

Improving Pit Storage Systems to Reduce Rots of Whiteyam (*Dioscorea rotundata*) In Ghana

By

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Abstract: Harvested tubers stored in dug pits (a common practice in Wenchi Municipal, Ghana) are prone to rot infections by soil-borne pathogens. Improving this system would go a long way to ensure food security and increased returns of yam growers and actors along the food chain. Efficacies of two chemical fungicides, Shavit F71.5 WP and Metalaxyl Mancozeb WP, in protecting buried whiteyams ('dente' and 'pona') tubers against rots were investigated. Healthy looking tubers were sprayed with the two chemical fungicides, dried and buried in dug pits using CRD design (3 replicates). Control was set-up with no application of fungicides on healthy tubers. Pits were further covered with cut vegetation and soil. After fourteen weeks, the tubers were exhumed when signs of sprouting were observed. Tubers were randomly sampled from each pit and the number of unrotten and rotten tubers recorded. Data was subjected to statistical analysis (ANOVA) and Decay Reduction Index (DRI) to determine significance due to the treatments in reducing yam tuber rots and effectiveness of fungicides in controlling yam rot respectively. There was significant differences between the fungicides and control ($P < 0.05$). Shavit WP had a DRI of 0.71 whilst Met. Mancozeb WP had 0.46 for 'dente'. DRI values recorded for 'pona' were 0.84 and 0.79 for Shavit WP and Met. Mancozeb WP respectively. Both fungicides are effective in controlling rots during post-harvest storage but Shavit WP is more potent. In order to improve shelf life of tubers and seed yams, coating surfaces with appropriate fungicides before burying is recommended.

Keywords: yam tuber rot, whiteyam, pit storage and fungicides

Introduction

Whiteyam (*Dioscorea rotundata*) contributes significantly to food security in Ghana and its availability on the market for a considerable part of the year helps prevent food shortages, particularly in the urban communities. The income generated by rural poor farmers who are engaged in yam production improves their living standards.

In 2005, FAO reported that Ghana is the second highest producer of yam (3.9 million metric tonnes per annum). It produces yams for local consumption and the export market. Yam is produced mostly in the Guinea-Savanna and Forest-Savanna transition zones in the country.

However, reasonable production occurs in almost all regions. White yam is much preferred to the other yam varieties and it constitutes about 80% of total yam produced in Ghana (Tetteh and Saakwa, 1994). Water yams (*D. alata*) are consumed when white yam becomes scarce or expensive.

Rot is a major factor limiting the post-harvest life of yams and losses can be very high. Losses due to post-harvest rot significantly affect farmers' and traders' income, food security and seed yams stored for planting. The quality of yam tubers are affected by rots, which makes them unappealing to consumers. Some white yam varieties such as 'dente', 'pona' and 'labreko', that are preferred by most consumers in Ghana, do not store for a long time due to attack by rot organisms. Because of their poor storability, farmers sell produce just after harvest to avoid losses, and this result in low income or reduced profits. This practice also affects farmers' food security particularly in the lean season. Stored yam represents stored wealth which can be sold all-year-round by the farmer or marketer.

Most rots of yam tubers are caused by pathogenic fungi such as *Aspergillus flavus*, *Aspergillus niger*, *Botryodiplodia theobromae*, *Fusarium oxysporum*, *Fusarium solani*, *Penicillium chrysogenum*, *Rhizoctonia spp.*, *Penicillium oxalicum*, *Trichoderma viride* and *Rhizopus nodosus* (Okigbo and Ikediugwu, 2002; Okigbo and Emoghene, 2004; Aidoo, 2007).

The storage methods for yam in most farming communities in Ghana are very poor. Yams are normally stored either in dug pits, in barns, raised platforms or by gradual harvesting. In the Wenchi Municipal of Ghana, most of the farmers store their reserved tubers by burrying in dug pits. These storage technologies, especially in pits, are prone to infections by soil-borne microorganisms (especially pathogenic fungi) that are likely to cause rot infections when storage is prolonged. The use of synthetic chemical fungicides has been found to significantly reduce storage rot in yam when applied according to manufacturer's recommendations and precautions (Booth, 1974; Noon, 1978).

This work was done with the primary aim of improving farmers' indigenous storage practice of burrying that could easily be practiced by farmers to increase on-farm storage life of some white yam varieties.

Materials & Methods

Location

The experiment was sited at Amponsakrom, a farming community in Wenchi Municipal of Brong Ahafo Region of Ghana. The geographical coordinates are latitude 7°44.3496'N and longitude 2°6.2736'W, on an altitude of 308m above sea level.

Evaluation of chemical fungicides

Efficacies of two chemical fungicides, Shavit F71.5 WP and Metalaxyl Mancozeb WP, in protecting yam tubers against rots were investigated on-farm, using two economically important whiteyam varieties 'dente' and 'pona'. Eighteen pits (1mx1m) were dug in a shade provided by trees. About One hundred and eighty healthy-looking tubers each of the two varieties were purchased from a farmer for the experiments. The tubers were then grouped into three (Sixty tuber each for two chemical treatments and control). They were then sprayed with the two chemical fungicides, Shavit F71.5 WP at a concentration of 2g/L (Manufacturer's recommendation) and Metalaxyl Mancozeb WP at a concentration of 7.5g/L, using a knapsack sprayer. After spraying, the tubers were allowed to dry in a shade and twenty tubers per treatment were buried in each pit with three replications. Each pit was further covered with cut vegetation and soil. The treatments were completely randomized with controls (no chemical applied). After fourteen weeks, the tubers were exhumed and examined when signs of sprouting were observed. Fifteen tubers were randomly sampled from each pit and the number of unrotten and rotten tubers recorded. The data was subjected to statistical analysis using Genstat statistical package 9.2 to determine significance due to the chemical treatments in reducing yam tuber rot disease. Also, the Decay Reduction Index (Amadioha, 1996) defined below, was calculated as a measure of the effectiveness of each chemical fungicide in controlling yam rot.

$$\text{D.R.I.} = \frac{\% \text{ decay in control} - \% \text{ decay in treated tuber}}{\% \text{ decay in control}}$$

Results and Discussion

Based on visual observations and crosssectional cuttings, the tubers that were not rotten looked very healthy and fresh (Plate 1). There was significant differences between the chemical treatments and the controls at $P < 0.05$. For 'dente', Shavit WP was significantly different from Metalaxyl Mancozeb WP. However, there was no significant difference between the two chemical treatments for 'pona' after the statistical analysis (Table 1) in protecting tubers against rots in pits.

After the DRI analysis, Shavit WP had a DRI of 0.71 whilst Metalaxyl Mancozeb WP had 0.46 for 'dente'. The DRI values recorded for 'pona' were 0.84 and 0.79 for Shavit WP and Metalaxyl Mancozeb WP respectively (Figure 1).

Rot organisms gain entry into tubers through wounds caused by insects, nematodes or poor handling before, during and after harvest. Since wounds cannot be entirely prevented especially during harvesting, there is a need to protect the surface of tubers against the entry of rot organisms or kill pathogens that have filled wounds at harvest with appropriate protectants such as fungicides. The ANOVA analysis and DRI show that they are all effective in reducing the incidence of rot disease during post-harvest storage. Though the two fungicides were able to reduce rot pathogen infections, Shavit WP was more potent than Metalaxyl Mancozeb WP. There have been some attempts to control post-harvest rots by improving storage methods. In order to improve the shelf life of stored tubers, the surfaces of the tubers have to be protected before storage. Soil burying is a common storage practice in the studied communities. They normally cover the stored tubers with the clayey part of the dug-out soil to prevent sprouting.

Shavit WP can reduce the occurrence of yam tuber rot disease by over seventy percent (70%) during storage of whiteyam tubers. Few experiments have been done by researchers on the control of yam tuber rot disease with chemical fungicides. Chemical fungicides such as Benlate and Captan, however, have been found to be effective in reducing rots of yams (Ogundana, 1970). Mancozeb is classified as a contact fungicide with preventive activity. It inhibits enzyme activity in fungi by forming a complex with metal-containing enzymes including those involved in the production of adenosine triphosphate (ATP) (SinoHarvest, 2005). Shavit F71.5 WP is a fungicide combining the systemic properties of triadimenol with the contact properties of folpet. Triadimenol belongs to the family of triazole fungicide and as such it is an inhibitor of biosynthesis of ergosterol (Makhteshim Chemical Works Limited-Israel, 2009).

Conclusion

Burying harvested whiteyam tubers in pits, as done by some farmers, especially at communities around Wenchi Municipal of Ghana and other parts of the world can be improved by coating the yam tuber surface with chemical fungicides. The two tested chemical fungicides can be depended on by farmers to increase shelf life of yam tubers in storage. This improved storage method can help farmers reduce losses particularly in the storage of seed yam (that is often stored for 12 to 16 weeks) before they are planted.



Plate 1: Cross-section of tubers treated with Shavit WP fourteen weeks after burial.

Table 1: Effect of chemical fungicides (Metalaxyl Mancozeb and Shavit) on mean number of rotten tubers from fifteen randomly sampled tubers stored in pits for fourteen weeks.

Treatment	Variety	
	<i>Dente</i>	<i>Pona</i>
Control	8.00 ^a	6.33 ^a
Met. Mancozeb	4.33 ^b	1.33 ^b
Shavit	2.33 ^c	1.00 ^b

SED(0.05)= 1.262 CV%= 39.7

*Values followed by the same letter within a column are not significantly different (p=0.05)

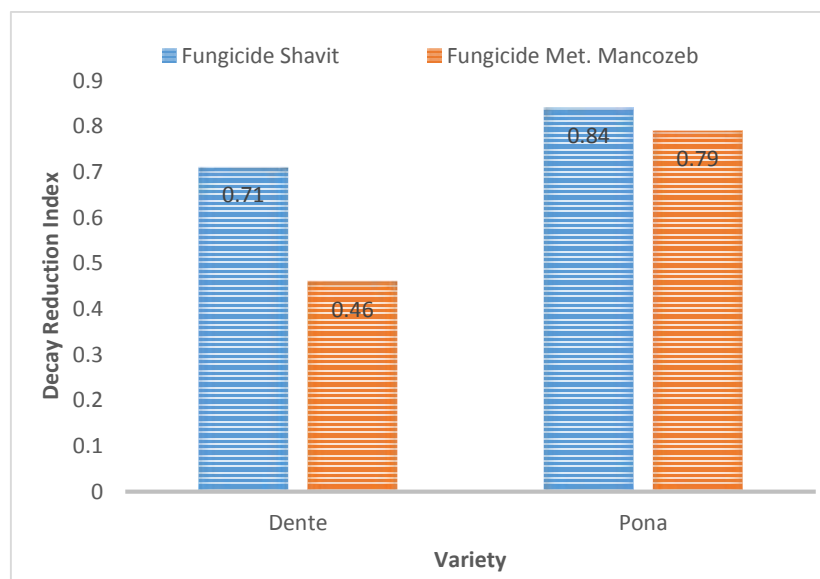


Figure 1: Decay reduction indexes for Shavit WP and Metalaxyl Mancozeb WP in controlling rot of whiteyam varieties stored in pits for fourteen weeks.

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