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Knowledge of extension officers on pest management in Horticulture in Thulamela Local Municipality in Vhembe District of Limpopo Province

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ABSTRACT

This paper focuses on the knowledge of the extension officers on pest management in horticulture in Thulamela municipality - Vhembe district. The study was conducted among 31 extension officers who were selected based on their speciality for dealing with crop production issues in the Thulamela municipality. The study revealed that most of the respondents had some shortcomings in different areas of their expertise such as limited knowledge of different pest management strategies (e.g. cultural control, biological control, and Integrated Pest Management). The majority (71%) of the respondents chose chemicals as a way for controlling pests, this is a cause of concern as it depicts their limited knowledge of other control methods (e.g. cultural, Integrated Pest Management, and biological) that are used to control pests. A small number of only 3.2% of the respondents knew the role that is played by natural enemies (biological control) in the management of pests. The study had the following recommendations, firstly, there is a need for agricultural extension officers to be regularly trained on pest management so that they can be up to date with new technology on plant protection issues. Secondly, there is a strong need to train agricultural extension officers on how to conduct pest surveillance, this will enable them to detect and manage pests on time.

Keywords: Agricultural extension officers, Pest, Pest management

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1. INTRODUCTION

This paper focuses on the knowledge of the extension officers on pest management in horticulture in Thulamela municipality - Vhembe district, Limpopo province. The fruit and vegetable industry (horticultural industry) is faced with many challenges such as porous quarantine borders, limited knowledge and management of key pests, and economic treaties. The industry is threatened by an infestation of different pests such as fruit flies and moths. Globally, fruit flies (Tephritid) pose a huge threat to the horticultural industry and they are also pests of economic importance that cause both direct and indirect damage to host crops. Direct fruit damage occurs when adult female fruit flies puncture the skin of a fruit & lay eggs under it causing the fruit to decay resulting in the fruit becoming unmarketable. According to Ishida, Nakahara, Minoura, and Dohino (2005), indirect damage comes from phytosanitary measures/conditions that are made or set by the importing country to protect its territory from the introduction and spread of quarantined pests.

Pests are a challenge for smallholder farmers in Thulamela municipality as these pests reduce the quantity and quality of the produce that are produced by farmers. Some of the pests that farmers experience include bagrada bug, aphids, and white flies. On top of these pests, other pests have invaded South Africa over the past few years such as the Oriental fruit fly, *Tuta absoluta*, Fall armyworm, Polyphagous shothole borer, and Banana bunchy top virus. These new pests are putting a lot of strain on farmers who were already dealing with pre-existing pests in the area.

To address the pest problem in Thulamela municipality, it is important to assess the knowledge of agricultural extension officers on pest management. Agricultural extension officers serve as a means of transferring important farming knowledge to farmers. They play a major role in the effective management of pests as they provide farming advice to farmers. According to Saleh, Man, Lafta, Saleh, Hassan, Nawi, and Kshash (2016), an agricultural extension officer mustreach farmers that are scattered throughout various communities with practical and useful data that will enable them to improve their yield. The objective of this paper was to investigate the knowledge of the extension officers on pest management in horticulture. Abbas, Lodhi, Bashir and Mehmood (2008) indicated that agricultural extension is a system of distributing the most recent information and farming methods to the farming community to improve their conventional farming practices.

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Agricultural extension officers (AEOs') are very significant in the implementation of integrated pest management (IPM). According to Raidimi and Kabiti (2019), extension can link growers with sources of agricultural inputs and outputs that are reliable and cheap, which may lead to the low cost of production and high income. Evaluating AEOs' educational needs and knowledge status is a crucial element in extension service delivery and the success of the technology dissemination process. There are prescribed standards for agricultural extension officer's level of education and training, according to the norms and standards for extension and advisory services. The document on the norms and standards for extension and advisory services also has standards for the employer on the nature and type of support that must be provided to the extension officers. According to the Directorate for Education and Training (2007), 80.2% of agricultural extension officers in South Africa have a diploma qualification however, the document on the norms and standards for extension and advisory services prescribes that the minimum academic qualification for an agricultural advisor is a Bachelor's degree in Agriculture.

The knowledge and skills in the agricultural extension system should be regularly assessed and updated to ensure that extension services stay relevant to the ever-changing agricultural landscape (Khwidzhili & Worth, 2019). According to Worth (2006), the learning-based model emphasizes the need to build capacity for learning throughout the extension system but most importantly among the farmers. There is a need to train agricultural extension officers for them to effectively respond to the needs of smallholder farmers, according to the National Development Plan for South Africa. This paper will help in identifying the extent of knowledge and training gaps of agricultural extension officers on pest management in horticulture.

2. LITERATURE REVIEW

2.1 Purpose of Agricultural Extension and How it is Evolving

According to Koch and Terblanche (2013), the main role of agricultural extension from its inception was to help growers make decisions that will improve their farming practices and the country's food security. Collett and Gale (2009) indicated that agricultural extension is the process of developing agricultural knowledge and skills amongst growers to bring good changes and enhance productivity. Agricultural extension contributes to poverty alleviation and food security by enhancing the productivity and income of growers (Raidimi & Kabiti, 2019). According to De Klerk, Drimie, Aliber, Mini, Mokoena, Randela, Modiselle, Vogel, De Swardt, and Kirsten (2004) agricultural

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extension ranges from narrow technology transfer to advisory services that widely address farming and related practices. Khwidzhili and Worth (2019) indicated that agricultural extension in South Africa is used to support the development of agriculture and it plays a major role in educating farmers to practice more efficient and profitable farming.

In South Africa (SA), the agricultural extension evolution dates back to 1902 when agricultural scientists were imported from England (Khwidzhili & Worth, 2019). Agricultural extension in SA was supported by the then National Ministry of Agriculture and began to take shape around 1925. About six extension officers were approved by the ministry to help the whole country by executing extension services. Academic institutions such as the University of Pretoria incorporated agricultural extension as an academic career in the early 1940s. According to Koch and Terblanche (2013) universities such as the University of Pretoria, the University of Venda, Tshwane University of Technology, the University of Fort Hare, Cape Peninsula University of Technology, the University of Limpopo, and North West University offered agricultural extension programmes. Some agricultural extension training was also offered by 11 agricultural colleges.

According to Khwidzhili and Worth (2019) in 1966 a professional body called the South African Society for Agricultural Extension (SASAE) was established to support extension officers. Even though the agricultural extension was incorporated into academic programmes and regardless of the role that it plays in a grower's livelihood and the economy; it was not recognised as a science by the South African Council of Natural Sciences (SACNASP). However, since 2013, agricultural extension is considered a science by SACNASP (Khwidzhili & Worth, 2019).

According to the norms and standards for extension and advisory services in agriculture (2005), agricultural extension in South Africa has in the past 10 years undergone important changes from being a dualistic service to being a single amalgamated service that caters to both commercial and small-scale farmers. The norms and standards for extension and advisory services in agriculture further stated that important changes in the policy, administration, delivery mechanisms, and systems for government services were introduced so that they could be in line with the new constitution and this was done in 1994 during the democratization of South Africa. In 1994, after the adoption of the South African Constitution, it was established that the board of extension policy would be done at the national level while the provincial governments would be responsible for the delivery and

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management of extension to farmers. According to Worth (2012), 9 separate extension services were formed which are bound by the broad national policy with no meaningful national coordination; they are only accountable to the provincial legislatures, governments, and individual political leaders in the province.

2.2 Profile of Agricultural Extension Advisors in South Africa and Challenges

A study was conducted in 2006 by the Department of Agriculture on the profiling of government extension officers, this was done to evaluate the state of current extension services against the norms and standards and to gain a sense of the levels of expertise and capacity at the department's disposal. According to the norms and standards for extension and advisory services, there are prescribed standards for agricultural extension officers' level of education and training. The document on the norms and standards for extension and advisory services also documents standards for the employer on the nature and type of support that must be provided to the extension officers. The document prescribes that the minimum academic qualification for an agricultural advisor is a bachelor's degree in Agriculture. According to the report on the profiling of the current government-employed extension and advisory service officers (2007), there are about 2210 employed extension officers in South Africa with the highest number in Limpopo province. According to this report, out of all the employed extension officers in South Africa, 80.2% have a diploma qualification and only 19.8% have a degree or higher qualification. Gauteng and Free State are the only provinces with a good percentage of officers with degree-level qualifications. Within all seven provinces of SA, female extension officers had higher educational qualifications than male extension officers.

According to the norms and standards for extension and advisory services, extension officers should be competent in the following areas: communication, client orientation, and customer focus, project management, management knowledge, problem-solving analysis, service delivery orientation, people management, and empowerment. The report for the Directorate of Education & Training (2007) indicated that very few extension officers have been formally exposed to skills programmes (such as communication, project management, computer, and people management training) that are crucial in the delivery of products and services to farmers. The majority (73%) of extension officers are male, with a 50/50 gender representation only found in KwaZulu-Natal. 93% of the extension officers are Africans while only 5% are Whites. 80% of the extension officers are above the age of 35 years while only 20% are below the age of 35 years. Based on the extension farmer ratio, it is evident that

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provinces such as KwaZulu-Natal, Limpopo, Eastern Cape, and Mpumalanga have the greatest shortfall of extension officers when compared to the four (Gauteng, Northern Cape, Western Cape and Free State) remaining provinces (Directorate Education & Training, 2007). According to the norms and standards for extension and advisory services in agriculture (2005), the key challenge for agricultural extension is a lack of capacity in the 9 provinces and a shortage of financial resources.

2.3 Importance and Harmful Effects of Pesticide Use

Pests are a major constraint for smallholder farmers and most smallholder farmers rely on pesticides to control these pests and to improve the crop yield. According to Maksymiv (2015) in the past 60 years, through the usage of pesticides, growers have managed to improve the production of foodstuff. The use of pesticides by growers to control pests and prevent yield loss has enhanced crop yield, food availability, and reasonable prices throughout the seasons. Pesticide usage by farmers in most countries has highly improved productivity, helped in controlling unwanted species, and has maintained the grass in sports grounds (Maksymiv, 2015). According to Damalas (2009), the usage of pesticides minimises pest infestations and prevents yield loss and loss of crop quality.

According to Damalas (2009) pesticides have many benefits which mostly go unnoticed, these benefits include economic benefits such as the protection of crop quality and yield and the minimisation of cost for inputs. Pesticides help in preventing the decrease in food production and the increase in food prices. If the production of food is low and the price of food is high, this might prevent growers from competing in international markets. The use of pesticides to control pests enhances crop yield, and crop quality and ensures reliable food supply at reasonable prices. Pesticide usage not only benefits farmers or consumers, but it also benefits society in general as they are also used around homes and businesses.

The improper or overuse of pesticides may cause problems such as the development of resistance by pests, health problems, and soil and water pollution. According to Jallow, Awadh, Albaho, Devi and Thomas (2017), 65% of growers indicated that pesticides are hazardous to the environment while 70.5% of the growers indicated that pesticides may be harmful to human health. Maksymiv (2015) indicated that the utilisation of pesticides may be a hazard to humans, animals, and the environment. The effect of pesticides on human health is due to the contamination of food as a result of toxic

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pesticides; these pesticides can also cause various diseases such as cancer. The toxicity of pesticides on humans or animals can occur through dermal absorption, inhalation, and ingestion.

According to Miller (2004), most of the sprayed pesticides do not reach the targeted species, inadvertently contaminating water, soil, air, and non-targeted species. Maksymiv (2015) indicated that pesticides can be harmful to organisms such as fish, birds, non-targeted plants, and beneficial insects. According to Cerejeira, Viana, Batista, Pereira, Silva, Valerio, Silva, Ferreira, and Silva-Fernandes (2003) the contamination of surface and groundwater by pesticides can harm aquatic plants and animals.

3. RESEARCH METHODOLOGY

3.1 Study Area

The study was conducted in the Thulamela municipality - Vhembe District Municipality, Limpopo Province of South Africa. According to Thulamela municipality IDP (2020/2021), it is one of the four municipalities in the Vhembe district and covers 2893.936 km^2 (2893 393 hectares). The Kruger National Park forms the boundary in the east while sharing the border with Makhado in the south and southwest (Thulamela local municipality, 2020). The municipally provides good agriculture as it produces fruits such as bananas, mangoes, avocados, and citrus and vegetables such as tomatoes, potatoes, and onions (Louw, 2017). Some of the areas of Thulamela have been shared with the new Municipality of Collins Chabane. Thulamela municipality consists of three service centres namely, Khumbe, Matangari and Thohoyandou service centre, where mixed cropping is practiced.

3.2 Sampling and Sample Size

Thulamela municipality has about 40 agricultural extension officers dealing with crop production issues (Department of Agriculture, Forestry and Fisheries [DAFF], 2015/16). These 40 agricultural extension officers formed the population within this study however, only agricultural extension officers who deal with crop production issues were sampled. The sampled agricultural extension officers work with farmers that produce fruits (such as banana, citrus, mango, avocado, litchi, granadilla, and peaches), vegetables (such as tomatoes, potatoes, butternut, peppers, and garlic) and nuts such as macadamia. Raosoft software and sample size formulas were used to calculate the sample size of the study. The following values (confidence level of 95%, and a margin of error of 5%, a population size of 40, and a response distribution of 50%) were populated on the Raosoft

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calculator and the sample size was automatically calculated. According to the Raosoft sample size calculator, a population of 40 agricultural extension officers produced a sample size of 37. Table 1 shows the sample size of the study.

Table 1: Sample size calculated and determined using Raosoft sample size calculator

Name of Municipality	Population	Actual Sample Size	Responses Received
Thulamela municipality	40	37	31
Total	40	37	31

Source: Own study

The sample size for agricultural extension officers was calculated using a Raosoft Database (undated) sample size calculator giving a confidence level of 95% and a margin of error of 5% (Table 1). The total sample size calculated was 37. The sample size was also calculated manually using the following sample size formula:

$$\text{Sample size} = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + \frac{z^2 \times p(1-p)}{e^2 N}}$$

Where N (population size) = 40, z (z-score) = 1.96, e (margin of error) = 0.05, p (standard of deviation) = 0.5.

$$\text{Sample size} = \frac{\frac{1.96^2 \times 0.5(1-0.5)}{0.05^2}}{1 + \frac{1.96^2 \times 0.5(1-0.5)}{0.05^2 \times 40}}$$

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$$\text{Sample size} = \frac{\frac{3.8416 \times 0.25}{0.0025}}{1 + \frac{3.8416 \times 0.25}{0.1}}$$

$$\text{Sample size} = \frac{384.16}{1 + 9.604}$$

$$\text{Sample size} = \frac{384.16}{10.604}$$

$$\text{Sample size} = 36.23$$

3.3 Data Collection

Data was collected by interviewing agricultural extension officers using a structured questionnaire with open and close-ended questions. The data was collected over two weeks with the sampled agricultural extension officers.

3.4 Data Analysis

The gathered data was analysed by using the Statistical Package for Social Sciences (SPSS) version 22.

4. RESULTS AND DISCUSSION

This section presents the findings of the study which covers the demographic details and the knowledge of the extension officers on pest management in horticulture.

4.1 Demographic Characteristics of Advisors

The results showed that the majority (54.8%) of the respondents that were interviewed were male, while 45.2% were female. The fact that the majority of the respondents are male is also supported by the report on the profiling of the current government-employed extension and advisory service officers (2007) which indicated that 73% of extension officers in South Africa are male. According to the DAFF (2017), most people see agriculture as a field that requires more labour force hence it is

predominated by males. Age plays a major role in the acceptance and adoption of new farming technology. The results showed that 51.6% of the respondents who were interviewed were above the age of 51 years, 41.9% were between the ages of 36 and 50 years and only 2% were below the age of 35 years. Ngaka and Zwane (2017) indicated that the majority of officials at the Provincial Departments of Agriculture (PDAs) are older as compared to those at the national head office who is in charge of extension.

Extension officers were asked to indicate the type of qualifications that they have. The results showed that the majority (64.5%) of the respondents had a bachelor's degree, while 35.5% had a national diploma. This indicates that the agricultural extension officers in the study area meet the requirements that are stated in the norms and standards for extension and advisory services in agriculture. According to norms and standards for extension and advisory service in agriculture (2005), advisors are required to have a degree qualification or higher qualification. Alibaygi and Zarafshani (2008) indicated that the professional qualification of AEOs is essential for the sustainability of every extension delivery system. According to Erbaugh, Kibwika, and Donnermeyer (2007), the professional qualifications of AEOs are a significant requirement for the effective distribution of information and innovation communication.

The respondents were asked to indicate their work experience in the field of extension, the results of this study showed that the majority (58.1%) of the respondents had more than 20 years of working experience, which plays a major role in the management of pests. Ngaka and Zwane (2017) conducted a study in the 9 provinces of South Africa and found that the majority of the respondents at the provincial level had more years of working experience. Muhammad (2017) indicated that work experience and age have a significant effect on AEO's ability to manage pests.

4.2 Constraints Caused by Pests, Pests Control Methods, and Meaning of IPM

Agriculture extension officers were asked to indicate the constraints caused by pests, the results are presented in Table 2 below. The results showed that 58.1% of the respondents were able to list at least four challenges that are caused by pests. Some of the constraints that were listed by extension officers include loss of market, poor quality products, loss of income, and high production cost. The fact that agricultural extension officers were able to list some of these constraints shows that they are aware of the constraints that can be caused by pests. This also indicates that pests are a challenge to

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farmers in the area as they affect the quality and quantity of the yield produced which results in unmarketable produce leading to lower farm income. Pests also cause farmers to spend more money on buying more production inputs. The production and marketability of fruits and vegetables are threatened by fruit flies as they reduce the quantity and quality of produce (Mugure, 2012). According to Sebstad and Snodgrass (2005), Africa's mango production is considered to be below its potential as a result of the increase in production costs and the reduction of the quality and quantity of marketable produce due to fruit flies.

Extension officers were asked to indicate the methods that are used to control pests, the results are presented in Table 2 below. Out of the four pest control methods that are listed in Table 2, only one has a high percentage of 71% whereas the other control methods were below 17%. This might be because chemicals are generally used for controlling pests. The results also indicate that extension officers have limited knowledge of other pest control methods. 5% of the respondents indicated that Integrated Pest Management (IPM) is used for controlling pests, while 3% indicated that cultural control is used and only 1% indicated that biological control may be used to control pests.

Table 2: Constraints Caused by Pests, Pests Control Methods & Meaning of IPM (n=31)

Constraints caused by pests	**Frequency**	**Percent**
Loss of market	1	3.2
Loss of income and high production cost	3	9.7
Poor quality products	9	29
All of the above	18	58.1
Methods used to control pest?		
Chemicals	22	71
Integrated pest management	5	16.1
Cultural control	3	9.7
Biological control	1	3.2
Meaning of IPM		
Yes	7	22.6
No	24	77.4

Source: Own study

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It is clear from the results that extension officers may have some knowledge of other pest control methods however, this knowledge may need to be improved on. Agricultural extension officers need to know all the pest control methods to advise farmers accordingly on the pest control methods that contribute to sustainable agriculture.

Extension officers were asked to explain the meaning of IPM, the findings are presented in Table 2 above. The results show that the majority (77.4%) of respondents indicated no to the question while 22.6% indicated yes to the question. This might mean that extension officers have not been capacitated enough on the issue of IPM or it might be because when pest management is discussed, chemical control generally comes to mind. It is difficult for one to provide advice on a subject or topic that one is not familiar with. Agricultural extension officers need to know the meaning of IPM, this will enable them to advise farmers on the usage of a wide variety of control methods and not to rely only on one control method. According to the Food and Agriculture Organisation of the United Nations [FAO] (2017), IPM means considering all available pest control techniques and other measures that discourage the development of pest populations, while minimising risks to human health and the environment.

4.3 Conducting Surveillance for Fruit Flies

Extension officers were asked to indicate if they know how to conduct surveillance for fruit flies, the results are presented in Figure 1 below. The results above show that the majority (93.5%) of respondents do not know how to conduct surveillance with only a small percentage (6%) indicating that they know how to conduct surveillance. This may be because surveillance programmes, such as the national fruit fly surveillance programme, are managed at the national level, especially for new pests.

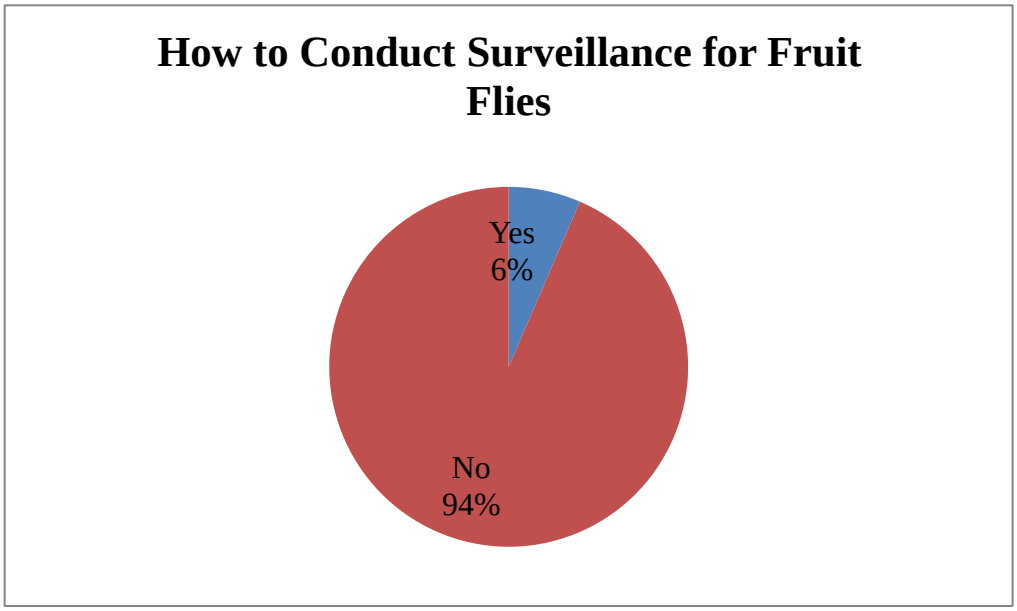

Figure 1: How to Conduct Surveillance for Fruit Flies (Source: Own study)

It is very important for agricultural extension officers to have the knowledge and to be able to conduct pest surveillance to advise farmers on the importance of conducting surveillance. According to Stringer, Soopaya, and Suckling (2019) surveillance for pests is carried out to detect new invasive species as soon as possible, to support trade while mitigating the risks of pest establishment. To conduct surveillance, traps are used to detect new pest invasions with enough time for delimitation of area of infestation and for monitoring population levels of established pests (Epsky, Morrill, and Mankin, 2008).

4.4 Identification of Fruit Fly

Extension officers were asked if they know how to identify fruit flies, the results are presented in Figure 2 below. Extension officers need to be able to identify pests and symptoms that are caused by different pests.

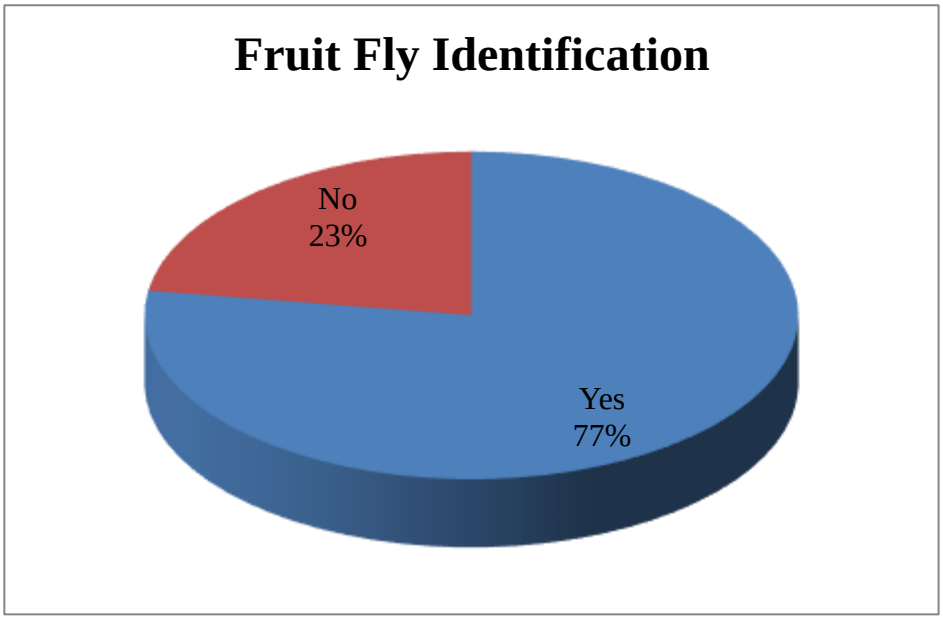

Figure 2: Fruit Fly Identification (Source: Own study)

The results in Figure 2 show that 77% of the respondents indicated that they know how to identify fruit flies, while the remaining 23% indicated that they do not know how to identify fruit flies. The ability to identify the pest and the growth stages that are most damaging to crops play a major role in the management of pests. Limpopo Department of Agriculture and Rural Development - (Vhembe district of which Thulamela municipality is a part) together with the Agricultural Research Council (ARC) have plant health clinics where extension officers have been trained to assist farmers with identifying pests and the damages that are caused by pests or diseases. Other countries have extension programmes such as plant health clinics where extension officers assist farmers with pest identification, for example, according to Flood (2010), Danielsen and Matsiko (2014) countries like Kenya and Uganda have an extension services unit on plant health referred to as "plant health clinics" wherein the plant doctors assist the farmers in pest identification and advisory services. Bandara and Kulatunga (2014) reported that extension advisors should have the relevant knowledge to enable them to advise farmers regarding pests, diseases diagnosis, and management.

4.5 Identification of Damage Caused by Pests

Extension officers were asked to indicate whether they can identify damage caused by pests, the results are presented in Figure 3 below. Pests cause damage to various parts of the plant such as fruit, stem and leaves. Agricultural extension officers must be capable of identifying the damages that are

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caused by different pests so that they can advise farmers accordingly about the best pest management strategies.

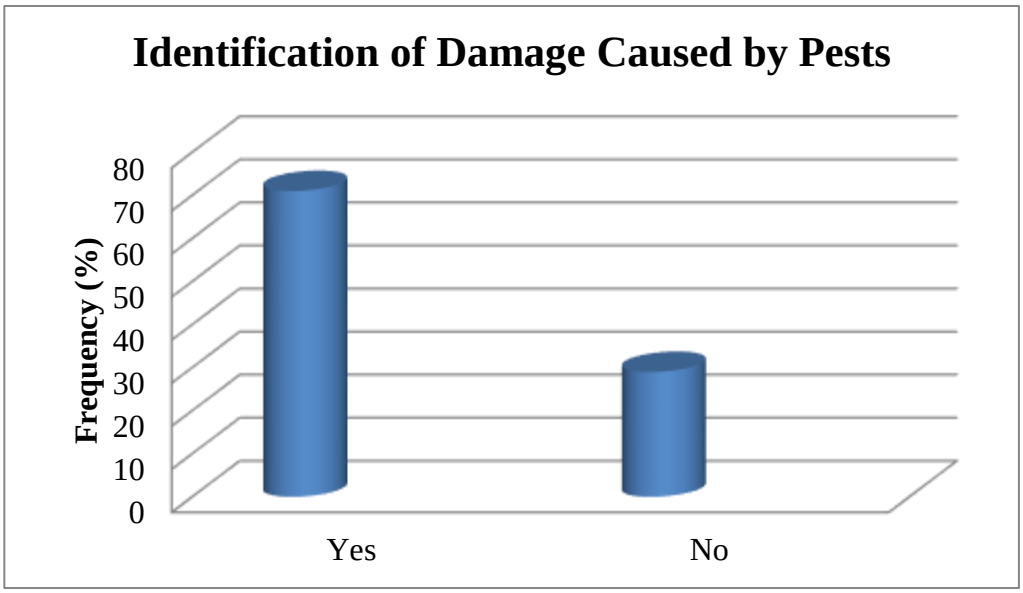

Figure 3: Identification of Damage Caused by Pests (Source: Own study)

According to Figure 3, the majority (71%) of respondents can identify the damage caused by pests, while 29% indicated that they are not able to identify the damage. The damage caused to plants play a major role in the identification of the type of pest and can assist in identifying the best pest control method. Fruit flies can cause severe damage to fruit as the larva tunnel inside the fruit, for example, according to Weems, Heppner, Nation, and Steck (2016), injury to fruit by fruit flies occurs through oviposition punctures and subsequent larval development. Following oviposition by fruit flies, there may be some necrosis around the puncture mark, and this is followed by the decomposition of the fruit (CABI, 2020).

4.6 Natural Enemies of Fruit Flies

Extension officers were asked to indicate whether they know the natural enemies of fruit flies, the results are presented in Figure 4. According to Figure 4, the majority (83.9%) of respondents are not familiar with the natural enemies of fruit flies, while 16% indicated that they are aware of the natural enemies of fruit flies. This might be because when pest control methods are discussed, for the majority of people, chemical control immediately comes to mind.

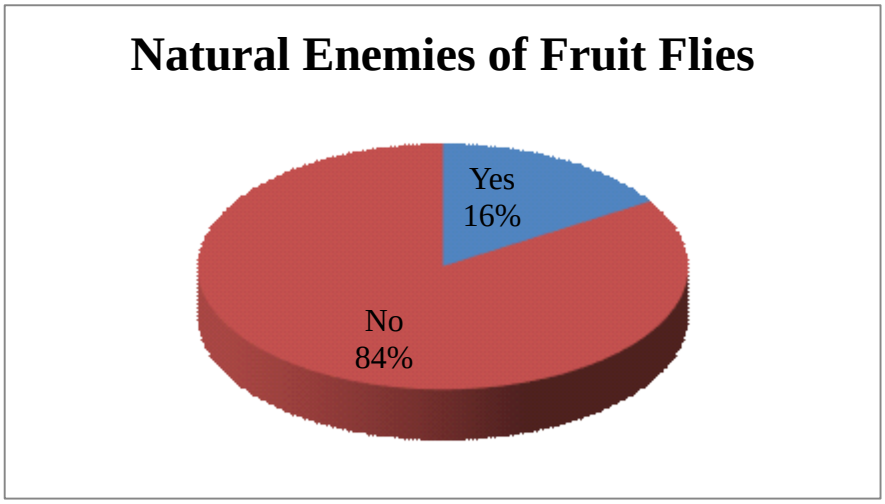

Figure 4: Natural Enemies of Fruit Flies (Source: Own study)

Natural enemies as a means of controlling pests, especially for smallholder farmers are hardly spoken about. The knowledge of extension officers on natural enemies of different pests is very important in the sustainable management of different pests. Natural enemies that are used to control fruit flies are things like birds and ants. According to Van Mela, Vayssieres, Van Tellingen, and Vrolijks (2007) African weaver ants showed a positive effect in controlling fruit flies including *Bacrocera dorsalis* in mango trees.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

This study aimed to investigate the knowledge of extension officers on pest management in horticulture. The study revealed that even though agricultural extension officers do have some knowledge of pest management in horticulture there are still some gaps that need to be addressed. These gaps include the lack of knowledge and understanding of different pest management strategies. When agricultural extension officers were asked to indicate the methods that are used to control pests, the majority (71%) indicated that chemicals should be used, however, there are other control methods such as IPM, cultural control, and biological control. The study also revealed that the majority of the extension officers had limited knowledge of the role that is played by natural enemies (biological control) in the management of pests, therefore there is a need to train them or improve their knowledge and understanding of the role that is played by natural enemies in pest management.

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5.2 Implications to the South African Farming Community

Agricultural extension officers need to know different pest management strategies so that they can effectively transfer the knowledge and skills to farmers, this will then contribute to improved crop production or yield. If extension officers do not have the relevant knowledge on pest surveillance this may harm farmers as this could indicate that they are not capable of properly advising farmers on the importance of conducting pest surveillance, which (pest surveillance) helps with detecting new pests in time and with monitoring of the pest population. Knowledgeable agricultural extension officers to effectively carry out their functions of delivering extension services to farmers. It is concluded that pests have a strong bearing in determining the quality of the harvests of farmers in horticultural crops, hence it is far more important for extension officers to have relevant knowledge on different pests, pests identification, and different management strategies to enable them to advise farmers accordingly.

5.3 Recommendations

Based on the findings of the study the following recommendations are presented**:**

- There is a need for agricultural extension officers to be regularly trained in pest management so that they can be up to date with new technology on plant protection issues.
- Agriculture extension officers need to be trained on how to conduct pest surveillance, this will enable them to detect and manage pests on time.

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