

Original Research Article

PESTICIDE USE PRACTICES BY MARKET GARDENERS IN THE SANTA AREA OF THE NORTH WEST REGION OF CAMEROON

ABSTRACT

Market gardening is commonly practiced by farmers of the Santa community of North West Region of Cameroon. This community is noted for its large cultivation of vegetables that is often exported to other parts of the country and even neighbouring countries such as Gabon, Congo and Equatorial Guinea. Cabbage (*Brassica oleracea var capitata* L.), carrots (*Daucus carota* L.), leeks (*Allium porrum* L.), tomatoes (*Lycopersicon esculentum* Mill.), celery (*Apium graveolens* L.) and onions (*Allium cepa* L.) are the main vegetables cultivated in this community. This work aimed at establishing how farmers use different pesticides to manage these pests. The methodology involved the use of structured questionnaires which were administered to 120 farmers to obtain information on demographics, constraints to successful crop production, general farm system and agronomic practices, knowledge of insect pest problems, types of pesticides used, dosage and rate of application, and different pests crops suffered from. Data was analysed using descriptive statistics and t-test by SPSS version 19. The study indicates that majority of market gardeners in Santa community are males (70%) with ages from 30-39 and most of them are married (76%). Farmers worked with relied on pesticides for pest control and did not dispose of empty pesticide containers properly such as throwing on the farm; use as drinking bowls and returned it to the pesticide vendors. This study provides valuable information on the pesticides used in pests and diseases control in vegetable production and health symptoms like stomach disorders, burns, and catarrh experienced by gardeners. A majority (94%) of farmers suffered from serious insect pest attacks on their farms and the most important pest was the cutworm (*Agrotis ipsilon*) which affected (65%). A majority (96%) of farmers also reported diseases attacks with late blight (*Phytophthora infestans*) affecting more than four-fifth (81%) of the farms especially in the rainy season.

Keywords: Pesticides, Market Gardening, Pests, Diseases, Santa

Introduction

Developing countries including Cameroon have witnessed very important socio-cultural changes in the last two decades. The most viable phase of these changes is the rapid population growth in most towns with new food habits and practices. Agriculture is amongst the main occupations for over 70% of Cameroonians and contributes enormously to the Cameroonian economy with an estimated 45% of Cameroon's gross domestic product (GDP) depending on Agriculture, and this agricultural sector is responsible for providing food security to both the Cameroonian rural and urban populations via local production (Wilfred *et al.*, 2016).

Cameroon is the food basket of the Central African Region in terms of food production and a significant proportion of her population depends on the production of fruits and vegetables for livelihood. Top vegetables cultivated include: onion, tomatoes, cabbages, carrots, Irish potatoes, leeks, celery, parsley, green beans, pepper, water melon, okra, lettuce and cucumbers (Abang *et al.*, 2013).

Pesticides are a major technological tool used worldwide to boost agricultural production. The Santa community of the North West Region is noted for its high agricultural output, especially in the domain of market gardening. The community produces vegetables for the nation as well as neighbouring countries like Gabon, Equatorial Guinea and Central African Republic. However, their adverse consequences, which may stem from misuse and environmental persistence, could lead to many undesirable effects.

Crop production is hindered by many pests and diseases. Pesticide use in the management these diseases and pests seems to be the most common practice in the Santa Area. Today, many market gardeners use pesticides regardless of the type of agriculture they practice: row crops, produce or animal agriculture. The majority of acres in developed countries have pesticides used on them. When pesticides are properly used, crop yields are increased with limited negative impact on the environment and non-target organisms. Considering that these crops serve as food crops to humans and other beneficial animals, there is an increasing need for proper regular control.

The overall objective of this study was to evaluate how farmers use pesticides to manage the pest problems associated with the production of some garden crops in Santa. Specifically the work sought to document the various types of pesticides and dosages used in market gardening

in Santa, identify the modes and rates of applications of the different pesticides in the farms by the farmers, and establish difficulties faced by market gardeners in the use of pesticides in the Santa community.

MATERIALS AND METHODS

STUDY AREA

Santa is situated in Mezam Division of the North West Region of Cameroon. Geographically it is located at Latitude 5.83° N, Longitude 10.15° E. The Santa community has altitudes of between 1000 and 2500m and characterized by mountain ranges, intermontane plains, deep valleys, and cascading upland streams. The rainy season runs from mid-March to mid-November. The rest of the year is the dry season. Average annual rainfall is about 2,288 mm. The average annual temperature is 19.7°C . At higher elevations of Mezam Division like Santa there are humic ferrallitic soils developed on basalts and trachytes (Ndenecho and Akum, 2009). This area is noted for its high level of market gardening activities throughout the year. Mezam presents a habitable landscape characterised by a mosaic of cultivated fields, fallows, woodlots, compound farms, and natural pastures in wooded savannas, gallery forests and raffia palm groves in valleys. The ecological circumstances of the Santa Area present several agro-ecological niches, which offer opportunities for the rearing of cattle, sheep, goats and poultry, the cultivation of tropical crops such as bananas (*Musa sapientum* L.), plantains (*Musa paradisiaca* L.), coffee (*Coffea Arabica* L.), cocoyams (*Colocasia esculenta* L.) and yams (*Dioscorea spp*) and the cultivation of temperate crops in afroalpine zones such as tomatoes (*Lycopersicon esculentum* Mill.), potatoes (*Solanum tuberosum* L.) and cabbage (*Brassica oleracea var capitata* L.) (Ndenecho and Akum, 2009).

METHODOLOGY

A structured questionnaire was designed based on published literature on the subject. Data were collected through a farm survey by face-to-face interviews with farm owners/farm workers. The questionnaire was designed in English and administered in “pidgin English”, which is understood by the majority of the farmers and pre-tested using small samples of farmers in the same areas before using it in this study. One hundred and twenty (120) farmers were involved. For proper coverage, the Santa community was divided into three (3) areas. These were the upper, middle and lower Santa areas. The Area was divided so as to find out if

the pesticide management techniques are uniform all over the area. Here, sixty (60) farmers were interviewed in upper Santa, and thirty (30) each from middle and lower Santa gardeners as most of the gardeners are concentrated in this upper area. The villages that were within this areas and involved in this research work included Mbei, Ndzong, Bamok, Akum, Awing, Ntaren, parts of Babajou and Pinyin.

The data collected (relevant to this work) included the following:

i. **Demographics:** The information here was based on the name, sex and age group of the farmer. Here the marital status, educational level, number of years of farming and the location of the farm were indicated.

ii. **Setbacksto successful crop production:** The farmers were asked if they encountered problems such as invertebrate pests, vertebrate pests, water shortage, soil infertility, weed infestation, land ownership, poor transportation and lastly in the marketing of their farm produce.

iii. **General farm system and agronomic practices:** The information obtained here was on the types of crops the farmers cultivated, why they cultivated those crops and the different varieties they cultivated, the number of times they cultivated per year, the area under cultivation and if they cultivated on the same plot each year. Also, information was gathered on their source of seeds, source of water and if they did mix cropping indicating the types of crops they mixed. The types of fertilizers used and crops they nursed were recorded.

iv. **Knowledge of insect pest problems:** This included questions to indicate if they experienced insect pest attacks in their farms, the different insect pests if at all they were present, the nature of the damage these insects caused and if they checked the insect pest population before deciding to control. The method the farmers used to control these insect pests in the farms were recorded, how they take the decision to control these pests and their opinion about chemical control of insects, were also noted.

v. **Disease problems:** This indicated if they had any diseases problems in their farms and the nature of the damage caused by the diseases ranking them in order of their economic importance.

vi. **Pesticides application.** The information obtained here was on the different pesticides the farmers used, where they got them from, why they used them, how they obtained information on how to use them and if they did follow instructions on the pesticides

containers. The number of times they sprayed, the person who did the spraying, the volumes or quantities they mixed with water before spraying and the number of litres or sachets they used per season, was also of interest.

In this section, the interval between sprays, the interval between last spray and harvest, and the equipment used were recorded. Information was obtained on whether the farmers used protective clothing when handling pesticides and the types they used. Where the farmers stored their chemicals, disposed of expired chemicals, what they did with empty pesticides containers and some consequences of pesticide misuse known were also put down. Farmers were asked if they observed any health problems during and after using pesticides and what they did when they noticed the problems.

DATA COLLECTION

The methods and tools for data collection were based on procedures for analysing agricultural problems and assessing farmers' Knowledge, Perceptions and Practices. Pre-designed data recording forms were used in gathering information on the following variables: Type of pesticide, dose, Frequency of application, target pests and diseases.

STATISTICAL ANALYSIS

Data was entered into Microsoft excel. Descriptive (frequency and percentage) and inferential statistics were used for data analysis with SPSS version 19 software. A one-way analysis of variance (ANOVA) was used to analyse if the dosages of pesticides the farmers used in the farms were in line with that which the manufacturer has put in place.

RESULTS

Demographic Data

The study indicates that out of the 120 farmers interviewed, the majority of them in the Santa area are males (70%) with ages ranging from 30-39 years and most of them are married (76%). Only about one-fifth (20%) of the farmers can be considered newcomers into market gardening (with experiences of 1–5 years). These were either producers of other crops or young farmers who are now independent from their parents.

Half of the interviewed population of the market gardeners had farms with surface areas between 1 to 5 hectares while one third (30%) of the population had farm sizes above 5 hectares. A majority of the farmers (60%) cultivated twice per year and (61%) of them grew their crops on the same plot. Mix cropping is a common practice by most of the farmers (61%), to 36% who practice monocropping. The main source of water supplied to the farms was from rivers around that were channelled to these farms with the use of pipes. Those who cultivated only once per year relied only on rain water as the main source of water while owners of very small farms carried water from nearby streams and watered their crops with, using a watering-can.

Setbacks to Market Gardening in Santa

The process of successful cultivation of crops in Santa is hindered by some constraints. These bring about low yields. All farmers indicated poor transportation as a major problem. Other major problems were invertebrate pests (94%) which destroy the crops in the farms as well as diseases (96%) on the crops. There is the problem of poor soil fertility (84%), weeds infestation (98%) and land ownership (61%). Other problems indicated by farmers are the absence of a good market for their crops (90%) and water shortage (88%). Some respondents said other problems were high cost of farm inputs and recommended the creation of cooperative unions to help market their crops.

Cropping Systems and Agronomic Practices

Farmers in Santa area cultivated different types of crops with different varieties. The most popular crops cultivated in this area were cabbage (66%), carrots (64%), potatoes (54%), leeks (56%), celery (46%) and tomatoes (24%). The different varieties of the crops cultivated and the proportion of respondents cultivating each variety are shown on table 1. These farmers

advanced their reasons for using these different varieties as having the technique needed to cultivate those crops and also on the established performance of these varieties on their soils.

Sources of seeds included previous harvests and registered seed retailers but the majority of the seeds were supplied by registered seed retailers. Most of the crops planted were sown in a nursery for at least 4 weeks before being transplanted. The major crops that underwent nursing before being transplanted were cabbage, carrots, leeks, celery and tomatoes. Only potatoes was not nursed. All farmers indicated that they used both the organic and inorganic fertilizers.

Table 1: Some garden crop varieties and the proportion of respondents cultivating each in the Santa Area

| Crop Variety Frequency Percentage (%) | | |
|---------------------------------------|-------------------|-------|
| CABBAGE | Globe master | 3038 |
| | Green colony | 4962 |
| CARROT | Technisem | 4558 |
| | Tropica | 3242 |
| POTATO | CIPIRA | 3655 |
| | Sponta | 0913 |
| | Mondial | 03 14 |
| | All the varieties | 1726 |
| LEEK | Technisem | 2740 |
| | Tropica | 2943 |
| | Vilmorine | 2317 |
| CELERY | Tropica | 2247 |
| | Topseed | 2640 |
| | Technisem | 0713 |
| TOMATO | Iron tomatoes | 29100 |

Insect Pests

Regarding attack of the different farms by insects, (94%) farmers indicated that their crops suffered serious damage from insects which lowered yields. The most serious insect pest that attacked all the crops used in the study area especially at the transplanted stage was cutworms (*Agrotis ipsilon*) (65%). They cut the young crops just when they have been transplanted at the

surface of the ground as seen in Figure 1. Most of these cutworms only come out at night when places are cold to cause destruction. Early in the morning they burrowed back into the ground to hide. Cutworms are brought to the surface whenever soil around the destroyed crops was dug up.

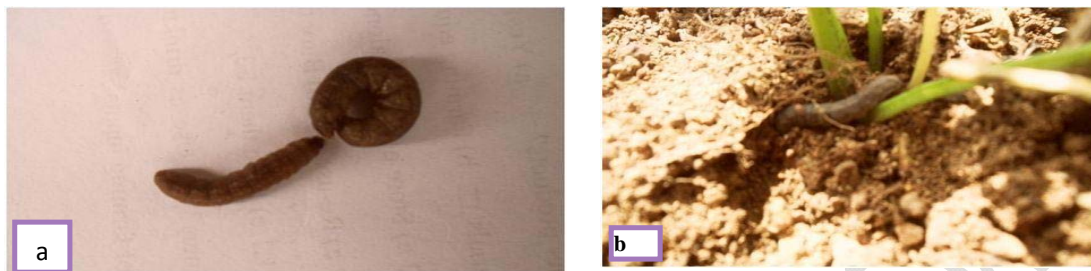


Figure 1: Cutworms (*Agrotis ipsilon*) (a) Larva, (b) Larva attacking young plant

Fruitworms (*Helicoverpa amigera*) (30%) also cause much destruction in the farms especially in the cabbage and tomato farms. They eat through the leaves of many crops and the fleshy parts of the fruits as seen in Figure 2. Other insect pests indicated by farmers in Santa were aphids (28%) that attacked mostly cabbage, potatoes and tomatoes; whiteflies (21%) and black ants (12%).



Figure 2: Fruitworm (*Helicoverpa amigera*) attacking fruit

| Pesticide | Active ingredient(s) | Manufacturer's Dose | Farmers's Dosage | Chemical group | % |
|---------------|--|---------------------|------------------|----------------|------|
| Cypercal 50EC | Cypermethrine 50 g/l | 35ml | 50ml | Py | 9.83 |
| Parastar40EC | Imidacloprid 20g/l + Lambdacyhalothrine 20g/l | 35ml | 48ml | Py + Oc | 5.86 |

| | | | | | |
|-----------------|------------------------------------|-------|------|----|-------|
| Fastac | Cypermethrine 50 g/l | 35ml | 50ml | Py | 5.86 |
| Callidium 40EC | Dimethoate 400 g/l | 35ml | 52ml | Op | 3.35 |
| Cypercot | Cypermethrine 10 % | 20ml | 49ml | Py | 2.93 |
| Ivory80WP | Mancozeb 80g/kg | 45g | 80g | Ca | 3.97 |
| Cigogne 50EC | Cypermethrine 50g/l | 45ml | 60ml | Py | 2.30 |
| Plantineb80WP | Manebe 80% | 90g | 63g | Ca | 3.97 |
| Syndrome 40 | Cypermethrine 40 g/l | 30ml | 60ml | Py | 1.26 |
| Cyperm-ax | Cypermethrine 50 g/l | 40ml | 64ml | Py | 1.46 |
| Cypercad- ium | Cypermethrine 50 g/l | 35ml | 60ml | Py | 0.63 |
| Tromissil50WP | Linuron50g/kg | 50g | 83g | Oc | 5.02 |
| Ridomil | Metalaxy/-M 6%+ Oxyde deCuivre 60% | 50g | 40g | Ph | 5.65 |
| Roundup | Glyphosate 360g/l | 150ml | 70ml | Op | 3.56 |
| Balear | Chlorothalonil 720g/l | 80ml | 60ml | Oc | 5.65 |
| Banko plus720EC | Chlorothalonil 720g/l | 80ml | 34ml | Oc | 6.07 |
| Pencozeb80WP | Mancozeb 800 g/kg | 80g | 53g | Ca | 9.00 |
| Action80 | Diuron 800g/kg | 50g | 53g | Oc | 3.56 |
| Mancoz-ane | Mancozeb 750g/kg | 90g | 50g | Ca | 3.77 |
| Manoz-ane | Mancozeb 750g/kg | 90g | 55g | Ca | 10.67 |
| Gramoxone | Paraquat 200 g/l | 70g | 75g | Oc | 3.77 |
| Mancoz-eb | Mancozeb 800 g/kg | 90g | 51g | Ca | 1.88 |

Table 2: Different pesticides used in market gardening in the Santa Area

Py = Pyrethroid, Oc = Organochlorine, Op = Organophosphate, Ca = Carbamate, Ph =Phenylamide

A chi square test analysis was conducted to determine the equality of proportion of farmers who used 'below recommended dose', 'recommended dose' and 'above recommended dose'. The proportion statistically differed over some pesticide as some farmers used farm more above the recommended dosages while others used far less dosages (Table 2)

Diseases

Diseases posed so many problems to effective market gardening in the Santa Area. Most farmers (96%) indicated that they suffered diseases attacks in their different farms. The most frequent disease that hindered crop production in the Santa community is late blight (81%). The clubroot disease (30%) commonly called “ginger” in Santa was specific to cabbage farms. This disease prevents the growth and extension of roots by the cabbage crop. Bacterial wilt was reported by potato farmers causing the rotting of the potato tubers in the ground, and the surface symptoms are withering and eventually death of the crop.

Pesticide Application

The majority of farmers (96%) depended on pesticide applications to control pests. While 80% of farmers do spot checks for pests before spraying, the frequency of spraying still indicated a calendar spray pattern with spraying every 7–9 days in some cases (20%). However, there is a difference in spraying frequency between the wet and dry seasons. During the wet season, farmers sprayed more frequently. The most commonly used active ingredients were Cypermethrine and Dimethoate against insects, Mancozeb and Maneb against fungi and Gramoxone against weeds (Table 2). More than 50% of the respondents applied pesticides up to 5 times or more per cropping season depending on the type of crop.

Pesticides were purchased by farmers in litres, kilograms, or packets. In terms of litres of chemical applied, a higher percentage of farmers (40%) used up to 15 litres of pesticide per year. In terms of 1kg sachets about 48% used 30 to 50 sachets of chemicals per year depending on farm size. The formulations that were mostly applied are emulsifiable concentrates(EC) and wettable powders(WP). The prices of the pesticides varied from one location to another depending on proximity to market. The prices were higher in areas like Awing as compared to Santa town.

Farmers did not have access to information about integrated pest management, pesticide usage and safety, insect and disease identification, and quality aspects of their vegetable crops. Sixty percent (60%) of the farmers were aware of the fact that pesticide residues could be present on the harvested crop. While 12% of the farmers said that the issue of pesticide residue was not a problem, 88% of them indicated residue of the pesticides on the crop could be a problem. They indicated that the solution to this residue could be to wash the crops well before consumption,

and to allow the crops to stay for long after last spray before harvesting them. And also to follow the rules and regulations associated with the use of pesticide

Storage of Pesticides and Disposal of Empty Pesticides Containers

Most of the market gardeners stored the chemicals in a store at home (56%). Some stored their chemicals on the farm (42%), while others stored them in their kitchen (2%). A majority of those who stored their chemicals at home said that they stored them together with other farming equipment or non-food items, while (9%) indicated that they stored their chemicals alone in a store. Some farmers said they would buy only the quantity needed for immediate use.

Pesticides application equipment most commonly used are hand carried lever operated knapsack sprayer commonly called “matabi” in Santa. The farmers have experienced various problems with this equipment during spraying. The most common problems identified were replacement of the piston and clogging of the nozzles.

Sixty four (53%) market gardeners discarded their empty containers into the environment as shown in figure 3, (24%) burnt pesticides containers, (11.5%) buried them, (6%) took the empty containers to pesticide dealers and (5%) used them as drinking cups and eating bowls.



Figure 3: Pesticide containers improperly disposed of on-farm and neighbourhood

Adverse Health Effects of Pesticides

Most farmers reported health problems after routine usage of pesticides (Figure 4). The most common symptoms reported by the interviewees were stomach disorders (35%), skin burns (26%), catarrh (23%) and chest pain (14%). Headache (11%) and cough (10%) were less commonly reported. Fifty-five (55%) of the farmers did not use protective clothing in the course of spraying. Their main reasons were that they cannot afford them (24%), think it is not necessary (17%), they are not available (2%), and they are time consuming (2%). Those who

used protective clothing indicated the different clothing as respirators, hand gloves, long trousers, boots and long sleeve shirts. Of the number that experienced health problems with the use of pesticides, (28%) indicated that they went to the hospital, (48%) handled it themselves and (2%) drank oil or milk to solve the problem.

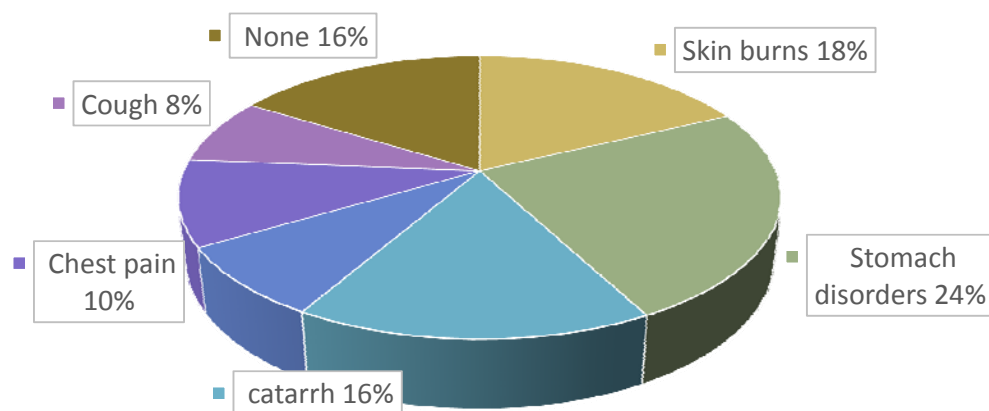


Figure 4 . Health concerns on the use of pesticides on farmers in Santa

DISCUSSION

The results indicated that more males (70%) than females (30%) were involved in market gardening activities in Santa. This might be due to the heavy labour required in the production of garden crops. This ties with the findings of Tandiet *et al.*, (2014) who in his study of tomato cultivators in Buea found males to constitute the largest numbers. Farmers in Santa cultivated different varieties of crops and most of them practiced mixed cropping. The result also indicated that a majority of the farmers were holders of the First School Leaving Certificate) F.S.L.C and this is in line with Tarla *et al.*, (2013) who discovered this same trend in education with farmers in Galim.

Half of the interviewed population of the market gardeners had farms with surface areas between 1 to 5 hectares while one third (30%) of the population had farm sizes above 5 hectares. This is because this area has enough land for agricultural use with a lesser population as compared to other towns with limited land. Tarla *et al.*, (2015) in a study on tomato farmers in Fumbot found may of them to have land ranging from 0.1 to 0.5 hectares.

The results also showed that insects and diseases were some of the major problems faced by farmers as with reports of Christopher (2010) who found out insect pests and diseases to be the major problems of vegetable production in Cameroon. Bhatet *et al.*, (2011) also found insects to be one of the main pests that cause high crop losses due to their negative effects on the crops in his study on the survey of insect pests damaging vegetable crops in Kashmir.

A total of 22 different pesticides were used by respondents, however, some products have the same active ingredient but were marketed under different trade names. They viewed pesticides as the most effective and efficient solution to pest problems as also reported by Dinham (2003) and Ngowi *et al.*, (2007). Farmers in the Santa community discard empty pesticide containers mostly into the environment without considering the effects they may cause. This is because most of them are not aware of the environmental effects of pesticide drift. This ties with the findings of Meijden (1998), who conducted a study on cocoa farmers in Cameroon which showed that the left over and empty containers were not properly disposed as the containers were sometimes washed and used for domestic purposes. This is also seen in studies carried out by Tarla *et al.*, (2013) in Galim which indicated that farmers abandoned the containers, burned, buried or isolated the containers.

Many farmers in the Santa community reported health problems after using pesticides such as stomach disorders, skin burns, catarrh, and chest pain, headache and cough. In another study by Kenko *et al.*, (2017) on environmental and human health assessment in relation to pesticide use by local farmers and the Cameroon Development Cooperation (CDC) they found similar symptoms on pesticide user. A greater population (55%) of these farmers did not use protective clothing during spraying of these pesticides and many of them advanced their reason that they can't afford it. This is opposed to the findings of Oyekale (2018) whose study on cocoa farmers' compliance with safety precautions in spraying agrochemicals and use of protective equipment in Cameroon found a greater population to put on protective clothing during spraying

Farmers in the Santa area did not respect the dosages of the manufacturer. They mostly mixed more than the dosages indicated on the pesticide containers for example for the insecticide Cypercal 50EC; they mixed 50ml in 16litres of water instead of 35ml as stated by the manufacturer. Their reasons for doing so were that the dosages of the manufacturer were not effective when sprayed the advanced same reason as in Tarla *et al.*, 2013 where farmers think that the manufacturer's instruction cannot be used to successfully produce vegetables because his initial research was not carried out under the conditions of the farmers.

For fungicides, most users mixed dosages lower than those recommended by manufacturers. This might be due to the fact that fungicides are sprayed more frequently than pesticides. All these could account for pest resistance to pesticides. The most commonly used active ingredients were Cypermethrine and Dimethoate against insects, Mancozeb and Maneb against fungi and Gramoxone against weeds. This is in line with what Guy *et al.*, 2017 found out in A pilot study in Cameroon to understand safe uses of pesticides in agriculture, risk factors for farmers' exposure and management of accidental Cases. While a greater population of the farmers discarded their empty pesticide containers because they knew the negative effects they could caused, some studies as Okolle *et al.*, (2014) found farmers to use the empty pesticides containers mainly to put water or oil.

CONCLUSION AND RECOMMENDATIONS

From this study the following conclusions were arrived at:

- This study provides valuable information on the pesticides used in pests and diseases control in market gardening, farmers' perceptions on pesticide usage, and health symptoms experienced by gardeners.
- From this study it can be seen that Farmers in the Santa area do not practice cultural or biological methods of pest control. This may account for the persistence of clubroot disease (*Plasmodiophora brassicae*) commonly called 'ginger' in cabbage which has not had pesticides to effectively control it. The bulk of the survey respondents indicated that they start applying insecticides on their crops from the nursery which suggest that these chemicals are deployed solely against insects.
- Santa gardeners lack appropriate knowledge on safe handling and use of pesticides. This is attributed to the complete absence of extension services and training. This information can be used to develop a training programme on pest management especially on pesticide use in the Santa area.
- Farmers in Santa face problems with insect pests and diseases, blight and cutworms, fruitflies, fruitworms, aphids and whiteflies, identified as the most important disease and insect pests respectively. Cutworms attacked all the garden crops in this area.
- Farmers in the Santa Area do not respect the dosages of pesticides recommended by the manufacturer, with the believe that the manufacturers' quantities were inefficient. This could probably lead to pests developing resistance and crops being burnt by overdosages.

RECOMMENDATIONS

From this study is recommended that farmers in Santa farmers in this community should endeavour to respect the doses of pesticide put up by the manufacturer to prevent development of resistance.

It is also recommended that farmers should dispose off their empty pesticides containers properly to avoid environmental contamination which is one of the causes if the undesirable health effects of pesticide.

People in this area rely mainly on pesticides to combat pest, it is therefore recommended that they should employ other methods of pest control to avoid the undesirable health effects of these pesticides.

- In this regard, there is an urgent need to educate the Santa market gardeners on good agricultural practices through Integrated Crop and Pest Management (ICPM) practices which will include both cultural, physical or mechanical, biological and chemical pests control methods. This can easily be obtained by organizing the farmers into small farming groups where the farmers are trained and are able to exchange their knowledge and experiences with each other.

- Training on safety standards which are primarily aimed at promoting practices that encourage farmers and pesticide users to adopt simple practices that protect them and the environment from hazards caused by pesticide exposure, will be beneficial to users and to the consumers. These include:

- wearing of protective clothing, eye protection goggles and nose mask,
 - ensuring safety for themselves and other farm workers; pesticides should be handled carefully,
 - thorough cleaning up (bathing) immediately after spraying or when pesticides accidentally come into contact with the skin,
 - Pesticide containers and leftover pesticides, obsolete stocks must be disposed in ways that do not threaten the health of humans or animals.
 - Pesticides should only be applied when needed (taking note of threshold level of attack) and after judging if it is profitable to spray.
- Investigations should be carried out on the farmers of this area to verify the level of pesticides residues in their bodies.
- Develop training courses for health personnel in the Santa area where pesticides are frequently used

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