

Survey of virus diseases on some major vegetable crops in some ecological zones of Ghana

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Abstract

A survey of vegetable virus disease was conducted in four major ecological zones of Ghana covering parts of Brong-Ahafo, Central, Western and Northern regions. Farms located in important growing districts in each region were assessed for general virus incidence and severity on economically important vegetables including tomato, pepper, egg-plant and okra. Thirty plants in each farm were scored for virus incidence and severity based on a 7-point scale where 0 represented no symptoms and 6 very severe infection. In most of the farms visited in Brong-Ahafo, Central and Western regions, virus infection was very severe on pepper, okra and egg-plant and moderately severe on tomato. Virus incidence and severity were, however, relatively low in the Northern Region. A few lines of pepper and egg-plant were observed to be resistant to viruses, and could be useful materials for breeding purposes. More research efforts are needed to develop effective control measures against the major virus diseases that threaten the survival of the vegetable industry in Ghana.

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Introduction

Vegetables are very important ingredients in the diet of most households in Ghana. They are essential addition to diet, providing much needed vitamins and minerals (Dixon, 1985). Vegetable farming is carried out basically in all the ecological zones in Ghana and are cultivated either as monocrops, or intercropped with cereals, legumes, root and tuber crops, plantation crops, etc. Vegetables most widely cultivated and of much economic importance include tomato, pepper, egg-plants and okra. National production figures for these crops as at 1987 were 20,400 ha; 57,000 ha; 28,000 ha and 21,000 ha for tomato, pepper, okra and egg-plant, respectively (PPMED, 1997). Those less widely grown but important vegetables include onion, cabbage, lettuce, cucumber and carrot.

Vegetable crops are generally susceptible to a host of diseases. Diseases affect yields both in quality and quantity and the most important are those caused by viruses. Virus infection often results in leaf mottling and distortion, reduction of leaf size and, quite often, stunting of infected plants. For example, some strains of the tomato

mosaic virus may cause the death of parts of the plant, especially the tip, or brown dead streaks along the stem (Chupp & Sherf, 1960). Common viral symptoms associated with the most widely grown vegetables in Ghana have been described by Critchley (1997).

The work reported here was carried in four ecological zones of Ghana, namely Guinea Savanna, Forest, Forest-Transition and Coastal Savanna. The objective was to investigate by means of a survey the incidence, intensity and spread of the major virus diseases on some vegetable crops of economic importance and to develop effective control measures.

Materials and methods

A survey of viral diseases on some vegetable crops including pepper, tomato, egg-plant, okra, cabbage, onion and carrot was conducted in the Brong-Ahafo, Central, Western and Northern regions of Ghana. The surveys in the Brong-Ahafo and Central regions were carried out in August, that of Western Region in September/October and in the Northern Region in October. In the Brong-Ahafo Region, eight districts, namely Berekum,

Tano, Sunyani, Asutifi, Asunafo, Techiman, Nkoranza and Wenchi were covered. In the Central Region, four important districts were covered, namely Mfantseman, Swedru, Winneba and Gomoa. In the Western Region, the districts were Mpohor, Wassaw East, Nzima East, Ahanta West and Ahanta-Shama East; and in the Northern Region, those covered were Tolon-Kubungu, Tamale, Savelugu-Nanton, West Mamprusi and Yendi.

For each location within a district, with a few exceptions, farms of not less than 0.5 ha were selected for evaluation. Twenty-six farms were evaluated in the Brong-Ahafo Region, 35 in the Central Region, 19 in the Western Region and 23 in the Northern Region. In each farm, virus incidence (% of total plants infected) as well as the % severity of total plants infected were recorded. Fifteen to 30 plants depending on size of farm were randomly selected and scored for virus damage mainly of the foliage and fruits. Crop growth stages of the various crops assessed were between 2 weeks after transplanting and fruiting stage. Foliar damage as a result of virus-infection was severe for almost all plants assessed, even for those that had fewer leaves infected. Thus, disease ratings for each plant was based on the percentage of leaves that showed infection.

Virus severity on each plant was rated based on a 0-6 scale, where

- 0 = No. of symptoms observed.
- 1 = 1-15% of foliage expressing symptoms.
- 2 = 16-30% of foliage expressing symptoms.
- 3 = 31-45% of foliage expressing symptoms.
- 4 = 46-60% of foliage expressing symptoms.
- 5 = 61-75% of foliage expressing symptoms.
- 6 = More than 75% of foliage expressing symptoms.

Few plants that had 15-75 per cent or more foliage showing wild infection were rated 1, 2 or 3. Plants which scored 2 or below on the scale 0-6 were considered as showing tolerance to the virus observed. Mean severity score for each crop/region was obtained by determining the mean

severity scores of the total plants assessed in all the farms per each region.

Results

Results showing percentage disease incidence and severity as well as the mean disease ratings of the various crops assessed in individual farms are summarized in Tables 1, 2, 3 and 4. Generally, most of the pepper, egg-plant and okra assessed in the four regions had severe virus infection, while tomato showed slight to moderate infection. The four crops were the most commonly cultivated. The few cabbage, onion and carrot crops evaluated showed no signs of viral infection.

For pepper, virus symptoms commonly observed were leaf curl disease commonly transmitted by the whitefly, *Bemisia tabaci*, vein mottling and mosaic transmitted by aphids. Leaf curl and mosaic were the common symptoms observed on okra. For those producing leaf curl symptoms the severely infected plants had reduced leaf size, distortion, and were stunted. Virus symptoms produced by tomato were leaf curl and mosaic with the severely infected plants showing leaf distortion, stunting and bronzing. For the egg-plants, mosaic was the most common symptom observed and plants that were severely infected were also stunted. The Brong-Ahafo Region recorded the highest percentage virus incidence and mean severity scores, respectively, for pepper (100%, 4.4), okra (98%, 4.0), tomato (71%, 3.1) and egg-plant (100%, 4.6) (Table 5). The Northern Region had the lowest percentage virus incidence and mean severity scores, respectively, for pepper (59.1%, 2.2), okra (41.2%, 2.1) and tomato (1.0%, 1.0). The Western Region had the lowest percentage incidence and severity scores for egg-plant (68.9%, 2.2).

Discussion

All the regions, except the Northern Region, had most of the farms evaluated showing over 70 per cent virus infection of pepper, okra and egg-plant; and in the Brong-Ahafo Region there was 100 per

TABLE I

*Incidence and Severity of Viruses on Vegetable Crops in Brong Ahafo Region**Berekum District*

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Mpatafo	1	Egg plant	Veinal mottle/mosaic	100	80	5.0
	2	Okra	Mosaic	90	90	4.2
Kutre No. 1	3	Pepper	Veinal mottle/mosaic/leaf curl/mishapen leaves	100	60	4.9

Tano District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Techire	1	Egg plant	Mosaic	100	80	5.5
	2	Egg plant	Mosaic	100	60	4.3
Kutre No. 1	3	Egg plant	Mosaic	100	80	5.4
Techimantia	4	Tomato	Mosaic/leaf curl	60	40	4.1

Sunyani District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Abesim	1	Egg plant	Mosaic	100	40	4.9
	2	Pepper	Veinal mottle/mosaic	100	80	4.8
	3	Pepper	Mosaic/veinal Mottle/leaf curl	100	60	4.6
	4	Egg plant	Mosaic	100	30	4.0
	5	Pepper	Mosaic/veinal Mottle/leaf curl	100	60	5.0
	6	Okra	Mosaic/leaf curl	100	60	3.8

cent virus infection on egg-plant and pepper in all the farms visited. This gives an indication of the susceptibility of these crops to viruses and also showed the extent of virus spread across these ecozones.

The Brong-Ahafo Region was found to be a

high disease-proned area, and it was also observed that vegetable production was quite intensive. Such intensity of production often results in the abuse of pesticides that could result in the destruction of natural enemies of destructive pests like the whitefly which transmits viruses

Asutifi District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Subriso	1	Okra	Mosaic	100	70	3.8
		Tomato	Mosaic	100	80	4.2
		Pepper	Leaf curl/mosaic	100	50	3.0
Nkaseim	2	Egg plant	Mosaic	100	60	4.0

Asunafo District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Kukuom	1	Egg plant	Mosaic Poor fruit formation	100	70	4.9
	2	Tomato	Mosaic	80	30	2.4

Techiman District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Tadieso	1	Tomato	Mosaic/leaf	80	30	3.1
	2	Pepper	Mosaic/veinal mottle	100	40	3.6
	3	Pepper	Mosaic/veinal	100	50	4.7
	4	Tomato	Mosaic	50	10	2.4
	5	Tomato	Mosaic/leaf curl	50	15	2.4

Nkoranza District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Manso	1	Tomato	Mosaic/leaf curl	80	30	3.2

Wenchi District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Akrobi	1	Okro	Mosaic	100	10	4.1
	2	Okro	Mosaic/leaf curl	100	60	4.1
	3	Tomato	Mosaic/leaf curl	100	20	3.0
Ofuman	4	Egg-plant	Mosaic	100	20	3.4

TABLE 2

*Incidence and Severity of Viruses on Vegetable Crops in Central Region**Mfantseman District*

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Buranamoa	1	Pepper	Mosaic veinal Mottle leaf curl	100	90	6.0
Osamkrom	2	Egg plant	Mosaic	100	70	4.8
Baifikrom	3	Egg plant	Mosaic	100	60	5.2
Baifikrom (Dam site)	4	Egg plant	Mosaic	100	60	4.6
"	5	Egg plant	Mosaic	100	60	4.8
"	6	Pepper	Mosaic/veinal mottle	100	60	4.2
"	7	Egg plant	Mosaic	100	60	4.2
"	8	Tomato	Mosaic/leaf curl	100	60	3.5

Swedru District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence</i>	<i>Disease severity</i>	<i>Mean disease score (0-6)</i>
Swedru	1	Cabbage	-	-	-	-
	2	Pepper	Mosaic/veinal mottle	100	15	3.0
	3	Pepper	Crop completely destroyed by <i>Sclerotium rolfsii</i>			
		Carrot	-	-	-	-
		Onion	-	-	-	-
		Cabbage	-	-	-	-
Abodwese	4	Pepper	Mosaic/veinal mottle	100	50	3.6
Nyakrom	5	Tomato	Mosaic/leaf	100	5	2.6
	6	Tomato	Mosaic/leaf curl	100	10	2.6

producing leaf curling in okra, pepper, tomato and egg-plant. Weeds that showed virus-like symptoms similar to those observed on the crops were more abundant in the Brong-Ahafo Region, and these probably served as alternative hosts for the viruses and vectors. It was also observed that most of the nurseries normally established in the farms had a lot of infected plants. In the Northern Region where virus incidence and

severity was relatively low, most of the plant nurseries were established in the homes of the farmers, and these were quite shielded from insect vectors carrying viruses. The relatively low disease pressure could also be attributed to the fact that there is only one growing season unlike the other three regions where vegetable cultivation is carried out throughout the year. Low or absence of alternative hosts in the dry season

Winneba District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Winneba	1	Cabbage	-	-	-	-
	2	Cabbage	-	-	-	-
Ekowful	3	Pepper	Mosaic/veinal mottle	20	2	1.7
	4	Pepper	Mosaic/veinal mottle	100	50	3.6
Osubonpayin	4	Cabbage	-	-	-	-
	6	Tomato	Mosaic	10	2	1.4
	7	Cabbage	-	-	-	-
	8	Tomato	Mosaic/leaf curl	70	50	3.6
Gada (near Kasoa)	9	Pepper	Mosaic/veinal mottle	60	30	2.6
	10	Pepper	Mosaic/veinal mottle	60	5	1.9
	11	Pepper	Mosaic/veinal	60	10	2.4
		Okro	Mosaic	50	20	1.8

Gomoa District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Ojobi	1	Pepper	Mosaic/veinal mottle	10	2	1.7
	2	Pepper	Mosaic/veinal mottle	100	80	4.2
	3	Pepper	Mosaic/veinal mottle	100	40	3.1
	4	Pepper	Mosaic/veinal mottle	100	40	3.0
Tettehkrom	5	Pepper	Mosaic/veinal	70	20	2.4
	6	Tomato	Leaf curl/bronzing	15	80	3.0
Potsin	7	Okra	Mosaic	70	5	2.4
	8	Egg plant (Tindar)	Mosaic	100	5	2.6
	9	Egg plant (Tindar)	Mosaic	100	40	3.0
	10	Pepper	Mosaic/veinal mottle	100	20	2.6

could also be one of the possible reasons for the relatively low disease pressure in the North.

In a few farms in the Central and Western regions, for example, Ekowful (Winneba District), Ojobi (Gomoa District), Anuanomasa (Ahanta-West District) and Takoradi (Ahanta-Shama East

District), virus disease incidence and severity on the different crops were low and this could be of epidemiological interest. Since the varieties of crops cultivated in most of the farms were same, the low virus infection might be attributed to low disease pressure resulting from low numbers or

TABLE 3

*Incidence and Severity of Viruses on Vegetable Crop in Western Region**Mpoho Wassaw East District*

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Mpohor	1	Egg plant	Mosaic	100	30	2.3
		Pepper	Veinal mottle/ Leaf curl mosaic	100	-	3.0
	2	Pepper	Veinal mottle/ Mosaic/leaf curl/ Bushy stunt	100	-	3.8
	3	Pepper	Veinal mottle/ Mosaic/leaf curl	100	40	3.4
	4	Egg plant	Mosaic	100	50	2.9
		Pepper	Veinal mottle/ Mosaic/leaf curl	100	-	3.8
	5	Tomato	Mosaic	90	10	1.8

Nzima East District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Awiebo	1	Egg plant	Mosaic	100	60	3.2
		Pepper	Veinal mottle/ mosaic	41	-	1.7
Sanzule	2	Tomato	Mosaic	5	1	1.4
Nyamebekyere	3	Egg plant	Mosaic	100	50	3.0
Kanokware	4	Okra	Mosaic	100	60	3.0
		Pepper	Meinal mottle/ mosaic	43	-	1.8

Ahanta-West District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Anuanomasa	1	Tomato	Mosaic	40	5	2.2
		Okro	Mosaic	90	1.	1.9
	2	Egg plant	Mosaic	15	-	1.3
	3	Egg plant	Mosaic	30	10	1.8
Funkuo	4	Pepper	Mosaic/veinal Mottle/leaf curl	100	-	2.5
		Egg plant	Mosaic	90	50	3.2
Sangalakrom	5	Egg plant	Mosaic	85	40	2.5
		Okro	Mosaic	70	40	2.4
		Tomato	Mosaic	30	20	1.7
		Cucumber	Mosaic	60	20	2.0

Ahanta-Shama East District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Takoradi	1	Okro	Mosaic	40	10	1.7
	2	Egg plant	Apparently symptomless			
		Okro	Mosaic	20	5	1.8
		Pepper	Veinal mottle/ mosaic	55	20	2.3
	3	Okra	Mosaic	95	60	3.5
	4	Okra	Mosaic	100	60	3.2
		Pepper	Veinal mottle/mosaic	65	20	2.3
	5	Pepper	Veinal mottle/ mosaic	50	10	1.9
	6	Pepper	Veinal mottle/ Mosaic	63.3	10	2.4

TABLE 4

*Incidence and Severity of Viruses on Vegetable Crop in Northern Region**Tolon-Kubungu District*

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Kpachi	1	Pepper	Veinal mottle/ mosaic	90	40	2.8
		Egg-plant	Mosaic/leaf	70	20	2.4
	2	Okro	Mosaic	50	13	1.4
	3	Pepper	Veinal mottle/Mosaic	70	40	2.9
Bontanga	4	Okro	Mosaic/leaf curl	40	20	2.2
Bontanga-Kpalso	5	Okro	Mosaic	40	10	1.8
	6	Okro	Mosaic	30	6	1.6

Tamale District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Dungu	1	Okra	Mosaic/leaf curl	25	20	2.3
		Pepper	Mosaic/veinal mottle	60	5	1.9
	2	Okro	Mosaic	60	40	2.6
	3	Tomato	Mosaic	1	0	1.0
	4	Pepper	Mosaic/veinal mottle	10	2	1.8
Kpasi	5	Pepper	Mosaic/veinal mottle	70	5	1.8

Savelugu-Nanton District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Bunlungu	1	Pepper	Mosaic/veinal mottle	40	1	1.3
Savelugu	2	Okro	Mosaic	80	70	3.2
Anshegu	3	Okro	Moasic	20	1	1.4
	4	Pepper	Mosaic/veinal	50	5	1.6

West-Mamprusi District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Gbinsi	1	Okra	Mosaic	20	20	2.0
	2	Okro	Mosaic	80	75	3.1
Nayorko	3	Pepper	Mosaic/vienal mottle	60	5	1.9
Sangu	4	Okra	Mosaic	20	10	1.7

Yendi District

<i>Town</i>	<i>Farm No.</i>	<i>Crop</i>	<i>Symptom</i>	<i>Disease incidence %</i>	<i>Disease severity %</i>	<i>Mean disease score (0-6)</i>
Gimle	1	Pepper	Mosaic/vienal mottle	70	5	2.2
	2	Pepper	Mosaic/veinal mottle	50	1	1.7
Chegu	3	Pepper	Mosaic/veinal mottle	80	5	2.3
	4	Okra	Mosaic	30	1	1.7

TABLE 5

Mean Percentage Incidence and Severity Scores of Virus Infection on Four Crops Evaluated in Four Regions of Ghana

<i>Region</i>	<i>Pepper</i>		<i>Egg-plant</i>		<i>Tomato</i>		<i>Okra</i>	
	<i>Incidence %</i>	<i>Mean score</i>	<i>Incidence %</i>	<i>Mean score</i>	<i>Incidence %</i>	<i>Mean score</i>	<i>Incidence %</i>	<i>Mean score</i>
Brong-Ahafo	100.0	4.4	100.0	4.6	71.4	3.1	98.0	4.0
Central	84.0	3.1	100.0	4.2	67.5	2.8	60.0	2.1
Western	74.3	2.6	68.9	2.2	41.2	1.8	73.6	2.5
Northern	59.1	2.2	70.0	2.4	1.0	1.0	41.2	2.1

absence of insect vectors largely responsible for the transmission and spread of most of the viruses associated with these crops. A few pepper and egg-plant lines were observed to be resistant or tolerant to viruses though other lines in the same farms showed severe symptoms of the viruses, and these promising lines could be useful materials for breeding work. Locations of high disease intensity could provide conducive environment for evaluation of breeding materials being developed for virus tolerance.

The observations made in this survey together with the information gathered from unpublished reports on similar surveys conducted in the Eastern, Greater Accra, Ashanti and Volta regions give an indication that viruses pose the most serious threat to the vegetable industry in Ghana. High disease incidence and severity were observed in most of the vegetable farms in practically all the major agro-ecological zones. Severe virus infection was also characteristic of

areas of intense cultivation. Research efforts that address effective control measures against diseases of viral nature through breeding and evasive measures are in progress. Integrated crop management strategies are recommended to reduce the incidence and adverse effects of plant viruses on vegetable production in Ghana.

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