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Assessing the diversity and intensity of pesticide use in communal area cotton production in Zimbabwe

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A survey was conducted in Checheche, Nemangwe, Sanyati and Tafuna areas of Zimbabwe to assess the level of insecticide use and use of protective clothing in smallholder cotton production areas where the Cotton Research Institute conducted cotton experiments. Compliance with the closed season legislation, the Plant Pest and Diseases Act, Chapter 19, Section 8 of 1988 was checked because of its role in seasonal pest survival. Generally, pest management was found to be anchored on the use of insecticides with 71.9% of the farmers having positive indications regarding dependence on insecticides for pest control. Fifty nine percent of the farmers did not use scouting as a method to determine the need to spray insecticides. The closed season that helps break life cycle of insects was predominantly not observed. Integrated pest management approaches need to be promoted for the sack of the environment and the future of humanity.

Key words: Closed season, insecticide, integrated pest management.

INTRODUCTION

Cotton plays a significant role in the economy of Zimbabwe as it is the second largest export crop after tobacco (Esterhuizen, 2009). In 2008 the crop earned the country about US $150 million (Esterhuizen, 2009). However, in spite of its contribution to national economies, cotton is regarded as the most environmentally “toxic” crop on the planet (Cummins, 2003). Cotton covers 2.5% of the world’s cultivated land yet it accounts for 24% of the world’s insecticide use making it the most insecticide intensive crop globally (Laura, 2010). Chemical insecticides are used extensively in cotton production to control insect pests, with the primary target being bollworms (Vitale et al., 2007). Bollworm pressure has a positive impact on insecticide use (Qaim et al., 2003; Cotton Handbook Zimbabwe, 1998). Studies have shown that in Zimbabwe chemical pesticides alone can account for 70% of the variable costs in cotton production (Mudimu et al., 1995). Chemical insecticides when used carelessly can harm not only the environment, but also valuable pest predators, and the health of growers. The purpose of this study was to assess and establish the range and quantities of pesticides that are used by cotton growers in Zimbabwe. The results of the study would provide baseline information for further survey at a national scale. The objectives of the study were: To determine level of pesticides use in smallholder cotton production sector of

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Zimbabwe and determine the extent of use of protective clothing

MATERIALS AND METHODS

Study areas

The study was carried out in the cotton growing areas of Checheche, Nemangwe, Sanyati, and Tafuna.

Checheche

Checheche is located in the South Eastern Lowveld, approximately 80 km north northeast of Chiredzi town along the highway to BirchnoughBridge. It is in Natural Region V. The study area is located approximately 20°49' S and 32° 15' E. The altitude of the area ranges from 395 m in the south to 404.4 m in the north.

Nemangwe

The area is located approximately 30 km west of Gokwe Growth Point. The study area lies within the 18° 11' 00 S to 18°° 12' 17 S and 28° 50' 25 E to 28° 51' 10 E coordinates in Natural Region IV. The altitude is about 1175 m. Soils are of loamy sand texture. The area is dominated by Mopani (*Colophospermunmopani*) woodlands. It is a smallholder communal area. The main landmark is Half-way Business Centre (H. B. C).

Sanyati

Sanyati area is located in Natural Region III on 17° 54' 47 S and 29°15' 15 E. The general altitude for the area is 832 m. Soils are of loamy sand texture. It is a smallholder communal area as well to the west of the area in Munyati river that flows northward.

The survey

The survey involved questionnaire interviews to collect baseline data on level of synthetic pesticide usage, and challenges regarding cotton stalk destruction in the areas under study.

Method of sampling

Sampling of respondents for questionnaire interviewees

Personal interviews were carried out using a designed questionnaire. Interviews were conducted in the villages of cotton growers who hosted Cotton Research Institute experiments in the same areas selected above. At each site, villages in which farmers hosting Cotton Research Institute experiments were located, identified and 50% of the villages were picked using simple random sampling. Heads of the selected villages were requested to provide names of all cotton growers in their villages. Fifty percent of the cotton growers in each village were randomly picked using simple random sampling method, and interviewed using prepared questionnaires. The interviewing team underwent a process of rehearsals to prepare them for the interviews. In Checheche, 13 farmers from Matikwa village in ward 26 of Chief Garawa were interviewed. In Nemangwe, eight farmers from Ndziko village in ward 12 of Chief Nemangwe were interviewed. In Sanyati, 11 out 12 farmers from Madhuveko village in ward 12 of Chief Wozhele were also interviewed. The twelfth farmer had gone to attend a funeral of a relative.

The questionnaire

The questionnaire was in four parts.

Part one

The first part sought to gather the farmer's location, average cotton hectares, and years of experience as a cotton grower.

Part two: pesticides

The second part was concerned with pesticides. Section one gathered information about a variety of insecticides and average quantities of each that a cotton grower applied seasonally. Seven insecticides were used on lepidopteran pests.

Section two sought to collect information on the standard of grower protection against insecticides. Chemicals sprays contaminate the environment and human beings and more-so those who conduct the spraying which poorly protected. Insecticides are mostly toxic chemicals. The assumption is that people who care less about their own personal safety against poisons would care lesser against poisoning the environment as well.

Part three: Slashing and destruction of cotton stalks to determine level of farmer compliance.

This part of the questionnaire collected information regarding slashing and destruction of cotton stalks. The information would help understand the causes behind ratoon cotton production and whether the cotton growers appreciated the ecological value of residue destruction as a cultural, non-chemical pest management tool. The information would also help to determine the level of compliance with regulations guiding cotton stalk destruction. The team leader of the plant inspectorate was also asked to tell the constraints regarding enforcement of the closed season regulation through personal one on one communication.

Statistical analysis

Statistical Package for Social Scientists (SPSS) was used for data entry and analysis of frequencies. Data from questionnaires were analysed for frequencies. Cross tabulation was done using SPSS to determine relationships between variables.

RESULTS

Factors affecting grower compliance with plant pests and diseases act; chapter 19:08 of the republic of Zimbabwe

Cotton growers gave a variety of reasons why the closed season legislation was being ignored by some of the growers. Farmers who rent rather than own land were also cited though rarely as the ones who leave standing cotton over the off season. The ratoon cropping, and laziness were cited as the major reasons for not complying with the closed season legislation. The price and unavailability of planting seed, and labour constraint were also common responses (Figure 1).

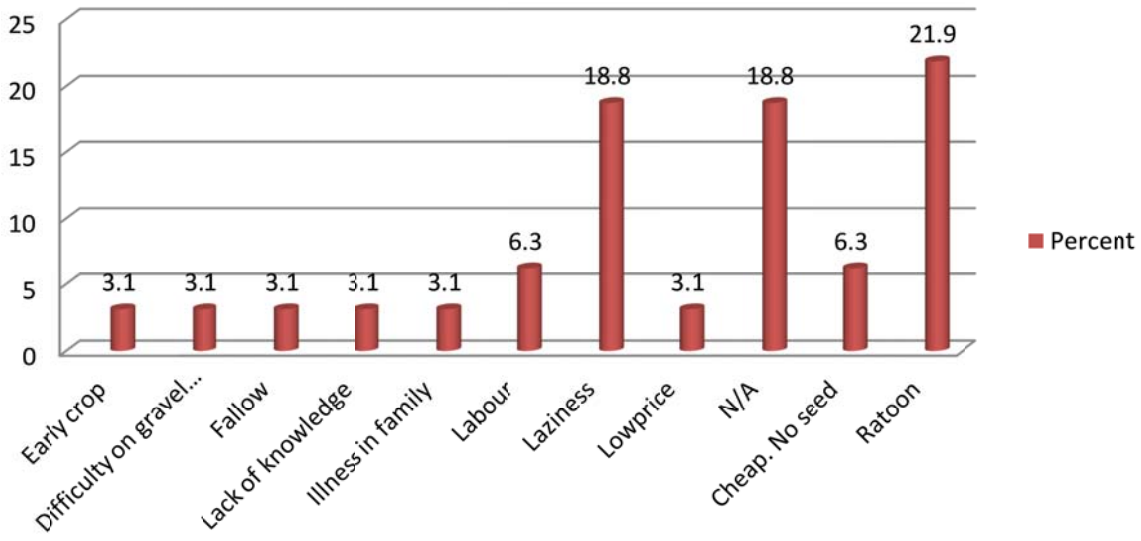

Figure 1. Diversity of reasons the farmers gave for not destroying cotton stalks.

Figure 2. Graphical presentation showinglevelof compliance with closed season regulations.

Compliance with closed season regulations

Results from the interviews showed that 71.9% of the farmers claimed to have had slashed cotton stalks in their fields while 28.1% admitted not to have slashed cotton stalks (Figure 2). However visits to the field by the survey team revealed that only 34.4% of growers had slashed while 65.6% had not slashed. Therefore the actual level of compliance with the above legislation by the time the survey was conducted was 34.4%. Under consideration also was whether the grower had slashed cotton stalks by the legislated date and not by the date of the interview.

Dependance on insecticides in the study areas

Cotton pest management in the study areas is dominated by use of insecticides.

A total of eight insecticides and two acaricides namely Mitac (Amitraz) and Tedion (Tetradifon) were recorded as having been used by cotton growers in the study area.

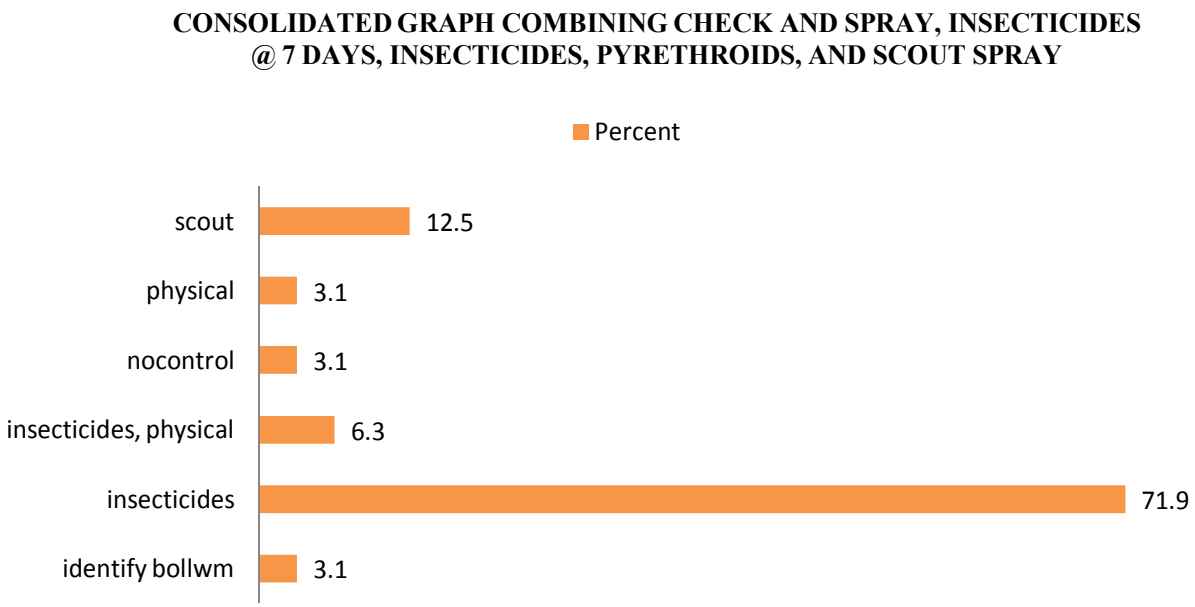

Figure 3. Showing the extent of reliance on chemicals for pest control by cotton growers.

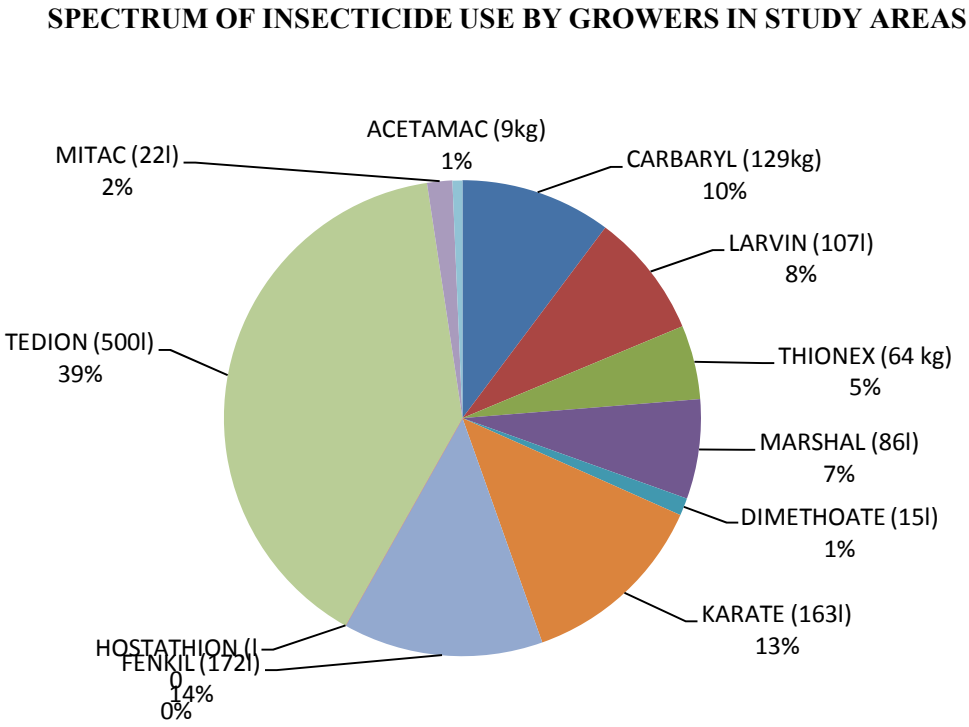

Figure 4. Showing a range of chemicals farmers said they used.

Insecticides accounted for 71.9% of responses given by cotton growers in the study areas (Figure 3).

Karate (lambda) and Fenkil (Fenvelarate) Carbaryl, Larvin (Thiodicarb 37.5 FW), and Thionex (Endosulphan 35 EC) were being used mainly against bollworms (Figure 4). Together the chemicals accounted for 50% of all chemicals used in the study areas. That could imply considerable bollworm pressure. Monocrotophos was also in use at Checheche. Such a highly poisonous product is not recommended for application using hand held equipment

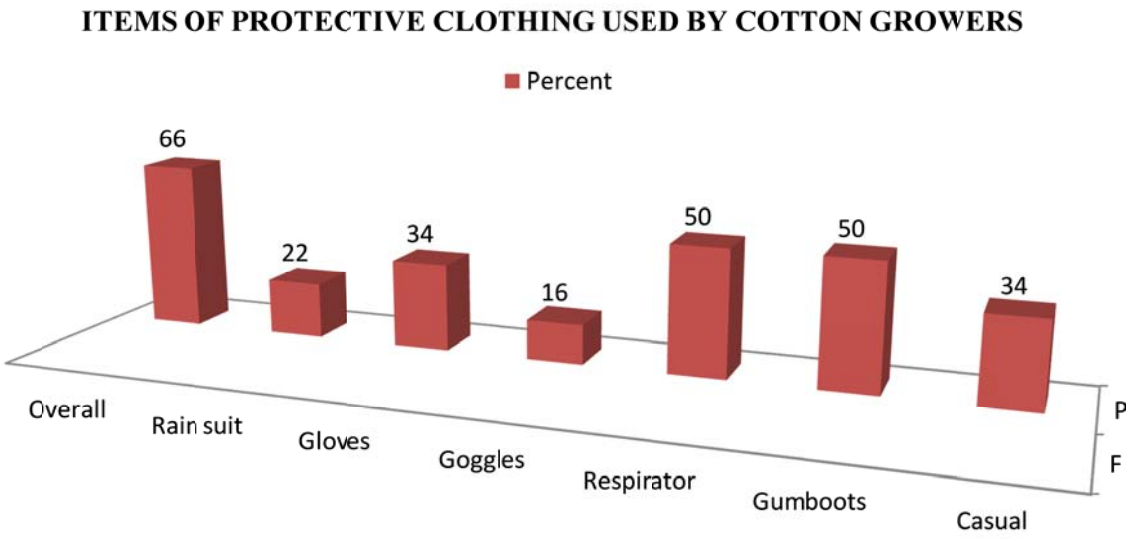

Figure 5. Graphical presentation of items of protective clothing used by growers in study areas combined.

as was the case in Checheche.

Assessment of protective clothing for use during handling of insecticides

Sixty six percent of respondents applied chemicals without any form of protective clothing while 66% handled chemicals with bare hands and 50 % without respirators (Figure 5). An important observation was that in some cases what respondents regarded as respirators were actually dust masks.

DISCUSSION

Factors affecting grower compliance with plant pests and diseases act chapter 19:08.

Level of compliance

The level of compliance with the closed season regulation by the time the survey was conducted was 34.4%. Under consideration also was whether the grower had slashed cotton stalks by the legislated date and not by the date of the interview. In the Low veld, Checheche included, the closed season started on 1st August and ends on 5th October each year. The survey was conducted from 6 to 8 September 2010 and most farmers had not slashed cotton stalks by that time; that was five weeks into the closed season. In the Middle veld, where Nemangwe, Sanyati, and Panmure are located, the closed season starts on 15 August and ends on 20 October each year. Most cotton growers had not slashed cotton stalks by 16-18 September 2010 when interviews were conducted in Nemangwe and Sanyati. That was a full month into the closed season.

Factors affecting compliance

Production of seed cotton from ratoon was cited by most growers as the major cause for not destroying cotton stalks. Ratoon is becoming popular because it ensures an early cotton crop which normally matures before a crop established from seed. The ratoon crop establishes quickly with the first rains of the season. The ratoon grows from a well-established root system hence can better survive through mid-season droughts. Farmers are able to sell their seed cotton and earn money earlier in the harvest period. Production of ratoon crop is cheap considering the current price of US $1.00 per kg of cotton seed. The recommended seed rate for cotton is 25 kg/hectare implying that the grower would have saved US $25.00 for every hectare.

Destruction of cotton stalks is becoming unpopular because of the low market price for seed cotton. There is no grower motivation to go back to the fields to slash and destroy cotton stalks after selling the crops at “unviable prices”. Destruction of cotton stalks does not offer a direct monetary benefit hence the reluctance to commit labour, the laziness, and, the prioritization of other family welfare issues over the future of the crop. Issues of labour, laziness and family illnesses are linked. When combined they account for 28% frequency.

From the point of view of the plant inspectorate there are several factors that led to complacency towards destruction of cotton stalks by cotton growers chief among them being lack of visibility of inspectors in cotton growing areas due to poor mobility and delayed amendment of the legislation to enable the inspectors to issue United

States dollar (US$) tickets (*Pers. Com,* 2010). At the time of the survey the Plant Pest and Diseases Act still stipulated fines in Z$ but the economy was using US$ it is not possible to punish offenders. The closed season regulation would continue to be ignored for as long as the enforcement agent remains logistically and legally incapacitated.

Pest management practices existing in the study areas

Over 70% of cotton growers in the study areas relied on insecticides alone for pest control. This is consistent with situations where the closed season is not strictly observed in cotton production. The only other method which rarely cited though was physical control, whereby grower pick and kill pests they find as they walk through the field. Scouting for pests before chemical application was mentioned although most growers failed to explain the technique.

The total area put to cotton by the study areas' sampled cotton growers in Checheche, Nemangwe and Sanyati was 137.5 hectares. Karate (Lambda) and Fenkil (Fenvelarate) are systemic pyrethroids used for the control of bollworms. Combined these chemical accounted for 335 L over 137.5 hectares, which is 2.4 L/hectare instead of about 0.8 l/hectare (Cotton Handbook, 1998). Conventional contact insecticides that growers indicated to have been using to target bollworms were Carbaryl, Larvin, and Thionex all of which account for 300 kg over 137.5 hectares, which is 2.2 kg/hectare. The national average cotton area is 360000 hectare/year. Assuming that each grower applies 2.4 L of pyrethroids per hectare and 2.2 kg of conventional insecticides per hectare, then, 877 090 L and 785 454 kg respectively could be sprayed into the environment annually. Such generous applications of insecticides to control crop damage by pests increases the direct risk of environmental pollution and kill non target pests. The environment is suffering. Growers are suffering too. Their standard of protection when handling insecticides is low.

The main ecologically appropriate cotton pest control tool is observance of host-free period. The low level of compliance with the closed season is linked to general "indiscipline" in the whole pest management regime at the expense of the environment. It was observed that even the acaricide rotation scheme is not being observed. In 2009/2010, Tedion (Tetradifon) was supposed to be used for red spider mite control in Region II only.Tedion is a sulphur compound with a long residual action (Mabveni, 2000). Cotton growers in Region III also used the same thereby increasing the risk RSM developing resistance to acaricides.Some 500 L of tedion was applied on 137.5 hectares that is 3.5 l/hectare against a recommended rate of 1.2 l/hectare (Cotton Handbook, 1998). Assuming that each grower in Zimbabwe applied 3.5 L, then, 1 2 million L of tedion alone could be sprayed into the environment annually. Of interest was that two growers in Checheche were using nuvacron (monocrotophos), a highly poisonous organophosphate. They got it from neighbouring Mozambique.

The latest global trends in pest control in cotton show that insecticide use is on the decline in most countries and cotton producers are rapidly moving toward minimal insecticide dependent cotton production systems (ICAC, 2007). It appears that Zimbabwean farmers are going in the opposite and wrong direction. There is need to rigorously promote environmentally friendly sustainable pest control systems. The closed season is environment friendly and will undoubtedly reduce insecticide use when strictly observed. While the total elimination of insecticides may not be feasible everywhere it is certainly possible to drastically reduce their use.

Conclusions

Cotton bollworm management in Zimbabwe was largely insecticidal. Cotton growers had a high risk of contamination by insecticides due to poor protection during handling. Integrated pest management was not popular among cotton growers.

Recommendations

Recommendations for future research and pest management practices are given below:

1) The legislation governing cotton closed season and destruction of cotton stalks should be enforced by Plant Quarantine Services as a matter of national priority. That could have the effect of suppressing pest population and of cutting down on the level of insecticide application into the environment.
2) Cotton growers should be trained in the application of integrated pest management techniques most of which are environment friendly and economically sustainable. Rigorous extension is essential in order to increase the level of social and environmental responsibility of cotton production.
3) Finally, legislation alone cannot bring about cooperation. Cotton merchants have to address growers'' grievances regarding producer prices and cost of input.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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