Disease of Tomato (*lycopersicon esculentum mill.*) and Fungicide use Pattern in the Akomadan Tomato Growing Area of Ghana

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ABSTRACT

A Survey of commercial tomato farms and nurseries in Akomadan during the wet and dry seasons of 1991 and 1992 identified Septoria leaf spot caused by Septoria lycopersici as the most serious leaf disease of tomato in the wet season. Incidence of Sclerotium wilt, early blight and leaf mould was limited. The major fruit diseases during the wet season were bacterial speck and spot. Fruit rots/spots caused by Phoma, Colletotrichum, Alternaria and Fusarium spp. infrequently occurred even in the wet season. The dry season crop was afflicted primarily by Fusarium wilt, blossom end rot and rook knot. Root knot and damping-off occurred in both dry and wet season nurseries. Fungicides used in the area in decreasing order of intensity were Dithane M-45, Kocide 101, Cocobre Sandoz and Champion. Despite their intense use, especially in the wet season, control of Septoria leaf spot, the main target of the control was poor. Three instances of fungicide misuse viz. (i) indiscriminate mixing of different fungicides (often at sub-optimal rates), (ii) adoption of improper spray programme and (iii) application of fungicides irrespective of disease level were identified. Control of Septoria leaf spot, bacterial speck/spot, Fusarium wilt and root knot should be further studied.

Keywords: *Lycopersicon esculentum, Septoria leaf spot, fungicides, diseases.*

INTRODUCTION

Tomato (Lycopersicon esculentum Mill.) is an important vegetable in Ghana. A major centre of production in the country is Akomadan in the Ashanti Region, where the crop is grown during the wet seasons (April - July and September - November) and in the dry season (December - March). The dry season crop is mainly grown with sprinkler irrigation at the Akomadan Tomato Irrigation Project (ATIP) site. Wet season production is not practised at the ATIP site. The operational size of the project is about 64 ha and close to two hundred farmers operate at the site on plots, each approximately 0.25 - 0.40 ha in size. A very limited amount of dry season production with manual watering also takes place on lands adjacent to streams. The wet season crop is grown exclusively outside the ATIP site. Some ATIP farmers and several non-ATIP farmers are involved in wet season tomato culture.

Despite its importance as a major tomato growing area in Ghana, no previous study on tomato disease in Akomadan exists even though disease control with fungicides is widely practised. Yeboah (-1989), mentioned diseases to be limiting factors to production but the specific diseases involved and their seasonal significance were not indicated. An attempt was, therefore, made to determine the various tomato diseases in the area and ascertain the types of fungicides and their mode of application used by farmers.

MATERIALS AND METHODS

Disease Survey: Surveys to determine the types of tomato diseases in the area were conducted during the dry (December - March) and wet (May - July and October - November) seasons of 1991 and 1992. These consisted of inspection of commercial tomato farms and nurseries within and outside the ATIP site. The dry season survey covered 150 farms at the ATIP site but the wet season study involved 50 farms all outside the ATIP site. Plants were examined for symptoms and identification of the diseases accomplished with the aid of standard references on tomato (McColloch et al., 1968; Barksdale et al., 1972). Where the identity of the disease was doubtful, samples of diseased plant parts were further studied in the laboratory. Generally, diseased fruits were cleaned with 70% ethanol

Dr. R. T. Awuah

and incubated either inside humidified bell jars or in transparent polythene bags for 24 - 48 h followed by microscopic examination of squash mounts from the necrotic tissue margins. In some instances, diseased leaf segments (2 - 4 mm^2) were surface sterilized with 10% commercial bleach, blotted dry and incubated in sterilized Petri dishes lined with moistened filter papers (5 - 10 segments per dish). Squash mounts of the tissues were microscopically examined after 4 - 5 days.

When isolation of a suspected fungal pathogen was necessary for identification, it was accomplished on chloramphenicol (500 ppm) sweet potato medium (Awuah, 1989) and potato dextrose agar. Fungi were identified according to Ellis (1971), Kulshrestha et al. (1976) and Nelson et al. (1983).

Mode of fungicide Use: This was ascertained by interviewing 60 farmers using appropriately designed questionnaire. The farmers specifically provided information on the types of fungicides utilized and rates of application, method of application, frequency of application in a season, and the level of disease control achieved. Farmers provided fungicide rates as the number of full milk tins (15.7 cc approx.) of formulated product per farm size of 0.40 ha and these were converted to g a.i. per hectare.

RESULTS

Leaf diseases: Several of the previously reported tomato diseases (McColloch et al., 1968; Barksdale et al., 1972) were observed in tomato fields in Akomadan but their seasonal distribution and severity varied. Septoria leaf spot caused by Septoria lycopersici Speg. was the most important tomato disease observed during the wet season. The disease was observed in all fields surveyed and all plants examined were infected to some extent. In some instances, the disease resulted in abandonment of farms. Young plants in nurseries were also attacked but to a much lesser degree. Early blight caused by Alternaria solani (Ell. & G. Martin) Sor. and leaf mould caused by Cladosporium fulvum Cke., occurred in all fields but with low incidence (1 - 2%). Incidence of Sclerotium wilt caused by Sclerotium rolfsii Sacc. was minor, being absent from most fields.

Fruit diseases: The major fruit diseases during the wet season were bacterial speck caused by (Pseudomonas tomato (Okabe) Altstatt and bacterial spot caused by Xanthomonas vesicatoria (Doidge) Dows. These were observed on green fruits in all farms. Disease incidence of 20 - 30% per farm were common. Fruit rots and spots caused by Fusarium, Alternaria and Phoma species and anthracnose, due to Colletotrichum coccodes (-Wallr.) Hughes were observed in most fields at low levels. These either occurred singly or in combination on ripened fruits. A moderate incidence (5 - 10%) of blossom end rot occurred in all farms during the dry season. The disease was, however, minor in the wet season.

Nursery diseases: Damping-off caused by Fusarium and Pythium and root knot caused by Meloidogyne sp. were the major nursery diseases. The former was particularly important in the wet season.

Root diseases: All farms surveyed had root knot infestation, but the above ground symptoms of the disease were more noticeable during the dry season. Fusarium wilt caused F. oxysporum Schlecht. emend. Synd. & Hans. f. sp. lycopersici was observed in patches in about 10% of fields at the ATIP site during the dry season but the disease was generally absent from the wet season crop. Bacterial wilt caused by Pseudomonas solanacearum E.F. Sm. was common to both the dry and wet season crops but its incidence in the few fields where it was observed was very low.

Fungicidal application: All sixty farmers interviewed adopted some kind of fungicide treatment against fruit and foliar diseases, particularly, Septoria leaf spot. The common fungicides were Dithane M-45 (Mancozeb) and the copper based fungicides Kocide 101, Cocobre Sandoz and Champion. Their rates and pattern of use are indicated by table 1 and fig. 1, respectively.

Five to six fungicide sprays were common in the dry season (Fig. 2). Eighty-one per cent of the farmers sprayed weekly, 9% sprayed once in 2 weeks and the rest sprayed when they could afford it. All farmers reported a slightly higher spray schedule during the wet season. The sprays usually commenced 3 weeks after transplanting and were terminated by the tenth week. They were applied with motorized knapsack sprayers (mist blowers) utilizing about 240 l water/hectare.

All farmers reported satisfactory disease control on the dry season crop but control of Septoria leaf spot (the main target of the spray) was generally poor in the wet season.

Few farmers (less than 10%) used Furadan 3G (Carbofuran) for root knot control in nurseries but

Table 1. Fungicides and typical rates of application against Septoria leaf spot of tomato in Akomadan.

Fungicides	Farmers using Fungicide		Applic. rates (g a.i./ha) of fungicides	Level of disease control
	No.	%		
Dithane alone	21	35	352.96	High
Either Dithane or Kocide alone	15	25	668.15 773.13	Moderate
Dithane alone or Kocide/Cocobre mixture	1	1.67	256.79 665/6.91	Moderate
Kocide alone or Dithane/Cocobre mixture	1	1.67	380 320.99/69.14	High
Dithane/Kocide mixture	16	26.66	353.46/403.97	Moderate
Kocide/Cocobre mixture	1	1.67	570.37/138.27	High
Dithane/Champion mixture	2	3.33	385.19/247.16	Moderate
Dithane/Kocide/ Cocobre mixture	3	5	366.75/443.62/ 69.14	High

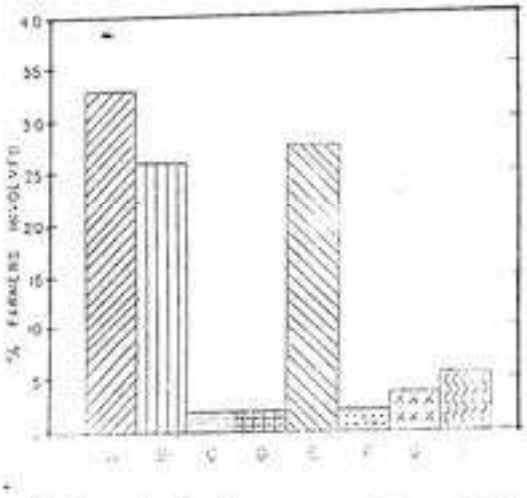

Fig.1. Typical pattern of fungicide use on tomato in Akomadan during the 1990 crop season. A, Dithane alone; B, either Dithane or Kocide alone; C, either Dithane alone or Kocide-Cocobre mixture; D, either Kocide alone or Dithane-Cocobre mixture; E, Dithane-Cocobre mixture; F, Kocide-Cocobre mixture; G, Dithane-Champion mixture; H, Dithane-Kocide-Cocobre mixture. Data based on responses from sixty farmers.

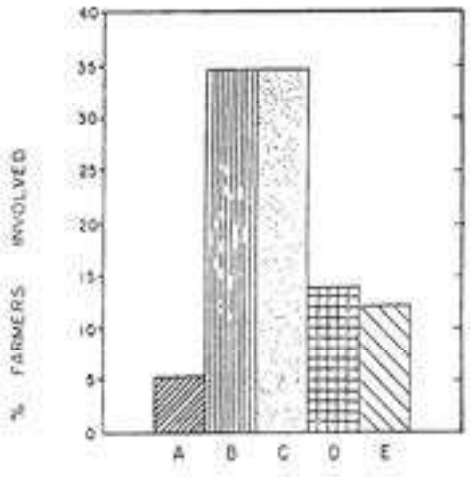

Fig. 2. Number of fungicide applications on dry season tomato in Akomadan. A, less than 5 sprays; B, 5 sprays; C, 6 sprays; D, 7 sprays; E, more than 7 sprays. Data is based on responses from sixty farmers.

field control with the chemical was not practised. Some farmers claimed to apply either Cocobre Sandoz or Kocide 101 suspension as a seedbed drench along rows of seedlings to check damping-off.

All farmers mixed fungicides with insecticides which were applied together. The preferred insecticides were Karate 2.5 EC (Lambda cyhalothrin), Thiodan 2.5 EC (Endosulphan) and Cymbush 10 EC (Cypermethrin). These insecticides were mainly intended to control the fruit worm Spodoptera littoralis.

DISCUSSION

The major disease problems of both dry and wet season tomato cultivation at the ATIP site and environs have been identified by the present study which happens to be the first detailed phytopathological investigation on tomato in the area. During the wet season, foliar diseases and fruit rots were prevalent, the most important being Septoria leaf spot. According to Leather (1959), the disease occurs nationwide especially in the Ashanti and Northern regions. The significance of Septoria leaf spot was evidenced by its devastating nature in several farms, resulting in total crop failures in poorly managed ones. Because no other disease manifested itself in such a disastrous fashion, Septoria leaf spot is considered to be the most economically important disease of tomato in Akomadan. The epidemiology of the disease is related to splashing rains, frequent showers and high humidity (Barksdale et al., 1972). These conditions are prevalent during the wet season tomato culture in the area. During the major cropping season of 1992 (April - July) for example, a total of 617.8 mm rainfall was recorded in the area and Septoria leaf spot incidence and severity were noted to be extremely high.

Frequent rains and warm weathers during wet season tomato culture are also conducive to the development of bacterial spot and speck which are spread through infected seeds (Barksdale et al., 1972). This means of spread could be very important in the epidemiology of the two diseases in Akomadan since farmers extract their own seeds and use them without prior treatment. Thus, selection of seeds from the dry season crop, which is generally free from spots and specks should be considered in controlling bacterial spot and speck. Adebanjo (1991) made a similar recommendation for amaranthus.

Foliar diseases such as early blight and leaf mould and fruit rots due to Fusarium, Alternaria, Phoma and Colletotrichum species appear minor even during the rainy season probably because unlike Septoria leaf spot, they are effectively controlled by the spray programmes adopted by farmers. Dithane M-45 sprays particularly are effective against anthracnose caused by Colletotrichum capsici and black rot due to Alternaria alternata on chilli fruits (Thind and Jhooty, 1987).

In the dry season, Fusarium wilt, root knot and blossom end rot are major diseases. Fusarium wilt of tomato is particularly aggravated in warm soils (Barksdale et al., 1972) and by soil moisture stress (Foster and Walker, 1947). These conditions are common at the ATIP site during the dry season. The 1992 dry season cultivation was characterized by frequent break-down of the irrigation facilities. Thus, longer irrigation schedules (10 - 14 day instead of the minimum 7-day schedule) with shorter cycles (approx. 30 min instead of 60 min) were adopted. The soils were dry and warm and Fusarium wilt was observed with heightened severity in fields where the disease previously was unimportant. In 1993, the disease was observed to be mild in these same fields possibly because shorter irrigation schedules (6 - 7 day) with a longer cycle (60 min approx.) were adopted. The palliative effects of enhanced irrigation on Fusarium yellows needs to be investigated.

Soil moisture stress during the dry season was partly responsible for the high incidence of blossom end rot in 1992. Though the primary cause of this disease is calcium deficiency in the plant (McColloch et al., 1968), periods of prolonged drought play a role in disease development (Barksdale et al., 1972). Blossom end rot is insignificant in the wet season suggesting that with improved irrigation of the dry season crop, the disease could be managed.

Observation of root knot in all fields in both the dry and wet seasons supports other reports of the close association of the disease with tomato culture (Barksdale et al., 1972; Chupp and Sherf, 1960). Tomato transplants, some with knotted roots, were sometimes observed being used for field planting by farmers at the ATIP site. The significance of these in the spread of the disease is obvious. Furadan 3G is available for root knot control but because of the cost involved, it is not used in the field. The few farmers who apply the chemical on nursery beds usually do so at rates far below the manufacturer's recommended rate of 25g of formu-

lation per sq. metre. Thus, seedbed control of root knot is poor.

It is evident from the present study that protectant fungicides, notably Dithane M-45 and Kocide 101 are highly preferred by Akomadan farmers for controlling foliar/fruit diseases and that use of fungicide mixtures is practised by some farmers. It was also noted that sprays were initiated regardless of disease level. Despite the intensity of fungicide use, especially during the wet season, control of Septoria leaf spot is poor partly because lower application rates of fungicides are utilized. For example, while Ferrandino and Elmer (1992) used 880 g a.i./ha of Dithane M45 to suppress Septoria leaf spot, Akomadan farmers use this fungicide at rates ranging from 257 to 668 g a.i. per hectare. Other factors possibly contributing to lack of effective chemical control of leaf spot in the area are the ineffectiveness of protectants in high rainfall areas (Awuah, unpublished data) and possible antagonistic effects of some fungicide mixtures (Tarr, 1972). Application of fungicide mixtures in the area is without basis and should be discouraged until the beneficial effects of the mixtures, if any, have been experimentally proven. In the interim, weekly applications of Dithane M-45 at rates used by Ferandino and Elmer (1992) could be used. In the long term, a study is required to identify other effective fungicides.

Even though foliar diseases are unimportant in the dry season, similar fungicides and application rates as used in the wet season (but with slightly lower spray schedule) are utilized. Most farmers claimed that the dry season spray is effective but it is now clear that such claims are unjustified since incidence and severity of foliar diseases especially Septoria leaf spot are negligible during the dry season. Thus, dry season sprays must be de-emphasized because they are wasteful of resources.

Continuous cropping of tomato in Akomadan especially at the ATIP site has resulted in a build up of diseases. Rotations with other crops such as maize, cowpea, cassava, groundnut, etc. must be considered to ameliorate this build up. Baidoo (1992) has shown that such crop substitutions would also be economical. Other non-chemical approaches to disease control such as farm sanitation and mulching should also be considered.

CONCLUSIONS

In surveys of tomato farms and nurseries within and outside the Akomadan tomato irrigation project site, Septoria leaf spot and bacterial speck/spot were identified as major diseases in the wet season. Early blight, leaf mould and fruit rots/spots were also observed during the season but were not as important. The above-mentioned diseases were minor on the dry season crop which was rather afflicted by Fusarium wilt, blossom end rot and root knot. Incidence and severity of these major dry season diseases appear to be ameliorated with adequate irrigation. Root knot and damping-off were observed on seedbeds in both seasons. Protectant fungicides primarily Dithane M-45 and Kocide 101, either singly or in mixtures, are routinely used in the area to control foliar and fruit diseases. Despite their intense use, especially in the wet season, control of Septoria leaf spot, a major wet season disease, is poor. Instances of fungicide misuse by farmers were identified. With the diseases of tomato in Akomadan now known, further studies must be directed at them especially on the control of the major ones such as Septoria leaf spot, bacterial spot/speck, Fusarium wilt and root knot.

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