Tomato Production in Foumbot (Cameroon) in Relation to Frequency and Dosage of Fungicide Application

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ABSTRACT

Tomato production in Foumbot, Cameroon suffers a great set back from fungal infection (blight). With the increase in blight severity and damage to tomatoes, farmers tend to increase the dosage of fungicide application as remedy. Considering the harm associated with indiscriminate application of pesticide, this research was aimed at deriving an appropriate treatment dose for Maneb (fungicide) on tomato in Foumbot.The experiment was carried out in the wet and dry season since the level of attack varies with season. Fungicide application was done with concentrations of 2,4,6 and 8 g/1 at frequencies of every 4,7 and 10 days. Data were collected on percentage disease index, percentage disease control and yield. Results showed that treatment is more effective if done frequently at low dosage than less frequently at high dosage.

Key words: Tomato, Fungicide, Frequency and Dosage.

RESUME

La production de tomate à Foumbot, Cameroun est limitée par les infections de champignons (*Phytophtora sp, et Alternaria sp*) Avec l'augmentation de la sévérité et des dommages de ces maladies sur tomates, les paysans tendent à augmenter les doses et les fréquences d'application des fongicides comme moyens de lutte. Au vu des risques liés à l'application aveugle des pesticides, cette recherche a été initiée en vue de trouver une dose de traitement et une fréquence appropriées avec le manèbe (fongicide) sur la tomate à Foumbot. La recherche a été effectuée pendant les saisons, sèche et pluvieuse puisque le niveau d'attaque varie avec les saisons. L'application de fongicide a été faite à des concentrations de 2, 4, 6 et 8 g/l aux fréquences de 4, 7 et 10 jours. Des données ont été collectées sur les paramètres suivants : index de la maladie en pourcentage, et le rendement. Les résultats ont montré que le traitement est plus efficace si fait fréquemment à bas dosage plutôt que moins fréquemment à dosage élevé.

Mots clés : Tomate. Fongicide, fréquence, dosage

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INTRODUCTION

Tomato is highly produced in the West Province of Cameroon. Foumbot is the leading producer of the crop in the West Province. This is due to the fact that the climatic condition and soil type of Foumbot support the growth of this crop. It is mostly grown in a mono cropping system.

Tomato production in Foumbot suffers a great set back from fungal infection (blight). Blight is now regarded as the most important disease of garden huckleberries, potatoes and tomatoes in Cameroon. (Fontem et al 1996) There are two types of blight in tomato viz: Early blight caused by *Alternaria solani* and late blight caused by *Phytophthora infestans*. The production of melanin-like pigment is one of the major characteristics of *Alternaria* Sp. Macroscopically, *Alternaria* sp. grow rapidly and the colony size reaches a diameter of 3 to 9 cm following incubation at 25°C for 7days on potato glucose agar, microscopically, *Alternaria* Sp. has separate brown hyphae. . (Collier et al 1998; Larone 1995)

Conidiophores are also separate and brown in colour, occasionally producing a zigzag appearance. They bear simple or branched large conidia (7-10 × 23-24 ì m),which have both transverse and longitudinal separations. These conidia may be observed singly or in acropetal chains and may produce germ tubes. (Collier et al 1998; Larone 1995)

The disease first becomes evident in senescent leaves, causing dark necrotic lesions in a characteristic concentric pattern. The fungus infects stems, leaves, and fruits of tomato. It may girdle seedlings causing damping-off in the seedbed. On the leaves, brown, circular spots are often surrounded by a yellow area. Leaf spots have characteristic dark concentric rings. Leaf spots usually appear on the older leaves first and progresses up the plant. As the disease progresses, the fungus may infect the stems and fruits. The spots on the fruit look similar to those on the leaves, brown with dark concentric rings. Dark, dusty spores are produced in concentric rings.

The spores can be seen if the spot is touched to a light-coloured object. Dillard et al (1995) had reported that the fungus could survive in soil and in infested crop and weed residues. It may be seedborne and carried by wind, water, insects, workers and farm equipment. The spores that land on tomato plants will germinate and infect the leaves when they are wet. Spores can enter the leaf, stem, or fruit. The fungus is most active during mild to warm temperatures and wet weather. The disease is worse during the rainy season. Early blight is most severe on plants stressed by heavy fruit load, nematode attack, or low nitrogen fertility.

Late blight appears on tomato leaves as pale green, water-soaked spots, often beginning at leaf tips or edges. The circular or irregular leaf lesions are often surrounded by a pale yellowish-green border that merges with healthy tissue. Lesions enlarge rapidly and turn dark brown to purplish-black. During periods of high humidity and leaf wetness, a cottony white mould growth is usually visible on lower leaf surfaces at the edges of lesions. In dry weather, infected leaf tissues quickly dry up and the white mould growth disappears. Infected areas on stems appear brown to black and entire vines may be killed in a short time when moist weather persists.

Late blight can also develop on green tomato fruit, resulting in large, firm, brown, leathery-appearing lesions, often concentrated on the sides or upper fruit surfaces. If conditions remain moist, abundant white mould growth will develop on the lesions and secondary soft-rot bacteria may follow, resulting in a slimy, wet rot of the entire fruit (Randall et al, 1995).

With the increase in blight severity and damage to tomato, farmers have turned to fungicide application as remedy. The frequency of application increases with season and the level of attack. For precautionary measures, most farmers tend to increase the dosage of application even above the recommended dose. The recommended dosage of Maneb by the manufacturer (ROHM AND HAAS ITALIA sri, Via della Filanda, 20060 GESSATE (M)-ITALY) is 2.5g/l at 7-10days spray intervals. Maneb (fungicide) was used because it has been identified as the most used fungicide on tomatoes in the western highlands of Cameroon (Fontem et al, 1999; Mathews et al, 2003). Maneb is a practically non-toxic ethylene (bis) dithiocarbamate in EPA toxic class IV. The chemical name is manganese ethylenebis (dithiocarbamate) (polymeric) (USDA 1996).

The wrongful use of pesticides has drawn the attention of the Food and Agriculture Organisation (FAO, 1998). The World Health Organisation had estimated one million people are poisoned annually from pesticides (W.H.O. 1986). The problem of wrongful use of pesticide by farmers is as a result of inadequate knowledge on how to use them. The adverse effects of pesticides on the health of tropical farmers have also been reported (Lum et al, 1993; Aguilar et al, 1993; Mwanthi & Kimani, 1993; Harris, 2000).

The objective of this work was to determine an appropriate frequency and dose of Maneb (fungicide) application on tomatoes in Foumbot.

MATERIALS AND METHODS

The research was carried out in Foumbot, West Province, Cameroon in the years 2002 and 2003. The experiment was sited at the Institute of Agricultural Research for Development (IRAD) Foumbot Station. The site is located between latitude 4^0 50' and 6^0 15' N and longitude 9^0 55' and 11^0 15'E. It has two seasons (wet and dry) with mean annual rainfall of 2000mm and the soil is volcanic (Andosols).

The experiment was a Randomised complete block design (RCB) having three blocks of 12 plots each. The blocks measured 6x4m each while the plots were 1x1m each. The plots were grouped in three according to spraying schedule i.e. every four days, every seven days and every ten days. Each frequency of application had four plots for different dosages (concentration) of application i.e. 2, 4, 6 and 8g/l (WP). Spraying was done using a 15 l knapsack sprayer.

A control plot for disease index was set up twenty meters away to avoid drifting of the pesticide.

The experiment was carried out in the two seasons (wet and dry) since late blight is more severe in the wet season and early blight is more prevalent in the dry season. In the dry season, it was carried out in October-December 2002 while in the wet season it was carried out in April-July 2003.

The following data were recorded in each plot and analysed: percent disease index, percent disease control, number of fruits per plant and yield per plot. Disease data were collected every week till harvest while yield parameters were obtained at harvest. Yield parameters were analysed using analysis of variance (ANOVA).

Table 1: Effect of Frequency and Dosage of Fungicide (Maneb) Application on Tomato Yield

Treatment	Yield Kg/Ha		No. of Fruits/Plant	
	2002	2003	2002	2003
	Oct-Dec	Apr-Jul	Oct-Dec	Apr-Jul
EVERY 4 DAYS				
2g/l	6546.80	5789.97	15.83	14.50
4g/l	8052.30	8120.37	16.08	15.83
6g/l	8565.37	8084.00	16.33	16.25
8g/l	8085.60	8016.60	15.42	15.67
EVERY 7 DAYS				
2g/l	4423.57	4109.80	13.00	11.33
4g/l	7105.93	6569.87	13.50	12.92
6g/l	8062.67	7989.30	15.58	14.33
8g/l	8152.67	8088.10	15.80	15.17
EVERY 10 DAYS				
2g/l	4104.20	3105.23	11.42	9.83
4g/l	6985.93	4554.47	13.00	11.70
6g/l	7905.20	7610.93	13.92	12.20
8g/l	8164.67	7925.73	14.75	12.83
LSD (0.05) FREQUENCY	20.58	46.04	0.15	0.28
LSD (0.05) DOSAGE	25.52	32.07	0.10	0.31

Percent disease index was worked out using the formula:

$$PDI = \frac{\text{sum of all numerical ratings}}{\text{Total plants observed x maximum ratings}} \times 100$$

Percent disease control (PDC) was calculated using the formula:

$$\frac{\text{Disease severity (\%) in control} - \text{disease severity in treatment}}{\text{Disease severity (\%) in control}} \times 100$$

For the disease data, 10 plants were selected randomly from each plot and plants were graded on a 1-9 scale (Subrahmanyam et al, 1995).

RESULTS AND DISCUSSIONS

The yield and number of fruits per plant data are presented on Table 1.

The yield obtained in the dry season i.e. Oct-Dec 2002 was higher than that obtained in the rainy season i.e. April – July 2003. This is due to the fact that disease development (growth and reproduction of the pathogen) is favoured by moderate temperatures and wet conditions. Yields were also affected by the frequency and dosage of fungicide application.

Yields generally diminished as frequency of application diminished. Plots where applications were done every four days gave the highest yields followed by plots of every seven and ten days respectively. The trend was the same in both the dry and wet season.. In terms of dosages, it was realised that 2g/l and 4g/l every four days were better than 2g/l every seven and ten days. But 6g/l every four days was not much better than 6g/l every seven days but was much better than 6g/l every ten days. Also 8g/l every four days gave lower yields than 8g/l every seven and ten days in the dry season but higher than 8g/l every ten days in the wet season.

In the dry season, yield of tomato increased with increase in dosage from 2-6g/l with reduced frequency of application but yield increased at 8g/l when frequency reduced from every four days to

Table 2 : Effect of Frequency and Dosage of Fungicide (Maneb) on Disease Control in Tomato

Treatment	%Disease Index		Pooled Mean	%Disease Control
	2002 OCT-DEC	2003 APR-JUL		
EVERY 4 DAYS				
2g/l	14.31	38.53	26.42	68.49
4g/l	12.29	30.11	21.20	74.70
6g/l	11.34	20.15	15.75	81.21
8g/l	11.11	18.01	14.56	82.63
EVERY 7 DAYS				
2g/l	33.27	50.14	41.71	50.24
4g/l	20.55	46.26	33.41	60.14
6g/l	12.37	26.34	19.36	76.90
8g/l	12.34	26.25	19.30	76.97
EVERY 10 DAYS				
2g/l	39.31	60.11	49.71	40.69
4g/l	28.43	53.17	40.80	51.32
6g/l	20.73	33.25	26.99	67.80
8g/l	14.33	28.16	21.23	74.67
CONTROL PLOT (UNTREATED)	71.26	96.37	83.82	-
SD	17.1	21.28	19.04	
CV (%)	5.67	4.04	4.60	
Mean	3.01	5.27	4.14	

every 7 and 10 days at a dosage of 8g/l.

In terms of number of fruits produced per plant, there was no significant difference in plants with 4, 6 and 8g/l concentration at frequency of every four days. For plants treated every seven and ten days, there was no significant difference at dosages of 6 and 8g/l. However, frequency and dosages of application significantly ($p=0.05$) affected the number of fruits produced and yield.

No results were recorded from the control plots because the disease index was too high resulting in the inability of the flowers to bear fruits.

The percentage disease index of all the treatments was consistently lower than the control in both the dry and wet season. However, the percentage disease index in the wet season was higher than that in the dry season. This is because the reproductive potential of this pathogen is very high under wet conditions.

Fungicide application every four days gave the best control. Percent disease index reduced with increase in dosage of fungicide. Though percent disease index reduced with increase in dosage of application, it was realised that at the frequency of every four and seven days, there was no considerable change from 6-8g/l in the dry season. In the rainy season, there was however a considerable change from 6-8g/l every four days but no considerable change from 6-8g/l every seven days in the wet season. In all, there was a steady rise in disease control from 2-6g/l but a relative small change from 6-8g/l.

In conclusion, it could be comfortably reported that the treatment against tomato blight is more effective if treatment is done more frequently at low dosage than less frequently at high dosage. This is partly because more frequent applications ensure better coverage. From the economic and environmental point of view, it could be recommended that Maneb applications on tomato in Foumbot be made at the rate of 6g/l every seven days during the dry season i.e. October to December while applications at 4g/l every four days during the wet season i.e. April to July is better.

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