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PYRETHROIDS USE AMONG FARMERS IN MAURITIUS, AS A MEANS TO COMBAT MAJOR PESTS IN CROP PRODUCTION

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ABSTRACT: The Mauritian agriculture is now shifting from sugarcane production to the growing of vegetables and fruits in a means to reduce net importing figures of fruits and vegetables. In an effort to adapt to challenges facing the agricultural sector, governmental and non-governmental organizations have consistently promoted pesticides as a yield augmenting and sole pests and disease combating means. Moreover, the extensive use of chemical pesticides in agriculture has also led to an increase in pest' resistance, serious environmental contamination and toxic residue accumulation. Many unsustainable agricultural practices have led to soil degradation mainly through loss of organic matter leading to a decrease in soil fertility. A study was conducted, where 300 farmers coming from the nine different districts in Mauritius were interviewed on the use of pesticides. A fully structured questionnaire was used to assess the environmental, socio- economic and agricultural impact of using pesticides. The main objective was to determine the main factors motivating farmers to use pesticides. The answers received from farmers originating from 5 main regions in Mauritius were analyzed. The regions were: (a) North, (b) East, (c) South, (d) West and (e) Centre. The findings demonstrated that more than 90 % of vegetable growers used pyrethroids group of pesticides. A factor analysis was conducted and the results of the statistical analysis showed that influence by fellow farmers was the main factor influencing farmers to use pesticides, followed by pricing and efficacy of pesticides, experience in farming, effectiveness of results, availability of pesticides and quickness of results.

KEYWORDS: Pesticides, Pyrethroids, Mauritius, Crop production, Pests and Diseases, Food Security.

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1. INTRODUCTION

Mauritius is a small island isolated from any large masses and is situated in the south western part of the Indian Ocean between latitude $19^0 58^{'}$ and $20^0 32^{'}$S and longitude $57^0 17^{'}$ and $57^0 46^{'}$E. The island is of volcanic origin and covers an area of 1865 km^2. [1] Agriculture employs 8 % of the total working population in Mauritius. 8459 hectares of land are under food crop production amounting to 113 957 t for the year 2014[2]. The country has the responsibility of addressing food security and self-sufficiency in certain crops for the population [2]. Productivity of crops grown for human consumption is at risk due to the incidence of pests, especially weeds, pathogens and animal pests. Crop losses due to these harmful organisms can be substantial and may be prevented, or reduced, by crop protection measures [3]. Pesticides have been used to prevent this. It has been reported that these important chemicals are used to improve crop productivity, protection of crop losses and improve the quality of food [4]. On the other hand, pesticides cause more harm than good, and it has been stated that pesticides do not affect crop yield. Instead, the excessive application of these chemicals cause plant mediated toxicity that tends to reduce crop yield by bearing stunted plants [5]. The increasing world population and changes in consumption pattern will need significant agricultural intervention

[6] unless crop yield is improved and the use of chemical fertilizers and pesticides are reduced. Excessive pesticides use could augment contamination and perturbation of managed natural ecosystems ultimately harming biodiversity and public health [7]. The haphazard use of chemical pesticides in agriculture has led to pests developing a resistance to common pesticides, serious environmental contaminations, toxic residues and negative impacts on non-target organisms and also the extinction of certain beneficial organisms [8]. Despite increasing application of tons of pesticides worldwide, more than 40% of all potential food production and another 20% of the harvested crop is lost to pests [9]. Only a small amount of this applied pesticide actually reaches the intended target organism and the vast majority ends up elsewhere in the environment [10]. Less than one percent of pesticides applied to the agriculture reach their pests, and more than 99% of it adversely affects unintended targets including the public and environmental health [11]. In a study conducted in Northern Tanzania, it was reported that 50% of farmers apply up to 5 times or more recommended dosage of pesticides on crops and eventually 68% of them reported having fell sick after routine application of pesticides [12].

2. MATERIALS AND METHODS

A survey was conducted where, 300 farmers were interviewed on pesticides usage. The current and normal practice of farmers to increase their yield is to protect their food crops as far as possible. This survey was carried out in view of gathering information on the following aspects and the objective of

this survey was to determine:

(a) Type of pesticides most commonly used in Mauritius ,

(b) Willingness of farmers to stop using pesticides

(c) Willingness of farmers to use the right dosage and respect post-harvest interval while using pesticides

Overview and description of population survey

The survey questionnaire was designed to have an overview of how farmers get on with pesticides use, the safety measures they apply while using it, do they respect the right dosage and application frequency. Also if farmers were aware of the dangers pertaining to excessive pesticides use. Farmers were also asked if they were willing to abandon the use of synthetic fertilizers and opt to use more environmentally friendly bio pesticides. A fully structured questionnaire was used to assess the environmental, socio – economic and agricultural impact of using pesticides in Mauritius. The sample surveyed was 300 farmers: 60 from the northern, southern, eastern, western and central part of the island respectively. The surveys were completely anonymous and all data were kept confidential. Figure A shows how the different locations were categorized.

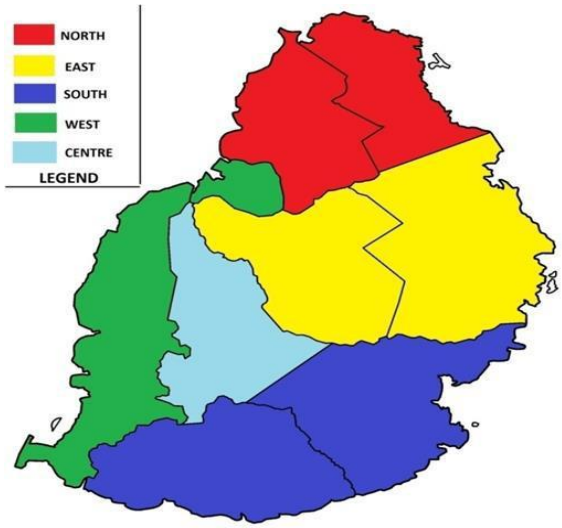

Figure A: Sampling map

3. RESULTS AND DISCUSSION

Analysis and Description

Based on the data collected from the farmers' survey, the demographic profile of the participants was categorized into different groups: gender, age, and level of education. As shown in table B, the number of male respondents was higher than female counterparts. Male showed more willingness to be interviewed and in most cases female farmers were the spouse of farmers. So, they preferred their

husband to be interviewed. 290 male farmers were interviewed as compared to 10 female farmers who agreed to be interviewed.

Table B: Gender of respondents

Respondent	Number
Male	290
Female	10
Total	300

For the age group, 46 – 60 years had the highest respondents i.e. 49.3 %, above 60 years of age had 33.7% and below 45 years had 17%. The categorization was based on segregating younger population (less than 45 years of age), the working group (46 – 60 years) and the retired or aged population (above 60). Most people to indulge in farming activities were above 45 years of age and this reflects the fact that youngsters were not anymore interested into farming. In terms of level of education, 165 farmers were educated until secondary level, 62 primary, 51 tertiary and 22 were not educated at all. The highest number of respondents were above 45 years of age and in this age group, many people were not interested in studying until tertiary level due abundance of job and in some cases people lack financial abilities too.

Incidence of pests and diseases

All 300 farmers interviewed used pesticides for the protection of crop grown from pests and diseases. 60.3% understood that the incidence of pests and disease has been increased by 10%, 23% think it has been increased by 10-20%, 1% see no change, while 15.7% see an increase of more than 20%. With the ban and controlled use of other group of pesticides (organophosphate, carbamates, organochlorine) 95 % of growers use pyrethroid group of pesticides most of the time. Pyrethroids have a frequency of application of 2, 3 and 7 days depending on the crop grown. 10% of growers use pyrethroids every 2 days, 47.7 % every 5 days and 42.3 % every 7 days. Vegetable growers normally grow a range of vegetables. If a farmer is growing beans and tomatoes at the same time and the latter has to apply deltamethrin to control caterpillars. He uses 2 days as delay period. After 2 days, he might harvest beans and tomatoes to sell to consumers. But, the problem on here is that the delay of application of deltamethrin for tomato is 2 days and beans 7 days. Not only, the grower is wasting pesticides but most importantly, he is putting the lives of his consumers at risk by making them eat beans harvested after 2 days of delay period following deltamethrin application.

Pesticides Personal Protective Equipment and Measuring device

Out of the 300 farmers interviewed, 297 answered positively to the use of a measuring device to quantify the right amount of pesticides. Measuring the right amount of pesticides is very important to

ensure that the exact dosage is being applied to the selected crop. Applying less than the exact dosage would not be effective in fighting the incidence of pests and diseases. On the other hand, applying more than the required dosage would result in wasting pesticides and also accumulating as residue in food crops and thus proving to be harmful for human consumption. 297 farmers used a measuring device to track the required amount of pesticides. Out of this 297; 28.6% used a measuring cylinder, 27.3% used a syringe, and 44.1% used the cap of pesticides bottle (illustrated in figure C).

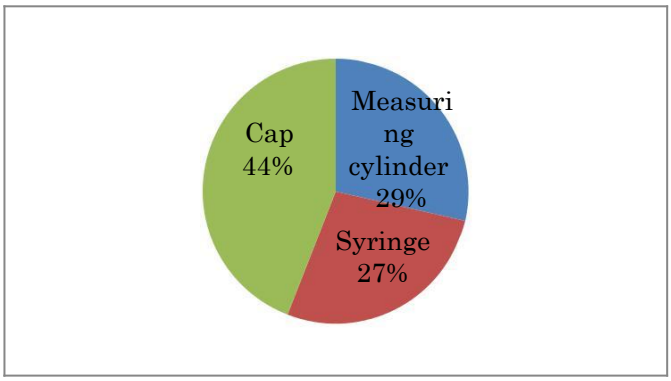

Figure C: Measuring device for pesticides

Measuring cylinders and syringes are calibrated measuring devices and these are used to give exact measurements. The cap of the pesticide bottle can hold an exact amount of liquid depending on its size. Yet, this could be misleading. If a farmer has to apply cypermethrin; the dosage of which is 1.25mL/L of water. The cap of the Cymbush (Cypermethrin) bottle measures at least 5 to 7 mL of liquid. So, if the farmer is blindly using the cap of the bottle as a measuring device he is being misguided and applying more than the required amount of pesticides. This reflects the dire reality in Mauritius, where most farmers have adopted the mentioned principle. It is because of this amateur method of measurement that pesticides residues beyond the Maximum Residue Limits are bound to be detected. Another important aspect of pesticide application is the use of personal protective equipment. The 'Le Guide Agricole' (2010) recommends the use of gloves, mask and boots while handling dangerous chemicals such as pesticides. Agriculture is an extremely hazardous industry associated with a large number of occupational injuries and chronic illnesses (Schenker, 1996). Out of 300 farmers, 24.3% and 28.3% rarely and sometimes respectively used personal protective equipment; 35% always and 12.3 % never used. Only 35% i.e. 105 farmers have always been using a personal protective equipment. The remaining either partially or some never use. Out of the five major health hazards faced by farmers and farm workers; health problems associated with the inappropriate use of pesticides have emerged as most important [13]. So, it is very important to wear necessary protective equipment while handling pesticides.

Pesticides and crop yield

Answering a likert scale question, out of 300 growers, 20.67% and 30.67 % recognized that pesticides application increases plant yield whereas 25.33% and 7% disagreed on that. There was also a group of farmers amounting to 7% of the lot that responded neutrally. This has been illustrated in figure D. Pesticide application in no way could force an increase in crop yield but pesticide is important for crop protection. Crop protection has been developed for the prevention and control of crop losses due to pests.

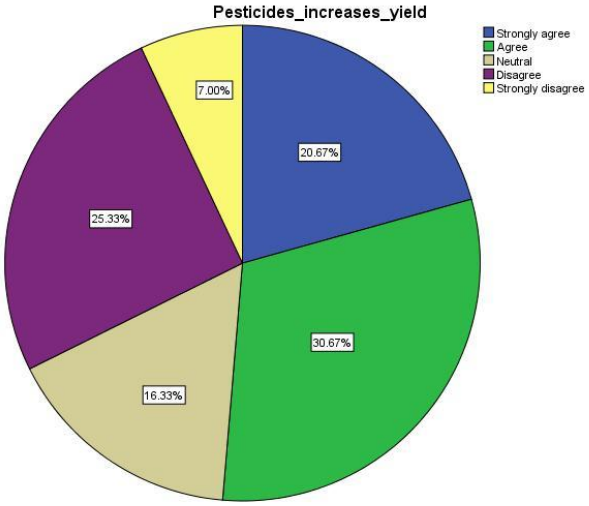

Figure D: Pesticides increases yield.

94.7% growers agreed on the fact that spraying more than required amount of pesticide increases crop yield. Pesticides do not increase crop yield. These important chemicals are not crop yield boosters; they counteract the effect of dangerous pests and diseases. Pests and disease contribute to a large amount of crop losses which pesticides can reduce. Increasing the rate of pesticides has important implications on the environment and on human health. So, increasing pesticides dosage renders agricultural product unfit for human use and consumption.

Dangers of using pesticides

Pesticides users very often only care about crop protection disregarding human health and environmental aspects of pesticides misuse. 39.7% of farmers think that pesticides misuse could lead to environmental pollution while 47% think that it can affect human health. The remaining 13.3% were not sure of the dangers pertaining to pesticides misuse. Pesticide poisoning is a major public health challenge in many parts of the world, especially in the developing countries. The World Health Organisation estimates about 300,000 deaths due to agricultural pesticide poisoning every year [14].

Factors motivating farmers to use pesticides

Pesticide has been regarded as a chemical that kills. It is applied in crop production to reduce crop losses through the infestation of pests and diseases. Most farmers have adopted pesticides due to many reasons. Along the farmer's survey, 13 likert scale questions were asked to the farmers pertaining to pesticide usage. A factor analysis was run after which the conditions were satisfactory. The KMO was 0.512, and 6 factors explained a cumulative variance of 60.25%. Table E: factor analysis factors

S/N	FACTOR
1	Influence by fellow farmers
2	Pricing and efficacy of pesticides
3	Experience in farming
4	Effectiveness of results
5	Availability of pesticides
6	Quickness of results

The factors extracted have been illustrated in table E. Factor 1; influence by fellow farmers is the main reason for farmers to choose pesticides. Farmers do communicate among themselves and they base on recommendations of friends and relatives who have tested or used the product already. Pricing and efficacy of pesticides is the second factor influencing the mind of the farmer. This factor is directly linked with the value for money. Farmers want to express themselves by telling that they get what they buy. Factor 3 is the experience in farming. Experienced farmers tend to be knowledgeable and thus they recommended pesticides. Effectiveness of results is the fourth factor. This principally takes into account the usefulness of the product. Farmers want to express themselves by telling that pesticides are very useful in tacking several problems in crop production. Factor 5 is availability of pesticides. According to farmers pesticides are readily available. In Mauritius, we have many agrochemical shops and all these agrochemical shops sell pesticides that are readily available to farmers. The last factor influencing the decision of farmers is the quickness of results. Pesticides are very quick in generating results. Pesticides act very quickly in controlling a certain pests or disease and thus farmers are able to minimize the crop loss.

4. CONCLUSION

The farmers' survey highlighted many constraints in the way farmers proceed with the usage and handling of pesticide. This is a very serious issue which will have to be resolved very quickly because pesticides can cause serious damage to human health and farmers are the one to be firstly harmed. The statistical analysis emphasized on the fact that farmers are easily influenced. The main factor

attributing towards farmers to use pesticides was peer pressure. More awareness campaigns showing the dangers of pesticides application will have to be brought forward to educate farmers and also make them conscious of what we can expect from pesticide misuse and mishandling. Finally, the best solution to all these problems would be the adoption of organic agricultural practices.

CONFLICT OF INTEREST

The authors have no conflict of interest.

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