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Determination of Sprout Control Treatment Using Seven Key Yam (*Dioscorea* spp.) Varieties of Farmers in Ghana

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Abstract Yams (*Dioscorea* spp.) are an important economic crop in Ghana. The formation of buds and subsequent sprouting of yam tubers influences postharvest losses. Efforts to prolong dormancy and inhibit bud and sprouting are therefore laudable. Seven key yam varieties of farmers identified as *Pona, Lariboko, Dente, Mutwumudoo, Serwah, Matches* and *Akaba* in Ghana were subjected to plant extracts from cocoa pod (*Theobroma cacao*) potash, neem (*Azachirata indica*) seeds, neem (*Azachirata indica*) leaves, sweetpotato (*Ipomoea batatas*) leaves to inhibit bud and sprout formation. The potash extracts suppressed bud formation in *Mutwumudoo, Akaba* and *Matches* compared to *Lariboko* and *Serwah* yam varieties. In a descending order of *Lariboko, Matches, Mutwumudoo, Serwah, Pona, Dente* and *Akaba*, neem seed extracts was able to suppress bud formation and subsequent sprouting. In neem leaves treatment, suppression of bud formation was highest in *Lariboko, Dente, Mutwumudoo, Akaba, Matches, Serwah* and *Pona* in a descending order. Sweetpotato leaves suppression of bud formation was highest in *Serwah, Akaba, Mutwumudoo, Dente, Matches, Lariboko* and *Pona* as the least. The control treatment showed higher number of buds formed in all the yam varieties in a descending order of *Akaba, Serwah Mutwumudoo, Lariboko, Dente, Pona* and *Matches* as compared to all the other treatments. The four plant extracts effect on bud formation and subsequent sprouting on the seven varieties of yam was comparable ($p = 0.05$). The control, sweetpotato and neem leaves plant extract performed poorly as compared to the potash and neem seed extracts. Interestingly, potash was the best bet plant extract in reducing bud formation and sprouting (0.26) while sweetpotato leaves was the least (0.42) and corresponding yam varieties was *Mutwumudoo* followed by *Matches* and *Akaba*.

Keywords: *yam, dormancy, bud, sprout, cocoa, potash, neem, sweetpotato, plant extracts*

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1. Introduction

Yam (*Dioscorea* spp.) is a major stable food with a significant source of dietary energy in Ghana and other West African countries. It is second to cassava in Ghana. Yam belongs to the genus *Dioscorea* (Family: *Dioscoreaceae*) [1,2,3,4]. The importance of yam extends into the socio-culture lives of producing regions in West Africa in festival ceremonies held annually to usher in newly harvested yams. Yams are cultivated often by subsistent farmers.

In Ghana, yam cultivation acreage in 2011 was estimated at 403,798Ha with corresponding production of approximately 5,855,138MT with 27,000 MT for export [5]. The per capita consumption of yam in Ghana is estimated at 42kg/annum and is the third largest producer of yams in the world, following Nigeria and Cote d'Ivoire [6]. Yams are planted in February - April and harvested in August - November depending on the variety in Ghana. Yams are cultivated in every region of Ghana by subsistent farmers but are concentrated in the Brong Ahafo and the Northern regions constituting about 37% and 34% of the total yam production in Ghana, respectively [5]. Yams have about 200 different varieties with fresh colour varying from white, ivory and yellow. Their shape is long and cylindrical with offshoots referred to as 'toes' while their exterior texture is rough and scaly. Yams have numerous health benefits such as vitamin B6, vitamin E, potassium, manganese, carbohydrate and fibres needed for health and vitality [7]. They are good sources of the unique fat-like substance called diosgenin, a hormone-like molecule with probably anti-cancer effects [8,9]. Depending on the variety, yam has a water content of 60-80% [10]. This reduces during storage and is influenced by the predominant climatic conditions such as temperature and relative humidity [11].

Ghana is a leader in yam exports into the markets of European Union, United States of America, neighbouring African countries such as Burkina Faso, Mali, Niger and Togo. United Kingdom is the largest foreign market for Ghanaian yam, followed by Netherlands, Italy and Germany [5]. The demand for West African products including yams would increase as more West Africans live in abroad. This will be achieved if quality specifications

are adhered to by producers and exporters. In the case of yam, this will be achieved when losses associated with yams are addressed. Yam losses during storage are two forms as endogenous and exogenous. The endogenous is physiological such as transpiration, respiration and germination. The exogenous factors are associated with pests, nematodes, rodents, rot bacteria and fungi.

Passam [12] indicated that dormancy duration occurs for *D. alata* (14 -16 weeks), *D rotundata* (12 -14 weeks), *D. cayenensis* (4 - 8 weeks) and *D. esculenta* (12 -18 weeks). These dormancy periods were influenced by temperature as its rise reduces dormancy and vice versa. Similarly high humidity promotes germination and low humidity prolongs dormancy [13]. The storage duration of yam is affected by the breaking of dormancy period and is associated with formation of buds and subsequent sprouting of yam.

Finding simple methods to prolong the dormancy period of tubers and to break this dormancy when required is very limited for key yam varieties. Low temperature (15°C) together with fungicide treatment or ionizing radiation (0.08–0.12 KGy) has been reported to prolong the storage duration in yams [12]. According to Passam [12] prolonging dormancy effectively by the application of sprout suppressant chemicals such as those widely used for potatoes was unsuccessful. This was attributed to the observation that in yam, sprouts are not formed until a late stage of dormancy and they originate from beneath the periderm and therefore are protected from the effects of such treatment. Other studies involved the application of plant growth regulators such as Gibberellic acid (GA3) [14,15,16]. The end of dormancy is signified by bud formation and subsequent sprouting as the yam tuber loses weight steadily and the amount of dry matter diminishes rapidly. Tubers of *D. cayenensis* and *D. rotundata* are not able to keep more than 1 to 2 months once dormancy is broken, unless considerable loss of tuber weight is to be accepted [17]. Additionally, the sensorial quality of *D. cayenensis* and *D. rotundata* declines once sprouting begins [18]. Osagie [19] employed both ionization and cool storage and reported reduced post-harvest losses to a negligible level due to the almost complete inhibition of sprouting and a decrease in respiration. However, these high techniques are not cost effective for subsistent yam farmers. Direct prevention of yam losses by using pesticides and other pre-storage conditioning, such as curing, has been investigated in the past [20]. Similarly, in view of the influence of sprouting on postharvest losses, efforts have been made to prolong dormancy by applying sprout regulators. This work determines among potash of cocoa (*Theobroma cacao*), neem (*Azachirata indica*) seed, neem (*Azachirata indica*) leaves and sweetpotato (*Ipomoea batatas*) leaves to prolong dormancy and inhibit bud and sprouting of seven key yam varieties farmers identified as *Pona, Lariboko, Dente, Mutwumudoo, Serwah, Matches* and *Akaba* in Ghana.

2. Materials and Methods

2.1. Fresh Yam Tubers

Seven key yam varieties of farmers' (*Dioscorea* spp.) freshly harvested and identified as *Pona, Lariboko, Dente, Mutwumudoo, Serwah* belonging to *Dioscorea rotundata* and *Matches* and *Akaba* belonging to *Dioscorea alata* were obtained from farm gates at Atebubu in the Atebubu-Amantin District of the Brong Ahafo region in Ghana through the Ministry of Food and Agriculture.

2.2. Plant Extracts Solution

A 600ppm solution of neem (*Azachirata indica*) seeds, neem (*Azachirata indica*) leaves, sweetpotato (*Ipomoea batatas*) leaves and potash of cocoa (*Theobroma cacao*) were prepared by dissolving 600mg in a litre (1000ml) of distilled water.

2.3. Methods

Four tubers each of seven key farmers' yam varieties were dipped each into the prepared solutions using 5cm apical portions for 2 min after which they were stored and monitored over a storage period of 55 day. A total number of 112 tubers of yams were used for the experiment. Parameters monitored were day of breaking of dormancy (bud formation) and quantity of buds formed.

2.4. Statistical Analysis

The experiment was carried out in triplicates and data analyses expressed as means ± standard deviation. Analysis of variance was performed and Duncan multiple test range was used to separate means using the Statgraphics Centurion 16.1.11 (StatPoint Technologies Inc., USA, 2010). At probability $p = 0.05$ comparisons between sample treatments and correlation analysis were done.

3. Results and Discussion

In sprout treatments with potash, bud formation occurred early in *Lariboko* and *Serwah* varieties compared to *Mutwumudoo, Akaba* and *Matches*, an indication of bud formation and subsequent sprouting in the former than the later varieties (Table 1). However, *Pona* and *Dente* varieties were intermediate compared to the other varieties to potash suppression of bud formation and subsequent sprouting. Neem seed treatment was able to suppress bud formation in *Lariboko, Matches, Mutwumudoo, Serwah, Pona, Dente* and *Akaba* in a descending order (Figure 1). In neem leaves treatment, suppression of bud formation was highest in *Lariboko, Dente, Mutwumudoo, Akaba, Matches, Serwah* and *Pona* in a descending order. In sweetpotato leaves treatment the suppression of bud formation was highest in *Serwah, Akaba, Mutwumudoo, Dente, Matches, Lariboko* and *Pona* as the least (Figure 1). The differences in the formation of buds and subsequent sprouting of yam varieties in the various treatment solutions was probably due to the inhibitory factors of the materials in use. The control treatment recorded the highest number of buds formed in all the yam varieties in a descending order of *Akaba, Serwah, Mutwumudoo, Lariboko, Dente, Pona* and *Matches* (Table 1).

Bud formation and subsequent sprouting in yams indicates dormancy has been broken. Treatments that are able to prolong dormancy inhibit buds and sprouts formation on yams. In studies by Passam [12] on prolonging dormancy, potatoes sprout chemicals could not

inhibits sprouting in yams. The author concluded that in yam, sprouts are formed at late stage of dormancy and this often occurs from beneath the periderm, which is not accessible to treatment. In subsequent trials the author used low temperatures (15°C) and fungicide treatment or ionizing radiation of 0.08 - 0.12 KGy to prolong the storage duration in yam. Gibberellic acid (GA3) had been used in the past to control yam sprout to some extent [14,15,16].

Table 1. Mean number of buds after 55 days of storage

Yam variety	Potash	Sweet potato leaves	Neem seeds	Neem leaves	Control
Pona	0.25±0.09[a]	0.56±0.18[a]	0.44±0.15[a]	0.50±0.16[a]	0.47±0.13[a]
Laribokor	0.38±0.16[a]	0.56±0.11[a]	**0.19±0.13[a]**	**0.31±0.13[a]**	0.80±0.07[bc]
Dente	0.25±0.25[a]	0.38±0.16[a]	0.44±0.20[a]	0.38±0.18[a]	0.67±0.04[ab]
Mutwumudoo	0.19±0.09[a]	0.38±0.38[a]	0.37±0.18[a]	0.38±0.26[a]	0.94±0.09[cd]
Serwah	**0.38±0.21[a]**	**0.31±0.31[a]**	0.38±0.31[a]	0.50±0.28[a]	1.13±0.04[d]
Matches	0.19±0.09[a]	0.44±0.22[a]	0.25±0.09[a]	0.44±0.20[a]	**0.47±0.13[a]**
Akaba	0.19±0.09[a]	0.38±0.18[a]	0.50±0.19[a]	0.38±0.21[a]	1.48±0.03[e]

In studies conducted by Wickham [13,21], the authors observed that GA3 treatment is much effective when the yam tubers were treated in a solution of 150 mg/litre GA3 for 22 hours.

However, different recommend concentrations for using GA3 had been reported [15,22]. Further, Osiuro [23] indicated that dormancy in yam was extended when higher concentration of GA3 was used, resulting in difficulty on appropriate concentration for GA3 usage.

Although the concentration of the agent is important to delay dormancy in yams, the point of time when it is applied is a critical factor in influencing the hormones for dormancy. Additionally, the condition of the yam tuber also influences the dormancy period of the tuber. According to Martin [15], applying agents towards the end of the natural dormancy lengthen the dormancy period. However, Wickham [13] disputed this fact. Passam [24] indicated that application of GA3 to freshly germinated tubers increased the incidences of rot on the tubers. In this study application of the natural agents just after harvesting of the tubers was best time and similar to that reported by Demeaux and Vivier [22].

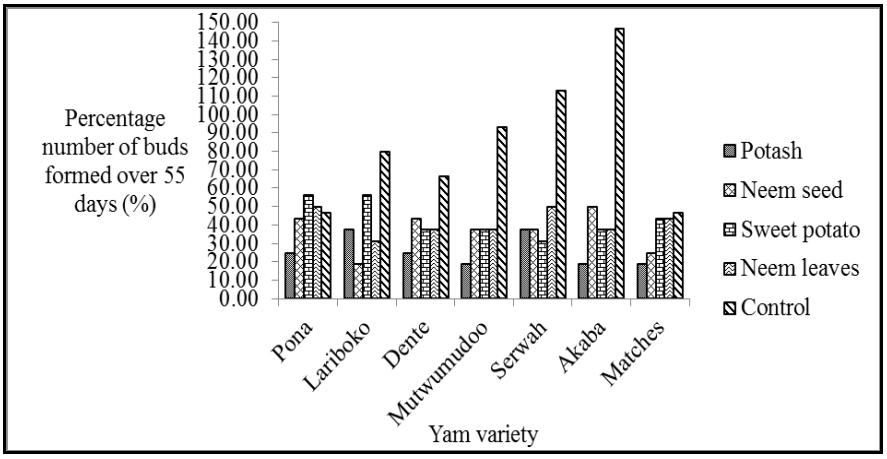

Figure 1. Plant extract on sprout control of yams

The effect of the four plant extracts on bud formation and subsequent sprouting of the seven varieties of yam was comparable (p = 0.05) as shown in Figure 2. Sweetpotato and neem leaves extracts performed poorly as compared to the potash and neem seed extracts. However, potash was the best bet in reducing bud formation and sprouting while sweetpotato leaves was the least best bet. Plant extracts from these two materials resulted in the least (0.26) and the most (0.42) number of buds on the yam varieties during the period of storage. The best bet plant extract was potash and corresponding yam varieties were *Mutwumudoo, Matches* and *Akaba*.

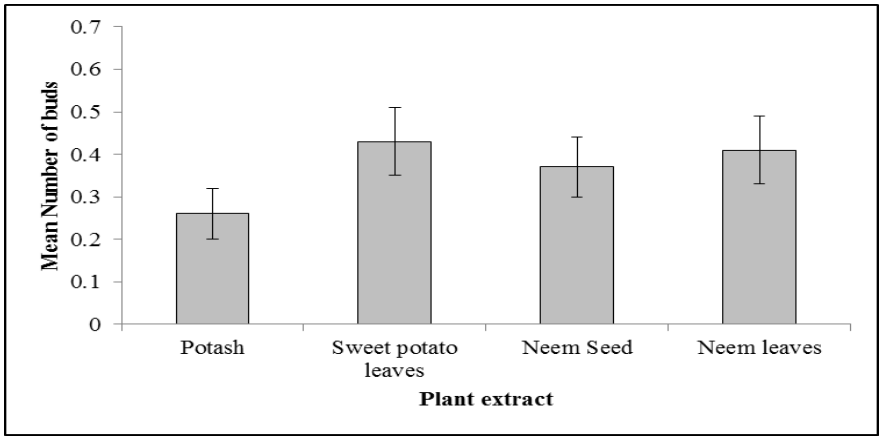

Figure 2. Effect of plant extract on buds formation on yams

4. Conclusion

The seven key yam varieties of farmers behaved differently towards the four plant extracts. The control, sweetpotato and neem leaves plant extract performed least compared to potash and neem seed treatments. Potash was the best bet plant extract in reducing bud formation and sprouting while sweetpotato leaves was the least. Subsequently, potash effect was best in yam varieties of *Mutwumudoo* followed by *Matches* and *Akaba*. Further research is needed on other plant extracts and their effect on the key yam varieties of farmers.

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References

[1] Coursey, D.G. The origin and domestication of yams in Africa. In. Harlan, J.R., Wet, M.J. and Stemler, A.B.L., (eds.) World Anthropology. pp. 385-408, 1976.

[2] Onwueme, I.C. The tropical tuber crops: yam, cassava, sweet potato, cocoyams. John Wiley and Sons, New York. pp. 234,1978.

[3] Passam, H.C., Read, S.J. and Rickard, J.E. The respiration of yam tubers and its contribution to storage losses. Tropical Agriculture 55: 207-214, 1978.

[4] Opara, L.U. Yam storage. In: Bakker-Arekema et al., (ed.) CIGR Handbook of Agricultural Engineering. Vol. IV. Agro processing. pp. 182-214. The American Society of Agricultural Engineers. St. Joseph. M. I. USA, 1999.

[5] MoFA. Statistics, Research and Information Directorate (SRID), Ministry of Food and Agriculture, Accra, Ghana, 2012.

[6] MEDA. 'Ghana yam market, sub-sector and value chain assessment'. Final Report for The Bill & Melinda Gates Foundation, 13th May 2011, 2011.

[7] Food and Agriculture Organization (FAO). Production Year Book 38. Rome, Italy. 1985.

[8] Green, K. R. and Simons, S. A. 'Dead skin' on yams *Dioscorea alata* caused by Colletotrichum gloeosporioides. Plant Pathology 43, 1062-1065, 1994.

[9] Mishra, D., Mishra, A.B. and Ruth G. C. Fungal rots of *Colocasia*, yam beet and carrot in Orissa markets. Orissa Journal of Agriculture Research 2, 156-159, 1989.

[10] Coursey, D.G. The magnitude and origin of storage losses in Nigerian yams. Journal of Science Food and Agriculture 8: 574, 1961.

[11] Sadik, S. Role of post-harvest technology of root and tuber crops. Plantains and bananas in West Africa, Rome, 1987.

[12] Passam, H.C. Dormancy of yams in relation to storage. In: Miege J and Lyonga SN (eds.) Yams/Ignames, pp. 285-293.Clarendon Press Oxford, 1982.

[13] Wickham, L. D., H. C. Passam, H. C. and Wilson, L. A. Tuber development storage and germination in yams (*Dioscorea* sp.) in response to pre-harvest application of plant growth regulators. Journal of Agricultural Science 102: 437-442, 1984.

[14] Okagami, N. and Tanno, N. Gibberellic acid-induced prolongation of the dormancy in tubers or rhizomes of several species of East Asian *Dioscorea*. Plant Growth Regulation 12:119-123. 1993.

[15] Martin, F. W. Prolonging the storage life of yams by removal offshoots and by treatment with gibberellic acid and waxes. Tropical Root Tuber Newsletter 10:39-44, 1977.

[16] Okagami, N., Tanno, N., Kawai, M., Hiratsuka, A., Satoh, K. I. and Keisuke, T. Expansion of trait of gibberellin-induced dormancy in the tertiary relict species of the genus *Dioscorea* (*Dioscoreaceae*). Plant Growth Regulation 22: 137-140, 1997.

[17] Passam, H. C. Sprouting and apical dominance of yam tubers. Tropical Science 19(1): 29-39, 1977.

[18] Nindjin, C. Amelioration du stockage traditionnel de l'igname (*Dioscorea* spp) en region centre de la Cote d'Ivoirecons´equences organoleptiques, physiques et biochimique. Universite de Cocody, Cote d'Ivoire, 2002.

[19] Osagie, A. U. *The Yam Tuber in Storage*. Nigeria University of Benin, Department of Biochemistry, Benin City, Nigeria, pp. 168-182, 1992.

[20] Ogundana, S. K. and Dennis, C. Assessment of fungicides for the prevention of storage rot of yam tubers. Pesticide Science 12: 491-494, 1981.

[21] Wickham, L. D., H. C. Passam, H. C. and Wilson, L. A. Dormancy responses to post-harvest application of growth regulators in Dioscorea species: I. Responses of bulbils, tubers and tuber pieces of three Dioscorea species. Journal of Agricultural Science, 102, 427-432. 1984b.

[22] Demeaux, M. and Vivier, P. Methodes modernes de conservation des ignames: (seminairesur l'igname, Abidjan, Cote-d'Ivoire, 2-5 Nov. 1983). Agronomical Tropical 39:184-191, 1984.

[23] Osiru, D. S. O. *Advances in Yam Storage*. Tropical Root and Tuber Crops Bulletin, 6 (1): 7, 1992.

[24] Passam, H. C. and Ireland, C. R. Effects of exogenous batatasin, batatasin analogues and gibberellins on the dormancy of stored yam tubers. Tropical Agriculture (Trinindad) 62(1): 41-46, 1985.