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Constraints to profitable dry season tomato and pepper production in the Kasena-Nankana and Talensi districts of the Upper East Region of Ghana with emphasis on pests and diseases.

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Research Paper

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ABSTRACT

Studies were conducted into pests and disease problems of tomato and pepper in two districts of the Upper East Region (UER), namely Kasena-Nankana and Talensi in 2011/2012 irrigation season. Farmer interviews as well as practical surveillance and field diagnoses were employed in the studies.. Farmers identified insects and diseases as the second most important production constraint after poor markets and prices that limit the production and hence profitability of these crops in the region. Whitefly *Bemisia tabacci*, leaf curl and mosaic viruses and vascular wilts were the three most important biological constraints mentioned by farmers and also confirmed from the our field surveys and diagnoses. Poor access to certified seed and high costs of agrochemicals are, in the view of most farmers, other important constraints that need to be addressed in order to promote profitable and sustainable production of tomato and pepper in the study area. Farmers lacked knowledge of alternative controls and generally relied on chemical sprays to cope with pests and diseases though these are seldom fully effective. In view of the well known adverse effects of pesticides on human health, biodiversity and the environment, it is essential to intensify educational and other awareness activities that would empower farmers to adopt integrated crop and pest management (ICPM) practices as alternatives to chemical control.

Key words: Insect pests, integrated pest management, tomato, pepper, dry season Ghana

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INTRODUCTION

Vegetable crop production remains a key source of livelihood and income for many rural communities in the Upper East region (UER). Vegetables are important from both the nutritional and health points of view as they supply essential nutrients including the vitamins and minerals often lacking in most traditional staple crops grown by farmers. Vegetables also provide the necessary bulk and fibre required to make a meal filling and also assists digestion of the staple finer foods. In fact, in times of food shortages, vegetables often constitute whole family meals. Vegetables such as Okro and vegetable jute impart a slippery consistency to soups and stews, thus facilitating swallowing of rough, starchy foodstuffs and dishes. Aromatic vegetables and herbs contain essential oils and compounds that enhance flavor and taste when incorporated in to otherwise tasteless foods, thus improving appetite. Finally some vegetable such as garlic, onion, bitter leaf possess health-improving attributes when consumed regularly (Norman, 1992; Waaijenberg, 2003; AVRDC 2006).

In spite of the huge potential for improving vegetable production in the UER and the numerous efforts made by both governmental and non-governmental organizations over the years to achieve same, production levels and economic returns remain sub-optimal.The main challenges include the low level of technology use, proliferation of pests and diseases, declining soil productivity, inadequate groundwater reserves as well as

socio-economic factors. There has been serious intensification of vegetable production at most dam and river sites over the years, with same crops (eg. pepper, tomato, onion) grown yearly on same plots for up to 10 years in some cases. This intensification has brought in its wake, several pest and disease problems some of which have threatened the vegetable production sector and rendered whole fields unusable. Insects, especially Whitelflies (*Bemisia tabacci*), leafhoppers (*Empoasca spp*) and fruit borer (*Heliverpa armigera*) have often cause severe to total destruction to tomato farms every growing season (Tanzubil et. al. 2004). The result is that yields and quality of harvests are negatively affected and farmers get caught up in debts arising from bank loans. The Northern Star Tomato Factory located at Pwalugu in the district is supposed to be fed with raw materials from these same farmers; hence its scale and duration of operations are also severely curtailed. , in recent times rendered on tomato and pepper as well as onion and continue to do so today.

Lack of scientific knowledge and appropriate technology is a common barrier to sustainable agricultural intensification there is need to be aware of what farmers know in order to help facilitate the development of workable integrated crop management (ICM) systems for the key vegetables cultivated by farmers. Surveys are useful tools for gathering ideas and opinions of farmers about pest and disease management at the same time as documenting their current practices. These studies were carried out to determine constraints militating against profitable and sustainable vegetable production, especially those relating to pests and diseases, which from previous studies appeared to be of increasing importance in the study area.

MATERIALS AND METHODS

Field visits and diagnosis

A total of 18 farms in the Talensi district (6 each at Yinduri, Pwalugu and Namogo) and 20 farms in the Kasena-Nankane district (5 each at Doba, Paga, Pungu and Namolo) were monitored monthly between January and March of 2011 and 2012. On each farm, plants were visually inspected for presence of eggs, nymphs and adults of insects. Sweep nets were also used to capture arthropod pests from crop foliage and weeds in each field. At each farm we deployed five (5) yellow sticky traps to monitor infestation by white flies, which were clearly abundant on all the fields visited. Samples of whole plants and plant parts showing signs of pests and disease infestation were also taken to the laboratory for closer examination and diagnosis. The incidence of the various insect pests and diseases were recorded as *Relative abundance* on a scale of 1 -5 where 5 = insects/disease occurs in high abundance/severity in all fields visited; and 1 = pest/disease seldom occurs (Tanzubil and Yakubu 1996). Disease conditions in plants were diagnosed based on symptoms observed on host plants and also characteristics of fungal growth on plant tissues where applicable.

Farmer interviews and community interactions

A total of 120 farmers, 75 and 45 each from Kassena-Nankana and Talensi respectively, were interviewed in both individuals and small group discussions, usually on their farms following the procedures adopted by Tanzubil and Yakubu, (1997). The checklist sought information on pest identity and damage, the farmers' perceptions of various insects and pests, levels of yield losses as perceived by the farmers and the control measures (if any) they employ. Responses were quantified (descriptive statistics) and subjected to ranking to arrive at relative weights given each pest by the farmers.

RESULTS

Diagnosis of field problems

Whiteflies, *Bemisia tabacci* were the most frequently encountered insect pests on all the fields visited in both districts, with mean *Relative abundance* (RA) scores of 4.5 and 4.3 for K-N and Talensi districts respectively (Tables 1 and 2).Nymphs and adults of these were caught in very high numbers in sticky traps deployed in all the fields and disturbance of any plant in the field, revealed swarms of whiteflies taking off and landing. Apart from direct feeding damage, *B. tabaci* is known to produce a sticky honeydew, which can predispose plants to fungal diseases and also reduce photosynthetic activity in affected plants. The insect is also known to actively transmit virus diseases such as leaf curl, yellow mosaic and mottle notably in tomato and pepper. The incidence and severity of attack by the insect increased with time from transplanting and by March, the percentage of plants affected were very high in most fields with nearly all plants showing typical damage symptoms including wilting, stunting and leaf curl. Fruit development was severely impaired in affected plants and some farmers suffered total crop failure, especially at Pwalugu, Namogo and Namolo.

Incidence of virus diseases transmitted by this insect was expectedly also very high with mean RA scores of at least 4.0 at all locations. Based on symptomatology, Tomato yellow leaf curl virus (TYLCV) and Tomato mottle virus were the most prevalent virus diseases affecting both crops and their incidence and severity appeared to be higher in K-N (4.8) than in Talensi (4.0).

Other insects found in the fields included leafhoppers *Empoasca spp*, aphids and fruit borers, particularly

Table 1. Relative abundance of insect pests and diseases of irrigated vegetable crops in the Kasena Nankani District, UER.

Pest/disease	Doba	Paga	Pungu	Namolo	Mean
whitefly	5	4	4	5	4.5
leafhoppers	3	3	1	3	2.5
Aphids	1	1	1	2	1.3
Fruit borer	3	2	3	2	2.5
Virus diseases	5	5	4	5	4.8
Wilts (fungal, bacterial)	4	2	2	4	3.0
Nematodes	2	2	3	3	2.5
Foliar diseases	1	1	1	3	1.5
Grasshoppers	3	3	3	2	2.8

*Based on score of 1-5 where 5 = insect in high abundance in all fields visited and 1= insect seldom occurs.

Table 2. Common insect pests of irrigated vegetable crops in the Talensi District, UER.

Pest identity	Relative abundance*			
	Pwalugu	Yinduri	Namogo	Mean
whitefly	5	4	4	4.3
leafhoppers	2	3	2	2.3
Aphids	2	2	1	1.7
Fruit borer	1	1	1	1.0
Virus diseases	4	3	4	3.7
Wilts	2	2	3	2.3
Nematodes	3	2	2	2.3
Foliar diseases	2	1	2	1.7

*Based on score of 1-5 where 5 = insect in high abundance in all fields visited and 1= insect seldom occurs.

Helicoverpa armigera. Leafhoppers were abundant in nearly all fields visited, with severely damaged plants showed the typical leaf curl and in some cases, *hopperburn* symptoms. They were the second most important insect pest after whiteflies and could possibly assume greater economic importance under continuous intensification of production and/or changing environmental conditions and agronomic practices. Occurrence of aphids was sporadic and more pronounced in some fields only, especially Pwalugu and Namogo in Talensi and Namolo in K-N. Fruit borers were present in all the fields visited but their incidence and damage was low, usually with less than 10% of plants attacked. Incidence of fruit borers appeared to be higher in the K-N (2.5) district than in Talensi (1.0) owing possibly to the more intensive cultivation of tomato in the former.

Apart from virus diseases, fungal wilt caused by *Fusarium spp,* and bacterial wilt caused by *Ralstonia solanacearum* constituted serious challenges to tomato and pepper productions with RA scores of 2.3 and 3.0 for Talensi and K-N respectively. The pathogens attack the stems and roots disrupting flow of water and nutrients and inducing wilting, yellowing and death of the leaves starting from the base upwards. Bacterial wilt causes rapid wilting of whole plants without yellowing of leaves while wilting is usually preceded by yellowing of leaves in the case of fungi. In many of the cases, attack by wilts coincided with reproductive growth and thus resulted in severe crop and yield losses.

Root-knot nematodes, *Meloidogyne spp* were another important pest with damage symptoms more pronounced on tomato than on pepper. Nematodes invade plant roots leading to production of root galls, root malformation and loss of root mass. Severely attacked plants develop show chlorosis (yellowing), become stunted and may die leading loss of plant stand in the affected plot. Though plant analysis showed RA values greater than 2.3 parasitic nematodes, aerial symptoms were usually not too obvious and overall impact on growth and yield was probably not economically significant.

Farmer interviews and community interactions

All farmers reported that pests and diseases were a major production constraint. In fact, they constituted the second most important constraint after marketing in the view of most farmers (Table 3). Non-availability and/or high costs of agrochemicals notably fertilizers and pesticides was a key constraint with two-thirds of farmers facing this problem annually. Other important constraints

Table 3. Constraints to dry season vegetable production reported by farmers.

Production constraints	Percentage of respondents		
	KN (75)	Tal.(45)	Mean
Water shortage	80.0	33.3	56.7
Lack of information and extension	42.7	33.3	38.0
Price fluctuations/marketing	97.3	88.9	93.1
Lack of good quality or certified seeds	46.7	33.3	40.0
Lack of inputs (fertilizer, pesticides)	66.7	66.7	66.7
Labour problem	20.0	33.3	26.7
Pests and diseases	90.7	93.3	92.0
Poor access to credit	24.0	42.2	33.1

Table 4. Percentage of farmers reporting the major pests and diseases.

Pest/disease problem	Main crops affected	Percentage of respondents		
		KN	Tal.	Mean
Virus leaf curl diseases	Tomato, pepper	88.0	62.2	75.0
Wilt	Tomato, pepper, egg plant	50.7	44.4	47.6
Leaf spot	Most vegetables	24.0	33.3	28.7
Fruit rot	Egg plant, tomato	13.3	17.8	15.6
Stem, root rot	Pepper, tomato, egg plant	10.7	17.8	14.3
Damping off	All vegetables	28.0	22.2	25.1
Nematodes	Tomato, pepper, eggplant	10.7	17.8	14.3
Fruit borer	Tomato, egg plant	56.0	46.7	51.4
whitefly	Tomato, pepper, okro	93.3	80.0	86.7
Grasshoppers	All vegetables	26.7	33.3	30.0
Others	Leafy vegetables, onions	40.0	66.7	53.4

KN=Kasena-Nankana; Tal=Talensi

mentioned by farmers were water shortage and inadequate supplies of good quality/certified seed with 56.7% and 40% respectively of respondents mentioning them as limiting factors. Labour was the least frequently mentioned constraint owing possibly to the reliance on family labour and the small sizes of holdings available to each farmer at each irrigation site. Results from the farmer interviews broadly tally with our field diagnosis, with whitefly and virus diseases being the most frequently encountered in both districts (Table 4). A mean of 87% and 75% of farmers mentioned whitefly and virus diseases respectively as reducing their yields and profits and indicated the need for assistance in controlling them. Fruit borers and wilts were other pests and diseases mentioned by over 47% of respondents. Damping off, leaf spots, grasshoppers and nematodes were other pests and diseases mentioned as constraints by respondents.

DISCUSSION

This study showed that farmers viewed pests and diseases as very serious constraints to vegetable production in the study area. This corroborates earlier reports on the subject in both the study area and Ghana at large. For instance, Tanzubil (1991), Tanzubil and Yakubu (1996) recorded many pests and diseases attacking irrigated vegetable crops in the various dam sites of the UER and expressed concern that these were becoming limiting factors to sustainable intensification in the region. In fact the total devastation of irrigated tomato fields in the UER in 2003 and 2004 were confirmed to have been caused by insect pests, nematodes and virus diseases (Tanzubil et. al. 2004). Ntow, (2001) and Asante and Ntow (2009) similarly reported high incidence of pests and diseases on these crops grown continuously under irrigation in the Akomadan and other areas in southern Ghana, thus making the problem a national one.Virus diseases especially, Leaf curl and Mosaic constituted the greatest threat to profitable and sustainable tomato and pepper production in the study area and there are currently no effective measures for managing them. Our findings confirm earlier reports of virus diseases devastating whole tomato and pepper fields in various parts of the UER over the years (Tanzubil and Yakubu, 1996, Tanzubil et. al., 2004). Both viruses are transmitted in a persistent manner by the whitefly, *Bemisia tabaci* (Gennadius) which occurred in very high abundance in all fields visited. The insect has an incredibly wide host range which includes annual and perennial plants of wild and cultivated species. There is therefore usually adequate food and suitable conditions

Table 5. Farmers' control measures for pests and diseases attacking vegetable crops.

Control measure adopted	Target pest/disease	% of respondents		
		KN	Tal.	Mean
Use insecticide	Insects,	88.0	66.7	77.65
Use chemical (unspecified)	Insects, diseases, others	93.3	80.0	86.65
No control	Diseases, whitefly, soil pests	28.0	33.3	30.65
Rogue diseased plants	Diseases, weeds	13.3	17.8	15.55
Hand picking	Fruit borers, caterpillars	10.6	11.11	11.86
Use ash	Leaf eaters, seedling insects	21.33	26.67	24.00
Rotation with non-hosts	Insects and diseases	10.6	17.8	14.20

KN=Kasena-Nankana; Tal=Talensi

for continuous breeding resulting in overlapping generations of whiteflies and virus inoculum throughout the growing period. Though most farmers are confronted with pest and disease problems annually, they reported a lack of alternative effective measures to manage them and have thus resorted overwhelmingly to repeated applications of pesticides.

Though many farmers reported that spraying pesticides on diseased plants did not result in appreciable control, they nonetheless continued to do so probably out of desperation and also as `insurance' against the other pests numerous pests often ravaging their crop fields. The exact types of chemicals used could not be determined in most cases as farmers simply referred to all pesticides as *DDT*. We however observed a worrying trend of some farmers using pesticides meant exclusively for such non-food crops like cotton and cocoa on account of their greater availability and lower costs. The negative effects of misuse of pesticides on humans, livestock, non-target organisms and the environment are now well known making the existing situation in the study area unacceptable. Misuse of pesticides under irrigation can be particularly dangerous as such chemicals easily pollute water bodies hence poisoning humans and livestock that drink from them as well the aquatic biota of such ecosystems. In fact, several studies on pesticide residues have reported water pollution, food contamination and accumulation of active toxicants in human fluids of farmers at Akomadan and other irrigation sites in Ghana (Ntow,2001; Asante and Ntow (2009) and this probably is the case also seen in the UER.

The high dependence on pesticides by vegetable farmers was attributable to their lack of awareness of other pest management strategies that are effective, inexpensive and yet friendly to the environment and this agrees with earlier reports by Tanzubil et. al., (2004). To minimize pest and disease problems in a sustainable manner, there would be the need to develop and/adopt more rational and ecologically-based pest management strategies than is currently the case. Pest management strategies including intercropping, use of certified seed, good field sanitation and crop rotation have been shown to significantly reduce insect pests and diseases and have thus been recommended for vegetable crop production in the study area (Tanzubil, 2011). Our results show that currently only a relatively small number of farmers (14 – 24%) deploy these methods on their fields to minimize pest attack while as many as 30% did nothing at all (Table 5). There is a need to intensify farmer education and training on these alternative pest management practices that are cost effective and environmentally friendly.

Another promising area is to intensify the use of biopesticides, used here to include insect growth regulators, botanical insecticides and microbial pesticides. In Ghana, *Bacillus thuringiensis* in various forms (eg. Dipel) has proved effective against some pests of vegetables in semi field conditions and may be useful against fruit borers in tomatoes and defoliators in leafy vegetables. Botanical materials, especially extracts from seeds of Neem (*Azadirachta indica*) have also proved effective as antifeedants and growth regulators against many foliage feeders such as thrips in onion and legumes, as well foliage feeding beetles and caterpillars on leafy vegetables (Dreyer, 1984; Tanzubil, 1991b; Tanzubil et al, 1994). Apart from lower costs, toxicity and environmental impact, Terbobri, (1993) showed that neem extracts treatments were most cost-effective and produced the highest benefit cost ratio when compared with synthetic insecticides applied to control onion pests in the Bawku district. There is the need to fine tune this knowledge for practical adoption by farmers.

Conclusion and recommendation

The study shows that pests and diseases have indeed become the main threat to profitable production of these crops under irrigation in the study area. It was also clear from our interactions and discussions with farmers that solving the purely biotic problems alone would not guarantee profitable and sustainable production of these vegetables by farmers. A total value-chain approach would be essential to ensure that all stakeholders work in tandem from seed to table and hence deal with the problems of low producer incomes, poor market access

and general food security.

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