types of farming, including the run-off from pesticides, fertilizers and feed lots. Crop protection in India begun in 1947- 48 with introduction of Benzene Hexa Chlorine (BHC) and Dichloro Diphenyl Trichloro Ethane (DDT) for the control of insect pest of agriculture and public health importance. Later, copper based Bordeaux mixture and

Burgundy mixture became prominent as they were more effective and not phytotoxic. From 1950 onwards, mercury compounds were introduced from Germany particularly, as seed dressers. Later, organophosphorous compounds, organosulphur fungicide, rodenticides were released for use. Today, India is the largest manufacturer of pesticides in the world.

There are more than 234 registered pesticides in India and the Indian pesticide industry includes more than 125 large and medium scale producers of more than 500 pesticide products. Among the various pesticide formulations produced, dust formulations constitute about 85% of the total, followed by water-soluble dispersible powder (12%) and dispersible powder (2%). India is one of the few remaining countries still producing and using some of the chlorinated pesticides such as DDT and lindane (Abhilash and Singh, 2009; Vijgen *et al.* 2011).

Use of pesticides in India is increasing at the rate of 2.00 to 5.00 per cent per annum and is about 3.00 per cent of total pesticides used in world. About 90,000 metric tonnes of technical grade pesticides are currently produced and more than 67.00 per cent is used in agriculture sector alone (Nigam and Murthy, 2000). However, the consumption of pesticides in India is relatively less i.e. 0.400 kg /ha than in USA (3 kg/ha), Malaysia (9 kg/ha) or Japan (11 kg/ha). Among the various states, Uttar Pradesh is the largest consumer followed by Punjab, Haryana and Maharashtra. Regarding the pesticide share across agricultural crops, cotton account for 45%, followed by rice (25%), chillies/vegetables/fruits (13-24%), plantations (7-8%), cereals other than rice seeds (6-7%), sugarcane (2-3%) and other (1-2%) (Gupta, 2004; Abhilash and Singh, 2009). There are 400 insecticides in the

schedule of Insecticide Act 1968 as against 129 at the time of enactment of the Act. Of these, 164 pesticides are registered so far, 78 products are being produced in India (Kulsheshta 1992).

Exposure to pesticides, both occupationally and environmentally, causes a range of human health problems. It is estimated that nearly 10,000 deaths occur annually due to use of chemical pesticide worldwide, with about three-fourth of these occurring in developing countries. At present, India is the largest producer of pesticides in Asia and ranks twelfth in the world for the use of pesticides with an annual production of 90,000 tons (Meera and Bahal, 2000). A vast majority of the population in India (56.70 per cent) is engaged in agriculture and therefore exposed to the pesticides used in agriculture. Pesticides being used in agricultural tracts are released into the environment and come into human contact directly or indirectly. Humans are exposed to pesticides found in environmental media (soil, water, air and food) by different routes of exposure such as inhalation, ingestion and dermal contact. Exposure to pesticides results in acute and chronic health problems. These range from temporary acute effects like irritation of eyes, excessive salivation to chronic diseases like cancer, reproductive and developmental disorders etc.

Although efforts are made to restrict pesticides to the targeted crops and their pests, pesticides easily reach adjacent vegetation, wild life, soil, water and sometimes humans. In this way, the impact of pesticides is felt throughout the environment and public health. Frequent use of pesticides often adversely affects the health of humans when they are exposed to them. Health and environment problems arise not only from use of chemicals and pesticides, but also from their production.

Frequent use of pesticides destroy not only targeted pest, but also naturally present beneficial predators and parasites, which help keep pest population in cultivated and wild areas in check. Without their natural enemies, secondary pests present in the crops are able to reach outbreak levels. Another serious and costly side effect of heavy pesticides use has been the development of pesticide resistance in pest, insects, pathogens and weeds.

There is a need to convey the message that prevention of adverse health effects and promotion of health are profitable investments for employers and employees as a support to a sustainable development of economics. To sum up, based on our limited knowledge of direct or inferential information, the domain of pesticides illustrates a certain ambiguity in situations in which people are undergoing life-long exposure. There is thus every reason to develop health education packages based on knowledge, attitude and practices and to disseminate them within the community in order to minimize human exposure to pesticides.

1.1 Need of the study

The Pune district is a major vegetable and fruit growing district of Maharashtra. The systematically designed research study with reference to awareness about adverse effects of pesticides by vegetable and fruit growers in Pune region has not been conducted so far. Therefore, it was necessary to study awareness of vegetable and fruit growers about adverse effects of pesticides. With this background, the present study was conducted with following specific objectives.

1.2 Objectives

1. To study the profile of the respondent farmer.
2. To study the extent use of pesticides and plant protection practices followed by respondent farmer.
3. To study the awareness of respondent farmers about adverse effects of pesticides.
4. To obtain suggestions of respondent farmers to minimise the adverse effects.

1.3 Scope of Study

The present investigation mainly pertains to awareness of the pesticide users about adverse effects of pesticides. The Pune district is a major vegetable and fruit growing and producing district of the Pune region. The results of study would provide guidance to planners and concerned agencies to prepare further programme of pesticide awareness in this district.

1.4 Limitations of Study

The study was restricted to limited vegetable and fruit growers from a few selected villages of three tahsils in Pune district of Pune region in Maharashtra. Considering limitations of time and resources at the disposal of the investigator, the study was confined to limited aspects. The findings of the study, therefore, would be applicable mainly to the area of the study or wherever similar conditions exist.

Layout of Thesis

This thesis has been divided into six chapters. The first chapter deals with brief introduction and objectives of the study. The second chapter devoted to review of literature gives brief account of relevant research work done in past. The third chapter is concern with details of methodology used for conducting research. The fourth chapter deals with results and discussion, finding of the study are presented in tabular form and discussed accordingly. Fifth chapter is devoted for summary, conclusions and implications upon finding of the study and sixth chapter deals with literature cited.

2. REVIEW OF LITERATURE

The review of literature is an essential aspect, which helps the researcher to get acquainted with the subject matter and channelizes his efforts in a desirable direction. The investigator referred the literature available and tried to collect the references pertaining to the topic of the study. The references having direct, indirect or derived application with the subject of the present study have been reviewed and presented in this chapter under the following heads

- 2.1 Profile of the respondent farmers.
- 2.2 Extent use of pesticides and plant protection practices followed by respondent farmers.
- 2.3. Awareness of respondent farmers about adverse effects of pesticides.
- 2.4. Suggestions of respondent farmers to minimize the adverse effects.

2.1 Profile of the respondent farmers

2.1.1 Age

Bhairamkar *et al.* (2002) observed that, three fifth (61.87 per cent) of the respondents belonging to middle age category. The average age of the respondents was 46 years.

Borate (2002) conducted a study on entrepreneurial behavior of the mango growers in Ratnagiri district of Maharashtra State. He observed that, majority (62.00 per cent) of the respondents belonged to 'middle' age category, while less than one-fifth (18.00 per cent) of the respondents belonged to 'young' age category. One-fifth (20.00 per cent) of the respondents belonged to 'old' age category. The average age of the respondents was 49.90 years.

Jaiswal (2002) revealed that, socio economic characteristics of respondents were observed and maximum percentage of respondents were belonging to middle age group, up to primary education level and occupied small size of land holding.

Thorat (2003) conducted experiment on study on technological gap and constraints in adoption of recommended cultivation practices of mango growers, revealed that, a majority (70.00 per cent) of the respondents were in the 'middle' age group, while 16.00 per cent of the respondents were in the 'old' age group and 14.00 per cent of them were in 'young' age group. The average age of the respondents was 46 years.

Naik (2005) conducted study on economic analysis of mango production, processing and export in South Konkan region of Maharashtra, observed that, the average age of the mango growers was 43.17 years.

Hanumanaikar *et al.* (2006) observed that, more than half (56 .00 per cent) of the respondents were 'middle' aged, followed by about a quarter of them (24.00 per cent) belonged to 'young' age group.

Ingole (2006) reported that, maximum number 40.00 per cent of fruit and vegetable growers belonged to middle age group followed by young age (35.33 per cent) proportion of fruit and vegetable growers. They also noted that average age of fruit and vegetable growers was 41 years.

Kadam (2006) revealed that, majority (67.36 per cent) of the respondents were in the 'middle' age group, while 16.58 per cent of the respondents were in the 'old' age group and 16.06 per cent of them were in 'young' age group. The average age of the respondents was 47 years.

Deshmukh *et al.* (2007) reported that, maximum number of the respondents belonging to middle age group (47.22 per cent) followed by young age group (34.72 per cent) and old age group (18.06 per cent).

Mishra *et al.* (2007) observed that, 61 per cent respondents were belonging to middle age category with mean 24-59 years.

Pinyupa P *et al.* (2009) found that, the respondents were 20 to 80 years of age with an average age of 52 years.

Kanwat (2011) reported that, majority (53.33 per cent) of the respondents were in 'middle' age group, while 33.33 per cent of the respondents were in 'old' age group and remaining 13.34 per cent of them were in 'young' age group.

Mokhele (2011) observed that, those younger than 30 years old accounted for only 4% of farm workers, while those between 30 and 59 years of age accounted for 85% and those over 60 years old accounted for 11%.

Kabir and Rainis (2012) revealed that, the average age of the vegetable farmers of the study area was 47 years.

Tekale and Gavit (2013) depicted that, majority of the respondents (64.00 per cent) belonged to middle age group (36 to 50 years).

2.1.2 Education

Angadi (1999), conducted study on knowledge, adoption and marketing pattern of pomegranate growers in Bagalkot district in Karnataka State and reported that, 30.00 per cent of the pomogranate growers had studied 'up to middle school' level, followed by 20.62 per cent, who had studied up to high school.

Chaugule (2000) observed that, about two-fifth (39.50 per cent) of the respondents were in the 'high school' category of education, whereas 23.50 per cent and 19.00 per cent were from the 'primary' and 'pre-primary' category, respectively, while 9.50 per cent respondents were from the 'college' category and only 8.50 per cent

respondents were from the 'illiterate' category. Average education completed by the respondents was 7th standard.

Katkar (2001) conducted study on adoption of mango production technology in Akola tahsil of Ahmednagar district, found that, 45.33 per cent of the respondents received 'primary' education, followed by 'secondary' education (28.00 per cent) and very few (7.34 per cent) of them had received 'higher' education, while 19.33 per cent of them were 'illiterate'.

Thorat (2003) observed that, a maximum number (46.00 per cent) of the respondents had 'secondary' education, followed by 'graduation' (23.00 per cent), 'higher secondary' (15.00 per cent), 'primary' (10.00 per cent) and 'pre-primary' (6.00 per cent) education. Only 10.00 per cent of the respondents were 'illiterate'. The average educational level of the respondents was 10th standard.

Kulhal (2004) revealed that, a maximum number (41.67 per cent) of the Guava growers were educated upto 'secondary' level, while 22.50 per cent of the respondents were educated upto 'higher secondary' and 'diploma level', only 7.50 per cent completed their 'graduation' and 19.16 per cent respondents were educated 'upto primary level', while 9.17 per cent were 'illiterate'.

Satale (2005) conducted study on training needs of mango growers with respect to post harvest management practices, observed that, a maximum number (36.00 per cent) of the respondents had 'college' level education, followed by 'secondary' (21.00 per cent), 'higher secondary' (20.00 per cent), 'primary' (10.00 per cent) and 'pre-primary' (8.00 per cent) education. Only 5.00 per cent of the respondents were 'illiterate'. The average educational level of the respondents was tenth standard.

Hanumanaikar *et al.* (2006) observed that, 22.50 per cent of the respondents were 'illiterate'. Majority (56.00 per cent) of the respondents had education 'upto primary' and 'middle school'. Nearly 18.00 per cent of the respondents had education 'upto high school' and only 4.00 per cent of the respondents had 'college education'.

Kadam (2006) reported that, maximum number (37.31 per cent) of the respondents had 'secondary' education and followed by 'graduation' (22.28 per cent). An equal number (19.17 per cent) of the respondents had 'primary' and 'higher secondary' education. Only 2.07 per cent of the respondents had 'pre-primary' education. The average education level of the respondents was 11th standard.

Pinyupa *et al.* (2009) observed that, majority (74.60 per cent) of the respondents had received 'primary school' education and followed by 'no education' (14.60 per cent), while 10.80 per cent of them had completed 'secondary school' education.

Sharma (2010) revealed that, 53.50 per cent of the respondent had education up to middle and 32.00 per cent were illiterate. Data further revealed that, 10.50 per cent and 4.00 per cent were educated upto high and senior secondary and above senior secondary school respectively.

Mazumder (2011) studied that, majority of the farmers were illiterate and a small group were educated/ literate.

Mokhele (2011) observed that, the majority (85.00 per cent) of farm workers terminated their educational studies at the end of primary school. These results indicate that the farm workers were relatively poorly educated, which might have resulted in an inability to properly read the instructions related to pesticide usage.

Kabir and Rainis (2012) revealed that, the educational level, the mean year of schooling was 5 which are below secondary education.

Nandal (2012) reported that, vegetable growers cum retail marketers group, 40.00 per cent women were illiterate, while 60.00 per cent were literate. Out of the literate women, 47.00 per cent were educated upto primary level, 10.00 per cent up to middle level, 2.00 per cent upto secondary level, and 1.00 per cent was above secondary level.

2.1.3 Annual income

Mandavkar *et al.* (1998) observed that, 60.00 per cent of fruit growers were having ‘medium’ annual income and identical number of the respondents (20.00 per cent) were having ‘low’ and ‘high’ annual income. The average annual income of the fruit growers was Rs. 80,525 /-

Chougule (2000) observed that, majority (37.00 per cent) of the respondents were having ‘lower’ annual income, while 35.00 per cent and 15.50 per cent of the respondents were having ‘high’ and ‘medium’ annual income, respectively. The average annual income of the respondents was Rs. 96,173/-.

Katkar (2001) recorded that, majority (69.33 per cent) of the mango growers had ‘medium’ level of annual income and followed by 16.00 per cent and 14.67 per cent had ‘high’ and ‘low’ level of annual income, respectively.

Thorat (2003) revealed that, more than half (57.00 per cent) of the respondents had ‘low’ annual income, while 24.00 per cent respondents had ‘high’ annual income and 19.00 per cent respondents had ‘medium’ annual income. The average annual income of the respondents was Rs. 1, 26, 010/-.

Deshmukh *et al.* (2007) reported that, the annual income of the majority of respondents (81.59 per cent) fall under medium level of income having Rs. 10001 to Rs. 87000 annum, while 10.76 per cent

respondents had high level of income and remaining only 7.63 per cent were in low level income.

Sonawane *et al.* (2009) indicated that, maximum number (46.00 per cent) of the respondents had 'medium' sources of information followed by 'low' (32.67 per cent) and 'high' (21.33 per cent) level of information sources.

2.1.4 Land holding

Sinha *et al.* (1991) conducted study on changing scenario of dry land horticulture in tribal areas, reported that, dry land fruit cultivation was mainly confined to farmers with more than 2 ha of land holding.

Ahire *et al.* (2002) revealed that, one third of the respondents (32.86 per cent) had possessed the marginal farm and 17.14 per cent had small farm having 0.1 to 1.00 ha and 1.01 to 2.00 ha farm size respectively. More than half (51.43 per cent) of the respondents had possessed the irrigated land up to 0.40 ha.

Mahindra (2003) observed that, farm women with 'medium' land holding (6 to 10 acres) were 26.67 per cent, while 20.00 per cent of the respondents had 'large and above' land holding (10 acres and above).

Thorat (2003) observed that, 37.00 per cent and 36.00 per cent respondents had 'semi-medium' and 'medium' land holding, respectively, while 13.00 per cent respondents had 'large' land holding. 'Small' and 'marginal' land holdings were owned by 11.00 per cent and 3.00 per cent respondents, respectively. The average size of land holding of the respondents was 6.91 ha.

Satale (2005) revealed that, 42.00 per cent of the respondents had 'semi-medium' land holding, 39.00 per cent of the respondents had 'medium' land holding. 'Large' and 'marginal' land holdings were

owned by 5.00 per cent and 2.00 per cent respondents, respectively. The average size of land holding of the respondents was 4.09 ha.

Jeyanthi, *et al.* (2005) reported that, the average farm size of the sample farmers was 2.75 ha with garden lands constituting the major portion of total land holding (90.68%). Vegetables were the major crops grown in the sample farms, occupying 62.46 per cent of the gross cropped area.

Parabat (2008) observed that, the majority of respondents (55.65 per cent) had small land holding between 1.01 to 2.00 ha, 31.11 per cent respondents had semi medium land holding i.e. between 2.01 to 4.00 ha, 11.11 per cent respondents had marginal land holding up to 1.00 ha and 2.22 per cent respondents had medium land holding between 4.01 to 10.00 ha.

2.1.5 Area under vegetable and fruit cultivation

Mundekar (1993) reported that, out of total mango growers in Ratnagiri district of Maharashtra, 93.00 per cent of the mango growers had 'small' mango orchards. Only 1.50, 0.50 and 0.50 per cent had 'medium', 'large' and 'larger' mango orchards, respectively.

Mane (1998) in his study on adoption of improved varieties of fruit crops by the fruit growers in Sindhudurg district', observed that, 66.50 per cent of the respondents had 'medium' area under mango crop, 16.00 per cent respondents had small area under mango crop and 17.50 per cent of the respondents had 'big' area under mango crop.

Prasad *et al.* (2004) found that, 58.00 per cent of the respondents had small size of land holding followed by 31.33 per cent of the respondents had medium size of land holding and only 10.67 percent of the respondents had large size of land holding.

Kadam (2006) observed that, 46.11 per cent of the respondents were having 'medium' area under Alphonso mango plantation, whereas, 28.50 per cent and 15.03 per cent of the respondents, respectively were having 'semi-medium' and 'marginal' area under Alphonso mango plantation. Only 6.21 and 4.15 per cent of the respondents were having 'large' and 'small' area under Alphonso mango cultivation, respectively. On an average, the mango growers was having 5.15 ha land under Alphonso mango.

Ingole (2006) revealed that, 64.67 per cent of respondents had cultivated fruit and vegetable on an area less than 1 ha, followed by 28.67 per cent of respondents cultivated fruit and vegetable crops on area between 1 to 2 ha. Only 6 per cent of them taken cultivation on an area between 2 to 4 ha.

Mahadik *et al.* (2009) revealed that, average area under Sahyadri rice variety was 0.20 ha.

Andhari and Sonawane (2012) reported that, 41.66 per cent tomato growers had small land holding, followed by 32.67 per cent of them had marginal land holding, a majority 55.33 per cent of respondents had medium size of area under tomato. However, 37.64 per cent and 7.33 per cent of them had small and large size of land under tomato cultivation respectively.

2.1.6 Experience in vegetable and fruit cultivation

Bhapkar (1994), in his study on cashew growers to assess the technological gap and causes of non-adoption of recommended practices in Sindhudurg district, reported that, two-third (66.66 per cent) of the respondents were in the category of 'medium' experience in cashew cultivation. There were 16.67 per cent each of the respondents in the

category of 'low' and 'high' experience in cashew cultivation. The average experience in cashew cultivation was 15.53 years.

More (1996) observed that, 62.00 per cent of the respondents had 'medium' experience, while the remaining 25.50 per cent and 12.50 per cent were in 'low' and 'high' experience categories, respectively. On an average, the respondents had 10 years of experience.

Zagade (1998) observed that, 13.50 per cent respondents had upto 11 years experience in mango cultivation, while 72.50 per cent had experience of 12 to 22 years. Remaining 14.00 per cent respondents had experience of 23 and above years. The average farming experience of the respondents was 17 years.

Bhosale (2003) revealed that, 58.13 per cent of the pomegranate growers had experience of '7 to 11 years', while 21.25 per cent had experience 'below 6 years'. About one fifth (20.62 per cent) of the respondents had farming experience of 'more than 12 years'.

Thorat (2003) revealed that, nearly half (49.00 per cent) of the respondents had 'medium' experience in mango cultivation, while remaining 26.00 per cent and 25.00 per cent of the respondents had 'low' and 'high' experience in mango cultivation, respectively. On an average, the respondents had 19.28 years of experience in mango cultivation.

Balasubramani *et al.* (2005) observed that, most of the respondents (63.30 per cent) had high level of experience in rice cultivation.

Tondare *et al.* (2005) observed that, more than 53.33 per cent of the respondents had 23 to 31 years of service experience followed by 38.67 per cent of the respondents had medium service experience (11 to 22 years).

Kadam (2006) stated that, less than three-fourth (74.24 per cent) of the respondents had 'medium' experience in mango cultivation, while

remaining 14.51 per cent and 7.25 per cent of the respondents had ‘low’ and ‘high’ experience in mango cultivation, respectively. On an average, the respondents had 21 years experience in mango cultivation.

Leonordo (2006) conducted study on ‘adoption of mango production technologies in Pangasinan’. He concluded that, the mango growers had experience in mango cultivation of ‘14-19 years’.

Andhari and Sonawane (2012) reported that, majority of the respondents (59.33 per cent) found to have 3 to 5 years of farming experience.

2.1.7 Extension contact

Marimuthu (2000) observed that, among the personal cosmopolite sources, Assistant Horticultural Officers served as a source for all (100.00 per cent), followed by Agricultural Officers (69.17 per cent), Bank Officials (65.00 per cent), Horticultural Officers (57.50 per cent), Agricultural Development Officers (51.67 per cent) and Assistant Directors of Agriculture (6.67 per cent).

Misal (2002) revealed that, 30.00 per cent of the respondents had ‘high’ extension contact, while 24.00 per cent of the respondents had ‘medium’ extension contact, whereas 10.00 per cent and 36.00 per cent of the respondents had ‘no’ and ‘low’ extension contact, respectively.

Darekar and Gholve (2002) conducted study on utilisation of information sources by the Parbhani Turab Cotton growers, indicated that, majority of farmers had always approached friends, neighbours, relatives, progressive farmers, local leaders, gramsevak, agricultural assistant and agricultural extension officers, while 45.00 per cent and 36.00 per cent farmers contacted to block development officers and university specialist, respectively to ask the information on package of practices of Parbhani Turab cotton.

Chorge (2009) revealed that, majority (69.58 per cent) of the respondents had 'medium' extension contact, while 19.58 per cent and 10.84 per cent of the respondents had 'low' and 'high' extension contact, respectively.

2.1.8 Sources of information

Ingole (2006) observed that, 55.33 per cent of fruit and vegetable growers had used medium sources of information, while 24.00 per cent and 20.67 per cent of them used high and low sources of information respectively.

Deshmukh *et al.* (2007) observed that, the majority of respondents fall under medium sources of information (69.09 per cent). However, remaining had used high source of information i.e. 16.6 per cent and only 14.23 per cent of the respondents show used source of information.

Mishra *et al.* (2007) observed that, the radio was the main source of information. The contact with information sources was observed the medium level.

Sasane *et al.* (2008) revealed that, the majority of sugarcane growers were always obtaining information through agriculture assistance of agriculture university.

Benal *et al.* (2010) observed that, the 72.50 per cent respondents possessed high level of source of information as compared to 17.50 per cent medium level and 10.00 per cent low level.

2.1.9 Risk preference

Nagaraja (2002) observed that, the majority (74.58 per cent) of the respondents were found to possess medium risk orientation, whereas 15.83 per cent and 9.58 per cent of the respondents were belonged to the high and low level of risk orientation, respectively.

Palkar *et al.* (2002) revealed that, majority of respondents had medium level of risk orientation (66.60 per cent).

Shashidhara (2004) revealed that, the majority of the farmers (70.83 per cent) had medium level of risk bearing ability and nearly equal percentage of respondents were found in high (15.17 per cent) and low (15.00 per cent) level of risk orientation.

Suresh (2004) indicated that, the majority of respondents had medium, low and high level of risk taking ability, at the rate of 62.02, 24.58 and 13.34 per cent, respectively.

Patil *et al.* (2010) notice that, high risk orientation was among 45.00 per cent of respondents and followed by an equal number of respondents with medium (27.86 per cent) and low (27.14 per cent) risk orientation.

2.1.10 Economic motivation

Tekale *et al.* (2013) revealed that, the over two third (71.00 per cent) of respondent were having medium level of economic motivation.

Johari *et al.* (2014) observed that, majority of the respondents 66 per cent, 76 per cent and 86 per cent in Block I, Block II and in the pooled sample respectively possessed medium economic motivation.

2.2. Extent use of pesticides and plant protection practices followed by the vegetable and fruit growers

Fernandez *et al.* (1994) observed that, the vegetable growers tend to be optimistic with regards to their output price forecast and so used more pesticides than what was economical.

Vasanta (1998) found that, majority of the vegetable growers of Andhra Pradesh were using pesticides at higher dose than the recommended level.

Meera *et al* (2000) observed that, irrespective of the recommendations by extension agencies and manufacturers, farmers were using pesticides in combination without knowing the ill effects on ecosystem. Majority of pesticides used in the region fell under 'highly toxic' category with high mammalian toxicity (LD 50 less than 50 mg/kg).

Matthews *et al.* (2003) reported that, 41.00 per cent did use herbicides, while 89.00 per cent relied on pesticides for insect and disease control.

Sanzidur (2003) observed that, about 77.00 per cent of farmers applied pesticides at least once in a crop season. Although about half of the farmers in Jamalpur and Jessore applied pesticides only once in a crop season, 63.00 per cent of Comilla farmers applied twice. Furthermore, 22.00 per cent of farmers in Comilla region applied as many as 3–5 times in a crop season.

Atreya (2005) found that, farmers spray insecticides such as parathion-methyl (classified as extremely hazardous 'Ia' by WHO); dichlorvos (highly hazardous 'Ib'); cypermethrin, deltamethrin, and fenvelerate (moderately hazardous 'II'), and fungicides such as mancozeb, and carbendazim (non- hazardous under normal use 'U') on crops such as potato (*Solanum tuberosum*), tomato (*Lycopersicon esculentum*), bitter gourd (*Momordica charantia*), cucumber (*Cucumis sativa*), chili (*Capsicum spp.*), cabbage (*Brassica oleracea var. capitata*) and cauliflower (*Brassica oleracea var. botrytis*). On an average farmers were spraying pesticides on crops like potato for 12.3 years, tomato for 9.8 years, and other crop such as bitter gourd and cucumber for 2.7 years.

Jeyanthi *et al.* (2005) revealed that, about 55 per cent the farmers applied 4 kg or less of technical grade pesticides per ha and the remaining

45 per cent used more than 4 kg of active ingredient a.i/ha and About 87 per cent of cauliflower growers applied pesticides amounting to 4 kg or less of a.i/ha and the remaining applied more than this quantity. The inter-farm variation in pesticide-use intensity ranged from 1.27 kg of a.i/ha to 6.43 kg of a.i/ha.

Baral *et al.* (2006) reported that, the Triazophos 40 EC was very popular, used by 33.00 per cent of farmers, closely followed by Cartap 50 SP by 31.00 per cent of farmers. Among granular insecticides, Carbofuran 3 G was used by 25.00 per cent of the farmers followed by Phorate 10G by 13.00 per cent of the farmers. Synthetic pyrethroids were used by 19 to 21 per cent of farmers. Neem insecticide was used by only 1.00 per cent of farmers. Insecticides like Cartap 50, Carbaryl 50 WP, Phorate 10 G, Acephate 75.00 per cent SP were applied at higher than recommended doses, while some others were used at below recommended doses.

Sule (2006) reported that, majority of farmers (52.5 per cent) made decisions about pesticide use only according to their own experience (47.54 per cent) or on the recommendations of other farmers (4.92%). Those who regard pesticides as harmful (17.86 per cent) consulted a technical expert.

Ngowia *et al.* (2007) reported that, most farmers were using insecticides (59 per cent), fungicides (29.00 per cent) and herbicides (10.00 per cent) with the remaining being rodenticides (2.00 per cent).

2.3 Awareness of vegetable and fruit growers about adverse effects of pesticides.

Meera *et al.* (2000) observed that, majority of the farmers were having 'low' to 'medium' awareness about the ill effects of pesticides on ecosystem, Almost 98.00 per cent of the farmers were

aware of the fact that pesticides adversely affected the human health. About 94.00 per cent of the farmers were aware that pesticides caused environmental pollution.

Hakan (2001) observed that, majority of the farmers (> 80.00 per cent) thought that that pesticides are a problem for their health. The most common answer, is that they 'feel tired' after spraying. Other symptoms of health effects are 'hot' skin, dizziness or headaches. Almost all farmers (85.00 to 100.00 per cent) regarded insecticides as the most problematic pesticide. They further expressed that most of the non-IPM rice farmers (84.00 per cent) thought that pesticides have no negative effect on the yield from their fields. Only a few knew about natural enemies to pests and consequently most were not aware that pesticides can decrease the number of natural enemies and thus increase the number of pests in their field.

Shinde (2002) revealed that, up to 36.11 per cent of respondents were having knowledge about protection from diseases and pest.

Matthews *et al.* (2003) reported that, 25.00 per cent of those interviewed washed their sprayers 'in the river'; probably because this was the nearest water supply and 9.00 per cent did not washed the sprayer after use. Of those that did wash the sprayer, more than one third said they used water and soap, while 18.00 per cent only rinsed with water.

Girase *et al.* (2005) revealed that, majority of the respondents (71.34 per cent) had medium awareness, while 17.33 and 11.33 per cent of the respondents had low and high awareness about watershed development respectively.

Islam *et al.* (2005) reported that, equal number (50.00per cent) of beneficiaries fall in medium and low level of awareness in

preimplementation phase. The low and medium level of awareness was observed in 37.50 per cent and 62.50 per cent of beneficiaries in implementation phase. No beneficiaries had shown high level of awareness in this regard at all.

Baral *et al.* (2006) reported that, nearly 50.00 per cent of farmers were aware of beneficial insects in their egg plant fields. More than half of the farmers (54.00 per cent) were aware of the harmful effects of pesticides on egg plant consumers and 41.00 per cent were mindful of the danger it posed to laborers working in the field. Approximately 40.00 per cent of farmers were aware of possible contamination of air and water by pesticides, and 26.00 per cent were mindful of the adverse effect of these chemicals on beneficial insects.

Sule (2006) reported that, 19.70 per cent of the respondents said that ‘pesticides have no harmful effect on environmental or human health’, but 80.30 per cent expressed the view that ‘pesticides may have harmful effects on environmental or human health’ in various ways. More than one third (34.4 per cent) of the farmers evaluated pesticides as slightly harmful, while 45.9 per cent said harmful.

Indira (2009) found that, one-third of the workers reported about reading the label on the pesticide packet either themselves or through help. But, only less than 3.00 per cent followed the instructions. The workers often related the toxicity of pesticides to the odour of the chemical and more pungent ones were considered as more toxic. The scientific categorization based on colour code was rarely understood. About two-third (63.00 per cent) of the farm workers knew that pesticides with different levels of toxicity were available in the market, starting from relatively safe ones to highly toxic. But, almost all

of them (99.50 per cent) could not understand the toxicity level after reading the colour code on the bottle.

Bhople *et al.* (2010) observed that, majority of the respondents completely knew about avoiding toxic pesticides (83.33 per cent) and spraying of chemical pesticides after applying bioagents (83.33 per cent).

Borate *et al.* (2010) reported that, majority (54.00 per cent) of the mango growers had low level of awareness about Eurep Gap certification norms, followed by high level (33.00 per cent). The average score 9.47 indicated medium awareness.

Mokhele (2011) observed that, the majority (56%) of farm workers always used protective clothing and equipment, while 44% of farm workers sometimes used them. A total of 52% of the farm workers never wore rubber gloves when using or handling pesticides, thus increasing their risk of skin exposure. The majority (93%) of farm workers never used goggles or other form of face cover.

Salame and Wakle (2013) observed that, majority of respondents possessed complete knowledge about number of spraying to be applied (65.00 per cent) and important diseases were known completely to two third majority.

Miah *et al* (2014) observed that, almost all (98%) respondents think that human health is endangered by pesticide application in the vegetable fields as well as consumption of contaminated food. Moreover, farmers particularly who are exposed to pesticides, suffering from at least one health problem such as- skin diseases, eye diseases, gastro-intestinal diseases, urine and sex related diseases, and other short term diseases which has link with pesticide poisoning. Current study found that 55%, 53%, and 52% having experience of health hazards i.e., eye irritation, headache and nausea, respectively at the time of pesticide application.

Hayajneh (2015) studied that, 73% of the samples questioned believe that the presence of these chemicals (pesticides) is harmful and know that these chemicals can reach their bodies through consuming foods contaminated with these chemicals. The 27% of the samples tested have no knowledge that these chemicals (pesticides) can be transferred to their bodies through consuming fruits and vegetables contaminated with pesticides. Great proportion of the samples under study (41%) have no knowledge about the health risks associated with the presence of these chemicals in foodstuff. It can be concluded that 36% have no knowledge of how to eliminate this problem, 4% think that these pesticides can be removed from foodstuff by cleaning which indicates that there must be a program to educate the public of the dangers of such serious issues.

2.4 Suggestions of vegetable and fruit growers to minimize the adverse effects.

Vasanta (1998) observed that, majority of the respondents (90.00 per cent) expressed the problem of increased pest infestation which made them to use excess pesticide dosage.

Sanzidur (2003) reported that, major beneficial effect of pesticide or insecticide use as perceived by farmers was 'destruction of insects' (39.20 per cent) and consequent 'increase in production' (24.40 per cent) with sharp regional variation in opinion. 'Preventing disease infestation' is also cited by 16.70 per cent of farmers. Only few (3.40 per cent) link it to 'requiring less fertilizer'.

Tiwari *et al.* (2005) revealed that, majority (62.14 per cent) of the respondents suggested privatization of extension services in the area of plan protection measures.

Manjunath (2010) revealed that, majority of farmers had Lack of knowledge about chemicals, number of spray and regard to technology

application were the major constraints as expressed by 43.42, 62.85 and 83.42 percent of respondents, respectively. High cost of chemicals and equipments were also the major constraints expressed by 76.00 and 51.42 per cent of respondents, respectively.

3. METHODOLOGY

This chapter deals with the methods and techniques used in conducting the present study. It describes area of the study and methods used for selection of respondents, collection and analyses of data and other details of methodology followed under the following major heads.

3.1 Locale of the study

3.2 Research design

3.3 Sampling procedure

3.4 Aspects of study

3.5 Variables and their measurement

3.6 Tools and techniques of data collection

3.7 Statistical methods used

3.8 Definition of terms and concepts

3.1 Locale of the study

The present study was conducted in Pune district of Maharashtra, which accounted 81,960 ha area under vegetable and fruit cultivation. Pune district comprises thirteen tahsils *viz.*, Haveli, Bhore, Velhe, Khed, Junnar, Ambegaon, Maval, Baramati, Shirur, Daund, Purandar, Mulshi and Indapur.

3.1.1 Geographical Location

Pune district lies between 17°-54' and 19°-24' North latitude and 75°-19' East longitude. Pune district is surrounded on the North by Ahmadnagar district, on the East by Ahmednagar and Solapur districts, on the South by Solapur and Satara Districts and on the West by Raigad and Thane Districts. Total geographical area of Pune District is 15642 sq. km. The landscape of Pune district is distributed triangularly in western Maharashtra at the foothills of the *Sahyadri* Mountains and is divided into three parts: *Ghatmatha, Maval and Desh*.

3.1.2 Soil

The soils of the district broadly belong to three classes' viz., black, brown and red. The Western part of the district is having lighter soils while the eastern part having deep black fertile soils. In some places one class of soils blends in to other with varying properties and they modified by sand, gravel, lime, salts and other ingredients. The western side the district comprising of Junnar, Ambegaon and Khed have medium black soil.

3.1.3 Climate and Rainfall

The mean daily minimum and maximum temperature for the hottest month i.e. May are 23⁰C and 37⁰C respectively. The evening breeze from west/north-west keeps the city summer nights at bearable levels. The minimum and maximum temperatures for coldest month i.e. December are 12⁰C and 30⁰C respectively. The relative humidity ranges from 36% in March to 81% in August.

Pune receives rainfall from the South-West monsoon, which begins around middle of June and lasts till the end of September. Three fourths of the annual rainfall of 700 mm occurs in just four months from June to September.

3.1.4. Population

The total population of Pune district according to 2011 census was 94,26,959. The density of population of Pune district is 603 per sq. km. and literacy rate is 87.2 per cent

3.1.5. Rivers

Bhima is the river of the Pune district mainly in Ambegaon, khed, Junnar tahsils. It rises in *Sahyadri* at *Bhimashankar* (Ambegaon tehsil) in the west of the district and then enters in to Solapur district. The main tributaries of *Bhima* are *Velu* and *Ghod* on its left, *Indryani*, *Mula* and

Mutha on right. *Karna*, *Kukadi*, *Pawana*, *Meena*, *Gunjawani*, *Pushpawani* and *Shinvgana* are the other rivers flowing in the district.

3.1.6. Industries and Employment

Maharashtra is one of the advanced state in the country and Pune is one of the industrially developed districts in the state. There are number of small scale industries and small manufacturing units mainly situated throughout the district mainly at Bhosari, Ranjangaon, Khed, Shikrapur, Chakan and Baramati.

3.1.7. Other facilities

Educational facilities are available throughout the district from primary school to higher degree level. Credit facilities are available through the branches of the Pune District Central Co-operative Bank Limited, Nationalized Banks and other commercial banks. Transport and communication facilities are quite adequate. Regulated markets are available throughout the district.

3.2 Research design

A research design is the arrangement of conditions for the collection and analysis of data in a manner that combines relevance to the research purpose with economy in procedure. In fact, the research design is the conceptual structure within which research is conducted. It constitutes the blue print for the collection, measurement and analysis of data. The ex-post facto survey design was used for the purpose of this study. When the study moves from present to future basing the interpretations of the happenings or the facts that have already occurred the design employed is known as ex-post-facto design.

3.3 Sampling procedure

Sampling is a method of selecting a fraction of the population in such a way that the selected sample represents the population. The

techniques for selecting the sample for the present study are explained here under.

3.3.1 Selection of tahsils

Pune district consists of thirteen tahsils (Junnar, Ambegaon, Rajgurunagar, Maval, Mulashi, Daund, Bhore, Velhe, Purandar, Baramati, Haveli, Shirur, Indapur) out of this khed, Ambegaon and Junnar these three tahsils was purposively selected because it shares major area under vegetable and fruit cultivation.

Table 1. Tahsil wise area under vegetable and fruit cultivation in Pune district

Sr. No.	Tahsils	Area under vegetable cultivation(ha)	Area under fruit cultivation(ha)	Total area under vegetable and fruit cultivation(ha)
1	Junnar	4111.99	10,216.05	14328.04
2	Khed	879.92	12196.01	13075.93
3	Ambegaon	1161.52	11848.72	13010.24
4	Shirur	3203.83	7023.98	10227.81
5	Indapur	6259.72	211.67	6471.39
6	Haveli	1903.44	3898.58	5802.02
7	Purandar	3998.55	1079.09	5071.94
8	Baramati	1768.82	2357.83	4126.65
9	Daund	1647.58	1486.99	3134.57
10	Bhor	1609.81	410.83	2020.64
11	Maval	1404.46	471.30	1875.76
12	Mulashi	1406.58	230.52	1637.04
13	Velhe	1019.228	149.54	1168.82

(Source: Report of District Superintending Agriculture Officer, 2011-12)

3.3.2 Selection of villages

Four villages each from Ambegaon and Junnar tahsils and five villages from Khed tahsil were selected considering the maximum area under vegetable and fruit cultivation based on the information obtained from the Taluka Agriculture Officer. Thus, in all 13 villages were

selected. (Appendix I)

3.3.3 Selection of respondents

Village wise list of respondents was collected (Appendix II). Making a total sample of 115 respondents who using the pesticides for plant protection measures on their major pest for the selected vegetable and fruit crops given in table 2, were prepared from the consultation with the dealers of plant protection chemical from Pune district.

Table 2. Vegetable and fruit crops with their major pests

Sr. No.	Crops	Major pests
A	Vegetables	
1	Onion	Thrips
2	Tomato	Leaf-miner
3	Potato	Aphid
4	Chilli	Thrips
5	Brinjal	Stem borer
B	Fruits	
6	Mango	Mango hopper
7	Sapota	Moth
8	Grapes	Mealy bug

Ten respondents were randomly selected from each village from Ambegaon and Junnar tahsils and seven respondents were randomly selected from each selected village From Khed tahsil. Thus, forty respondents, each from Ambegaon and Junnar tahsils and from Khed tahsil, thirty-five respondents were selected.

3.4 Aspects of the study

The major aspect of the study was to know the profile of the vegetable and fruit growers, nature and extent of use of pesticides by the

vegetable and fruit growers and to assess the level of awareness about adverse effects of pesticides among vegetable and fruit growers.

3.5 Variables and their measurement

For the present study two sets of variables namely, independent and dependent variables were selected. The methods and techniques used for measuring the dependent and independent variables are described below.

Table 3. Variables and their measurements

Sr. No.	Variables	Measurement
I	Independent variables	
A	Personal and socio-economic characteristics	
1	Age	Chronological age of individual grower in completed years
2	Education	Number of standards in formal school passed by individual grower.
3	Land holding	Total hectares of land possessed by each of the grower.
4	Annual income	Income in rupees of the grower and his family derived from all sources in a year.
5	Area under cultivation	Actual land in hectares put by the individual grower under vegetable and fruit crop.
6.	Farming Experience	The number of year actually spent in farming.
B	Communication characteristics	
7	Extension contact	Number and frequency of contact with extension personnel.
8	Sources of information	All probable sources of information about awareness on adverse effect of pesticides were listed out and farmers responses to them were elicited on three point continuum

		: Always, sometime and never
C	Psychological characteristics	
9	Risk preference	The schedule was developed
10	Economic motivation	The schedule was developed
II	Dependent variable	
1	Awareness	The schedule was developed

3.5.1 Independent variables

3.5.1.1 Age

The chronological age of the respondents at the time of interview was taken into consideration. The respondents were categorized into three categories. The categorization was done according to categories made by government.

Sr. No.	Age	Years
1	Young	Up to 35 yrs
2	Middle	36 yrs to 55 yrs
3	Old	56 yrs and above

3.5.1.2 Education

Formal education successfully completed by the respondents was taken into consideration. The following categories were made on the basis of categories by government of Maharashtra.

Sr. No.	Education	Standard
1	Illiterate	No formal schooling
2	Primary	1 st to 7 th standard
3	Secondary	8 th to 10 th standard
4	Higher secondary	11 th and 12 th standard
5	College	Above 12 th standard

3.5.1.3 Annual income

It refers to the income received by the respondents from all the sources during the preceding year were worked out. The following three categories of annual income were made. The categorization was done on the basis of mean \pm S.D. as given below.

Sr. No.	Category	Annual income
1	Low	Up to. Rs. 1,50,000
2	Medium	Rs. 1,50,001 to 6,00,000
3	High	Rs. 6,00,001 and above

$$\text{Mean}=3,77,539 \quad \text{SD} = 2,41,044$$

3.5.1.4. Land holding

The size of land holding contributes to the income of the respondents and provides an opportunity to try the innovations. The following classifications of five categories were made on the basis of categories by government of Maharashtra.

Sr. No.	Category	Land holding
1	Marginal	Up to 1.00 ha
2	Small	1.01 to 2.00 ha
3	Semi-medium	2.01 to 4.00 ha
4	Medium	4.01 to 10.00 ha
5	Big	10.01ha and above

3.5.1.5 Area under vegetable and fruit cultivation

It is the actual area of respondents in hectares on which vegetable and fruit was grown. The growers measured on the basis of actual area put under vegetable and fruit cultivation.

On the basis of total area under vegetable and fruit, the respondents were categorized according to the maximum and minimum basis as follows.

Sr. No.	Category	Area under vegetable and fruit cultivation
1	Low	Up to 1.00 ha
2	Medium	1.01 to 2.00 ha
3	High	2.01 ha and above

3.5.1.6 Experience in vegetable and fruit cultivation

The number of years actually spent in cultivation of vegetable and fruit by the respondents was treated as his experience. Three categories were formed. The categorization was done on the basis of mean \pm S.D. as given below.

Sr. No.	Category	Experience in vegetable and fruit cultivation
1	Low	Up to 10 yrs
2	Medium	11 to 36 yrs
3	High	37 yrs and above

$$\text{Mean} = 23.25 \quad \text{SD} = 13.94$$

3.5.1.7 Extension contact

It refers to the frequency with which the respondents meet the various extension personnel. It was measured based on number of contacts of the respondent during a year with the extension personnel. According to that alternatives like 'regularly', 'sometimes' and 'never' and scores of two, one, and zero was given to these alternatives respectively. After calculating the cumulative score, the respondents were categorised in three groups. The categorization was done on the basis of mean \pm S.D. as given below.

Sr. No.	Category	Extension contact
1	Low	Up to 9 score
2	Medium	10 to 16 score
3	High	17 score and above

$$\text{Mean} = 12.86 \quad \text{SD} = 4.13$$

3.5.1.8 Source of information

It refers to sources through which respondents obtained the information about day to day happening. Sources of information were considered in schedule. Vegetable and fruit grower were asked to give answers to alternatives like ‘regularly’, ‘sometimes’ and ‘never’ and scores of two, one, and zero was given to these alternatives respectively.

Thus total score for an individual respondent was worked out on the basis of score obtained the respondents were grouped into three categories of information sources. The respondents were classified into three categories as given below by using mean \pm SD.

Sr. No.	Category	Source of information
1	Low	Up to 4 score
2	Medium	5 to 7 score
3	High	8 score and above

$$\text{Mean} = 5.74 \quad \text{SD} = 1.68$$

3.5.1.9 Risk preference

It refers to willingness and ability of the respondents to take risk in use of pesticides. Some statements which show risk bearing ability were included in the schedule. The respondents were asked to give their response within three alternatives i.e. agree, somewhat agree and disagree. Scores assigned were viz., agree-2, somewhat agree-1 and disagree-0 for statement.

The total score for each respondent were worked out and was considered as an indicator of risk bearing ability. On the basis of total score obtained the respondents were grouped into three categories. The categorization was done on the basis of mean \pm S.D. as given below.

Sr. No.	Category	Risk preference
1	Low	Up to 5 score
2	Medium	6 to 9 score
3	High	10 score and above

$$\text{Mean} = 7.81 \quad \text{SD} = 2.31$$

3.5.1.10 Economic motivation

It referred to the occupational success in terms of profit maximization and the relative values on individual place on economic ends.

The statements with responses viz., agree, undecided, disagree were assigned scores 2, 1 and 0, respectively. The total economic motivation score of all the respondents was worked out and they were grouped into three categories. The categorization was done on the basis of mean \pm S.D. as given below.

Sr. No.	Category	Economic motivation
1	Low	Up to 5 score
2	Medium	6 to 8 score
3	High	9 score and above

$$\text{Mean} = 7.41 \quad \text{SD} = 1.72$$

3.5.2. Dependent variable

‘Awareness of respondents about adverse effects of pesticides’ was the dependent variable for the study. Awareness is an important factor which enables respondents to become knowledgeable and skilful with regard to pesticide’s health hazards, hazards to wild life and environment.

A schedule was specially developed and used to measure awareness quantitatively. For ascertaining the awareness of respondents 28 questions were prepared through consultation with Advisory Committee Members and referring the relevant literature on adverse

effect of pesticides.

The respondents were requested to answer each question. They answered to each question may be 'Yes', or 'No'. The responses to each question were grouped into two categories and assigned scores of one and zero for 'Yes' and 'No' answer respectively. The scores on all the items of awareness test of each respondent were summed up and this sum totally indicated the awareness score for the individual respondents. The obtained awareness score ranged from 0 to 28.

On the basis of awareness score obtained, the respondent were categorized into three categories.

Sr. No.	Category	Score
1	Low	Up to 14 score
2	Medium	15 to 19 score
3	High	20 score and above

$$Mean = 17.33 \quad SD = 3.25$$

3.6 Tools and techniques of data collection

The methods used and procedure followed for collecting the data are described in this part.

3.6.1 Construction of interview schedule

By keeping the objectives of the study in view, an interview schedule was designed. The first part of the schedule consisted of questions for getting information regarding independent variable viz., age, education, land holding, annual income, area under cultivation, farming experience, extension contact, sources of information, risk preference, economic motivation and awareness as the dependent variable. An interview schedule was constructed in local language i.e. *Marathi* and was designed into two parts. Part I was designed to obtain the information about profile of respondents and part II designed to seek the information about the awareness of respondents about adverse effects

of pesticides. While preparing the schedule, attention was given to make the questions simple, self explanatory with clarity, so that the respondents could understand the same and give the response more accurately. The structure interview schedule used for collection of information is given in Appendix III.

3.6.2 Pre-testing of interview schedule

Before finalizing the interview schedule, it was pre-tested outside the sample area for reliability and validity of the questions by interviewing ten respondents. Certain changes were made in the schedule in the light of practical experience of pre-testing. Thus it was finally ready for data collection.

3.6.3 Collection of data

Personal interview technique was used for data collection. For obtaining maximum accuracy in data collection, the author established rapport with the respondent and tried to win their confidence. The purpose of the study was explained to them and they were assured that the information furnished by them would be kept confidential and used strictly for the purpose of the study. Whenever necessary, questions were explained to them to ensure proper understanding. This helped in getting appropriate responses. If the respondents were not available at the time of first visit, subsequent visits were made. The filled in interview schedules were checked immediately after the closure of interview for their completion in all respects.

The author personally interviewed 115 respondents with the help of interview schedule as mentioned above. About 30-35 minutes required to interview each respondent.

3.7 Statistical methods used

The data were processed and tabulated by using simple frequencies and the parameters like percentage, mean and standard deviation were used for analysis of data.

1. Percentage

Percentage is used in descriptive analysis of data for making simple comparison.

2. Mean

Mean is calculated by following formula.

$$\bar{X} = \frac{\sum x_i}{N}$$

Where,

\bar{X} = Mean

N = Number of respondents

$\sum x_i$ = Value of respondents

3. Standard deviation

Standard deviation is a measure of variability calculated around mean. It was denoted by Greek letter σ (sigma) and calculated with the following formula.

$$SD = \sqrt{\frac{\sum (x_i - \bar{X})^2}{n}}$$

Where,

SD = Standard deviation

x_i = Score of each respondents

\bar{X} = Mean

n = Number of respondents

3.8 Definition of terms and concepts

Definitions of some of the terms used in the present study are given below.

A. Independent variables

1) Age

It is defined as the chronological age of the respondents at the time of interview.

2) Education

It refers to the number of years of formal education successfully completed by the respondents.

3) Annual income

It refers to the income in rupees received by the respondent and his/her family members from all the sources during a year.

4) Land holding

It is area of land in hectares possessed by an individual for cultivation.

5) Area under vegetable and fruit cultivation

It is defined as the net area cultivated under fruits and vegetable out of gross total area owned by the farmer.

6) Experience in vegetable and fruit cultivation

It is defined as the number of years actually spent in cultivation.

7) Extension contact

It refers to the frequency with which the respondents meet the various extension personnel.

8) Source of information

It means exposure of the respondent to newspaper, radio, television, farm magazines and extension publication for getting the information.

9) Risk orientation

Risk orientation is ability of the respondent growers to take risk and uncertainty by changing his way of living and traditional farm practices.

B. Dependent variable

10) Awareness

Awareness is the state or ability to perceive, to feel, or to be conscious of events, objects or sensory patterns. It is defined as an individual's awareness about the adverse effect of pesticides.

4. RESULTS AND DISCUSSION

The findings of the research study are presented and discussed in this chapter in the following sequence.

4.1. Profile of the vegetable and fruit growers.

4.2. Extent use of pesticides and plant protection practices followed by respondent farmers.

4.3. Awareness of respondent farmers about adverse effects of pesticides.

4.4. Suggestions of respondent farmers to minimise the adverse effects.

4.1 Profile of the vegetable and fruit growers

The data in respect of the selected personal and socio-economic characteristics of the vegetable and fruit growers are presented and discussed in this part.

4.1.1 Age

The data regarding age of the respondents are presented in table-4.

Table 4. Distribution of the respondents according to their age

Sl. No.	Age	Respondents (n=115)	
		Number	Percentage
1.	Young (Up to 35 yrs)	24	20.87
2.	Middle (36 yrs to 55 yrs)	72	62.61
3.	Old (56 yrs and above)	19	16.52
Total		115	100.00

The data from table 4 and fig. 1 revealed that, a majority (62.61 per cent) of the respondents were in the 'middle' age group, while 20.87 per cent of them were in the 'young' age group and remaining 16.52 per cent of the respondents were in the 'old' age group. The average age of the respondents was 46 years.

This indicated that, most of the vegetable and fruit growers were in 'middle' age group. There is migration of the young generation to the city

area for jobs. This might be one of the reasons for high percentage of middle age respondents in sample.

Deshmukh (2007) had also observed similar pattern of age distribution amongst the respondents.

4.1.2. Education

The information pertaining to the formal education of the respondents is presented in table 5.

Table 5. Distribution of the respondents according to their education

Sl. No.	Education	Respondents (n=115)	
		Number	Percentage
1.	Illiterate (No formal schooling)	2	1.74
2.	Primary (1 st to 7 th std.)	12	10.44
3.	Secondary (8th to 10th std.)	70	60.87
4.	Higher secondary (11 th and 12 th std)	14	12.17
5.	College (Above 12 th std.)	17	14.78
Total		115	100.00

It is found from table 5 and fig. 2 that, a maximum number (60.87 per cent) of the respondents had completed ‘secondary’ education, followed by ‘college’ education (14.78 per cent). The respondents in the category of ‘higher secondary’ were 12.17 per cent, followed by ‘primary’ (10.44 per cent). Only two respondents (1.74 per cent) belonged to the ‘Illiterate’ category. The average educational level of the beneficiaries was 9th std.

This shows that, all the respondents were not sufficiently educated and most of them were educated up to secondary level. This in turn, might have influenced their awareness level.

The results of the present study are more or less similar to Thorat (2003) and Kadam (2006).

4.1.3 Annual income

The data regarding annual income of the respondents are given in table 6.

Table 6. Distribution of the respondents according to their annual income

Sl. No.	Annual income	Respondents (n=115)	
		Number	Percentage
1.	Low (Up to. Rs. 1,50,000)	14	12.17
2.	Medium(Rs. 1,50,001 to 6,00,000)	72	62.61
3.	High(Rs. 6,00,001 and above)	29	25.22
Total		115	100.00

The data from table 6 and fig. 3 revealed that, maximum number (62.61 per cent) of the respondents had 'medium' annual income, while 25.22 per cent respondents had 'high' annual income and 12.17 per cent respondents had 'low' annual income. The average annual income of the respondents was Rs 3.77 lakhs.

It could be said that the respondents had good level of economic returns, considering size of land holding, area under vegetable and fruit production. This might be attributed to the cash crops like vegetable and fruit which might have helped them in increasing their annual income. Similarly, production of vegetable and fruit in early season by using new technology and proper plant protection measures for getting good early market might have helped them in increasing their income.

This finding is similar with the findings of Katkar (2001) and Sonawane *et al.* (2009).

4.1.4 Land holding

The information regarding size of land holding of the respondents is given in table 7.

Table 7. Distribution of the respondents according to their size of land holding

Sl. No.	Land holding	Respondents (n=115)	
		Number	Percentage
1	Marginal (Up to 1.00 ha.)	53	46.09
2	Small (1.01 to 2.00 ha.)	41	35.65
3	Semi-medium (2.01 to 4.00 ha.)	14	12.17
4	Medium (4.01 to 10.00 ha.)	4	3.48
5	Large (10.01ha. and above)	3	2.61
Total		115	100.00

It is revealed from table-7 and fig. 4 that, near about half (46.09 per cent) of the respondents had ‘marginal’ land holdings, followed by ‘small’ land holdings (35.65 per cent), while 12.17 per cent of the respondents had ‘semi-medium’ land holdings and 3.48 per cent of the respondents had ‘medium’ land holdings. Only 2.61 per cent of the respondent had ‘large’ land holding.

Thus, it is observed that, vegetable and fruit cultivation has been undertaken by ‘marginal’ type of the farmers, followed by ‘small’ type of the farmers having nearly about 2.00 ha of land, which might have helped them in diversifying their agriculture where vegetable and fruit crops might have got prominence.

4.1.5 Area under vegetable and fruit cultivation

The observations regarding area under vegetable and fruit owned by the respondents are shown in table 8.

The data from table 8 and fig. 5 revealed that, more than half (53.91 per cent) of the respondents had ‘low’ area under vegetable and fruit, while 30.44 per cent of the respondents had ‘medium’ and 15.65 per cent of the respondents had ‘high’ area under vegetable and fruit. The average area under vegetable and fruit of the respondents was 1.5 ha.

Table 8. Distribution of the respondents according to their area under vegetable and fruit cultivation

Sl. No.	Area under vegetable and fruit	Respondents (n=115)	
		Number	Percentage
1	Low (Up to 1.00 ha)	62	53.91
2	Medium (1.01 to 2.00 ha)	35	30.44
3	High (2.01 ha and above)	18	15.65
Total		115	100.00

Therefore, it could be inferred that, the average area under vegetable and fruit cultivation was quite satisfactory. Owing to typical geographical situation of Pune region, where average size of land holding was comparatively low, the vegetable and fruit growers in present study have put a substantial area under vegetable and fruit, which could be considered as commercially viable proposition.

The findings are in conformity with the findings of Mundekar (1993) and Ingole (2006).

4.1.6 Experience in vegetable and fruit cultivation

The data pertaining to the experience of the respondents in vegetable and fruit cultivation are given in table 9.

Table 9. Distribution of the respondents according to their experience in vegetable and fruit cultivation

Sl. No.	Experience in vegetable and fruit cultivation	Respondents (n=115)	
		Number	Percentage
1	Low (Up to 10 yrs)	23	20.00
2	Medium (11 to 36 yrs)	71	61.74
3	High (37 yrs and above)	21	18.26
Total		115	100

It is observed from table 9 and fig. 6 that, maximum (61.74 per cent) of the respondents had 'medium' experience in vegetable and fruit cultivation, while remaining 20.00 per cent and 18.26 per cent of the

respondents had 'low' and 'high' experience in vegetable and fruit cultivation, respectively. On an average, the respondents had 19 years of experience in vegetable and fruit cultivation.

The study showed that, majority of the respondents had fairly satisfactory experience in vegetable and fruit cultivation. The present findings are in close conformity with the findings of Bhapkar (1994), More (1996) and Kadam (2006).

4.1.7 Extension contact

The information regarding extension contact of the respondents is given in table 10.

Table 10. Distribution of the respondents according to their extension contact

Sl. No.	Extension contact	Respondents (n=115)	
		Number	Percentage
1	Low (Up to 9 score)	17	14.78
2	Medium (10 to 16 score)	79	68.70
3	High (17 score and above)	19	16.52
Total		115	100

It is observed from table 10 and fig. 7 that, maximum (68.70 per cent) of the respondents had 'medium' extension contact, while remaining 16.52 per cent and 14.78 per cent of the respondents had 'high' and 'low' extension contact, respectively. On an average, extension contact of the respondents had 12 score.

It can be said that, almost all the vegetable and fruit growers were in contact with extension personnel, though, intensity of their extension contact varied which might have reflected in their awareness regarding adverse effects of pesticides.

The findings of the present study are more or less similar with the findings of Chorge (2009). However, the results are dissimilar to the findings of Misal (2002) .

4.1.8 Sources of information

The information regarding sources of information of the respondents is given in table 11.

Table 11. Distribution of the respondents according to their sources of information

Sl. No.	Sources of information	Respondents (n=115)	
		Number	Percentage
1	Low (Up to 4 score)	30	26.09
2	Medium (5 to 7 score)	68	59.13
3	High (8 score and above)	17	14.78
Total		115	100.00

It is observed from table-11 and fig.8 that, majority (59.13 per cent) of the respondents had ‘medium’ sources of information, while remaining 26.09 per cent and 14.78 per cent of the respondents had ‘high’ and ‘low’ sources of information, respectively. On an average, sources of information of the respondents had 6 score.

The sources of information might have increased the awareness of the farmers about adverse effects of pesticides and also motivated them to use pesticide carefully with least hazards to environment and ecology.

4.1.9 Risk preference

Risk preference refers to willingness of vegetable and fruit growers to take risk in using pesticides for cultivation. The data about risk preference of vegetable and fruit growers obtained and they were grouped according to their risk preference. The distribution of respondents is given in table 12.

Table 12. Distribution of respondents based on their risk preference

Sl. No.	Risk preference	Respondents (n=115)	
		Number	Percentage
1	Low (Up to 5 score)	18	15.65
2	Medium (6 to 9 score)	86	74.78
3	High (10 score and above)	11	9.57
Total		115	100.00

It is revealed from table 12 and fig. 9 that, 74.78 per cent of respondents were belonged to medium risk preference category, while 15.65 per cent of them belonged to low risk preference category and remaining 9.57 per cent of respondents belonged to high risk preference category. Medium risk preference of vegetable and fruit growers was noticed due to medium to high level of annual income of vegetable and fruit growers. On an average, the respondents had 7 score of risk preference.

The present findings are in close conformity with the findings of Suresh (2004) and Shashidhara (2004).

4.1.10 Economic motivation

Every farmer normally tends to possess the basic urge to earn more. In order to understand the level of economic motivation, pertinent data were collected and the details are presented below in table 13.

Table 13. Distribution of respondents according to their economic motivation

Sl. No.	Economic motivation	Respondents (n=115)	
		Number	Percentage
1	Low (Up to 5 score)	18	15.65
2	Medium (6 to 8 score)	82	71.30
3	High (9 score and above)	15	13.04
Total		115	100.00

The above table 13 and fig. 10 indicates that, majority of the vegetable and fruit growers (71.30 per cent) had medium level of economic motivation behaviour followed by 15.65 per cent of the respondents had low level of economic motivation behaviour and the remaining 13.04 per cent of the vegetable and fruit growers had high level of economic motivation behaviour.

From the above results it could be inferred that, majority of the vegetable and fruit growers were under medium to low level of economic motivation behaviour. This indicates the interest of the respondents to earn more profit per unit area under vegetable and fruit cultivation. On an average, economic motivation of the respondents had 8 score.

4.2 Extent of use of pesticides and plant protection practices followed by the vegetable and fruit growers

The results of the present investigation, in respect of nature and extent of use of pesticides by the vegetable and fruit growers is given in table 14.

It is observed from table 14 that, out of 110 vegetable and fruit growers who had used 'Fipronil' of which vast majority (80.00 per cent) of them were using it 'more than recommended dose' and only 20.00 per cent of the respondents were using 'as per recommended dose'. Among tomato growers, in case of 'Dimethoate', majority (90.00 per cent) of the respondents were using 'more than recommended dose', followed by one-tenth of the respondents (10.00 per cent) 'as per recommended dose'.

The respondents of potato growers those were using 'Thiamethoxam' 52.00 per cent of them using it 'as per recommended dose' and 48.00 per cent of them were using 'more than recommended dose', whereas, out of 52 respondents of chilli growers those who were using 'Imidachlorpid' maximum number (42.00 per cent) of them were using 'more than recommended dose', followed by 31.00 per cent 'as per

recommended dose' and 27.00 per cent 'less than recommended dose'. Out of 37 'Dichlorvos' using respondents, majority (89.00 per cent) of them were using 'more than recommended dose' followed by 11.00 per cent respondents 'less than recommended dose'.

Table 14: Distribution of the respondents according to nature and extent of pesticides used by them

A	Chemical method					
Sl. No.	Crop (Major pest)	Pesticides & dose (ml/10 lit)	As per recommended dose	More than recommended dose	Less than recommended dose	Total
a	Vegetables					
1	Onion (Thrips)	Fipronil (20 gm)	22 (20.00)	88 (80.00)	-	110 (100.00)
2	Tomato (Leaf-miner)	Dimethoate (20 ml)	7 (10.00)	61 (90.00)	-	68 (100.00)
3	Potato (Aphid)	Thiamethoxam (250 gm)	26 (52.00)	24 (48.00)	-	50 (100.00)
4	Chilli (Thrips)	Imidachlorpid (20 gm)	16 (31.00)	22 (42.00)	14 (27.00)	52 (100.00)
5	Brinjal. (Stem borer)	Dichlorvos (20 ml)	-	33 (89.00)	4 (11.00)	37 (100.00)
b	Fruits					
6	Mango (Mango hopper)	Acephate (10 gm)	-	24 (100.00)	-	24 (100.00)
7	Sapota (Moth)	Carbaryl (15 ml)	13 (15.00)	76 (85.00)	-	89 (100.00)
8	Grapes (Mealy bug)	Monocrotophos (16 ml)	5 (18.00)	23 (82.00)	-	28 (100.00)

In case of 'Acephate' all mango growers (100.00 per cent) were using these pesticides 'more than recommended dose'. Whereas out of 89

‘Carbaryl’ users majority of them (85.00 per cent) were using it ‘more than recommended dose’ while 15.00 per cent of them were using it ‘as per recommended dose’. In case of ‘Monocrotophos’ users majority of them were using ‘more than recommended dose’ (82.00 per cent), while only 18.00 per cent of them were using ‘as per recommended dose’.

B	Other measures	Yes	No	Total
a)	Mechanical measures			
1	Cutting of infected branches	44 (38.26%)	71 (61.74%)	115 (100.00)
2	Cleaning of orchard	107 (93.04%)	8 (6.96%)	115 (100.00)
3	Use of smoke	-	115 (100.00%)	115 (100.00)
4	Intercultural operations	71 (61.74%)	44 (38.26%)	115 (100.00)
b)	Biological measures			
5	Use of "Rakshak trap"	69 (60.00%)	46 (40.00%)	115 (100.00)
6	Use of parasites and predators	—	115 (100.00)	115 (100.00)

(Figures in parentheses indicate percentages)

In case of other measures, it was observed that majority (61.74 per cent) of the respondents had not followed the practice of 'cutting of infected branches', whereas majority (93.04 per cent) of the respondents were following the practice of 'cleaning of orchard'. Out of 115 respondents none of them followed the practice of 'use of smoke' for the control of insect-pest. Three-fifth (60.00 per cent) of the respondents were using 'Rakshak trap' for the control of fruit fly, while 61.74 per cent followed 'intercultural operations'. It is observed that, none of the respondents were 'using parasites and predators' for the control of pest and diseases in vegetable and fruit.

From the above findings it can be inferred that, most of the vegetable and fruit growers were using pesticides without considering the recommendations. Most of the vegetable and fruit growers had used two to three pesticides for the control of pest. Majority of the farmers were using pesticides more than recommendations of university without considering the dose of application of pesticides. As in case of biological control no one knows the use of parasites and predators for the control of mango pest. Overall the use of pesticides for the control of vegetable and fruit pest is more in Pune district, so it is necessary to make the vegetable and fruit farmers aware about the recommendations of university and safety application of pesticides through mass media, method demonstration, etc.

The findings of the present study are in conformity with the findings of Fernandez *et al.* (1994), Vasanta (1998).

4.3 Awareness of vegetable and fruit growers about adverse effects of pesticides

The results regarding overall awareness about adverse effects of pesticides is given in table 15.

Table 15: Distribution of respondents according to their awareness about adverse effects of pesticides

Sl. No.	Awareness	Respondents (n=115)	
		Number	Percentage
1	Low (Up to 14 score)	23	20.00
2	Medium (15 to 19 score)	71	61.74
3	High (20 score and above)	21	18.26
Total		115	100.00

It is observed from table 15 and fig. 11 that, majority (61.74 per cent) of the respondents had 'medium' awareness about adverse effects of pesticides, while remaining 20.00 per cent and 18.26 per cent of the

respondents had ‘low’ and ‘high’ awareness, respectively. On an average, awareness of the respondents had 17 score.

The findings of the present study are in conformity with the findings of Meera and Bahal (2000).

4.3.1 Details of awareness of vegetable and fruit growers about adverse effects of pesticides

It is observed from table 16 that, as regards to adverse effects of pesticides on soil and water pollution, majority (59.13 per cent) of the respondents were aware about adverse effect ‘persistent chemicals contaminate soil for longer period’, followed by ‘kills pests as well as small organisms in soil’ (37.39 per cent), ‘decrease in biodiversity of soil’ (33.04 per cent). Large majority of the respondents were not aware about the adverse effect of pesticide 'decrease in water retention' (93.04 per cent).

Table 16: Distribution of respondents according to details of awareness of respondents about adverse effects of pesticides.

Sl. No.	Adverse effects of pesticides	Respondents (n=115)	
		Yes (%)	No (%)
A.	Soil and water pollution		
1	Decrease in biodiversity of soil	38 (33.04)	77 (66.96)
2	Kills pests as well as small organisms in soil	43 (37.39)	72 (62.61)
3	Decrease in water retention	8 (6.96)	107 (93.04)
4	Persistent chemicals contaminate soil for longer period	68 (59.13)	47 (40.87)
B.	Effects on living creatures		
1	Death of valuable pollinators like honey bee	83 (72.17)	32 (27.83)
2	Developed pesticide resistance in pest due to constant use	62 (53.91)	53 (46.09)
3	Amphibians like frog leads to major damage	45 (39.13)	70 (60.87)
4	Water contamination leads to death of	28	87

	fishes and aquatic insects	(24.35)	(75.65)
5	Grazing on contaminated grass leads to animals poisoning	36 (31.30)	79 (68.70)
6	Reduction in reproduction capacity of animals	5 (4.35)	110 (95.65)
C. Effects on human health			
1.	Adverse effects on workers during production, transport and use, as follow		
a.	Irritation in eyes	108 (93.91)	7 (6.09)
b.	Itching on skin	104 (90.43)	11 (9.57)
c.	Brain disorders	9 (7.83)	106 (92.17)
d.	Loss of appetite	21 (18.26)	94 (81.74)
2.	Children seem to be greatly susceptible to toxic effects of pesticides like leukemia, brain cancer and birth defects	16 (13.91)	99 (86.09)
3.	Eating of foods having chemical residues leads to		
	Fatigue	68 (59.13)	47 (40.87)
	Headache	109 (94.78)	6 (5.22)
	Nausea	97 (84.35)	18 (15.65)
	Vomiting	71 (61.74)	44 (38.26)
	Breathing problems	37 (32.17)	78 (67.83)
	Blood disorders	13 (11.30)	102 (88.70)
	Loss of weight	6 (5.22)	109 (94.78)
	Muscle pains	10 (8.70)	105 (91.30)
	Paralysis	4 (3.48)	111 (96.52)
4.	Constant contact of pregnant women with pesticides leads to death or disorders in new born.	14 (12.17)	101 (87.83)

In case of awareness regarding, adverse effects of pesticide on living creature, majority of the respondents (72.17 per cent) were aware about 'pesticide causes death of valuable pollinators like honey bee', followed by 'pest may become resistant to pesticide due to constant use years after year' (53.91 per cent). It is further observed that vast majority of the vegetable and fruit growers (95.65 per cent) were not aware about fact that pesticide leads to 'reduction in reproduction capacity of animals', followed by 'water contamination leads to death of fishes and aquatic insects' (75.65 per cent), and 'grazing on contaminated grass leads to animals poisoning' (68.70 per cent). It is observed that three-fifth (60.87 per cent) of the respondents were not aware about the adverse effect 'amphibians like frog leads to major damage.

As regards the adverse effects of pesticides on human health, it was observed that majority of the respondents were aware of the adverse effects namely, 'irritation in eyes' (93.91 per cent) and 'itching on skin' (90.43 per cent) at the time of production, transport and use of pesticides. While majority of the respondents were not aware about the fact that, pesticide poisoning leads to 'brain disorders' (92.17 per cent) and 'loss of appetite' (81.74 per cent) of workers during production, transport and use of pesticides. Majority of the respondents (86.09 per cent) were not aware about the adverse effect that 'children seem to be greatly susceptible to toxic effects of pesticides like leukaemia, brain cancer and birth defects'. Majority of the respondents were aware about eating of foods having chemical residues leads to 'headache' (94.78 per cent), 'nausea' (84.35 per cent), 'vomiting' (61.74 per cent) and 'fatigue' (59.13 per cent). Whereas majority of the respondents were not aware about the adverse effect that eating of foods having chemical residues leads to 'loss of weight' (94.78 per cent), 'paralysis' (96.52 per cent), 'muscle pains' (91.30 per cent), 'blood disorders' (88.70 per cent) and 'breathing

problems' (67.83 per cent). Majority (87.83 per cent) of the respondents were not aware about fact that 'constant contact of pregnant women with pesticides leads to disorders in new born or death'.

From the above results, it is clear that majority of the respondents had medium level of awareness about adverse effects of pesticides. Most of them were not aware about the adverse effects of pesticides on soil health, living creature, human health, children's health, residual effect of pesticides on human beings, as well as pregnant women. The vegetable and fruit growers might have understood one side of the pesticides i.e. their effects in control of pest and diseases. But most of them were unaware about the other side of pesticide use i.e. their adverse effects. The farmers must know both the sides of the pesticides use and they should make the balanced use of pesticides by considering their long term effects on human health and environment. Majority of the farmers had awareness regarding general adverse effects of pesticides, but they were not able to understand the specific scientific concepts regarding the pesticide residual hazards.

4.4 Suggestions of vegetable and fruit growers to minimize the adverse effects of the pesticides.

The constraints and suggestions were invited about knowledge level and adoption of recommended plant protection practices. The details of knowledge level of a respondent are summarized in table 17.

Table 17 : Details of suggestions of vegetable and fruit growers to minimize the adverse effects of the pesticides

Sl. No.	Suggestions	Respondents (n=115)	
		Number	Percentage
1	Pesticides should be kept away from reach of children and animals	113	98.26
2	Pesticides should be stored in cool, dry, safe and locked room	98	85.22
3	Washing of spray pumps near the river and wells should be avoided	81	70.43
4	The clogged nozzle and other parts should not be blown by mouth	74	64.35
5	Empty tins of pesticides should not be used	62	53.91
6	Grazing animals should be kept away from sprayed area at least for two weeks	59	51.30
7	Pesticides should be used by reading labels carefully	53	46.09
8	Safety clothing should be used while handling and using the pesticides	47	40.87
9	While preparing mixture of pesticides, deep utensils and wooden sticks should be used	46	40.00
10	Spraying should be done looking to direction of wind	44	38.26
11	Smoking and chewing tobacco should be avoided while spraying pesticides	43	37.39
12	Hands should be washed with soap immediately after spraying is over	41	35.65
13	Over use of pesticide should be avoided	39	33.91
14	Used containers should be buried deep in soil	33	28.70
15	Vegetable and fruits should be harvested after persistent period of pesticide is over, to avoid residue in it.	26	22.61

It is observed from table 17 that, almost all (98.26 per cent) of the respondents having knowledge that ‘pesticides should be kept away from reach of children and animals’, followed by 85.22 per cent of the respondents said that ‘pesticides should be stored in cool, dry, safe and

locked room'. Other important cognition to the vegetable and fruit growers was that 'washing of spray pumps near the river and wells should be avoided' (70.43 per cent), whereas majority (64.35 per cent) of the respondents said that 'the clogged nozzle and other parts should not be blowed by mouth'. Further, important cognition to the respondents was that, 'empty tins of pesticides should not be used' (53.91 per cent), while majority (51.30 per cent) of them said that 'grazing animals should be kept away from sprayed area at least for two weeks'. More than two fifth each (46.09 per cent) of the respondents knows that 'pesticides should be used by reading labels carefully', 'safety clothing should be used while handling and using the pesticides' (40.87 per cent), Further, important cognition to the respondents was that, 'while preparing mixture of pesticides, deep utensils and wooden sticks should be used' (40.00 per cent), whereas 38.26 per cent of the respondents knows that 'spraying should be done looking to direction of wind' and 'smoking and chewing tobacco should be avoided while spraying pesticides'(37.39 per cent). More than one third (35.65 per cent) of the respondents knows that 'hands should be washed with soap immediately after spraying is over' and 33.91 per cent of the respondents knows that 'pesticides should be used according to recommendations' and It was observed that 28.70 per cent of the respondents knows that 'used containers should be burried deep in soil' followed by 'fruits should be harvested after persistent period of pesticide is over, to avoid residue in it' (22.61 per cent).

The suggestions given by the vegetable and fruit growers may be viewed from the point of view of strengthening the research on awareness about adverse effects of pesticides and safe use of pesticides, which will help in designing the development strategies. The suggestions given by the vegetable and fruit growers may be used suitably by the concerned development and extension agencies in the region to increase the

awareness level among vegetable and fruit growers about adverse effects of pesticides.

The findings of the present study are similar with the findings of Vasantha (1999).

5. SUMMARY, CONCLUSIONS AND IMPLICATIONS

This chapter deals with the summary of the findings of the study and the implication for the future line of action and research.

Introduction

Pune district of the Maharashtra is especially known for vegetable and fruit cultivation. The present investigation mainly pertains to awareness of the vegetable and fruit growers about adverse effects of pesticides. The Pune district is a major vegetable and fruit growing district of the Maharashtra. The vegetable and fruit growers use pesticides for the control of pests and diseases. It was observed that vegetable and fruit growers were using pesticides without considering the recommendations, which results in excess use of pesticides. The excess use of pesticides leads to major problems to human health and environment. The systematically designed research studies with reference to awareness about adverse effects of pesticides by vegetable and fruit growers in Pune district had not been conducted so far. Hence, the present study was planned and conducted in Pune district.

An investigation entitled “Awareness among the vegetable and fruit growers about adverse effect of pesticides” was carried out with following objectives.

1. To study the profile of the respondent farmer.
2. To study the extent use of pesticides and plant protection practices followed by respondent farmer.
3. To study the awareness of respondent farmers about adverse effects of pesticides.
4. To obtain suggestions of respondent farmers to minimize the adverse effects.

The study was conducted in Pune district of Maharashtra. Considering the maximum area under vegetable and fruit cultivation, three tahsils viz; Khed, Ambegaon and Junnar were selected. From Ambegaon and Junnar tahsil, four villages were selected. Ten vegetable and fruit growers were selected randomly from each village from Ambegaon and Junnar tahsil and from Khed tahsil five villages were selected and seven vegetable and fruit growers were selected randomly from each village. In all, 115 farmers were selected. An interview schedule was specially designed in line with the objectives set forth to collect the needed information. The data were collected by personally interviewing the selected farmers. The findings of the study are summarized here under.

5.1 Profile of the vegetable and fruit growers

It was observed that majority (62.61 per cent) of the respondents was in the 'middle' age group and their average age was 46.00 years. As regards education, a maximum number (60.87 per cent) of the respondents had completed 'Secondary' followed by 'College' education (14.78 per cent). Amongst the respondents, 46.09 per cent and 35.65 per cent had 'marginal' and 'small' land holdings, respectively. The average land holding of the respondents was 1.75 ha. It is revealed that, majority number (62.61 per cent) of the respondents had 'medium' annual income. The average annual income of the respondents was Rs. 3.77 lakh. Regarding experience in vegetable and fruit cultivation, 61.74 per cent of the respondents had 'medium' experience in vegetable and fruit cultivation. On an average, the respondents had 19 years of experience in vegetable and fruit cultivation. With regards to area under vegetable and fruit, 53.91 per cent of the respondents were having 'low' area under vegetable and fruit cultivation with an average area of 1.5 ha. Maximum numbers of the respondents (68.70 per cent) were in the 'medium'

category of extension contact. Majority of the respondents (59.13 per cent) were in the category of 'medium' source of information. Whereas, 74.78 per cent of the respondents had 'medium' risk preference and 71.30 per cent of the respondents in the 'medium' category of economic motivation.

5.2 Extent of use of pesticides and plant protection practices followed by the vegetable and fruit growers

It was observed that out of 110 onion growers who used 'Fipronil', vast majority (80.00 per cent) of them were using it 'more than recommendation', while in case of 'Dimethoate', majority (90.00 per cent) of the respondents were using 'more than recommendation' and out of those who were using 'Thiamethoxam', 48.00 per cent were using it 'as per recommendation'. Whereas, out of 52 respondents who were using 'Imidachlorpid', maximum number (42.00 per cent) were using 'more than recommendation'. out of 37 respondents who were using 'Dichlorvos', majority (89.00 per cent) were using 'more than recommendation', while in case of 'Carbaryl' out of 89 users, majority (85.00 per cent) were using it 'more than recommendation' whereas in case of Monocrotophos users, majority (82.00 per cent) were using 'more than recommendation'. In case of 'Acephate' all respondents (100.00 per cent) use 'more than recommendation'.

In case of other control measures, none of the respondents followed the practice of 'use of smoke' and 'using parasites and predators' for the control of pests and diseases in vegetable and fruit.

5.3 Awareness of vegetable and fruit growers about adverse effects of pesticides

Majority (61.74 per cent) of the respondents had 'medium' level of awareness about adverse effects of pesticides. The average awareness level score was 17.35.

5.3.1 Details of awareness of vegetable and fruit growers about adverse effects of pesticides

It was observed that majority (59.13 per cent) of the respondents were aware about adverse effects namely 'Persistent chemicals contaminate soil for longer period', followed by 'kills pest as well as small organism in soil' (37.39 per cent), and 'decrease in biodiversity of soil'(33.04 per cent). Large majority of the respondents were not aware about the adverse effect of pesticide 'decrease in water retention' (93.04 per cent). It was observed that, majority (72.17 per cent) of the respondents were aware about 'pesticide causes death of valuable pollinators like honey bee', followed by 'pest may become resistant to pesticide due to constant use year after year' (53.91 per cent). It was further observed that vast most (95.65 per cent) of the vegetable and fruit growers were not aware about fact that pesticide leads to 'reduction in reproduction capacity of animals', followed by 'water contamination leads to death of fishes and aquatic insects' (75.65 per cent), and 'grazing on contaminated grass leads to animals' poisoning' (68.70per cent). More than three-fifth (60.87 per cent) of the respondents were not aware about the adverse effect 'amphibians like frog leads to major damage'.

As regards to adverse effects of pesticides on human health, it was observed that majority of the respondents were aware of the adverse effects namely, 'irritation in eyes'(93.91 per cent) and 'itching on skin of workers' (90.43 per cent) during production , transport and use of pesticides. While, majority of the respondents were not aware about the fact that, pesticide poisoning leads to 'brain disorders' (92.17) per cent) and 'loss of appetite' (81.74 per cent) of workers during production, transport and use of pesticides. Majority (86.09 per cent) of the respondents were not aware about the adverse effect that 'children seem to be greatly susceptible to toxic effects of pesticides like leukaemia,

brain cancer and birth defects'. Most (94.78 per cent) of the respondents were aware about eating of foods having chemical residues leads to 'headache', followed by 'nausea' (84.35 per cent), 'vomiting' (61.74 per cent) and 'fatigue' (59.13 per cent). Whereas, most (94.78 per cent) of the respondents were not aware about the adverse effect that eating of foods having chemical residues leads to 'loss of weight', followed by 'paralysis' (96.52 per cent), 'muscle pains' (91.30 per cent), 'blood disorders' (88.70 per cent) and 'breathing problems' (67.83 per cent). Majority (87.83 per cent) of the respondents were not aware about fact that 'constant contact of pregnant women with pesticides leads to disorders in new born or death', whereas, 79.13 per cent of the respondents were not aware about fact that, 'pesticides lead to danger of fire'.

5.4 Suggestions of vegetable and fruit growers to minimize the adverse effects of the pesticides.

Various suggestions were given by the respondents, of which major were 'pesticides should be kept away from reach of children and animals' (98.26 per cent), 'pesticides should be stored in cool, dry, safe and locked room' (85.22 per cent), 'washing of spray pumps near the river and wells should be avoided' (70.43 per cent), 'the clogged nozzle and other parts should not be blowed by mouth' (64.35 per cent) and 'empty tins of pesticides should not be used' (53.91 per cent).

5.5 Conclusion

Majority of the vegetable and fruit growers belonged to the middle age group most of them had received secondary education, having marginal land holding and followed by small, medium income group, medium experience in vegetable and fruit cultivation, had medium extension contact, medium Source of information, medium risk orientation, with medium economic motivation.

Majority of vegetable and fruit growers possessed medium awareness about adverse effect of pesticides.

5.6 Implications of the Study

The study was undertaken to investigate the awareness about adverse effect of pesticides followed by the vegetable and fruit growers. In the light of findings the implications are given below.

- 1) It is therefore suggested that extension worker, organizer, planners should consider these attributes which help to increase awareness about adverse effect of pesticides. Thus, the socio economic status and living standard of the vegetable and fruit growers can be improved by less health and environmental hazards.
- 2) Considering, the suggestions towards the improved use of pesticides, the concerned institutions, agricultural Department and extension Agencies and agri clinic service centers should provide sufficient information, facilities.
- 3) Extension Agencies, which are concerned with plant protection measures, have to make conscious efforts for rapid diffusion of bio-pesticides and their effects related to the plant protection for the vegetable and fruit growers. This can be done by arranging tours, exhibition and demonstration for improving knowledge of bio-pesticides use.
- 4) It was observed that the growers were not following the schedule recommended for the control of pest and diseases in vegetable and fruit. The importance of using that schedule needs to be explained to the farmers and they need to be motivated by the extension agency to follow the recommended dose of pesticides and also give the knowledge about importance of other measures like use of Rakshak trap, cutting of infected branches, inter cultural operation which will minimize the overuse of pesticides by the vegetable and fruit growers.

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