FARMER MANAGEMENT PRACTICES OF CITRUS INSECT PESTS IN KENYA

[SHORT COMMUNICATION]

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ABSTRACT

A formal citrus insect pest survey was conducted in two citrus growing districts of Kenya, Bungoma and Machakos, to determine important insect pests of citrus and evaluate the pest control practices used by small-scale farmers. Observations were made on the insect pests and their damage, methods of pest control practiced, pesticide products used, sources of farming knowledge and how decisions to control the insect pests. Farmers identified important pests as aphids (*Toxoptera citricidus* Kirkaldy), psyllids (*Trioza erytreae* Del Guercio), citrus black flies (*Aleurocanthus woglumi* Ashby), false codling moths (*Cryptophlebia leucotreta*), soft green scales (*Coccus viridis* Green), citrus woolly whiteflies (*Aleurothrixus flocossus* Maskell), mites (*Phyllocoptruta oleivora* McGregor), fruit flies (*Ceratitis spp*), leaf miners (*Phyllocnitis citrella* Stainton), and orange dogs (*Papillio demodocus*) in decreasing order of importance. Farmers' management practices included indigenous traditional knowledge and mainly pesticides. Farmers mainly used their own experience and that of their neighbours to decide on what to use and when to deal with the insect pest situations. Current insect pest management practices by citrus farmers are inadequate to deal with insect pest and disease situations within farms. These findings have an implication in the spread and management of huanglongbing disease (HLB) and citrus tristeza vectored by psyllids and aphids, respectively.

Key words: Citrus, Farmer perceptions Insect pests

INTRODUCTION

In Kenya, citrus (*Citrus* spp.) fruits rank third after bananas and mangoes. Citrus fruits are important sources of income to resource-poor farmers, employment in rural areas, and human nourishment (Araujo, 1977). The main varieties grown include sweet oranges, lemons, limes, tangerines and grapes in decreasing order of importance. All citrus fruits produced in Kenya are consumed locally, but the annual total production falls short of the

demand. Over the last two decades citrus fruit production has been declining with very little efforts being put in place to reverse the trend.

Citrus growers in Kenya, consist mainly of small-scale farmers (Seif, 1996), who realize on-farm yields of 4-10 t/ha, while the crop has a potential capacity of producing up to 50 t/ha for countries that practice integrated pest management programmes (FAO, 1996) and 75 t/ha in high density plantings (Obukosia and Waithaka, 2000). Low yields of citrus fruits are attributed to various insect pests and diseases, inadequate capital, inadequate planting materials and poor orchard management practices in decreasing order of importance (Obukosia, personal comm.). It is difficult to accurately estimate the yield losses due to insect pests and diseases in a perennial crop. However, in Kenya, Huanglongbing (HLB) disease of citrus has been identified as a major limitation (Ministry of Agriculture, 1982). Kenya Agricultural Research Institute (1991) reported that whole orchards had been lost due to HLB disease of citrus, while mild infestations caused up to 25% yield loss. Huanglongbing disease is caused by an uncultured phloem restricted bacterium '*Candidatus' Liberobacter* spp and is transmitted by two vectors namely the African citrus psyllid (*Triozae erytreae* Del Guercio) and the Asian citrus psyllid (*Diaphorina citri* Kuyawama) (Jagouiexa *et al*., 1994). In Kenya, the citrus psyllid is an important vector of the citrus greening disease (Ministry of Agriculture, 1982). In response to the insect pest problems on citrus, chemical control has been recommended (Beige *et al*., 1984). Unfortunately, financial and other socio-economic constraints hinder small-scale farmers from using pesticides.

The present study was conducted to obtain basic information on insect pests that attack citrus in Kenya, later to be used to develop pest management technologies that are sustainable and compatible with citrus farmers' conditions. The specific objective was to determine important insect pests of citrus and evaluate the practices used by small-scale farmers in controlling HLB and viral diseases that have destroyed the citrus industry in Kenya.

METHODOLOGY

A survey was conducted in two citrus growing districts of Kenya, Bungoma and Machakos. The districts were stratified according to the major agricultural ecological zones within them. These were lower midlands (LM), Upper midlands (UM) and lower highlands (LH) (Table 1). Bungoma district in the western zone received more rainfall and represented the high altitude areas, while Machakos in the eastern zone represented the lower altitude areas; over 80% of the district is semi arid.

Table 1. Description of the main agricultural ecological zones

Zone	Altitude (m)	Mean temp.	Rainfall
Lower highlands (LH)	1800 - 2400	15 C - 18 C	1000 -1800mm Low evaporation
Upper midlands (UM)	1300 - 1900	18 C - 21 C	700 - 1800mm Low evaporation
Lower midlands (LM)	800 - 1300	21 C - 24 C	700 - 1800mm High evaporation

Source: Jaetzold and Schimdt (1983a and b)

Using a stratified random sampling technique, 21 farms, with a minimum of five mature citrus trees from each stratum were sampled. By means of a questionnaire 63 farmers drawn from the two districts were interviewed. The questionnaire consisted of two parts. The first sought characteristics of farms or farmers such as age, experience as a citrus farmer, education level, area (ha) of land under cultivation and the purpose of growing citrus among other enterprises in the farm. The second part focused mainly on the constraints that hinder on-farm citrus production, pests observed on farms, ranking in order of importance, methods of pest control practiced, pesticide products used, source of farming knowledge and how decisions were made. The health status of the trees was also scored on a scale of 1-3; where 1 = healthy, 2 = moderately healthy, and 3 = unhealthy. Data collected were converted into frequencies and means using descriptive statistics to determine important pests of citrus, farmer perceptions about the pests, common control methods practiced by the farmers and sources of knowledge used to make pest management decisions.

RESULTS

Farm Resources and Socio-economic Characteristics

Farm sizes ranged from 1.9 ha to 3.5 ha of which 10% to 14% was committed for citrus production as a cash crop (about 100 trees) and 15% of the farmers in Bungoma district used their own seedlings compared to 70% of the farmers in Machakos who were having difficulty in obtaining quality planting materials. More orchards (70%) in Bungoma had unhealthy trees unlike in Machakos where fewer orchards (40%) had unhealthy trees. Less than 50% farmers in Bungoma sprayed their crop compared to 70% farmers in Machakos district. Most orchards were intercropped, 52% and 80% in Bungoma and Machakos, respectively. Crops used in both districts for intercropping included maize, pigeon peas, beans, potatoes (*Solanum tuberosum*), sweet potatoes and vegetables (Table 2).

Table 2. Farm resources and socio-economic characteristics in Bungoma and Machakos districts (% of farmers or farms)

Variables	Bungoma	Machakos
Farm sizes	3.5 ha	1.9 ha
Farms intercropped	52	80
Farmers using own seedlings	15	70
Farmers with difficult in getting seedlings	82	57
Farmers using seedlings from nurseries	84	30
Farms with unhealthy trees	72	40
Farmers growing citrus as a cash crop	72	93
Farmers spraying citrus	42	70

Perceived Citrus Production Constraints

Farmers reported that insect pests and diseases were major production constraints. Other constraints included inadequate capital, inadequate disease-free planting materials, drought or water stress, marketing, low soil fertility and other social problems in decreasing order of importance (Table 3). Water stress was a more pressing problem (rank 3) for farmers in Machakos compared to farmers in Bungoma who gave inadequate planting materials rank 3. Aphids, black flies, psyllids, false codling moths and scales were perceived to be of primary importance. Aphids, black flies and false codling moths were ranked highest in Machakos followed by scales, while aphids, psyllids and mites were ranked 1, 2 and 3, respectively in Bungoma. Other insects reported were whiteflies, fruit flies, leaf miners and orange dogs (Table 4). Most of these insects were found in the higher altitude zones where moisture was available throughout the year or in irrigated orchards in the lower midland zones. Psyllids, whiteflies, aphids and leaf miners were observed to be most abundant during the on-spot assessment of random citrus trees in the orchards. Machakos district had whiteflies, aphids and psyllids as the most abundant insects occurring in over 60% of the orchards assessed. Aphids and whiteflies were less prevalent in Bungoma (<40% of the farms assessed). However, all farms had psyllids or psyllid damage in Bungoma district (Table 5).

Pest Control Practices by the Farmers

Chemical control was the most common pest management practice used. Forty per cent of the farmers in Bungoma and about 70% of the farmers in Machakos used chemicals to control insect pests and diseases in the orchards. Of the farmers that applied chemicals, 14% practiced calendar/routine spraying, while 40% practiced periodic application of pesticides (during flowering of the crop only) (Table 6).

Table 3. Constraints to citrus production reported by farmers

Constraint	Bungoma	Machakos	Rank
Pest and diseases	30	40	1
Inadequate capital	26	18	2
Inadequate planting materials	23	13	3
Drought or water stress	7	15	4
Marketing	6	4	5
Low soil fertility	1	3	6
Others	6	5	7

Others include theft and social problems

Table 4. Percentage farmers reporting and ranking pests

Pest species	Bungoma	Machakos	Mean and rank
Aphids (*Toxoptera* spp.)	18	15	17 (1)
Black flies (*A. woglumi*)	9	15	12 (2)
Scale insects (various)	9	11	10 (5)
Psyllids (*Trioza erytreae*)	15	10	12 (2)
Whiteflies (*Aleurocanthus floccosus*)	7	9	8 (6)
False codling moth (*C. leucotreta*)	9	15	12 (2)
Mites (*Phyllocoptruta oleivora*)	10	4	7 (7)
Fruit flies (*Ceratitis* spp.)	3	9	6 (8)
Leaf miner (*Phyllocnitis citrella*)	3	2	3 (10)
Orange dog (*Papilio demodocus*)	6	1	4 (9)
Others	6	6	6

Overall ranking is shown in parenthesis

Table 5. Percentage of farms where pest damage was observed

Insect pest species	Bungoma	Machakos	Mean and rank
Aphids (*Toxoptera* spp.)	21	63	42 (3)
Black flies (*Aleurocanthus woglumi*)	3	46	25 (4)
Scale insects (various)	18	7	13
Psyllids (*Trioza erytreae*)	100	63	82 (1)
Whiteflies (*Aleurocanthus floccosus*)	36	69	59 (2)
False codling moth (*C. leucotreta*)	-	-	-
Mites (*Phyllocoptruta oleivora*)	3	23	13
Fruit flies (*Ceratitis* spp.)	0	1	1
Leaf miner (*Phylocnitis citrella*)	46	33	40 (3)

-: insect or damage not observed because trees were flowering with no fruit

Commonly used chemicals were synthetic pyrethroids such as lambda cyhalothrin and permethrin (these are common scientific names). Others were organophosphates like diazinon, fenitrothion and dimethoate. A few farmers (11%) used fungicides (Table 7). Apart from chemicals a few farmers used Indigenous Technical Knowledge (ITK) to manage insect pests. Indigenous Technical Knowledge consisted of local materials such as wood ash, and/or non-chemical spray formulations (a mixture of detergent soap with a weed, Mexican marigold (*Tagetes minuta*) in liquid form), which the farmers used to control pests, particularly aphids.

Table 6. Insecticide use and frequency of application (% citrus farmers that used pesticide to control pests) in Bungoma and Machakos

Pest control method	Frequency of application	Bungoma	Machakos	Mean
Chemical control	Calendar	5	23	14
Chemical control	Periodic	36	44	40
No pest control	N/A	59	33	46

Overall mean for the two districts

Table 7. Percent farmers using common pesticides to protect their citrus

Trade name	Common name	Bungoma	Machakos	Rank
Karate	Lamda-cyalothrin (I)	35	46	1
Diazinon	Diazinon (I)	24	15	2
Ambush	Permethrin	17	4	3
Fenitrothion	Fenitrothion (I)	3	12	4
Dimethoate	Dimethoate (I)	-	8	
Sumicidin	Fenvaralate (I)	3	-	
Dithane M45	Mancozeb (F)	7	4	
Bayleton	Triadmefon (F)	-	8	
Kocide 101	Copper (F)	3	-	
Orthene	Acephate (I)	3	-	
Foliar feed	Various nutrients	3	4	

I: insecticide, F: fungicide -: pesticides not reported in the district

Sources of Pest and Disease Control Knowledge

Farmers largely used their own experience and that of other farmers or neighbours to manage insect pest situations in their farms. Over 50% of the farmers applied chemicals after observing pests, while less than 10% relied on advice from government extension agents. The rest (38%) relied on the advice of chemical company salesmen and agricultural input stockists to control pests in their farms (Table 8).

Table 8. Percent farmers who used sources of information to make pest management decisions

Sources of farming information	Bungoma	Machakos	mean
State agricultural extension officers	5	6	6
Other farmers and own knowledge	60	52	56
Others	35	40	38

Others: Chemical company salesmen, agricultural input stockists

DISCUSSION

Results indicated that citrus production is practiced by small-scale farmers, who commit part of their land to grow citrus as a cash crop. However, for efficient land use, farmers intercropped citrus with other food crops. Unfortunately, these crops may modify the microclimate to favour multiplication of insect pests and create more problems on citrus. No habitat modification research has been done to guide the farmers on which crops to use as for intercropping. Most farmers used seedlings from nurseries that were not certified, while others used their own seedlings. They were not assured of cleanliness of the plant materials. This could be the reason why orchards had unhealthy citrus trees.

Citrus farmers encountered similar problems and they applied similar practices to solve insect pests within the farms. They perceived insect pest and diseases as the major constraints. Several insect pests among them aphids, black flies, psyllids, false codling moth, scales, mites, whiteflies, leaf miners, fruit flies and orange dogs were identified as problems. Smith *et al*. (1997) made similar observations on citrus in Australia and concluded that farmers controlled insect pests using pesticides because pesticides are easy to use. Psyllids, whiteflies, aphids and black flies were ranked high during on-farm assessment of the orchards. Psyllids and aphids are known vectors of destructive citrus diseases (HLB and tristeza). Magomere (2005) determined the distribution of HLB and psyllids across agro-ecological zones (AEZ) and established that psyllid distribution showed significant differences across AEZs with most psyllid counts encountered in altitudes above 1500 m. This coincided with high PCR and visual scores of HLB. Huanglongbing disease decreased with decrease in altitude in both districts.

While chemical control method was viewed as an easy way of achieving farmers' objectives of reducing or eliminating insect pests, it is not a sure way of preventing spread of diseases in citrus orchards. Psyllids are persistent vectors of HLB and are carriers throughout their lifetime because of the transovarial transmission of the HLB. On the other hand, aphids are

non-persistent vectors of viral diseases such as tristeza and by spraying them they are not eliminated before probing and passing on the pathogen. In addition, aphids are disturbed by spraying hence probe several sites before settling down. Furthermore, chemical use among the farmers is limited by financial constraints and hence the pests remain largely uncontrolled.

CONCLUSION

This study established that insect pests are a problem and that present chemical control practices by the farmers are not effective in managing the insect pests. Pests of concern are citrus aphids, psyllids, whiteflies, black flies, leaf miners, scales, fruit flies and mites. Citrus aphids and psyllids are known vectors of citrus diseases. Farmers rely on one another for information on pest management practices due to lack of reliable technical information and they use planting materials from uncertified sources. In addition they practice intercropping which may be increasing pest problems. All these may be contributing towards the spread of HLB and other viral diseases of citrus in Kenya.

RECOMMENDATION

There is need for a study on the relationship between insect pests, disease pathogens and plant-hosts to help design appropriate strategies of managing the insect pests and diseases of citrus. A disease certification scheme to avail clean planting materials for farmers needs to be developed and implemented.

ACKNOWLEDGEMENT

This study was carried out with funds from Rockefeller foundation (RUFORUM) to which we are grateful. The farmers' co-operation and government extension staff participation is greatly appreciated.

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