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EFFICACY OF FOLIAR / SOIL BASED FUNGICIDES COMBINATION FOR CONTROL OF GINGER LEAF SPOT (*Phylosticta zingiberi*)

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ABSTRACT

Field trials were conducted to ascertain the efficacy of three fungicides on leaf spot disease of ginger (*Zingiber officianale* Rose) at National Root Crop Research Institute, Umudike, Nigeria. The fungicides were marketed as Team (Mancozeb/ Carbendazim}, Hi-shield (Mancozeb) and Funguran-OH (Copper oxide), and were used as sole and in various combinations for soil and foliar treatment against the disease, using ginger varieties UG1 and UG2, as test crops. The result of the two year 2007 and 2008 trials revealed that the fungicides in their various applications reduced disease severity and increased rhizome yield of the ginger. There was significant difference in the effects of the various fungicide applications, with Team (Mancozeb/ Carbendazim) in both single and combination, showing more efficacy than others. The two ginger varieties equally exhibited significant differences in their susceptibility to the disease, with UG1 having high tolerance to it, giving high rhizome yield, unlike UG2 which was highly susceptible, with low yield.

Key words: Fungicides, ginger leaf spot, disease control, Nigeria, Rhizome yield.

INTRODUCTION

Ginger (*Zingiber officianale* Rosc) is a highly valued crop in the international market. It is widely cherished for its aroma, pungency, high oil and oleoresin content; therefore used in industries for manufacture of chocolate, ginger ale, biscuits, essential oils, bread and many products as spices (Madu *et al*., 2009). In Nigeria, the crop is faced with disease problems that affect the growth, yield and storage (Graham *et al.*, 2005). The crop's value as an aphrodisiac is undoubtedly connected to its widespread use as a systemic tonic and hormone. It is a herb to be discovered, experienced and enjoyed in abundance (Christopher *et al.*, 2010). From its origin to the present, ginger is the world's most widely cultivated herb. Testimonials and economic importance of ginger have been recorded as far back as five thousand years old Greek literature to 200BC. The crop is easy enough to handle, if it does not fall victim to pests and diseases. Unfortunately, yields are never easily guaranteed due to many pests and diseases. In Nigeria the crop is faced with disease problems that affect the growth, yield and storage (Nwaogu *et al.*, 2009). A concerted effort has been made over the past eight years by the National Root Crop Research Institute (NRCRI), Umudike, in Nigeria, to combat ginger diseases (Nwaogu *et al.*, 2009). Ginger requires tropical, subtropical and humid climate for its growth. This environmental condition favours disease development in Nigeria for many crop, as combined action of the temperature and humidity provide ideal environment for incubation of most disease pathogens. (Ohazurike and Obi, 2000). The most widely spread major disease of ginger in Nigeria, is leaf spot disease (*Phylosticta zingiberi*). *Phylosticta zinfiberi* (leaf spot) is highly prevalent in Nigeria, causing serious leaf necrosis on ginger plants (Nwoagu *et al*, 2009: Okwulehie, 1997). The disease devastates ginger at both field and storage, causing low yield on field and rhizome rots at storage. The disease moves from field to storage and vice visa, recycling the problem because of ignorance. In Nigeria, National Root Crop Research Institute, Umudike, has made several management efforts to solve the disease problem of ginger, but the solution being far to reach. This therefore calls for a sound comprehensive pathological approach to save ginger farmers from this discouraging situation. It has been established that healthy crops give better yield than unhealthy ones (Ohazurike and Obi, 2000: Graham *et al.*, 2005). Healthy plants depend on sound and good disease management approach. There is need to develop a good control package against this disease of ginger. This project was therefore, designed to develop a combined fungicide application approach that could form an effective disease control package for ginger leaf spot.

MATERIALS AND METHODS

The field trial was conducted at ginger research farm of National Root Crop Research Institute (NRCRI), Umudike, Nigeria. Umudike is in the Eastern part of Nigeria, with Annual rainfall of 2000 to 2400 mm and temperature of 28 to 32^0C (Peter, 2005). The research work was conducted over the period of April to December, 2007 and repeated in 2008. Two ginger varieties, UG1 and UG2, developed by NRCRI, were assessed to determine their response to fungicide application in terms of growth, yield and disease severity. The three fungicides were, Mancozeb/Carbendazim (Team- contact/systemic), Mancozeb (Hi-shield- contact) and copper oxide (Fanguran-OH-

contact). The words, Team, Hi-shield and Funguran-OH, are the various trade names for the respective pesticides. Mancozeb/carbendazim (Team) and Hi-shield which is equally Mancozeb, are purely fungicides. Team as seen above is produced as combination of Mancozeb and carbendazim by the manufacturer as contact and systemic fungicide. While copper oxide which has Funguran - OH as trade name, is a fungicide with appreciable levels of bactericidal action. The field was laid in split plot arrangement fitted into Randomized Complete Block Design (RCBD) with 3 replications. The plot size was 3x2m with planting spacing of 20cm. The pesticides were applied both as soil and foliar treatment: sole and in combination as shown below.

(1) Mancozeb/carbendazim (Team) – sole, applied both soil and foliar.
(2) Mancozeb (Hi-shield) – sole, - applied both soil and foliar.
(3) Copper oxide (Funguran – OH) sole, applied both soil and foliar.
(4) Team (foliar) + Hi-shield (soil)
(5) Team (soil) + Hi-shield (foliar)
(6) Team (foliar) + Funguran – OH (soil)
(7) Team (soil) + Funguran – OH (foliar)
(8) Hi – shield – OH (foliar) + Funguran – OH (soil)
(9) Hi – shield (soil) + Funguran – OH (foliar).
(10) Control (no treatment).

The three pesticides were wettable powder (WP) formulations.

Initial chemical application was done at planting by soil application, which involved spreading 3g of each per hole before the seed rhizome was covered with soil. Subsequent application was done by spraying the soil and foliar at 42 days after planting (DAP) and 72DAP respectively, with 30g of the pesticide dissolved in 20 litres of water. Manual knapsack sprayer was used for the spraying on the field. As the ginger plants grew on the field, observations were made on establishment count, tillering capacity, disease scoring, plant vigour, and survival. At harvest, yield/plant and per hectare, as well as rhizome rot levels and marketable yield were calculated. Data collected were analyzed and mean separation based on calculation of standard error for differences (SED).

RESULT AND DISCUSSION

Table 1 shows the percentage plant establishment on the field. There were significant differences among the fungicide treatments with respect to plant establishment. The significant effect of the fungicide was more noticeable on UG2 variety, where the untreated plots (control) had the least crop establishment, except for Team (foliar) + Funguran-OH (soil) combination . Tables 2 and 3 show incidence and severity of leaf spot disease, respectively. The fungicide combinations and singles differed in their effect on disease severity. The control (untreated plot) had more leaf spot incidence and severity, with less plant vigour when compared with the treated plots. Such effect was equally prominently clear on UG2 variety which was highly infected. On yield, the various fungicide treatments differed in their effects (Table 4). The result equally revealed more yield on the treated plots than on the control. The reduced disease infection observed on treated plots might have contributed to high rhizome yield obtained on them (GMC, 2007). When plant vigour increased because of less disease infection, high yield should be expected (Nwawuisi and Odoh, 2006; Ohazurike and Obi, 2000). The effects of the fungicides were noticed more on the variety UG2, which was highly susceptible to leaf spot disease. The high disease severity observed on it led to low yield and marketable level obtained. Such would have been the case in UG1 variety, but its high tolerance to the disease brought about the reverse, thereby leaving it with high yield. The variety had impressive adaptation to the condition. Level of tolerance to a particular disease, is a measure of the severity. Incidence could be high and depends on number, while disease severity determines the actual effect/ impact on the host (Grench *et al*., 2008, Graham *et al*., 2005)). This was the case in UG1, which exhibited high tolerance and adaptation, irrespective of leaf spot disease incidence. This led to the encouraging and impressive rhizome yield/ hectare (39.00 and 26.33 tons/hectare) obtained on the control (untreated plants), as against the low yield in UG2 (11.83 and 13.58 tonne/hectare) for 2007and 2008 plantings. The high yield in UG2 (25.83 and 33.00 tonne/ha) obtained in fungicide combination, Team (forliar) and Hi-shield (soil) for both years revealed the efficacy of the fungicide combination, while the control had as low as 11.83 and 13,58 tonne/ha. Obtaining such high yield from a high susceptible variety to disease, was an indication of effective control exhibited by the fungicides. This impressive efficacy of the fungicides led to the encouraging marketable levels, as against the reduced market quality of the rhizomes from untreated (control) plots. Disease severity during its incidence, determines yield and quality of products (Asumugha

et al., 2006, Okwulehie and Nnodu, 1988). There is direct and positive correction between disease severity and level/quality of yield.

Table 1. Establishment count of the ginger plants on the field.

Treatments	Establishment (%)							
	2007				2008			
	4WAP		6WAP		4WAP		6WAP	
	UG1	UG2	UG1	UG2	UG1	UG2	UG1	UG2
Mancozeb / Carbodazin(Team)	56.33	43.00	85.00	70.00	77.67	65.67	79.33	67.33
Mancozeb (Hi-shield)	67.67	64.67	72.00	77.00	62.63	57.00	68.67	67.00
Curper oxide (Funguran-OH)	71.67	50.00	76.00	68.00	64.00	62.00	73.67	46.00
Team(foliar) + Hi-shield(soil)	71.00	43.33	84.33	69.00	73.87	66.67	84.67	68.67
Team(soil) + Hi-shield(foliar)	82.33	71.33	95.67	87.00	59.67	49.67	63.33	70.33
Team(foliar) + Funguran-OH(soil)	73.00	43.67	83.67	58.33	57.33	37.00	62.33	42.00
Team(soil) + Funguran-OH(foliar)	77.33	48.67	82.33	74.33	67.33	66.67	75.67	69.00
Hi-shield(foliar) + Funguran-OH(soil)	66.33	35.67	79.33	62.67	59.67	55.00	69.00	58.00
Hi-shield(soil) + Funguran-OH(foliar)	67.33	59.00	62.67	71.67	50.67	57.00	73,33	59.67
Control (no treatment)	75.00	34.67	87.00	59.33	73.33	46.00	65.00	53,33
SED	2.24	3.84	2.85	2.73	2.66	3.50	2.28	3.22

WAP = Weeks After Planting

Table 2. Incidence of leaf spot on the ginger plants at 6 months after Planting (MAP).

	Incidence of leaf spot (%)			
	2007		2008	
Treatment	UG1	UG2	UG1	UG2
Mancozeb / Carbodazin(Team)	21.67	26.67	20.33	51.67
Mancozeb (Hi-shield)	25.00	36.66	31.67	51.57
Curper oxide (Funguran-OH)	21.67	25.00	38.33	65.00
Team(foliar) + Hi-shield(soil)	25.00	28.33	23.33	56.47
Team(soil) + Hi-shield(foliar)	26.67	33.33	46.67	40.00
Team(foliar) + Funguran-OH(soil)	28.33	46.67	38.63	55.00
Team(soil) + Funguran-OH(foliar)	35.00	33.33	30.00	60.67
Hi-shield(foliar) + Funguran-OH(soil)	28.33	40.00	43.33	56.33
Hi-shield(soil) + Funguran-OH(foliar)	33.33	33.33	45.00	56.42
Control (no treatment)	25.00	48.33	44.67	71.34
SED	1.59	2.50	2.98	2.65

Table 3. Severity of leaf spot disease on the plants at 6MAP.

	Severity of leaf spot (%)			
	2007		2008	
Treatment	UG1	UG2	UG1	UG2
Mancozeb / Carbodazin(Team)	1.90	2.40	2.10	2.50
Mancozeb (Hi-shield)	2.11	3.94	2.60	3.10
Curper oxide (Funguran-OH)	2.94	2.98	3.01	2.98
Team(foliar) + Hi-shield(soil)	2.40	2.31	2.35	2.40
Team(soil) + Hi-shield(foliar)	2.11	2.22	2.19	2.31
Team(foliar) + Funguran-OH(soil)	1.90	2.50	1.94	2.52
Team(soil) + Funguran-OH(foliar)	2.40	2.52	2.41	2.60
Hi-shield(foliar) + Funguran-OH(soil)	1.94	3.40	2.24	3.44
Hi-shield(soil) + Funguran-OH(foliar)	2.20	3.01	2.60	2.94
Control (no treatment)	3.04	3.62	3.20	3.80
SED	0.10	0.15	0.13	0.15

Disease severity key: 1 = Minor, 2 = Moderate, 3 = High, 4 = very high

Table 4. Yield of the ginger in respect of the fungicides applied.

	Yield (tonne)/ ha (2007)		Yield (tonne)/ ha (2008)	
Treatments	UG1	UG2	UG1	UG2
Mancozeb / Carbodazin(Team)	41.50	25.83	29.84	18.00
Mancozeb (Hi-shield)	36.00	26.18	33.50	15.60
Curper oxide (Funguran-OH)	30.50	18.18	27.66	22.75
Team(foliar) + Hi-shield(soil)	35.83	25.83	35.02	33.00
Team(soil) + Hi-shield(foliar)	39.18	32.50	30.68	16.18
Team(foliar) + Funguran-OH(soil)	41.68	16.83	30.83	18.75
Team(soil) + Funguran-OH(foliar)	36.33	19.85	31.63	17.68
Hi-shield(foliar) + Funguran-OH(soil)	36.68	14.68	28.18	14.58
Hi-shield(soil) + Funguran-OH(foliar)	35.50	22.68	28.58	14.58
Control (no treatment)	39.00	11.83	26.33	13.58
SED	1.04	1.99	0.85	1.82

Table 5. Marketable levels of the rhizomes after harvest.

	Marketable levels (%)			
	2007		2008	
Treatment	UG1	UG2	UG1	UG2
Mancozeb / Carbodazin(Team)	88.33	65.00	83.33	75.00
Mancozeb (Hi-shield)	85.00	66.67	90.00	76.67
Curper oxide (Funguran-OH)	73.33	55.33	83.33	65.35
Team(foliar) + Hi-shield(soil)	90.00	53.33	95.00	63.42
Team(soil) + Hi-shield(foliar)	82.67	65.00	87.67	70.00
Team(foliar) + Funguran-OH(soil)	87.67	70.00	92.63	75.00
Team(soil) + Funguran-OH(foliar)	73.33	63.33	78.33	73.00
Hi-shield(foliar) + Funguran-OH(soil)	80.00	48.33	90.00	60.33
Hi-shield(soil) + Funguran-OH(foliar)	81.67	50.00	86,67	61.00
Control (no treatment)	80.00	48.33	85.00	60.44
SED	1.89	2.63	1.57	2.11

CONCLUSION

The fungicides in their combined form and singles were found to have effectively reduce ginger leaf spot disease, leading to increase rhizome yield. The fungicide Team (mancozeb / Carbendazim = contact and systemic), was highly effective in both single and combination with other fungicides. The variety UG1 is relatively more tolerant to the disease, therefore, should be an ideal variety for ginger cultivation in the area. The farmers are advised to apply control measure and adopt the use of Team (Mancozeb/ Carbendazim), both as single or in combination, because the formulation is both contact and systemic,

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