

EFFECT OF HOT WATER AND FUNGICIDE TREATMENT OF CASSAVA *Manihot esculenta* Crantz V.N:S:N STAKES ON SEVERITY OF CASSAVA MOSAIC VIRUS AND BROWN LEAF SPOT DISEASES

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ABSTRACT

A screenhouse potted experiment was set up to evaluate responses of five cassava varieties (TMS 0510, TME 419, TMS 0581, TMS 0505 and TMS 30572) to the pre-planting effect of hot water and fungicide treatment on severity of Cassava mosaic virus and Brown leaf spot diseases. The treatments were hexaconazole (5% SC), hot water (50°C) plus hexaconazole (5% SC), and distilled water (control). The stakes were dipped in each treatments for 60 minutes and air dried for 2 hours before planting in 10-litre plastic pots containing sandy-loam soils previously steam sterilized at 120°C. Each treatment was replicated thrice giving a total of 48 observations. Data were collected and analysed for disease severity as well as growth and yield attributes. The result showed that percentage disease severity was highest in control, intermediate in fungicide treatment and lowest in fungicide plus hot water treatment. At the 6th week after planting (WAP), percentage disease severity was significantly lowest in fungicide plus hot water treated cassava variety 30572 (3%) and highest in the controls especially in cassava variety 505 (9.9%). At the 21st WAP disease severity values for variety 419 were: 19.4% (fungicide plus hot water), 26.3% (fungicide alone) and 31.8% (control) respectively. Plants heights and number of leaves per plant were also significantly highest for the fungicide plus hot water treatment followed by the fungicide alone treated plants. The highest yield parameters such as stem girth (9.4cm), average number of tubers per plant (25.2) and average weight of tubers per plant (10.4g) were obtained in variety TME419 treated with fungicide plus hot water. The study showed that fungicide and hot water treatment of stakes before planting could serve as a control measure for viral and fungal diseases in cassava.

Keywords: *Cassava, Fungus, Virus, Heat Therapy, Disease Severity*

1.0 INTRODUCTION

Cassava (*Manihot esculenta*) is one of the most cultivated and the most consumed crop in sub-Saharan Africa [1]. It has established itself as a staple food source for humans and a veritable source of local raw materials for industries [2]. About 95 percent of the cassava produced in Africa is used for human consumption and five percent for industrial uses such as starch [3]. This has therefore led to expansion of cassava cultivation among farmers [4]. Sub-Saharan Africa grows 55% of the world's production of cassava and Nigeria contributes 21% of the total [5]. Diseases and pests causing economic losses have continued to take their toll on cassava crops. These diseases and pests as well as adverse agronomic conditions combine to reduce cassava root yields [6]. Brown leaf spot (BLS) of Cassava is of worldwide distribution and occurs in most cassava fields. It is a fungal disease of the leaf caused by several *Cercospora* species which induce brown leaf spot (BLS) [7]. The Symptoms of BLS on cassava are visible on both sides of the lamina but are more pronounced on the upper surface, where the spots are a uniform brown with a distinct darker border. On some cultivars there may be a yellow halo

around the spots and as the disease progresses leaves turn yellow, dry and eventually fall [8].

It has been reported that the disease can cause yield losses on individual plants of up to 20% [9]. Numerous studies showed the effect of various systemic fungicides on brown leaf spot disease. These studies can be regarded as especially valuable in disease management practice and suppression of pathogen's spore production on infected plant tissue [10]. Experiments by [11] have also shown that hot water dips of fruits at temperatures above 40°C for 15 minutes is effective in the control of fungal pathogens. Cassava mosaic disease (CMD) is the most important of all cassava diseases known in Africa and almost all traditional cultivars of cassava cultivated are susceptible to this disease [12]. The symptoms of CMD occur as characteristic leaf mosaic patterns that affect discrete areas. Severely affected leaves are reduced in size and twisted, with yellow areas separated by areas of normal green colour [13]. Depending on variety and time of infection, CMD causes yield losses of up to 95% [14]. Experiments have shown that some viruses can be eliminated from infected plants by heat therapy

and these methods are widely used to develop virus free plants of vegetatively-propagated crops for further propagation and release to growers [15].

In view of the importance of cassava and its potential to serve as an engine for agricultural development as well as job creation in Nigeria, threats to its production by pathogenic diseases must be considered very seriously. The first step to achieving this, is to improve upon the health and germination status of cassava stakes that invariably influence crop yield. The objective of the study therefore was to evaluate the effect of the treatment of cassava stakes with hot water and fungicide on the severity of Cassava mosaic virus and Brown leaf spot infections.

2.0 MATERIALS AND METHODS

2.1 Source of Cassava Stakes

Stakes of five cassava cultivars (TMS 0510, TME 419, TMS 0581, TMS 0505 and TMS 30572) were obtained from the field of the Roots and Tuber Expansion Project (IFAD) in Ajassee-Ipo, Kwara State-Nigeria. The stakes were collected from plants that showed symptoms of cassava mosaic virus and brown leaf spot fungal infection.

2.2 Treatments and Planting Procedures

Before planting, the stakes of each cassava cultivar were cut into 12 pieces (20-cm length) that contained about 5-6 buds. The treatments were: (i) Hot water at a constant temperature of 50°C (ii) Systemic fungicide Hexaconazole 5% SC (iii) The combination of hot water at a constant temperature of 50°C and systemic fungicide hexaconazole 5% SC (iv) Distilled water at room temperature (control). Three stakes of each cultivar were dipped in each of the treatments for 1 hour and then left to air dry for 2 hours. Planting was done in 10-litre plastic pots containing soils that were previously steam sterilized at 120°C. Each treatment was in triplicate thus giving a total of 48 observations. The pots were arranged in a randomized complete block experimental design in an insect proof screenhouse.

2.3 Data Collection and Analysis

Data were collected fortnightly on growth parameters such as: stem length, stem girth using a tape rule. The number of leaves per plant and those showing symptoms of cassava mosaic virus and brown leaf spot were counted and recorded. The yield data (number and weight of tubers per plant (g) were taken at six months after planting. The percentage disease severity was calculated as:

$$\frac{\text{Total No. of diseased leaf/pot (symptomatic leaves)}}{\text{Total No. of leaves per plant}} \times 100$$

All collected data were subjected to analysis of

variance. Treatment means, when found significantly different, were separated by the New Duncan's Multiple Range Test at 5% level of probability.

3.0 RESULTS AND DISCUSSION

3.1 Effect of on Percentage Disease Severity

Table 3.1 shows the effect of the treatment combinations on percentage disease severity of CMD and BLS. There were no differences in percentage disease severity at the 3rd week after planting (WAP). However from the 6th to 21st WAP, there were significant differences in disease severity. At the 6th WAP, percentage disease severity was significantly lowest in fungicide plus hot water treated cassava variety 30572 (3%) and highest in the controls especially in cassava variety 505 (9.9%). By the 9th WAP the control plants particularly in variety 505, still manifested the highest disease severity (13.2%) , followed by the fungicide alone treatments [variety 505 (9.6%)] and the values were the lowest for the fungicide plus hot water treatment in variety 30572(4.9%). This observable trend was consistent to the 21st WAP.

The result suggests that fungicide and/or hot water treatments of cassava stem cuttings before planting significantly caused a reduction in BLS and CMD infections. The finding supports the view of [16], that hot-water treatment of CMD diseased cuttings had a positive effect on the regeneration of symptomless cassava plants. The phenomenon was ascribed to gene silencing which led to the development of fewer symptoms. [17] also confirmed the reactions of fungicides in suppressing CBB in cassava cuttings treated with synthetic fungicides. The action was proven to be due to the restriction of bacterial multiplication and the slow inactivation of the pathogen in the treated cassava cuttings. In the present study, it is inferred that fungicide and hot water treatment of cassava stakes either singly applied or in combination, conferred some level of resistance to CMD and BLS and consequently resulted in reduced severity of the diseases in the cassava cultivars.

3.2 Effect on Stem Length

The effect of the treatments on stem length becomes manifest from the 6th WAP (Table 3.2). The significantly tallest plants were in fungicide plus hot water treated plants. The control plants on the other were the shortest. The plants heights at 6WAP (18.9cm) and 21WAP (82.6cm) were the significantly tallest for cassava variety TME 419 treated with fungicide and hot water. This showed that use of fungicide and hot water at 50°C had the most positive effect on plant regeneration. [18] is of the opinion that the primary effect of fungicide treatments is restricted to early stages of plant growth and is known to have plant

growth regulator activity when applied. [19] is also of the view that soaking Arabic gum seeds in hot water at 40°C improved the germination and emergence of the seeds. These findings are also in agreement with [20] stating that temperature range of 43°C to 49°C had no significant deleterious effect on the survival of cuttings and regeneration of cassava plants.

3.3 Effect on Number of Leaves

Table 3.3 revealed that irrespective of cassava variety, the number of leaves per plant were significantly highest in the fungicidal and hot water treatment from the 6th to the 21st WAP in contrast to the control. At 21WAP for instance, variety TME 419 treated with fungicide plus hot water had an average of 82.6 leaves and the same variety under control conditions had the lowest value (33.3). According to [21], leaves produce starches and protein which are the building blocks for cell growth and development. It is therefore intuitive to note that the amount and health of leaves on a cassava plant during the growth of the crop could be an important factor that would affect crop yield.

3.4 Effect on Yield Parameters

The result of the effect of the treatments as it affect yield parameters such as stem girth, number of tubers and weight of tubers on per-plant basis is shown in Table 3.4. It showed that irrespective of variety, the fungicide and hot water treatment resulted in the highest growth parameters. However, stem girth (9.4cm), number of tubers (25.2) and weight of tubers (10.4g) were also significantly highest in variety TME 419 as it was in all the other variables measured in the experiment. The control plants also generally had the lowest growth indices followed by the fungicide alone treated plants. This signifies that the highest yields were obtained in the fungicide plus hot water treatment. The beneficial effects of fungicidal and hot water treatment in attaining appreciable yields in the cassava cultivars is attributable to its ability to

stimulating plant resistance to BLS and CMD. The treatment also produced the highest plant growths and the lowest disease severity and it is generally assumed that disease is logically related to yield.

The higher yields established in the treatment plants is therefore an indication of the suppressive ability of the fungicide used (Hexaconazole 5% SC) and heat therapy (hot water) against fungal and viral pathogens. This result corroborates previous experiments that highlight the usefulness of fungal and thermal treatments of planting materials in suppressing disease pathogens. [22] proved that a successful control of fungal diseases can be obtained by using a wide array of fungicides. [23] in their experiment showed the high efficacy of hot water treatments in controlling against *Alternaria* species in vegetable seeds. [24] also reported that using hot water treatment on cassava cuttings had a significantly positive effect of CMD disease reduction on the regeneration of symptomless cassava plants, which led to an increased yield compared to the non-treated cuttings.

4.0 CONCLUSION

Investigation from this study showed that the combination of fungicide and hot water treatment of cassava cuttings before planting is an effective therapy in ameliorating fungal and viral disease severity in cassava plantings in potted experiments under greenhouse conditions. Further field experiments are however necessary to fully justify this assertion.

Acknowledgement

The authors wish to acknowledge The Roots and Tuber Expansion Project of the International Fund for Agricultural Development (IFAD) in Ajassee-Ipo, Kwara State Nigeria for the provision of the cassava varieties used in the course of this study.

Table 3.1: Effect of treatment on percentage disease severity

TREATMENT/ VARIETY	3wk	Week	After	planting	15wk	18wk	21wk
		6wk	9wk	12wk			
C X TMS 30572	2.4 ^{NS}	7.9 ^d	12.8 ^f	22.4 ⁱ	28.5 ^h	33.3 ^h	35.2 ^e
C X TMS 0505	2.2 ^{NS}	9.9 ^e	13.2 ^g	23.3 ^j	29.7 ⁱ	34.7 ⁱ	37.1 ^f
C X TMS 0510	2.3 ^{NS}	8.8 ^e	12.6 ^f	22.1 ⁱ	29.1 ⁱ	33.9 ^h	36.8 ^{ef}
C X TMS 0581	2.4 ^{NS}	8.2 ^e	12.2 ^f	21.9 ^h	27.9 ^g	31.2 ^g	33.3 ^d
C X TME 419	2.8 ^{NS}	7.2 ^d	11.9 ^{ef}	20.2 ^g	26.7 ^f	30.6 ^g	31.8 ^c
FA X TMS 30572	2.4 ^{NS}	5.8 ^c	8.9 ^{cd}	16.4 ^e	22.8 ^{de}	26.8 ^f	28.0 ^b
FA X TMS 0505	2.5 ^{NS}	6.2 ^c	9.6 ^d	17.7 ^f	23.4 ^e	27.2 ^f	29.6 ^b
FA X TMS 0510	2.4 ^{NS}	6.0 ^c	9.2 ^d	16.8 ^{cd}	22.1 ^d	26.2 ^f	27.8 ^b
FA X TMS 0581	2.3 ^{NS}	5.8 ^c	9.1 ^d	16.1 ^c	22.3 ^d	26.9 ^f	27.7 ^b
FA X TME 419	2.7 ^{NS}	4.9 ^b	8.0 ^c	15.5 ^c	21.6 ^d	24.7 ^e	26.3 ^b
FHT X TME 419	2.6 ^{NS}	3.4 ^a	5.6 ^a	10.6 ^{ab}	15.6 ^b	18.9 ^b	19.4 ^a
FHT X TMS 0505	2.1 ^{NS}	3.9 ^a	6.8 ^b	11.2 ^b	17.7 ^c	20.6 ^d	21.3 ^a
FHT X TMS 0510	2.5 ^{NS}	3.8 ^a	6.2 ^b	10.8 ^{ab}	16.1 ^b	19.8 ^c	20.4 ^a
FHT X TMS 0581	2.0 ^{NS}	3.6 ^a	6.4 ^b	10.9 ^{ab}	15.9 ^b	18.7 ^b	20.0 ^a
FHT X TMS 30572	2.2 ^{NS}	3.0 ^a	4.9 ^a	9.6 ^a	14.6 ^a	17.7 ^a	19.8 ^a

Key: C = distilled water, FA= fungicide, FHT= fungicide plus hot water, NS= not significant. Means followed by the same letter (s) are not significantly different at p=0.05 using the New Duncan's Multiple Range Test.

Table 3.2: Effect of treatment on Stem length (cm)

TREATMENT/ VARIETY	3wk	Week	After	planting	15wk	18wk	21wk
		6wk	9wk	12wk			
C X TMS 30572	7.2 ^{NS}	10.7 ^g	14.9 ⁱ	21.4 ^h	35.7 ^f	41.4 ⁱ	45.7 ⁱ
C X TMS 0505	7.4 ^{NS}	10.4 ^g	13.7 ^j	19.9 ^h	34.1 ^{fg}	38.6 ^j	42.5 ^k
C X TMS 0510	7.1 ^{NS}	11.6 ^f	14.6 ⁱ	20.1 ^h	35.1 ^f	41.0 ⁱ	44.8 ^j
C X TMS 0581	7.3 ^{NS}	12.4 ^{ef}	15.9 ^h	21.3 ^{gh}	36.7 ^{ef}	42.4 ^{hi}	45.9 ⁱ
C X TME 419	7.6 ^{NS}	13.9 ^{cd}	16.9 ^g	22.4 ^f	39.8 ^e	49.6 ^g	54.8 ^h
FA X TMS 30572	7.7 ^{NS}	14.1 ^c	20.6 ^{ef}	29.4 ^e	49.3 ^d	59.2 ^e	65.0 ^f
FA X TMS 0505	7.4 ^{NS}	13.7 ^{de}	19.4 ^f	28.4 ^e	48.8 ^d	57.2 ^f	63.6 ^g
FA X TMS 0510	7.3 ^{NS}	14.8 ^c	20.3 ^{ef}	29.8 ^e	49.5 ^d	59.7 ^e	66.0 ^f
FA X TMS 0581	7.6 ^{NS}	15.4 ^c	21.0 ^{de}	30.4 ^{cde}	50.3 ^d	60.6 ^e	66.7 ^f
FA X TME 419	7.4 ^{NS}	16.3 ^c	22.5 ^{cd}	32.5 ^c	53.4 ^c	62.8 ^d	71.3 ^e
FHT X TME 419	7.5 ^{NS}	18.7 ^a	24.5 ^b	37.6 ^b	56.8 ^b	69.9 ^b	79.1 ^b
FHT X TMS 0505	7.0 ^{NS}	17.9 ^b	23.2 ^c	36.3 ^b	54.4 ^{bc}	66.6 ^c	73.3 ^{de}
FHT X TMS 0510	7.2 ^{NS}	17.8 ^b	24.0 ^b	37.8 ^b	55.9 ^b	67.7 ^{bc}	75.2 ^d
FHT X TMS 0581	7.4 ^{NS}	17.7 ^b	24.4 ^b	37.9 ^b	56.7 ^b	69.1 ^b	77.1 ^c
FHT X TMS 30572	7.7 ^{NS}	18.9 ^a	26.9 ^a	40.2 ^a	61.4 ^a	74.8 ^a	82.6 ^a

Means followed by the same letter (s) are not significantly different at $p=0.05$ using the New Duncan's Multiple Range Test.

Table 3.3: Effect of treatment on number of leaves

TREATMENT/ VARIETY	3wk	Week	After	planting	15wk	18wk	21wk
		6wk	9wk	12wk			
C X TMS 30572	6.4 ^{NS}	11.6 ^g	22.7 ^g	25.6 ^h	27.3 ^h	29.3 ^h	32.4 ⁱ
C X TMS 0505	6.2 ^{NS}	11.4 ^g	19.2 ⁱ	23.2 ⁱ	24.4 ^j	26.2 ⁱ	28.7 ^k
C X TMS 0510	6.1 ^{NS}	12.6 ^f	20.8 ^{hi}	24.1 ⁱ	26.4 ⁱ	28.2 ^h	31.1 ^j
C X TMS 0581	6.3 ^{NS}	11.8 ^g	19.9 ⁱ	23.9 ⁱ	27.8 ^h	28.6 ^h	31.0 ^j
C X TME 419	6.5 ^{NS}	12.9 ^f	24.1 ^{ef}	27.7 ^g	30.2 ^g	32.4 ^g	33.3 ⁱ
FA X TMS 30572	6.3 ^{NS}	18.6 ^d	29.6 ^c	35.2 ^e	39.9 ^e	42.6 ^d	45.5 ^g
FA X TMS 0505	6.4 ^{NS}	17.9 ^e	23.2 ^f	33.1 ^f	36.5 ^f	39.2 ^{ef}	43.0 ^h
FA X TMS 0510	6.2 ^{NS}	18.0 ^d	27.3 ^d	34.6 ^e	37.1 ^f	40.9 ^e	44.0 ^{gh}
FA X TMS 0581	6.4 ^{NS}	17.9 ^e	25.4 ^e	32.4 ^f	36.8 ^f	40.4 ^e	45.4 ^g
FA X TME 419	6.1 ^{NS}	21.6 ^c	32.5 ^b	38.5 ^d	42.2 ^d	46.9 ^c	51.2 ^f
FHT X TME 419	6.6 ^{NS}	23.4 ^b	34.3 ^b	43.3 ^b	48.1 ^b	53.7 ^b	79.1 ^b
FHT X TMS 0505	6.4 ^{NS}	22.6 ^b	28.9 ^c	38.1 ^d	42.6 ^d	46.2 ^c	73.3 ^e
FHT X TMS 0510	6.3 ^{NS}	21.0 ^c	32.1 ^b	42.0 ^c	46.1 ^c	47.8 ^c	75.2 ^d
FHT X TMS 0581	6.4 ^{NS}	22.3 ^b	33.3 ^b	41.6 ^c	45.4 ^e	46.4 ^c	77.1 ^c
FHT X TMS 30572	6.5 ^{NS}	25.2 ^a	37.1 ^a	46.6 ^a	51.6 ^a	54.6 ^a	82.6 ^a

Means followed by the same letter (s) are not significantly different at $p=0.05$ using the New Duncan's Multiple Range Test.

Table 3.4: Effect of treatment on yield parameters

Treatment/Variety	Stem girth (cm)	Number of tubers/plant	Average weight of tubers/plant (g)
C X TMS 30572	4.4 ^f	11.6 ^b	4.6 ^f
C X TMS 0505	3.3 ^g	11.4 ^b	4.1 ^f
C X TMS 0510	4.1 ^f	12.6 ^g	4.4 ^f
C X TMS 0581	4.3 ^f	11.8 ^b	4.7 ^f
C X TME 419	4.7 ^f	12.9 ^g	5.6 ^e
FA X TMS 30572	6.3 ^d	18.6 ^e	6.6 ^d
FA X TMS 0505	5.4 ^e	17.9 ^{ef}	6.3 ^d
FA X TMS 0510	6.9 ^d	18.0 ^e	6.6 ^d
FA X TMS 0581	6.7 ^d	17.9 ^{ef}	6.0 ^d
FA X TME 419	7.8 ^c	21.6 ^d	6.9 ^d
FHT X TME 419	8.1 ^b	23.4 ^b	9.3 ^b
FHT X TMS 0505	7.7 ^c	22.6 ^c	8.7 ^c
FHT X TMS 0510	8.6 ^b	21.0 ^d	8.0 ^c
FHT X TMS 0581	8.2 ^b	22.3 ^c	8.3 ^c
FHT X TMS 30572	9.4 ^a	25.2 ^a	10.4 ^a

Means followed by the same letter (s) are not significantly different at $p=0.05$ using the New Duncan's Multiple Range Test.

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