

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

ABSTRACT

Agriculture plays a very important role in the economy of Cameroon. In most instances it is still small scaled and depends largely on house hold labour, with about 70% of the active population engaged in it. The Western Highlands of Cameroon is noted for its high involvement in agriculture especially the cultivation of vegetable crops such as 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.). This work sought to identify the pests and diseases that hinder successful gardening and how they are managed by farmers. 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. The main diseases identified were clubroot (*Plasmodiophora brassicae*) and late blight (*Phytophthora 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. 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 Foubot 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.

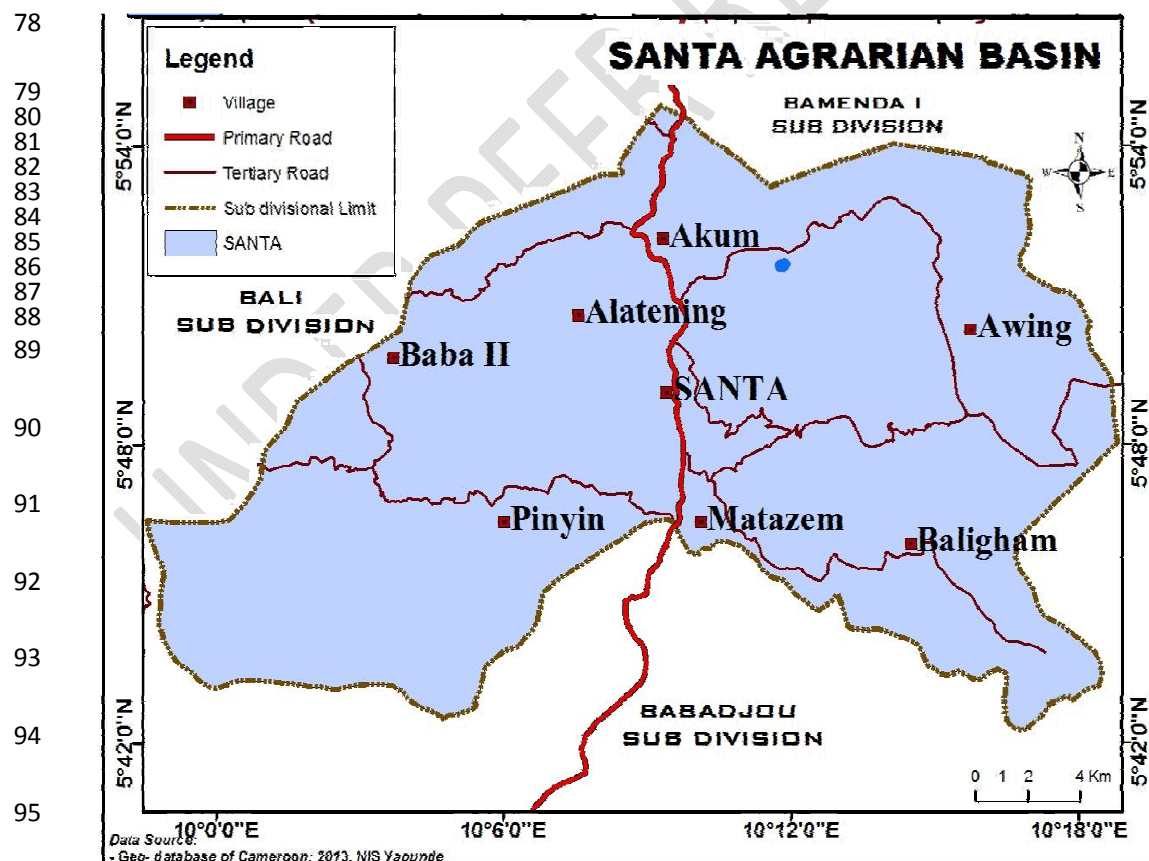
Yield and quality are central to sustainable vegetable production. If not properly managed, pests and diseases can dramatically reduce crop yield and subsequent returns. At this economic injury level, there is the need to employ control measures, which may have a great negative effect on the practice 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

64 Study area

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

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



96 Figure1. Map of Santa Sub Division showing the different villages

97 Identification of pests and diseases and their mitigation

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

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

106 **Data collection**

107 Pre-designed data recording forms were used in gathering information on the following
108 variables: insect pests, diseases, pesticides used to combat pests and their frequency of
109 application.

110 **Statistical analysis**

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

113 **RESULTS**

114 **Pests and Diseases of Garden Crops and their Management**

115 **Cabbage (*Brassica oleracea*)**

116 The insect pests common with cabbage at transplant stage were cutworms (*Agrotis*
117 *ipsilon*), which eat through the stems of the crop at the ground level and made the crop to
118 fall, whiteflies (*Bemisia tabaci* L.), aphids (*Myzus persicae* L.) and fruitworm
119 (*Helicoverpa amigera* L.) . The farmers used cypercal (cypermethrine) and parastar
120 (imidachlopride and lambdacyhalothrine) for their control during dry season. During this
121 transplant stage, there was no disease affecting cabbage (Table 1). Whiteflies, aphids and
122 fruit worms affected the crop mostly in the dry seasons as damage was more visible on
123 crops while the only pest insect pest caused visible damages in the rainy season was
124 cutworms.

125 At the flowering and maturation stages, whiteflies, aphids fruitworms and grasshoppers
126 were seen and same chemicals used for their control as during transplant. At the flowering
127 and maturation stages clubroot was the only disease affecting cabbage and no pesticide
128 was applied for its control (Table 1).

129 Table 1: Pests and diseases of cabbage, pesticides and their frequency of application
 130 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	-

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132 **Tomato (*Lycopersicon esculentum*)**

133 The major insect pest that damaged tomato at transplant stage was cutworm. The
 134 other insects at this stage were crickets (*Gryllus sp.*) and spider. Cypercal, Parastar
 135 and Cypercot (cypermethrine) were used against the cutworms. Blight was observed
 136 at this stage but did not cause visible severe damage in the dry season and was only
 137 sprayed in the rainy season with Mancozeb and Mancozane (Table 2).

138 The flowering stage of this crop suffered from a new set of pests. These were fruit
 139 worms (*Helicoverpa amigera* L), fruitflies (*Dacus puntatifrons* L), aphids, leaf
 140 miners and the cutworms. The fruit worms ate through the fruits, fruitflies stung the
 141 fruits creating black spots on them, the leaf miners mined the leaves and cutworms

142 present at this stage did not have major effects because the stems of the plant were
143 already hardened. The insecticides used at this stage were Cypercal, Parastar,
144 Cypercot (Table 2).

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

UNDER PEER REVIEW

151 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

152 **Celery (*Apium graveolens* L.)**

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

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

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

170 **Leeks (*Allium porrum* L.)**

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

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

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183 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 Mancozeb, Manozane, Plus	Parastar, Cypercal,	Pencozeb, Mancozeb, Balear,
Frequency during dry season	Thrice	-	Four	Four	Five	Five
Frequency during rainy season	Thrice	-	Thrice	Sixteen	Five	Twenty

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187 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

188 **Potato (*Solanum tuberosum* L.)**

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

194 At the flowering stage, the insect pests were fruitworms and aphids and the pesticides
195 used for their control were Parastar, Cypercot and Fastac. Blight was persistent at this
196 stage causing leaves to turn yellow and eventually drying off, managed with
197 Pencozeb, Manozane and Mancozeb at this stage. Bacteria wilt was also noticed at
198 this stage. Crops affected by bacteria wilt withered and when uprooted the potato
199 tuber inspected was watery and soft in texture.

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

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209 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.*, [7]. The most prominent pest of cabbage was the black cutworm (*Agrotis ipsilon*) which affected the early growing stage. Norida and John [8] 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, [9] 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.* [10]. 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°C increase in temperature has the potential to increase the number of insect life cycles by one to five times [11,12]. 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 [13]. The main disease that affected tomatoes was blight during all the growth stages of the crop and was seen during both seasons. Fontem [14] 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.

242 A wide range of pests affected celery in the fields observed and the Key insect pests
243 were cutworms, whiteflies, aphids, crickets and fruit worms. Blight was also seen
244 affecting the crops. Farmers relied heavily on the use of pesticides to control these pests
245 as reported by Ntonifor *et al.* [15]. Producers used a wide range of pesticides, as many
246 farmers believe that the only way to tackle pest problems was to use pesticides.
247 Insects affected potatoes in the field at its different growth stages. Some affected the
248 foliage, tubers and transmitted diseases as seen in the findings of Radcliffe and
249 Ragsdale, [16]. Blight was less visible in the dry season such that some farmers did not
250 spray their farms against this disease during this season. Blight caused the greatest
251 visible damage in the rainy season [14]. Bacteria wilt disease was also a problem in the
252 farms as crops were affected by this disease leading to low yields. This is in line with the
253 findings of Kaguongo *et al.*[17] who indicated bacteria wilt as an important disease
254 contributing to yield reduction and considered it more problematic than blight since it
255 has no known chemical control procedures and many farmers do not know how to
256 control it.

257 **CONCLUSION**

258 It can be concluded that insect pests were a main problem in the dry season while there
259 was reduced infestation in the wet season as there was less visible damage observed
260 from insects. Blight was more visible in the rainy season than in the dry season.
261 From this study it is seen that the most prominent insect pest is the cutworm. This insect
262 pest is seen to attack all the crops that were used in this study. They attack primarily at
263 the stage when the crop has just been transplanted due to the fact that the stems of the
264 crops are still very tender and they can chew through during feeding with their
265 mandibles. Other insect pests noted in this study were aphids, crickets, whiteflies, fruit
266 flies, leaf miners and black ants. These insects were all treated with insecticides.
267 The main insecticides that the farmers here used were Cypermethrine and Dimethoate ,
268 with Mancozeb and Maneb being the fungicides that were mostly used and Gramoxone
269 being the herbicide of choice by most gardeners. Each group of these pesticides had
270 almost the same active ingredients
271 All these crops suffered from fungal attack except the cabbage plant that was affected
272 mainly by insect pests. This fungus that attacked the crops was *Pythophthora infestans*

commonly known as blight. It caused the leaves of Tomato, potato, celery and leeks to become yellow and eventually dry off. Bacterial wilt was also reported in the potato farms that were observed.

The findings of this study also present another disease which affects only cabbage called clubroot disease and it affects the roots of the crop such that the roots do not extend into the soil, and thus the crop would wither and die as a result of no water being drawn up by the roots as they were damaged.

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