Original Research Article

IDENTIFICATION AND MANAGEMENT OF PESTS AND DISEASES OF GARDEN CROPS IN SANTA, CAMEROON

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Authors' contributions

This work was carried out in collaboration between all authors. Konje C.N proposed and supervised the topic, Abdulai A.N carriedout the field studies and Wrote the daft manuscript. Achiri Denis Tange and Nsobinenyui D and managed the literature searches.Tarla DN AND Margaret Awah Tita read and approved the final manuscript. All authors read and approved the final manuscript

ABSTRACT

Aims: This work sought to identify the pests and diseases that hinder successful gardening and how they are managed by farmers. Also the work sought to identify the pesticides used to manage these pests and their frequencies of application.

Place and Duration of study: This work was carriedout in the Santa Area of the North West Region of Cameroon. This study was conducted from June 2013 to February 2014.

Methodology: It was carried out on six farms in Santa, a Sub-division in Mezam Division of the North West Region of Cameroon. On each of the farms, an area of 20 x 20 m was mapped out and the plants in it were observed. Insect pests, diseases and their method of mitigation were surveyed at each growth stage.

Results: The main diseases identified were clubroot (*Plasmodiophora brassicae*) and late blight (*Phythophthora infestans*) while Aphids (*Myzus persicae* S.), whiteflies *(Bemisia tabaci*) fruit worms (*Helicoverpa amigera*), Cutworms, fruitfly (*Dacus punctatifrons*) and grasshoppers (*Zonocerus variegatus*) were the prominent pests. The most applied pesticides were Cypermethrine and Dimethoate against insects, and Mancozeb and Maneb against fungi.

Conclusion: From this study the most prominent pest of cabbage was the black cutworm (*Agrotis ipsilon*), which affected the early growing stage. The main disease that affected tomato was blight. This was seen in both seasons, but the severity of attack was greater in the rainy season. Insect pests were a main problem in the dry season causing high economic losses while there was reduced infestation in the wet season. The findings suggest an urgent need to educate the Santa farmers on good agricultural practices through integrated crop and pest management (ICPM) practices to include cultural, physical or mechanical, biological and chemical-control methods.

Key Words: Diseases, Pesticides, Pests, Santa (Cameroon), Vegetables

INTRODUCTION

Agriculture is one of the pillars of the economy of Cameroon though in most instances it is practiced at a small scale and depends largely on house hold labour, with about 70% of

the active population of this country engaged in it. Also, this sector is responsible for providing food security to both the rural and urban populations of this country via local production [1]. The Western Highlands of Cameroon is noted for its high involvement in agriculture especially the cultivation of vegetable crops such as cabbage (*Brassica oleraceavar capitata* L.), carrots (*Daucus carota* L.), leeks (*Allium porrum* L.), tomatoes (*Lycopersicon esculentum* Mill.), celery (*Apium graveolens* L.) and onions (*Allium cepa* L.) [2]. The main areas noted for the production of these garden crops in Cameroon are Santa and Foumbot in the North West and West Regions respectively. The cultivation of these crops has brought an increase in agricultural production used to feed the nation. Among various economic and social benefits, market gardening has a vital and multifaceted role in providing food security, meeting the demands of consumer markets, utilising labour and generating income. The income generated from market gardening also provides indirect socio-economic benefits for market gardeners, such as greater access to household items (televisions, chairs) and greater mobility from the purchase of motor vehicles, motorbikes or bicycles [3]. As urban centres expand, the demand for fresh garden produce increases and the land devoted to market gardening also expands, usually in the periphery [4]. This is particularly true in developing countries where rapid urbanisation is prevalent.

Yield and quality are central to sustainable vegetable production. If not properly managed, pests and diseases can dramatically reduce crop yield and subsequent returns. At this economic injury level, there is the need to employ control measures, which may have a great negative effect on the practice of market gardening if not properly managed. Today, pests and diseases are better managed using an integrated approach and this approach brings together the best mixture of chemical, biological and cultural methods to manage pests and diseases. To successfully apply any management strategy against pests or diseases, the first step is to identify them correctly for appropriate action to be taken and this gave reason for this work to be carried out to identify the pests and diseases that hinder successful gardening and how they are managed in the Santa community of Mezam Division.

MATERIALS AND MEHODS

Study area

This study was carried out in Santa, one of the Sub-divisions in Mezam Division of the North West Region of Cameroon. It is located between latitudes 5° 42′and 5° 53′ north of the equator and longitudes 9° 58′ and 10° 18′ east of the Greenwich Meridian. The population of this area estimated in 2008 was 99851[5] and 90% of this population are engaged in farming and grazing. It covers a surface area of about 532.67 km². It is bordered to the North by Bamenda Sub Division, West by Bali and Batibo Sub-Divisions, South by Wabane, Babadjou and Mbouda and the East by Galim [6].

The mean annual temperature of the area varies from 21.8 to 30.8 ºC. Its annual rainfall is between 2000 -3000 mm and rainy season starts from March to September and dry season from October to February. The soils in this area are fertile and support a large human population. The altitudinal range is from 600 to 2600 m, making this highland favourable for animal rearing, crop and vegetable production basin in the Western Highlands of Cameroon.

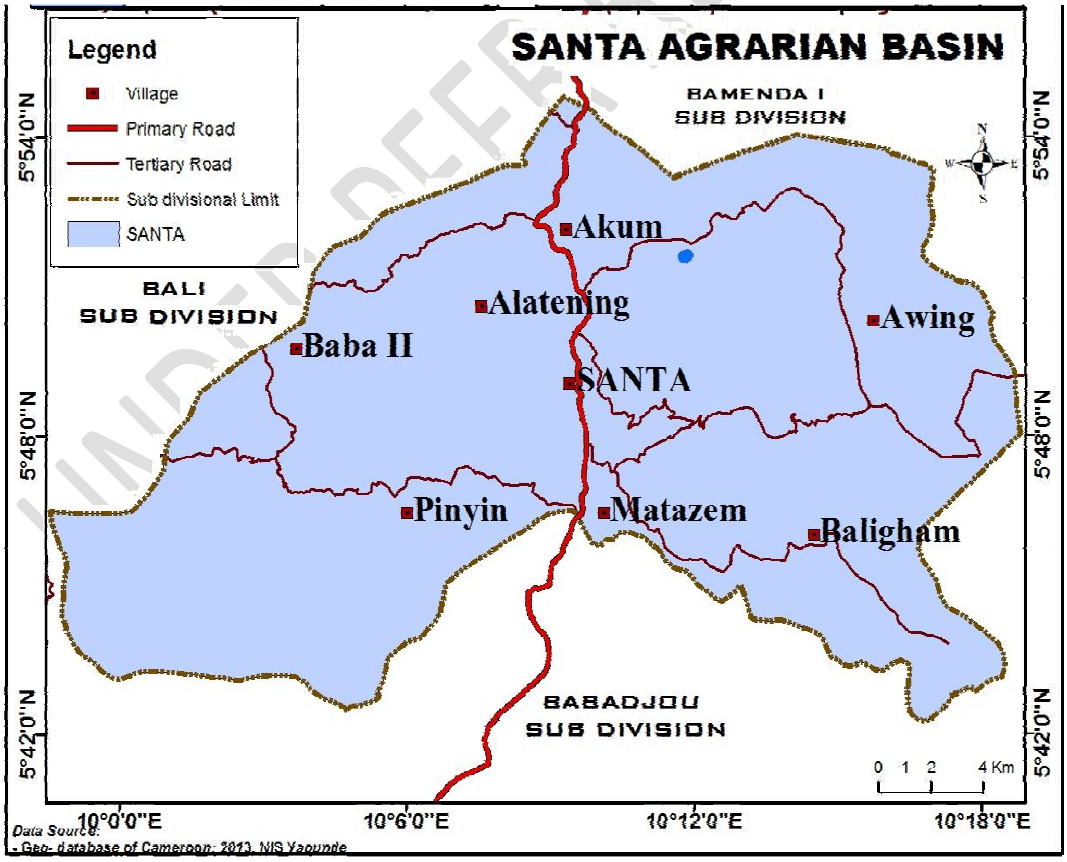

Figure1. Map of Santa Sub Division showing the different villages

Identification of pests and diseases and their mitigation

Identification of pests and diseases was carried out three times on six farms (two at the upper, two at the middle and two at the lower Santa) during different growth stages of tomatoes, cabbage, potatoes, leeks and celery. They were observed from seedling through flowering to maturity. This study was conducted from June 2013 to February 2014.

On each of the farms, an area of 20 x 20 m was mapped out and the plants therein observed for pests and diseases at each growth stage during dry and rainy seasons. The parts of the crops observed were stems, leaves, flowers and fruits. The type of pesticides and their frequency of application used to combat pests and diseases were noted.

Data collection

Pre-designed data recording forms were used in gathering information on the following variables: insect pests, diseases, pesticides used to combat pests and their frequency of application. The insects and diseases were identified with the aid of photographs by Vurela *et al*.,[7]

Statistical analysis

Data was entered into Microsoft excel. Descriptive statistics was used to analyse the results.

RESULTS

Pests and Diseases of Garden Crops and their Management

Cabbage (*Brassica oleracea*)

The insect pests common with cabbage at transplant stage were cutworms [(*Agrotis ipsilon*)(Hufnagel, 1766) (Lepidoptera: Noctuidae)] which eat through the stems of the crop at the ground level and made the crop to fall, whiteflies [(*Bemisai tabaci* L.) (Gennadius, 1889) ((Hemiptera: Aleyrodidae)], aphids [(*Myzus persicae* L.)(Sulzer,1776)(Hemiptera: Aphididae)] and fruitworm [(*Helicoverpa amigera* L.)(Hardwick,1965)(Lepidoptera: Noctuidae)]. The farmers used cypercal (cypermethrine) and parastar (imidachlopride and lambdacyhalothrine) for their control during dry season. During this transplant stage, here was no disease affecting cabbage (Table 1). Whiteflies, aphids and fruit worms affected the crop mostly in the dry seasons as damage was more visible on crops while the only pest insect pest caused visible damages in the rainy season was cutworms.

At the flowering and maturation stages, whiteflies, aphids fruitworms and grasshoppers [(Zonocercus variagatus)(Dish, 1966)(Orthoptera: Caelifera)] were seen and same chemicals used for their control as during transplant. At the flowering and maturation stages clubroot [(*Plasmodiophora brassica)* (Woronin, 1877) (Plasmodiophora: Plasmodiophoracea)] was the only disease affecting cabbage and no pesticide was applied for its control (Table 1).

Table 1: Pests and diseases of cabbage, pesticides and their frequency of application used for their control

	Growth stage					
	Transplant		Flowering		Maturity	
	Pests	Disease(s)	Pests	Disease(s)	pests	Disease(s)
Pest/ disease	Cutworms, whiteflies, aphids and fruit worms	-	whiteflies, aphids, fruit worms,and grasshoppers	Clubroot	whiteflies, aphids, fruit worms, and grasshoppers	Clubroot
Pesticide	Cypercal Parastar	-	Cypercal Parastar	-	Cypercal Parastar	-
Frequency during dry season	Thrice	-	Thrice	-	Thrice	-
Frequency during rainy season	twice	-	Twice	-	Twice	-

Tomato (*Lycopersicon esculentum*)

The major insect pest that damaged tomato at transplant stage was cutworm. The other insects at this stage were crickets [(*Gryllus sp*.)(Laicharting, 1781)(Orthoptera:Gryllidae)] and spiders. Cypercal, Parastar and Cypercot

(cypermethrine) were used against the cutworms. Blight [(*Alternaria solani*)(Sorauer, 1896) (Pleosporales: Pleosporaceae)] was observed at this stage but did not cause visible severe damage in the dry season and was only sprayed in the rainy season with Mancozeb and Mancozane (Table 2).

The flowering stage of this crop suffered from a new set of pests. These were fruit worms (*Helicoverpa amigera* L), fruitflies [(*Bactrocera cucurbitae*)(Newman, 1834)(Diptera:Tephritidae)], aphids, leaf miners [(*Tuta absoluta*)(Meyrick, 1917)(Lepidoptera:Gelechiidae)] and the cutworms. The fruit worms ate through the fruits, fruitflies stung the fruits creating black spots on them, the leaf miners mined the leaves and cutworms present at this stage did not have major effects because the stems of the plant were already hardened. The insecticides used at this stage were Cypercal, Parastar, Cypercot (Table 2).

In the third stage of growth when the crop had reached maturity, the pests were fruit worms, aphids and whiteflies. Blight was also present and caused damage such as fruit rot, irregular ripening of fruits, some dropping to the ground and leaves yellowing and dry off. The chemicals used to spray were still those used at the flowering stage with insecticides being sprayed at higher frequencies per month (Table 2).

192 Table 2: Pests and diseases of tomato, pesticides and their frequency of application used for their control

	Growth stage					
	Transplant		Flowering		Maturity	
	Pests	Disease(s)	Pests	Disease(s)	Pests	Disease(s)
Pest/ disease	Cutworms, crickets, spiders	Blight	Cutworms, whiteflies, aphids, fruit worms, fruit flies.	Blight	Fruitworms, Aphids, Whiteflies, Fruit flies,	Blight
Pesticide	Cypercal Parastar Cypercot	Pencozeb	Cypercal Parastar	Banko plus, Manozane, Mancozan, Pencozeb	Cypercal Parastar	Banko plus, Manozane, Mancozan, Pencozeb,
Frequency during dry season	Twice	Thrice	Four	Eight	Thrice	Four
Frequency during rainy season	Thrice	Four	Thrice	Twelve	Four	Sixteen

Celery (*Apium graveolens* L.)

The most prominent pest of celery at transplantation during dry and rainy seasons was the cutworm which feed on the stem of the celery plant. Another insect seen at this growth stage was cricket that ate through the leaves creating holes on them. The insecticides used for pests control were two cypermethrine based chemicals Cypercal, and Cypermax and Parastar made of imidachlopride and lambdacyhalothrine as active ingredients. Blight was the only disease that brought about visible crop damages in all stages and was managed using pencozeb and Balear at transplant stage. These different pesticides were either sprayed once or twice a month (Table 3).

In the second growth stage, cutworms were still seen and whiteflies and aphids were mostly seen in the dry season. Pests were managed using cypermax, cypercal or parastar. Blight was controlled with Balear, Banko plus, Mancozeb, Manozane or Pencozeb. They were used only once at this stage (Table 3).

At maturity, leafminers were the only insects seen during dry season were sprayed two times with Parastar, and Cypercal, at this stage for insect pests. Blight had its visible effects at this stage mostly in the rainy season and Pencozeb, Mancozeb, Manozane, Banko plus (chlorothalonil and carbendazime) and Balear were used for its control (Table 3).

Leeks (*Allium porrum* L.)

The main pest of leek at transplant was cutworm that fed on the stems of the plant cutting through and was managed using cypercal, Parastar and Fastac as the main insecticides to kill these cutworms in the farms (Table 4).

At flowering and maturation stages, the main insect pest was aphid which was controlled with Parastar and Callidim (dimethoate) during flowering and cypercal during maturation. Blight caused the leaves to turn yellow at the flowering and maturation stages mostly visibly during rainy season. It was controlled with Manozane, Moncozeb or Pencozeb during flowering and Pencozeb, Manozane and Moncozan at maturation. In the rainy season blight was sprayed 7 to 8 times in a month. In the dry season the effect of blight was very minimal and some farmers did not spray their farms with fungicides (Table 4).

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225 Table 3: Pests and diseases of celery, pesticides and their frequency of application used for their control

	Growth stage					
	Transplant		Flowering		Maturity	
	Pest	Disease(s)	Pests	Disease(s)	Pests	Disease(s)
Pest/ disease	Cutworms	Blight	Cutworms, Whiteflies, Aphids	Blight	Leaf miners,	Blight
Pesticide	Parastar Cypercal, Cypermax	-	Parastar, Cypercal	Pencozeb Balear Banko Plus Mancozeb, Manozane,	Parastar, Cypercal,	Pencozeb, Mancozeb, Balear,
Frequency during dry season	Thrice	-	Four	Four	Five	Five
Frequency during rainy season	Thrice	-	Thrice	Sixteen	Five	Tweenty

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229 Table 4: Pests and diseases of leek, pesticides and their frequency of application used for their control

	Growth stage					
	Transplant		Flowering		Maturity	
	Pest	Disease(s)	Pest	Disease	pest	Disease
Pest/ disease	Cutworms	-	Aphids	Blight	Aphids,	Blight
Pesticide	Cypercal, Parastar Fastac	-	Parastar, Callidim	Manozane, Mancozeb	Cypercal,	Pencozeb, Mancozeb, Manozane
Frequency during dry season	Twice	-	Twice	Seven	Twice	Seven
Frequency during rainy season	Twice	-	Once	Seven	Once	Eight

Potato (*Solanum tuberosum* L.)

During sprouting, the pest of potato during both dry and rainy seasons was cutworms, managed with Parastar, Cypercal and Fastac. The nature of damage by cutworms was more visibly in the rainy than dry season. At this early growth stage blight was also observed. Most farmers did not bother about blight at this stage, but the few who did used Ridomil for its control (Table 5).

At the flowering stage, the insect pests were fruitworms and aphids and the pesticides used for their control were Parastar, Cypercot and Fastac. Blight was persistent at this stage causing leaves to turn yellow and eventually drying off, managed with Pencozeb, Manozane and Mancozeb at this stage. Bacteria wilt [(*Pseudomonas solanacearum*)(Smith, 1896)(Burkholderiales:Ralstoniaceae)] was also noticed at this stage. Crops affected by bacteria wilt withered and when uprooted the potato tuber inspected was watery and soft in texture.

At maturity, aphids, fruitworms and blight were still persistent. The insects were sprayed with Parastar. Plantineb, Pencozeb and Balear were the main fungicides used against blight at this stage (Table 5).

252 Table 5: Pests and diseases of potato, pesticides and their frequency of application used for their control

	Growth stage					
	Transplant		Flowering		Maturity	
	Pest	Disease	Pests	Diseases	Pests	Disease
Pest/ disease	Cutworms	Blight	Fruitworms, Aphids, Leafminers,	Blight Bacteria wilt	Aphids, Fruitworms	Blight
Pesticide	Parastar, Cypercal, Fastac,	Ridomil	Parastar, Fastac,	Pencozeb, Monozane, Mancozeb	Parastar, Fastac,	Pencozeb, Monozane Mancozeb
Application frequency for dry season	Thrice	-	Thrice	Seven	Twice	Seven
Application frequency for rainy season	-	Twice	Twice	Eight	Twice	Seven

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DISCUSSION

Six cabbage farms observed through the growth stages revealed insect pests as the main problem to proper cabbage growth. The pests were cutworms, fruit worms, aphids and whiteflies. This is in line with the findings of Dzomeku *et al.,* [8]. The most prominent pest of cabbage was the black cutworm (*Agrotis ipsilon*) which affected the early growing stage. Norida and John [9] in Malaysia found *A. ipsilon* to be recognized by 80% of the farmers during the early growing period. This contradicts the findings of Talekar and Shelton, [10] who found diamondback moth (*Plutella xylostella*) as the most prominent pest of cabbage worldwide. This might be due to climatic factors that do not favour its survival in the Santa area or the farmers sprayed with insecticides and controlled its population. A range of insecticides were used to kill insect pests by the farmers, at different spraying frequencies. The insects caused more visible crop damage in the dry season than in the rainy season as in conformity with studies by Nsobinenyui *et al.* [11]. This might be due to increase temperatures. Increase temperature is known to speed up the life cycle of insects leading to faster increase in pest population. It has been estimated that a $2^{o}C$ increase in temperature has the potential to increase the number of insect life cycles by one to five times [12,13]. The main disease of cabbage in this area was clubroot disease (*Plasmodiophora brassicae)* commonly called 'Ginger' in this area which affected the roots of the cabbage plant. Here this disease did not respond to any pesticide and the only method farmers used for its control was crop rotation to disrupt the life cycle of the fungus.

The different tomato farms observed had the same kind of pests at its different growth stages. In the dry season the effects of insect pests were more visible than that of fungi on the crop. Many more farmers spray against insects than diseases in the dry season and this could suggest that insect pests are more serious in the dry season. The main insect pests of tomatoes in the dry season were cutworms, aphids, fruit flies, leaf miners, whiteflies and fruit worms. This is also reported by Sait [14]. The main disease that affected tomatoes was blight during all the growth stages of the crop and was seen during both seasons. Fontem [15] in a study on the severity of tomato diseases in Cameroon found that blight was the most severe disease in the wet season in Cameroon and is widely distributed on foliage and fruits.

A wide range of pests affected celery in the fields observed and the Key insect pests were cutworms, whiteflies, aphids, crickets and fruit worms. Blight was also seen affecting the crops. Farmers relied heavily on the use of pesticides to control these pests as reported by Ntonifor *et al*. [16]. Producers used a wide range of pesticides, as many farmers believe that the only way to tackle pest problems was to use pesticides.

Insects affected potatoes in the field at its different growth stages. Some affected the foliage, tubers and transmitted diseases as seen in the findings of Radcliffe and Ragsdale, [17]. Blight was less visible in the dry season such that some farmers did not spray their farms against this disease during this season. Blight caused the greatest visible damage in the rainy season [15]. Bacteria wilt disease was also a problem in the farms as crops were affected by this disease leading to low yields. This is in line with the findings of Kaguongo *et al*.,[18] who indicated bacteria wilt as an important disease contributing to yield reduction and considered it more problematic than blight since it has no known chemical control procedures and many farmers do not know how to control it.

CONCLUSION

It can be concluded that insect pests were a main problem in the dry season while there was reduced infestation in the wet season as there was less visible damage observed from insects. Blight was more visible in the rainy season than in the dry season.

From this study it is seen that the most prominent insect pest is the cutworm. This insect pest is seen to attack all the crops that were used in this study. They attack primarily at the stage when the crop has just been transplanted due to the fact that the stems of the crops are still very tender and they can chew through during feeding with their mandibles. Other insect pests noted in this study were aphids, crickets, whiteflies, fruit flies, leaf miners and black ants. These insects were all treated with insecticides.

The main insecticides that the farmers here used were Cypermethrine and Dimethoate , with Mancozeb and Maneb being the fungicides that were mostly used and Gramoxone being the herbicide of choice by most gardeners. Each group of these pesticides had almost the same active ingredients

All these crops suffered from fungal attack except the cabbage plant that was affected mainly by insect pests. This fungus that attacked the crops was *Pythophthora infestans*

316 commonly known as blight. It caused the leaves of Tomato, potato, celery and leeks to
317 become yellow and eventually dry off. Bacterial wilt was also reported in the potato
318 farms that were observed.
319 The findings of this study also present another disease which affects only cabbage called
320 clubroot disease and it affects the roots of the crop such that the roots do not extend into
321 the soil, and thus the crop would wither and die as a result of no water being drawn up
322 by the roots as they were damaged.
323
324 **RECOMMENDATION**
325 From this study it is noticed that farmers use a lot of pesticides to manage pests some of
326 which are toxic and have negative repercussions on the health of farmers and
327 consumers, therefore there is an urgent need to educate the Santa farmers on good
328 agricultural practices through Integrated Crop and Pest Management (ICPM) practices
329 which will include both cultural, physical or mechanical, biological and chemical pests
330 control methods. This can easily be obtained by organizing the farmers into small
331 farming groups where the farmers are trained and are able to exchange their knowledge
332 and experiences with each other.
333 Training on safety standards which are primarily aimed at promoting practices that
334 encourage farmers and pesticide users to adopt simple practices that protect them and
335 the environment from hazards caused by pesticide exposure, will be beneficial to users
336 and the consumers.
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