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MANAGEMENT OF PURPLE BLOTCH DISEASE IN ONION (*Allium cepa* L.) USING ORGANIC AMENDMENTS

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ABSTRACT

The management of purple blotch disease in onion by soil amendments was investigated in a screen house experiment. Soil application of poultry droppings, cattle dung, rice husk and neem leaves at 100, 150 and 200g/kg soil reduced purple blotch severity significantly. Soil amendments with poultry droppings was most effective; reducing the severity from 4.8 ± 0.2 in the unamended soil (control) to 1.4 ± in poultry dropping amended soil at 200h/kg soil. The soil population of *Alternaria porri* was reduced from 36 ± 1.7 x $10^5 g^{-1}$; also at 200g/kg poultry dropping amendment. The amended soils developed microflora including *Trichoderma harzianum, Fusarium culmorum, Penicillium cyclopium, Bacillus cereus* and *B subtilis*. Highest populations of the fungi were contained in poultry dropping amended soil. *Bacillus cereus* and *B. subtilis* were also higher in poultry dropping amended soil. The suppression of purple blotch disease of onion .examined in this study was related directly to microbial properties of the amendments.

Key words: Onion; Purple blotch; Soil amendments

INTRODUCTION

Purple blotch caused by *Alternaria porri* Ell. (Ciferri) is an important disease of onion worldwide and is more prevalent in warm, humid environment. The disease is a major constraint to onion production in Nigeria with a yield loss ranging from 25 – 40% annually ('Yar'adua, 2003)). The pathogen is soil borne and its inoculum can remain viable in the soil for many years. The use of fungicides as soil drenches was found to be effective in managing purple blotch, (Suheri and Price, 2001). However, the development of resistance to fungicides by some plant pathogens and environmental degradation potential has caused considerable difficulties in the continuous use of chemicals.

The application of organic amendments to soil is emerging as an economically and environmentally acceptable alternative to disposal through landfill and incineration. However, levels of disease control, by soil amendments have not been consistent. Not only do amendments from different materials vary in disease suppression but those from different batches of the same material are also variable (Flores *et al.*, 2006). This variability is poorly understood because of the poor understanding of the mechanisms by which the amendments suppressed plants diseases. This paper reports on the efficacy of some selected organic soil amendments in the management of purple blotch in onion.

MATERIAL AND METHODS

Preparation of Soil Amendments

Soil amendments were prepared from a variety of organic materials which included poultry droppings, cattle dung, rice husk and neem leaves.

Plants and Pathogen Materials

Susceptible onion cultivar (Gindin Tasa) commonly grown in Sokoto State and a virulent isolate of *Alternaria porri* were used as plant and pathogen materials.respectively.

Experimental Design and Management

Experiments were carried out in the Botanical garden of the Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto to investigate the efficacy of the selected organic soil amendments on purple blotch disease severity. Two kilogram (2kg) of autoclaved soil was filled into polypots (20cm diameter and 30cm deep) to which amendments were incorporated at three different concentrations of 100, 150, and 200g/kg soil in each pot. Subsequently the amended soil was drenched with 20ml spore suspension of *A. porri* containing 40 x 10^5 spore/ml. Six weeks old five onion seedlings were then transplanted per pot. Five seedlings per pot of inoculated unamended soil served as control. The treatments were replicated four times. The seedlings were assessed for disease symptoms typical of purple blotch: elliptical purple lesions with yellow halo six weeks after inoculation following the method of Suheri and Price (2001). A scoring scale of 1 – 5 (where 1 = no disease, 2 = 1 – 20% leaves with purple lesions, 3 = 21 – 40% leaves with purple lesions, 4 = 41 – 70% leaves with purple lesions, and 5 = 71 – 100% leaves with purple lesions) was used to assess disease severity.

Experiments were conducted to isolate and enumerate populations of bacteria and other fungi from the different treatments using dilution plate techniques: One gram each of the five soil amendment types together with unamended control was placed in 9ml of sterile distilled water in McCartney bottles and shaken on a vortex mixer for 10 min and then serially diluted, from which 1ml of 10^6 diluents was plated on potato dextrose agar (David and Maria, 2005). The plates were incubated at 28^0c for 7 days and the fungi were identified based on morphological and cultural features. Another set of inoculated plates were incubated at 37^0c for 48h and then examined for the growth of bacteria present which were then sub cultured on nutrient agar until pure cultures were established adopted from Barrow and Feltham (1993). Fungal and bacterial colonies recovered from the plates were enumerated and population expressed as colony forming unit per gram of amended soil. Results were subjected to analysis of variance, where necessary, treatment means were compared using the Turkey Kramer Multiple Comparisons, Graph Pad Instat Software, 2007 (San Diego USA).

RESULTS

The various amendments significantly suppressed disease severity from 4.8 ± 0.2 in the control to 1.4 ± 0.2, 2.2 ± 0.2; 3.0 ± 0.3 and 4.0 ± 0.2 at the concentration of 200g/kg of poultry droppings, cattle dung, rice husk and neem leaves respectively (Table 1). The suppression of disease was higher in poultry droppings with a value ranging from 1.4 ± 0.2 to 2.5 ± 0.2. The reduction in disease was least in neem leaf amended soil 4.0 ± 0.2 – 4.5 ± 0.3), which was lowest but not significantly different from that of unamended control (4.8 ± 0.2). The results revealed that application of varying concentrations of the amendments to the soil had substantial suppressive effect on the disease severity. With exception to neem leaves, all the amendments significantly decreased the severity of purple blotch disease compared to the control. There was a gradual decrease in the severity of the disease as the concentration of the amendments increased. Generally, higher concentrations (150 and 200g/kg) were more effective in suppressing the disease.

All amendments significantly reduced the inoculum of *A. porri* in the soil, the pathogen population ranging from 7.3 ± 2.3 to 22 ± 1.7 x 10^5 cfu/g compared to 36 ± 1.7 in the control (Table 1). Poultry droppings were found most effective in reducing the inoculum load of *A. porri* to level of 7.3 ± 2.3 at 200g/kg concentration of the amendment. The reduction in purple blotch disease by various amendments was found to be associated with increase in secondary soil microbial populations.

The number of propogules of *Trichoderma harzianum* ranged from 8 ± 2 x 10^5 to 21 ± 1 x 10^5 cfu/g of amendments (Table 2) while that of *Penicillium cyclopium* ranged from 16.4 ± 1.4 x 10^5 to 25.3 ± 1.5 x 10^5 cfu/g. The population count of the fungus was significantly different at all the three concentrations compared with the control (16.4 ± 12 x 10^5 cfu/g). Poultry droppings supported the highest population of *P. cyclopium*, (25 ± 1.5 x 10^5 cfu/g) at the concentration of 200g/kg soil except the rice husk having the lowest fungal count (16.4 ± 1.45 x 10^5 cfu/g). The population of *F. culmorum* ranged from 17.7 ± 2.6 x 10^5 to 30 ± 1.3 x 10^5 cfu/g. The fungal count was highest in poultry dropping at the concentration of 200g/kg soil and lowest in neem leaves.

Different amendments significantly influenced the soil population of the bacteria, also (Table 3). Poultry droppings has the highest bacterial population ranging from 34 ± 2.0 and 35.4 ± 3.7 x 10^5 cfu/g respectively for *Bacillus subtilis* and *B. cereus* followed by cattle dung (30 ± 2.0 x 10^5 and 31 ± 3.7 x 10^5 cfu/g) respectively for *Bacillus subtilis* and *B. cereus* at 200g/kg concentration. Neem leaves amended soil supported the least population of the bacteria (25.7± 0.6 x 10^5 and 26 ± 1 x 10^5 cfu/g) at 200g/kg soil. .

Table 1: Effect of soil amendments on the severity of purple blotch on onion

Amendment	Concentration (g/kg)	Disease Severity	*Population of *A. porri*
Poultry Dropping	100	2.5 ± 0.2c	36.0 ± 1.7a
,,	150	1.7 ± 0.3d	19.0 ± 2.6c
,,	200	1.4 ± 0.2d	11.5 ± 2.2e
Cattle dung	100	3.0 ± 0.5c	7.3 ± 2.1f
,,	150	2.5 ± 0.3c	20.7 ± 2.3c
,,	200	2.2 ± 0.2c	15.0 ± 2.0d
Rice husk	100	4.0 ± 0.2a	8.2 ± 1.5f
,,	150	3.5 ± 0.3b	23.0 ± 2.6b
,,	200	3.0 ± 0.c	17.2 ± 1.9d
Neem leaves	100	4.5 ± 0.3a	10.4 ± 1.6e
,,	150	4.3 ± 0.3a	22.0 ± 1.7b
,,	200	4.0 ± 0.2a	17.0 ± 2.0d
Control	0	4.8 ± 0.2a	7.6 ± 1.2f

*cfu x $10^5 g^{-1}$ Means with same letters in column are not significantly different ($p > 0.05$)

Table 2: Effect of amendments on fungal populations in soil.

Type of Amendments	Concentration (g/kg)	Fungal Population		
		T. harzianum	*P. cyclopium*	*F. culmorum*
Poultry Dropping	100	14.3 ±1.7b	22.2±0.7a	24.0±2.0b
	150	17.6 ±1.5a	24.7±1.2a	26.4±1.3a
	200	21.0 ±1.0a	25.3±1.5a	30.5±1.3a
Cattle dung	100	11.0 ±2.0b	20.0±2.6b	21.0±1.7c
	150	13.7 ±3.2b	20.6±1.6b	24.0±2.0b
	200	20.0 ±3.0a	22.7±0.6a	27.0±2.0b
Rice husk	100	10.0 ±2.0b	16.4±1.4b	18.0±2.0c
	150	12.8 ±1.1b	18±3.0b	23.0±2.0b
	200	15.7 ±2.3b	24.3±1.1a	26.0±1.7a
Neem leaves	100	8.0 ±2.0c	16.7±1.5b	17.7±2.5c
	150	11.0 ±1.0b	18.7±1.2b	21.0±1.6c
	200	13.0 ±2.0b	20.0±3.0b	25.0±1.0a
Control	0	12.3 ± 1.7b	16.0 ± 1.2b	19.0 ± 1.8c

*cfu x $10^5 g^{-1}$ Means with same letters in column are not significantly different ($p > 0.05$)

Table 3: Effect of amendments on bacterial population

Type of Amendments	Concentration (g/kg)	Bacterial Population	
		B. subtilis	*B. cereus*
Poultry Dropping	100	24.0±1.0b	26.0±2.0b
	150	18.0±2.0b	30.0±2.0a
	200	34.0±2.0a	35.4±3.7a
Cattle dung	100	22.0±1.0b	26.0±1.0b
	150	26.0±2.0b	28.0±1.0b
	200	30.0±2.0a	31.0±1.0a
Rice husk	100	21.3±2.3b	23.0±2.6b
	150	24.0±1.5b	25.0±2.0b
	200	26.0±1.0b	26.0±2.0b
Control	0	24.3±1.5b	23.8±0.7b

*cfu x $10^5 g^{-1}$Means with same letters in column are not significantly different ($p > 0.05$)

DISCUSSION

Findings of this study support a general increase in soil populations of bacterial and fungal microflora in soils with corresponding decrease in inoculum density of *A. porri* after amendment with organic wastes. The increase in microbial activity might be responsible for purple blotch disease control. It is possible that the increased microbial activity results in increased competition between populations of other microbes with the purple blotch pathogen *(A. porri*) for root exudates essential for the germination of its propagules. This observation was complemented with a reduction in the population of *A. porri*. The antagonists which competed for the readily available utilizable nutrients with the pathogen might have already affected the multiplication of purple blotch which could be one of the reasons of low build up in amended soil. Species of *Trichoderma* spp. and *Penicillium* spp. have been found to show potential as biological control agents against seed and seedling pathogens (Loritor *et al*., 1994). *Trichoderma harzianum* is also known to produce cell wall degrading enzymes such as chattiness, 1, 3 – glucanases and cellulases which are important in mycoparasitism for the colonisation of host fungi (Savoie *et al*., 2001). The increase in microbial populations after the incorporation of soil amendments was probably due to their stimulation by organic materials.

The mechanism by which soil amendments have led to suppression of the pathogen has been attributed to various reasons; one of these is the increase in soil saprophytic microbes leading to competition with the pathogen (Savoie *et al*., 2001). Induced defence reaction in the host plant tissue has also been reported (Davide and Maria, 2005). Similarly, Shehu and Suberu (2008) demonstrated that microorganisms present in the composted organic matter were responsible for suppression of purple blotch pathogen. When the composts were sterilized by autoclaving, they lost their effectiveness. It therefore, seems clear that suppression of purple blotch of onion by organic amendments of soil examined in this study was related directly to the microbial properties of the amendments.

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