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Improving Sprouting Ability of White Yam Minisetts (*Dioscorea alata* Poir) Var Pona and Dente Using Different Disinfectants and Protectants in Sterilized Saw Dust

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Abstract: The present study was conducted to evaluate the effectiveness of different disinfectants and protectants in improving sprouting and controlling rotting of yam minisetts. Results revealed that disinfection of both the sprouting medium and yam minisetts increase significantly the percentage sprouting of the Pona minisetts. Benlate was more effective in reducing the incidence of minisett rot and enhanced sprouting of the minisetts in roasted sawdust than the other protectants or disinfectants. Benlate-treated Pona minisetts gave high percentage sprouting and low percentage rotting in the roasted sawdust compare to that of Dente minisetts. Quicklime and neem wood ash were also effective in reducing incidence of minisett rot and increased sprouting of yam minisetts significantly compared with sodium hypochlorite, aqueous neem leaf extract and untreated minisetts (control).

Key words: Yam cultivars, minisetts, disinfectants, pre-sprouting, roasted sawdust

INTRODUCTION

Pona is the most popular cultivar of white yam (*Dioscorea rotundata*, Poir) cultivated in Ghana due to its early maturity, excellent eating qualities of the tuber and easy digestibility. Cornelius (1998) identify Pona as the most preferred cultivar of white yam by foreign markets and hence a source of foreign exchange for the country. Considerable employment, income and food security can be generated as opportunities provided by increasing Pona production.

Unfortunately, total yam production is far below requirement for export and home consumption throughout the year. A scarcity and expensive planting materials have been the major problem confronting yam production in general, which constitutes over 33% of production cost (Orkwor and Asadu, 1997). Solution to the problems of high cost and scarcity of yam planting materials has been offered through the introduction of yam minisett technique, which has increased the multiplication ratio from 1:5 to 1:30 (Orkwor and Asadu, 1997). Pona, unlike Dente and other white yam cultivars, has poor response to yam minisett technology, due mainly to the rotting of the minisetts in the sprouting medium caused by a complex of rot pathogens. Similarly, it has been reported that both the sprouting medium and the yam minisetts are sources of minisett rot pathogens. Various methods and recommendations had been made in order to control minisetts rot pathogens associated with yam cultivars; the use fungicides and wood ash for the treatment of yam minisetts are very popular (Otoo *et al*., 1987; Osai and Ikotun, 1994; Asare-Bediako, 2003).

This study attempted to evaluate the effectiveness of different disinfectants in improving yam minisett sprouting and control the incidence of yam minisett rot diseases using different disinfectant and protectants in roasted sawdust.

MATERIALS AND METHODS

Sterilization of sprouting medium: A metal drum; 85 cm in height and 55 cm in diameter was cut lengthwise into halves and used as troughs. Each was filled with moistened sawdust to about three- quarters full. The trough was then placed over fire to heat the sawdust and was periodically stirred with a piece of batten for an hour then allowed to cool (Heat sterilization). The roasted sawdust was allowed to stand for two days before use.

Preparation of yam minisetts: Pona and Dente yam minisetts were prepared; a clean, healthy, medium sized mother seed yam that had sprouted was cut into several short cylindrical pieces, each about 5 cm long. Depending on the circumference of the pieces, each was cut longitudinally into 2, 3, 4 or more pieces such that each piece had a periderm. Each piece termed minisett

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weighed between 25 to 30 g, according to the procedure described by Otoo *et al.* (1987). The yam minisetts were treated with two disinfectants (wood ash and quicklime) and three protectants (benomyl or Benlate, sodium hypochlorite and aqueous neem leaf extract). All the treatments herein described were made simple for farmers adoption.

Wood ash: An amount of 120 g of *Senna seamea* wood ash was added to 4 L of water in a plastic bowl to form a suspension and small basketful of minisetts was dipped into the suspension for 3 min. The treated minisetts were then spread on palm fronds for 1 h to surface dry.

Quick lime: Lime suspension was prepared by adding 120 g of quicklime to 4 L of water. A small basketful of minisetts was dipped into the suspension for 3 min. The treated minisetts were then spread on palm fronds shade for 1 h to surface dry.

Benomyl (Benlate): Twenty five gram of benomyl was added to 4 L of water to form suspension and small basketful of minisetts was dipped into the suspension for 3 min. The treated minisetts were then spread on palm fronds for 1 h to surface dry.

Sodium hypochlorite (household bleach): The minisetts were surface sterilized by dipping a small basketful of the setts into 1:10 water dilution of household bleach (5.25% active sodium hypochlorite) for 3 min. The treated setts were then spread on palm fronds for one hour to surface dry.

Aqueous neem leaf extract: Fresh neem leaves were thoroughly washed and 1.2 kg were blended, soaked overnight in 4 L of water and the suspension filtered, small basketful of setts was dipped into the filtrate for 3 min. The treated setts were then spread on palm fronds for one hour to surface dry.

Control: For the control; the minisetts were only treated with sterilized distilled water.

Pre-spouting of minisetts: Treated minisetts were pre-sprouted in perforated boxes measuring 50×40×11 cm. Each box (experimental unit) contained 21 minisetts, comprising equal numbers of minisetts from head, middle and tail regions of mother seed yam, each for Pona and Dente cultivar. All the minisetts were laid out on a layer of moist heat sterilized sawdust in a box in such a way that their periderms touch the sawdust and spaced about 1 cm apart. They were then covered with another layer of moist heat sterilized sawdust. The boxes were watered as at when necessary in the screen house.

Experimental design and treatment: The treatment comprised; two yam cultivars (Pona and Dente) and six disinfectants and protectants (wood ash, lime, benomyl, sodium hypochlorite, aqueous neem leaf extract and control). The experiment was laid out in a 2×6 factorial design. The 12 treatment combinations were laid out as a Completely Randomized Design with three replications. Data were taken on the following parameters four weeks after planting; Percentage sprouted minisetts; percentage rotten minisetts; percentage sprouted but rotten minisetts and percentage unsprouted and unrotten minisetts. Square root data transformation was done before analysis of variance, mean values were separated using Duncans New Multiple Range Test (DNMRT).

RESULTS

The effect of different disinfectants and protectants on percentage sprouted minisetts of Pona and Dente white yam cultivars are presented in Table 1. Mean percentage sprouted minisetts recorded in both Pona and Dente yam cultivars were high. Dente minisetts produced slightly higher mean % sprouting than Pona minisetts. There was, however, no significant difference ($p>0.05$) between them. The interaction effects between yam cultivar and disinfectants or protectants on percentage sprouted minisetts was not significant ($p>0.05$). However, the mean percentage sprouted minisetts was significantly influenced ($p<0.01$) by the various disinfectants or protectants applied. Benlate-treated minisetts recorded highest mean percentage sprouting of 92.5%, which was not significantly different from 86.7% recorded for lime-treated minisetts. Benlate treated minisett were significantly higher than the minisetts treated with the other disinfectants and control. The percentage sprouting of lime-treated minisetts was significantly higher than the untreated minisetts (control) but was not significantly different from minisetts treated with wood ash, sodium hypochlorite and aqueous neem leaf extract with respect to percentage sprouted minisetts.

Table 1: Effect of disinfectants or protectants on percentage sprouted Pona and Dente yam minisetts

	Yam cultivar		
Disinfectant/protectants	Pona	Dente	Means (Protectants/ disinfectants)
Benlate	91.7ns	93.3ns	92.5a
Lime	83.3	90.0	86.7ab
Neem leaf extract	74.7	78.3	76.5bc
Sodium hypochlorite	76.3	78.3	77.3bc
Wood ash	77.7	78.7	78.2bc
Control	73.3	75.3	74.3c
Means (Yam cultivars)	79.49ns	82.32ns	
SE			2.41
CV (%)	7.34		7.34

ns: Not significant at 5% level. Values bearing identical letter(s) are not significantly different by DMRT at 1% level

Table 2: Effect of disinfectants on percentage rotten Pona and Denteh yam minisetts

Disinfectants/Protectants	Yam cultivar		Means (Protectants/ disinfectants)
	Pona	Dente	
Benlate	3.33ns	5.00ns	4.16e
Lime	10.0	5.00	7.50d
Neem leaf extract	14.3	12.3	13.3b
Sodium hypochlorite	15.0	13.3	14.2b
Wood ash	11.7	11.7	11.7c
Control	17.3	15.3	16.3a
Means	11.93	10.43	
SE			0.33
CV (%)	25.85		25.85

ns: Not significantly different at 5% level, Means bearing identical letter(s) are not significantly different by DMRT (p>0.01)

Table 2 shows the mean percentage rotten minisetts recorded for Pona and Dente. These percentages were very low. Although the mean percentage rotten minisetts was slightly higher in Pona (11.9%) than in Dente (10.4%), they did not differ significantly from each other. Interactions effect between disinfectants and yam cultivars were not significantly different. However, there was significant difference in percentage rottened minisetts due to disinfectants or protectants applied. Minisetts protected with Benlate resulted in significantly lower mean percentage rot (4.11%) than those treated with other disinfectants or protectants and the control. Similarly, protecting minisetts with lime resulted in significantly lower mean percentage rotting (7.5%) than treating with wood ash, sodium hypochlorite, aqueous neem leaf extract and the untreated minisetts, having mean percentage rotting of 11.67, 14.17, 13.29 and 16.29% respectively. The percentage of minisetts which got rottened after disinfecting with sodium hypochlorate did not differ significantly from those of neem extract-treated minisetts but was significantly higher than wood ash-treated minisetts and lower than untreated minisetts.

Effect of disinfectants or ptotectants on percentage spouted but rotten minisetts of Pona and Dente white yam cultivars are shown in Table 3. Fewer minisetts sprouted but rotted at the end of the experiment. Pona minisetts recorded slightly higher percentage sprouted but rotten minisetts (5.83%) than Denteh minisetts (5.23%). However, they were not significantly different from each other. Yam cultivar and disinfectants or protectants interaction effects on percentage sprouted but rotten minisetts was not significantly different. Similarly, the mean percentage sprouted but rotten minisetts were not significantly influenced (p>0.5) by the disinfectants.

Mean percentage unsprouted and unrotten yam minisetts are shown in Table 4. The effect of disinfectants and protectants on percentage yam minisetts were seen in the low percentages of the planted minisetts that were not rottened nor sprouted. There was no significant difference

Table 3: Effect of disinfectants on percentage sprouted but rotten Pona and Dente yam minisetts

Disinfectants/Protectants	Yam cultivar		Means (Disinfectants/ Protectants)
	Pona	Dente	
Benlate	5.00	1.67	3.33
Lime	5.00	1.67	3.33
Neem leaf extract	8.33	8.33	8.33
Sodium hypochlorite	6.67	6.67	6.67
Wood ash	5.00	8.34	6.67
Control	5.00	4.67	4.84
Means (Yam cultivars)	5.83ns	5.23ns	
CV (%)	38.42		38.42

ns = not significant at 5% probability level

Table 4: Effect of disinfectants on percentage unsprouted and unrotten yam minisetts

Disinfectants/Protectants	Yam cultivar		Means (Disinfectants/ Protectants)
	Pona	Denteh	
Benlate	0.00	0.00	0.00
Lime	1.67	3.33	2.50
Neem leaf extract	2.67	1.25	1.96
Sodium hypochlorite	2.17	1.67	1.92
Wood ash	5.67	1.33	3.50
Control	4.33	4.67	4.50
Means(Yam cultivars)	2.75 ns	2.04ns	
CV (%)	58.33		58.33

ns: Not significantly different at 5% level

due to yam cultivar. There was also no significant difference due to interaction between the yam cultivars and disinfectants or protectants. Similarly, no significant differences among the disinfectants regarding their influence on mean percentage unsprouted and unrotten minisetts. All of the planted minisetts protected with Benlate sprouted and did not rot. The untreated minisetts (control) recorded relatively higher mean percentage unsprouted and unrotten minisetts (4.50%).

DISCUSSION

The observed significantly higher percentage sprouted minisetts and lower percentage rotten minisetts generally recorded could be attributed to the heat sterilized medium used for pre-sprouting the minisetts. Earlier studies revealed that heat sterilization was found to be the most effective method in controlling soil-borne minisett-rot pathogens (Asare-Bediako, 2003). This explains why the untreated minisetts recorded high percentage sprouting though it was the lowest compared to the treated minisetts. The significantly higher percentage rotting recorded for untreated minisetts suggested that, treatment of minisetts was necessary to prevent rotting and improve the percentage sprouting of the minisetts. Osai and Ikotun (1994) reported the importance of the disinfection of minisetts before planting because the minisetts themselves are sources of rot pathogens.

Benlate-treated and lime-treated yam minisetts produced significantly better sprouting. Thus, indicating that both disinfectants had the ability to slow down or prevent minisett rot pathogens thereby improving sprouting of the minisetts irrespective of the yam cultivar. The significantly higher mean percentage rotten minisetts observed in the lime-treated minisetts, than in Benlate-treated minisetts seems to indicate that protecting with Benlate was more effective in protecting yam minisett from rot pathogens than any of the disinfectant used followed by lime and wood ash. Benlate completely inhibited pathogens growth, while lime slowed down the growth rate of rot pathogens. This finding confirmed the earlier report of Martin (1973), that benomyl is a protective and eradicant fungicide with systemic activity and effective against a broad range of fungi. Lime could, however, be a better substitute for Benlate. The efficacy of lime in controlling growth of fungi had been reported by several researchers (Thompson *et al*., 1977; Ogali *et al*., 1991; Cornelius, 1998).

The non-significant difference recorded among yam minisetts treated with lime and wood ash for percentage sprouted minisetts and percentage rotten minisetts suggested that lime or wood ash can be used to treat yam minisetts to reduce rot and improve yam sprouting. The result of this study, confirms the earlier report of Adimora (1986) and Otoo *et al.* (1987); that the incidence of post harvest decay of yam tubers could be reduced by treating all cut and wounded surfaces with alkaline materials such as wood ash or lime in the complete absence of chemicals. Among the treated yam minisetts, those treated with sodium hypochlorite and aqueous neem leaf extract performed poorly with high rotting and low percent sprouting. Thus, sodium hypochlorite was not an important disinfectant to improve yam minisett sprouting ability. The main constraint to the Pona minisetts technology was rapid rotting of the minisetts in the sprouting medium. However, Pona cultivar had higher response to the minisetts technique as compared to Dente cultivar probably because both the minisetts and the sprouting media were disinfected against rot pathogens. This seems to suggest that under aseptic conditions Pona yam minisetts can sprout better than Dente minisetts.

It is concluded that, Benlate, quick lime and wood ash are the best disinfectant in that order in preventing or controlling yam minisett rot pathogens. They also improve yam minisett sprouting ability irrespective of the yam cultivars used.

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