

A Survey on Pesticide Usage in the Vegetable Crops of Manjoor

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Abstract

Green revolution relied on extensive use of pesticides, which is necessary to limit the high levels of pest damage that inevitably occur in crops. Though modern pesticides, fertilizers and technological improvements have greatly increased yields, the application of pesticides has seriously affected the soil and water ecosystems. Manjoor is an intensive vegetable cultivating area, situated in Kadathuruthy block of Kottayam district in Kerala. The major vegetables cultivated in this area are Bittergourd, Snakegourd, Peas, Cucumber, Littlegourd, Amaranthus and Tapiocca. The application of pesticides mainly belonging to the class organophosphorus and carbamates. The chemical pesticides used at Manjoor belonged to the categories of extremely hazardous (Ia), highly hazardous (Ib), moderately hazardous (II) and slightly hazardous (III) as per the classification of pesticides by WHO. The important pesticides used in the study area are Phosphomidon, Monocrotophos and Carbofuran. Pesticides which are banned for use in vegetables (Monocrotophos), those that are restricted use pesticide (RUP) in India (methyl parathion) and PAN Bad Actor Chemical group (Mancozeb, Carbendazim and quinalphos) are used in this area. The farmers at Manjoor do not use any personal protective measures while applying the pesticides and report health disturbances such as headache, skin diseases, breathing problem and allergy.

Keywords: Pesticides, cultivation, Hazardous, Health disturbances.

Introduction

Vegetable cultivation is one of the most economically important and dynamic branches of agriculture. India has a wide variety of climate and soils on which a range of vegetable crops can be grown. Hence, vegetable production has increased in our country. Vegetables are also a main source of diet in Indian sub-continent. Pesticides constitute an important component in agriculture development and protection of public health in India since the tropical climate is very conducive to pest breeding.

Green revolution relied on massive application of pesticides and synthetic nitrogen fertilizers. In 1970s, a huge dosage of pesticides revolutionized the farming ways in India. However, in due course, the pests grew immune to the pesticides and the farmers started dumping out even higher quantity of pesticides.

More than 500 different pesticide formulations are being used in our environment, mostly in agriculture (Manuel, 2008) and for the control of biological public health hazards. Currently, there are 165 pesticides registered for use in India and there is a sequential rise in the production and consumption of pesticides in India during the last three decades. Among the predominant classes of pesticides used in India are insecticides, which account for 75 per cent of total consumption, followed by fungicides (at 12 per cent) and herbicides (at 10 per cent). The consumption pattern of these chemicals in India differs with rest of the world. The domestic demand for pesticides in India accounts for about 76% of the total pesticides used in the country as against 44 % globally. Furthermore, 54 percent of the total quantity of pesticides used in the country is used in cotton, with 17 per cent in rice and 13 per cent in vegetables and fruits (Devi, 2010).

The pesticide residues in food in India, especially vegetables, are the highest in the world. This is mainly due to the unregulated use of pesticides. In India, crop production increased to 100% but the cropping area has increased only marginally by 20%. For this, pesticides played a major role in achieving the maximum crop production. However the improvement in yield is sometimes concomitant with the occurrence and persistence of pesticide residues in soil and water. Compiling the data on

consumption level of pesticides in agriculture in Kerala (1995-96 to 2007-08), the total quantity is estimated at 462.05 metric tonnes (MT) (2007-08) technical grade material of insecticides, fungicides, weedicides and rodenticides (Devi, 2010).

Modern agriculture practices reveal an increase in use of pesticides and fertilizers to meet the food demand of increasing population. Presently, chemical pesticides are common weapon to control crop pests and farmers use them frequently as these pesticides are easy to use, easily available and fast in action. But if used improperly, many of these inputs have deleterious effects on human health and the environment. The problems due to pesticides are more severe because of poor selection of pesticide and short harvesting interval of crops after pesticide application (Sharma, 1994). According to a survey of farmers using pesticide continuously for over five years or more, over 60% of the farmers do not wait even two weeks between spraying pesticides and harvesting the crops.

According to World Health Organization (1990) estimates, pesticides cause 30, 00,000 cases of poisoning and 2,20,000 deaths annually across the globe, the majority of which are reported from developing countries. Pesticide poisoning in Kerala has a long history. The State became the focus of interest and research in 1958 following the death of more than 100 people who had consumed wheat flour that had been contaminated with pesticides during transportation. The long term impact of pesticides in the state has been highlighted in study undertaken by the Thiruvananthapuram Medical College in 1993. This study focused on health problems at the Kuttanad area of Kerala which is predominant rice cultivating area and found a very high occurrence of cancer of the lip, stomach, skin and brain, lymphoma, leukemia and multiple myeloma. These were linked to

the high pesticide use in the area. Pesticides used in the food crops in the state include chemicals which are banned for sale in Kerala (Endosulfan), banned for use in fruits/vegetables (Monocrotophos) and those permitted for restricted use only (Methyl Parathion, Lindane and Methoxy Ethyl Mercury Chloride). Many of the chemicals are banned/not approved in many other countries and belong to the PAN Bad Actor Chemical group (Mancozeb, Carbendazim, Paraquat, Lambda Cyhalothrine, Diuron, Quinalphos) (Devi, 2010)

Manjoor, an important vegetable growing area in Kerala is practicing intensive cultivation. Continuous cultivation of vegetables, especially in the same mounts and the ever-increasing use of chemical fertilizers and pesticides has reduced the productivity of the soil and the yield of vegetables in Manjoor (John, 2004).

In order to develop an understanding about the vegetable cultivation, nature of pesticide application, including the types of pesticide, quantity and frequency of usage a survey has been carried out among the farmers of the study area with the following objectives.

Objectives of the Survey

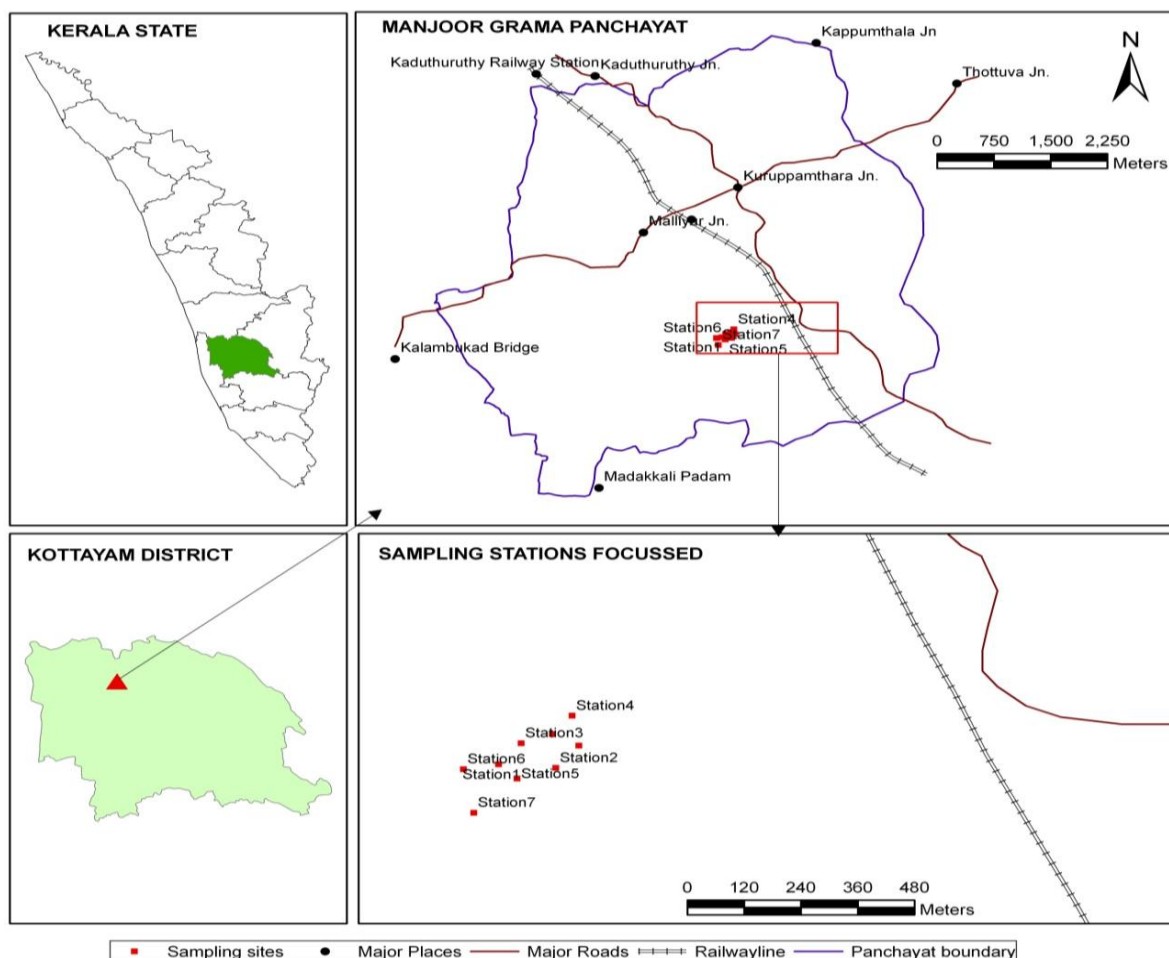
1. To identify the types of cultivation in Manjoor.
2. To understand the type, quantity and frequency of application of pesticides
3. To record the diseases encountered due to the frequent exposure to pesticides.

Materials and Methods

Study area

Manjoor is an important vegetable cultivating area, situated in Kaduthuruthy Block of Kottayam district (Fig.1). The vegetable cultivation in this area started from the early 1970s.

Fig. 1 Study area



Materials and Methods

Questionnaire

The interview questionnaire was designed to elicit details on land ownership, types of crop cultivated, duration of each crop, exposure to pesticides, the use of pesticides, the commonly used pesticides, precautions taken and signs and symptoms of illnesses related to pesticide exposure.

Data collection

A survey was conducted among 100 farmers for the collection of data for a period of two months from September 2002 to December 2002.

Results

Agricultural development continues to remain the most important objective of Indian planning and policy. In the process of development of agriculture, pesticides have become an important tool as a plant protection agent for boosting food production. However, exposure to pesticides both occupationally and environmentally causes a range of human health problems.

Survey results at Manjoor among 100 agricultural workers for a period of two months by direct questionnaire method revealed a farming area of 35 cents to four acres for each farmer. Twenty three percent of the farmers are tenant farmers. The major crops cultivated in this area are bitter gourd, snake

gourd, pea plant, little gourd, amaranthus, paddy cultivation, ladies finger, tapioca and cucumber (Table 1.1).

The cultivation of vegetables is done on raised mounts of 2 to 7 feet in wetlands. In the 1970s and 1980s rotation of crops between rice and vegetable cultivation was followed but now the rotation among different vegetables is being practiced. The life cycle of pea plant, bitter gourd, cucumber, snake gourd has duration of four months. They start yielding after about two months of life. Little gourd, has a life of a little more than six months. Cucumber is a creeper cultivated in the summer season only. Tapioca stems are planted in January and harvested towards the end of May and early June before the commencement of the south-western monsoon. The cowpea and snake gourd are cultivated in all seasons while bitter gourd and cucumber are cultivated during one season only.

The Manjoor area was a paddy cultivating area in the 1970s and 1980s (Table 1). Now due to the intensification of vegetable cultivation, paddy is restricted to only certain areas. In the survey only one of the respondents had paddy cultivation which is cultivated only during one season. The ladies finger and amaranthus are mainly cultivated as intermittent crops. Ladies finger is grown during January to march while amaranthus cultivation is avoided during the

rainy season. The major vegetables cultivated in this area are snake gourd and pea plant. Bitter gourd which had occupied a prominent position earlier has almost entirely disappeared from cultivation due to the widespread attack of leaf mosaic virus.

The vegetable farmers in Manjoor apply different kinds of pesticides which include Furidan, Astaf, Contaf, RogorandTatafen of Rallis (India) Ltd, Sevin, Confidor, HosthaionandMetacid of Bayer (India) Ltd, Navacron and Dimecron of Ciba Geigy (India) Ltd, Fytolan of Syngenta(India) Ltd, Starthene of Swal Corporation Ltd, Indofil of Indofil chemicals Ltd and Baviston of Biostadt India Ltd. These chemicals belong to the chemical families organophosphates, carbamates, pyrethroids, triazoles, neonicotomyles and inorganic carbon (Table 2). The pesticides are applied to all the crops

cultivated here except for that of tapioca and the usage for amaranthus is minimal. The usage and type of pesticides used is similar in all the crops. The pesticides are applied at an average rate of 3 to 7 times per month. In the case of the dose of chemicals, the manufacturer's prescription was used as a guide. More often the quantity of the formulation was not strictly followed.

Among the pesticides the usage of organophosphorus pesticide Dimecron, an extremely hazardous pesticide is more compared to the other pesticides. The chemicals used here belong to the categories of Ia (extremely hazardous), Ib (highly hazardous), II (Moderately hazardous), III (slightly hazardous) and U (unlikely to present acute hazard in normal use) as per the World Health Organization (WHO) classification.

Table 1. Types of Vegetable crops cultivated in the study area

Type of crop	Scientific name	Family	Duration	Pesticide usage	Type of pesticides used
Pea plant	Pisum sativum	Leguminosae	4 months	Yes	Organophosphates, carbamates, pyrethroids, triazoles, neonicotomyles and inorganic carbon
Cucumber	Cucumis sativus	Cucurbitaceae	4 months	Yes	Organophosphates, carbamates, pyrethroids, triazoles, neonicotomyles and inorganic carbon
Little gourd	Cocinia grandis	Cucurbitaceae	6 months	Yes	Organophosphates, carbamates, pyrethroids, triazoles, neonicotomyles and inorganic carbon
Bitter gourd	Momardica charantia	Cucurbitaceae	4 months	Yes	Organophosphates, carbamates, pyrethroids, triazoles, neonicotomyles and inorganic carbon
Amaranthus	Amaranthus	Amaranthaceae	1 to 2 months	Yes	Organophosphates, carbamates, pyrethroids, triazoles, neonicotomyles and inorganic carbon
Snake gourd	Trichosanthis anguina	Cucurbitaceae	4 months	Yes	Organophosphates, carbamates, pyrethroids, triazoles, neonicotomyles and inorganic carbon
Plantain	Musa sps	Musaceae	6 months	Yes	Organophosphates, carbamates, pyrethroids, triazoles, neonicotomyles and inorganic carbon
Tapiocca	Casavasps	Euphorbiaceae	4 to 6 months	No	Nil
Ladys finger	Abelmoschus esculentus	Malvaceae	3 to 4 months	Yes	Organophosphates, carbamates, pyrethroids, triazoles, neonicotomyles and inorganic carbon
Paddy	Oryza sativa	Poaceae	6 months	Yes	Organophosphates, carbamates, pyrethroids, triazoles, neonicotomyles and inorganic carbon

Table 2. Type of pesticide used in the vegetable farms at Manjoor

SI No	Pesticide used	Active ingredient	Chemical group	Manufacturer	Classification of pesticides	% of people using pesticides	Remarks
1	Furidon	Carbofuran	Carbamate	Rallis(India) Ltd	Ib	25	Ib -Highly hazardous
2	Tatafen	Fenvelerate	Pyrethroid	Rallis(India) Ltd	II	22	II-Moderately hazardous
3	Ekalux	Quinalphos	Organophosphates	Syngenta	II	20	II-Moderately hazardous
4	Confidor	Imidacloprid	Neonicotomyles	Bayer(India) Ltd	II	19	II-Moderately hazardous
5	Starthen	Acephate	Organophosphates	Swal	II	10	II-Moderately hazardous

	e		phosphates	corporation Ltd			hazardous
6	Nuvacron	Monocrotophos	Organo-phosphates	Ciba Geigy Ltd	lb	27	lb- Highly hazardous
7	Dimecron	Phosphomidon	Organo-phosphates	Ciba Geigy Ltd	la	39	la- Extremely hazardous
8	Hosthain	Triazophos	Organo-phosphates	Bayer(India) Ltd	lb	11	lb-Highly hazardous
9	Metacid	Methyl parathion	Organo-phosphates	Bayer(India) Ltd	la	13	la- Extremely hazardous
10	Rogor	Dimethioate	Organo-phosphates	Rallis(India) Ltd	II	14	II-Moderately hazardous
11	Asataf	Acephate	Organo-phosphates	Rallis(India) Ltd	II	16	II-Moderately hazardous
12	Sevin	Carbaryl	Carbamate	Bayer(India) Ltd	11	19	II-Moderately hazardous
13	Contaf	Hexaconazole	Triazole	Rallis(India) Ltd	III	18	III- slightly hazardous
14	Baviston	Carbandezim	Carbamates	Biostadt India Ltd	U	12	U- Unlikely to present acute hazard in normal use
15	Fytolan	Copper oxy chloride	Inorganic copper	Syngenta India Ltd	III	30	III- slightly hazardous
16	Indofil	Mancozeb	Carbamate	Indofil chemicals Ltd	U	16	U- Unlikely to present acute hazard in normal use

The signs and symptoms of diseases related to pesticide exposure are represented in Table 3. Fifty two percent of the respondents had certain symptoms of pesticide exposure. Some of the signs and symptoms with a higher prevalence were excessive headache (20%), allergy (13%), breathing problem and skin diseases (11%). The other signs and symptoms are eye irritation (7%), itching (5%), vision problems (4%), asthma and burning sensation (3%) and dizziness (1%).

Table 3. Health problems reported by the farmers of the study area

Types of health problems	% of respondents reported the problem
Head ache	20
Breathing problem	11
Allergy	13
Skin allergy ,skin irritation,	11
Asthma	3
Eye irritation	7
Itching	5
Dizziness	1
Burning sensation	3
Vision problems	4
Total respondents	100

Discussion

Kerala is a land with a total geographical area of 38.85 lakh hectares, and the proportion devoted to agriculture is nearly 58 percent. Large-scale vegetable cultivation was started in Manjoor from the early 1970's. Rice-vegetable rotation was practiced throughout the 1980s and 1990s. Later landowners took to vegetable cultivation as they found that vegetable cultivation was profitable and the rotation among different vegetables was followed. As rice cultivation turned increasingly uneconomic, the demand for land for vegetable cultivation increased (John, 2004). Among the respondents of survey only one person had the practice of paddy cultivation.

Since the life cycle of vegetables cultivated in Manjoor lasted for four to six months crop rotation among different vegetables was followed. Crop rotation may be defined as a "Process of growing different crops in succession on a piece of land in a specific period of time without decreasing the soil fertility" (Sahai, 1982). Crop rotation helps in the fixation of nutrients in the soil and reduces plant diseases. The plants of the same taxonomical group should not be cultivated continuously since the nutrient need of a family is similar and the yield of the crops gets reduced. Plants within the same taxonomic family also tend to have similar pests and pathogens. This leads to the addition of more chemical fertilizers and pesticides. The earlier practice of rice-vegetable rotation was better in Manjoor as it helped in the retaining of soil nutrients. But now most of the

vegetables cultivated in the study area belong to a same taxonomic group (Table 1.1).

At Manjoor the frequency of pesticide application is very high. The pesticide application is high in this area as some of the farmers in this area are tenant farmers. They are not concerned about the fertility of the soil but are only concerned about the yield. The tenant farmers retain the field for as long as four or five years at a stretch. Every year the height of the mount is slightly increased. The residues of chemical fertilisers and insecticides increase in the mounts year after year and spoiling the fertility of the soil. As the landlords continue to get the rent mutually agreed upon, they are not at all worried about the severe damage caused to the soil. Some of the farmers who continue their cultivation in the mounts confessed that the yields of vegetables decrease year after year. Destruction of the mounts and construction of fresh mounts are costly activities. Further, the tenant-farmers fear that if the mounts are destroyed and the ground levelled, new tenants may come and offer higher rent to the landowners thus depriving them of their opportunity to continue cultivation. As rent is fixed in these areas on a yearly basis, the tenant farmers try to make the maximum use of the soil throughout the year. Hence, in the place of crop rotation between paddy and vegetables, a new system of continuous rotation of different vegetable has developed in this area.

There are totally 12 pesticides and 4 fungicides applied in this area and there is a tendency among farmers to change the chemicals in each spray. The pesticides mostly belong to the chemical group organophosphates and carbamates. Majority of the chemicals used belong to organo phosphate group which is reported as the major cause of health problems due to insecticides in India (Puri, 1998). Farmers at Manjoor generally opt for quick results and apply most toxic chemicals even while the safer ones are technically suitable. Organophosphate and carbamates insecticides are known to inhibit acetyl cholinesterase which plays an important role in neurotransmission at cholinergic synapses by the rapid hydrolysis of neurotransmitters acetylcholine to choline and acetate (Raouf et al., 2005).

The important pesticides used in the surveyed area are Phosphomidon, Monocrotophos and Carbofuran. Phosphomidon (2-chloro-2-diethylcarbamoyl-1-methylvinyl dimethyl phosphate) is a broad spectrum, systemic and contact organophosphate insecticide used extensively to protect crops. It is an extremely hazardous pesticide as per the classification of WHO (world health organization). The primary mechanism of action of Phosphomidon is neurotoxicity. They are designed to be effective inhibitors of acetylcholine esterase through interaction of nucleophilic active site serine of the enzyme to form a phosphorylated enzyme derivative (Suke, 2008). The second most commonly used pesticide in the surveyed area is monocrotophos (MCP), an organophosphate pesticide which is used indiscriminately in India to control insect pests (Ujwala, 2007). It works systemically on contact and is extremely toxic to birds and mammals. All

applications of this chemical were discontinued in the US since 1998. In India, this chemical is banned for use in vegetables (Devi, 2010) but still it is being used at Manjoor for cultivating vegetables.

Methyl parathion which is also a commonly used pesticide at Manjoor, is said to inhibit cholinesterase enzyme in the human brains, cause genotoxic effect in mammalian somatic cells and increase the abnormalities in chromosomal structure (Erkan, 2010). It is categorized as a restricted use pesticide (RUP) in India by the Central Insecticide Control Board (Devi, 2010). The chemical pesticides used at Manjoor belong to the categories of extremely hazardous (Ia), highly hazardous (Ib), moderately hazardous (II) and slightly hazardous (III) as per the classification of pesticides by WHO. Many of the chemicals used in the study area are banned/not approved in many other countries and belong to the PAN Bad Actor Chemical group (Mancozeb, Carbendazim and quinalphos).

Department of Health Services of Kerala has found residue of organochlorine, organophosphate and Carbofuran groups in 25 of 86 samples of cauliflower, tomato, bitter melon, spinach, grapes, oranges and apples. Market surveys done in Kerala by the All-India Coordinated Research Project on Pesticide Residue also revealed high levels of pesticide residue in okra and amaranthus.

The farmers at Manjoor do not use any personal protective measures while applying the pesticides. The findings of other studies done in developing countries also support this observation (Salameh et al., 2004; Atreya, 2007). The cost factor, general lethargy, and the discomfort associated with the use (in the hot and humid climate) were reported as the reasons for non adoption of personal protective measures. The diseases encountered by the farm workers at Manjoor are headache, skin diseases, breathing problem and allergy. Complaints from Carbofuran poisoning while mixing the liquid form of Carbofuran with seeds are nausea, vomiting, headache, weakness, dizziness and blurred vision (Satar et al., 2005). A study undertaken by the Thiruvananthapuram Medical College has reported very frequent cases of cancer of the lip, stomach, skin and brain, lymphoma, leukemia and multiple myeloma from the Kuttanad rice area of Kerala, linking the same to high pesticide use in the area (Dinham, 1993). In another study, Krishna (2001) has found skin allergy and headaches to be, among the health hazards induced by pesticides, skin allergy and headaches were found to be the most prominent pesticide-induced health hazards.

Conclusion

Manjoor is an important vegetable growing area in Kerala where the cultivation started three decades ago. The rotation of vegetables is practiced here. The major vegetables grown in this area are bitter melon, snake melon, pea plant, little melon, amaranthus, ladies finger, Tapioca and cucumber. The survey conducted among the agricultural workers revealed the application of pesticides mainly belonging to the class organophosphorus and carbamates. The frequency and rate of application of

pesticides is higher in this region since some of the farmers in this area are tenant farmers. They are not concerned about the fertility of the soil but are only concerned about the yield. The chemical pesticides used at Manjoor belong to the categories of extremely hazardous (Ia), highly hazardous (Ib), moderately hazardous (II) and slightly hazardous (III) as per the classification of pesticides by WHO. The important pesticides used in the surveyed area are Phosphomidon, Monocrotophos and Carbofuran. Pesticides which are banned for use in vegetables (Monocrotophos), those that are restricted use pesticide (RUP) in India (methyl parathion) and PAN Bad Actor Chemical group (Mancozeb, Carbendazim and quinalphos) are used in this area. The farmers at Manjoor do not use any personal protective measures while applying the pesticides and hence the diseases encountered by the farm workers at Manjoor are headache, skin diseases, breathing problem and allergy.

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