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Research Article

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The efficacy of moringa and neem extracts on post-harvest decay and sprouting ability of stored sweet potato [*Ipomea batatas* (L.) Lam] roots produced in Makurdi, Nigeria.

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Abstract

A study was conducted in 2018 and 2019 to determine the effects of moringa and neem extracts on control of post-harvest decay of stored sweet potato roots. A 3x3x3 factorial arrangement laid out in Randomized Complete Block Design was used to produce three varieties of sweet potato (King J, Mothers delight and Ogege) at the Teaching and Research Farm of the Joseph Sarwuan Tarka University Makurdi. At harvest, 45 roots from each variety were selected and divided into three groups of 15 roots each. Three serial concentrations (high, medium and low) extracts of moringa and neem leaves were prepared and applied to two of the groups respectively, while the third group was left as control before storage. Both neem and moringa extracts significantly suppressed Post-harvest decay in all the varieties at all storage durations. However, not only did high application rate formulation significantly offer better protection, but it also produced significantly higher number of sprouts. King J variety stored better while Ogege variety was more susceptible to decay. It was therefore concluded that even though neem is more efficacious, both neem and moringa extracts control post-harvest decay of sweet potato roots in storage especially when high application rate is used.

Keywords: Decay, extracts, longevity, roots, sprouts.

Introduction

Sweet potato [*Ipomea batatas* (L.) Lam] is a root crop which is used widely in Nigeria more as a food crop than for the industry or export. Scott *et al.* (2000) reported that many of the developing world's poorest food producers and the most undernourished households depend on roots and tubers as an important source of food and nutrition. Srinivas (2009) added that sweet potato rank among the top ten food crops produced in developing countries. The crop is believed to have originally been domesticated at least 5000 years ago (Austin, 1988). According to Zhang *et al.* (2000), the use of molecular markers made it possible to discover that the highest diversity of the crop was found in Central America thus supporting the hypothesis that Central America is the primary center of diversity and most likely the center of origin. Columbus brought it to Europe in 1492 where it was later brought to Africa in the 16th century by Europe and Portuguese explorers (Yen, 1982). FAOSTAT (2001) rated sweet potato as being the seventh most important food crop in the world in terms of production. It has now become an important secondary food crop for many Nigerians whose staple diet is based on cereals (Awojobi, 2004). It also serves as an important crop for food security in many parts of the developing world. In Nigeria, average per capita consumption is about 24kg per year with higher proportions in the Northern part of the country (Dandago *et al.,* 2011).

China is the highest producer of sweet potato in the world and is responsible for about 80 % of the total world output followed by Vietnam. In both countries, about 65 % of their total production is used for animal feed, principally pig feed (Bottema, 1992). Sweet potato leaves are also consumed as vegetables and in Brazil they are rated as the fourth most consumed vegetable of high energy value rich in carbohydrates. It also supplies reasonable quantities of vitamin A. C and some of the B complex (Miranda, 2002). Burry (2011) reported that the leaves and tender shoots of sweet potato are very nutritious and have added nutritional value with greater amount of protein and crude fibre. However, the method of preparation affects the final nutritional status, for example boiled versus deep-fried and the amount of oil used inhibits bio accessibility to beta-carotene in the food. Anyaegbunam and Nto (2011) stated that a number of initiatives in Nigeria encourage consumption of orange-fleshed sweet potatoes which contain beta-carotene and help fight vitamin A deficiency, which can result in blindness for pregnant women and children and even death for a high percentage of children per year. In Nigeria, Ajaiyeoba (2010) estimated that 28.1% of all children under the age of five are vitamin A deficient. He advised that there is an urgent need for relevant authorities to pursue active and realistic policies in order to prevent unnecessary blindness morbidity and mortality in Nigerian children.

Even though sweet potato does not attract high market patronage compared to other tuber and root crops, like yam and cassava in Benue state and most parts of Nigeria, it is still highly valued by peasant farmers. Most peasant farmers are able to produce little of the cash crops and dispose of the produce in order to meet their financial needs. It is therefore the sweet potato which does not have high market patronage that serves as food security when all other products are disposed of. Since sweet potato produces more biomas and nutrients per hectare than most other crops, it is well suited for this purpose. Rehm and Espig (1991) compared the nutritional content of sweet potatoes to maize and cassava and reported a higher yield in calories per hectare for sweet potatoes than maize and nearly as much as cassava. Sweet potatoes also yielded larger amounts of protein in kilograms per hectare than cassava. More so, sweet potato does not have a long life cycle and can produce edible roots even with a short duration of rainfall without irrigation. In spite of all the benefits accrued from sweet potato production and usage, more attention over the years has been paid by researchers to development of new technologies for propagation of other crops while sweet potato suffered neglect. In Nigeria and Benue state in particular, sweet potato is mainly propagated by vine-cuttings, planted on mounds or ridges (Egbe, 2012). The planting materials (i.e. the vines) are usually scarce and hard to come by during the planting season. This scarcity is caused mainly due to the difficulty experienced by farmers in their efforts to store healthy roots through the dry season from which new vine sprouts would develop and produce enough planting material for the new season. It is difficult to preserve planting material through the transition period which transverses the dry season to a new wet season. In a study conducted to identify the socio-economic constraints affecting the production processing and marketing of sweet potato in Kumi District of Uganda, Mudiope *et al.* (2001) reported that major sweet potato production constraints were related to high labour cost and inadequacy of availing planting material after the long dry season. Mmasa *et al.* (2012) corroborated this report when in a study conducted to determine the socio economic factors affecting consumption of sweet potato products in Tanzania observed that the chronic shortage of seed was the most important challenge that needed to be dealt with.

Efforts by farmers to store harvested roots in order that sprouts from these roots would be used as planting material the next season are often thwarted due to high incidence of pests and diseases. Pests and diseases have been identified as being one of the major factors that result to high sweet potato roots post-harvest losses. Even though Mudipe *et al.* (2001) reported that late harvested potatoes suffer more weevil damage than those harvested as soon as they are mature, sweet potato seed farmers are constrained from undertaking early harvests, for fear of losing some of the seed quality characteristics associated with seed maturity. Kortse and Oladiran (2012) reported the superiority in longevity of more matured seeds over the less matured ones in a study conducted to determine the quality of egusi-itoo melon seeds harvested at different fruit ages. Due to these constraints, sweet potato seed farmers have to find alternative means of preserving sweet potato roots that would store well during the dry season and produce adequate sprouts in the forthcoming croping season for production of enough vines that would satisfy farmers demand. Attempts in the recent past to use protective chemicals have not satisfied the desires of most farmers because of the high cost of these chemicals which are beyond their affordable limits. Also, majority of the farmers are not literate enough to strictly follow manufactures safety and other instructions on the use of these chemicals. Another disadvantage which is also worthy of note is the fact that, some of these chemicals have side effects which are injurious to human health. It is in an effort to breach this gap that this study was conducted to determine if plant extracts of neem and moringa which can be secured locally at no cost and are not injurious to human health can effectively be used to reduce the menace usually caused by pests during storage of sweet potato roots.

Materials and Methods

Three varieties of sweet potato (i.e. TIS 86/0356 Yellow flesh referred to locally as '**King J**', TIS 87/0087 White flesh referred to locally as '**Mothers delight**' and 440293 Orange flesh referred to locally as '**Ogege**') were produced during the 2018 and 2019 growing seasons at the Teaching and Research Farm of the Joseph Sarwuan Tarka University Makurdi – Nigeria. The study was a 3 x 3 x 3 factorial arrangement laid out in Randomized Complete Block Design. In each production season, a total land area of 30 x 7 meters was cleared and divided into three equal plots of 10 x 5 meters each, leaving a distance of one meter between each plot and another. With the use of a hoe, 50 heaps were made in each plot. One variety was allocated to each of the three plots and bulk planting was done. Planting was conducted on 24th May 2018 and 18th April 2019 respectively. Vine cuttings of approximately 36 cm long, each bearing not less than 4 nodes were planted on each heap. All other cultural operations based on research recommendations for sweet potato production were strictly complied.

Harvest was conducted on 10th November 2018 and 5th October 2019 respectively with the use of a small hoe. At harvest, 45 robust appearing sweet potato roots with almost uniform size (550 – 600 g in weight and 4 – 5 cm in diameter) of each variety were selected and divided into three groups of fifteen roots each (for each of the three varieties). For each variety, two of the groups comprising 15 roots each were allocated moringa and neem treatments respectively while the remaining group was left as control.

Fresh leaves of moringa (*Moringaoleifera*)and of neem (*Azadiractaindica*) were obtained at the University Teaching and Research Farm and cleaned with the use of running tap water and soaked in 1% solution of sodium hypo chloride for 30 seconds. They were then rinsed with sterile distilled water and air dried at normal room temperature (25 – 30^{o}C) for 8 days. 500 g each of moringa and neem leaves were weighed and pounded using a mortar and pestle. The mortar and pestle were washed after pounding each type of leaf to avoid mixtures. The pounded plant materials were then grounded into fine powder using an electric blender (Zhejiang hk-8300, 2010 model). The powders were further sieved to pass through a 0.05 mm sieve and 500 g each of plant powders were obtained and immediately packed in plastic bottles and stored in a refrigerator at 4^{o}C for a period of 48 hours to minimize loss of volatile organic substances.

Serial dilutions of the crude extracts of each plant botanicals were then prepared to give three different concentration levels of 20, 60 and 100 g/ml thus: 20 g/ml of the extract was obtained by mixing 20 g of each plant botanical with 100 ml of water using a measuring cylinder. The macerates were transferred to beakers and then allowed to stand for six hours after which they were filtered through Whatman No.1 filter paper before filter-sterilizing them by means of Millipore filters (Millipore filter corporation, Bedford, Massachusetts USA) to form extract concentrations. The same procedure was used in producing the other two concentration levels by substituting 60 g plant botanical to replace 20 g and 100 g to replace 20 g in order to obtain 60 g/ml and 100 g/ml concentrations respectively.
A pit measuring about 3m^2 was dug and a grass thatched shed was constructed above the pit to protect contents of the pit from direct sunlight. Each of the three groups of each variety was applied one of the three plant extract concentrations (20, 60 and 100 g/ml) of both moringa and neem respectively. The application was in replicates of five roots each for each group. Thereafter, each group of treatment was collected in plastic baskets and stored in the constructed pit. The untreated roots were in like manner collected and stored. Observations were conducted on the stored products at two weeks intervals to determine the level of deterioration until the 12th week of storage.

After the 12th week of storage, the Andrew Carberry (2017) method was used to test-sprout the roots and percentage sprouting was determined by visual evaluation for roots growth during the germination test period using the formula:

$$PS = \frac{Number\ of\ tuber\ growth}{\text{Total number of roots sown}} \text{ X } 100$$

Data collected on all the evaluations were subjected to analysis of variance using Genstat 12th edition and significant differences were separated using Least Significant Difference at 5% level of probability.

Results

Effects of variety on post-harvest decay

When roots were treated with neem and moringa extracts, post-harvest decay was significantly suppressed in all the varieties studied. This was evidenced by the significantly higher post-harvest decay recorded in the control than in the treated varieties (Figure 1 and 2). Significant variations in percentage decay were recorded between each treated and untreated (control) variety. In both years of study, decays started at relatively small percentages at the beginning of storage and increased progressively in all the varieties with increasing storage duration. The decays generally recorded higher values in 2018 than the values obtained in 2019.

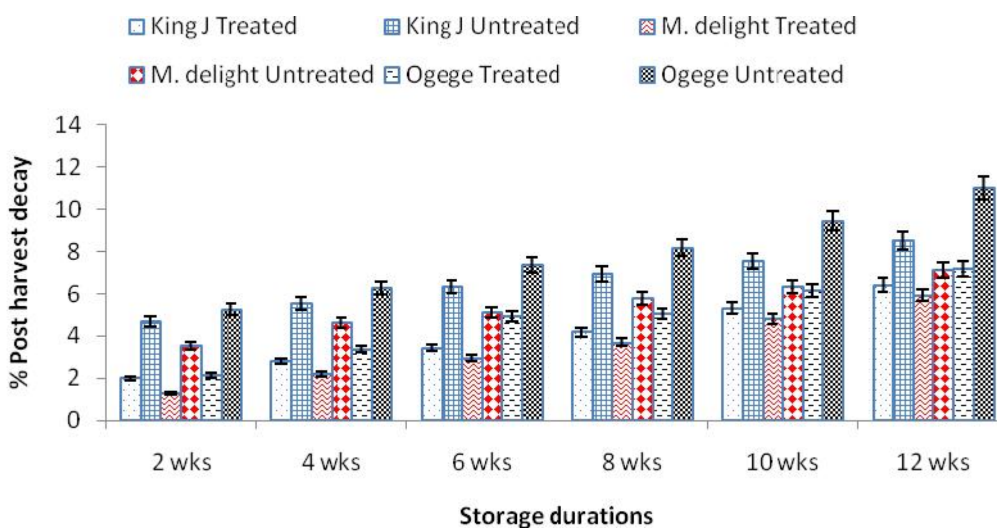

Figure 1 Variations in post-harvest decay of treated and control varieties of stored sweet potato evaluated at fortnightly intervals for storage duration of 12 weeks in 2018.

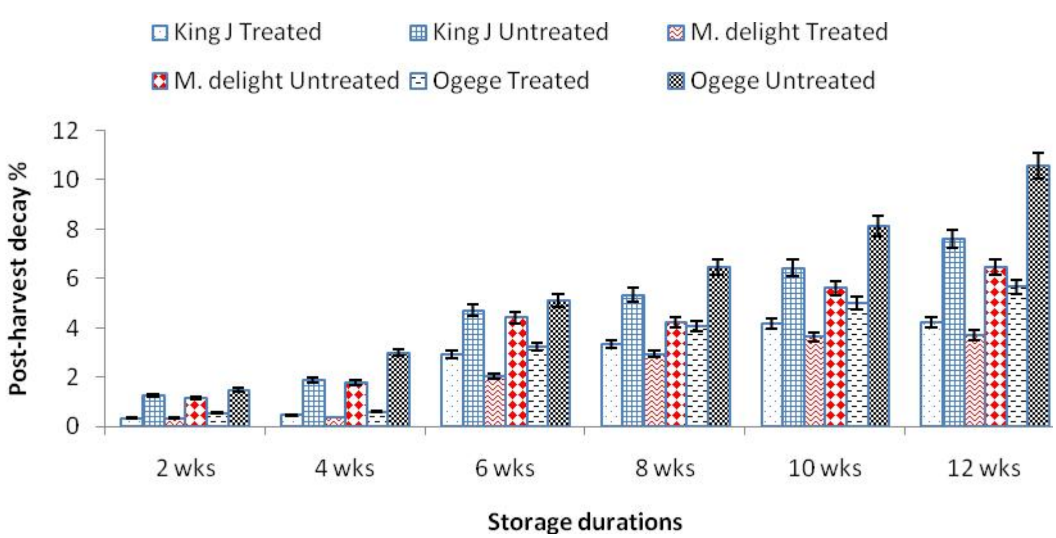

Figure 2 Variations in post-harvest decay of treated and control varieties of stored sweet potato evaluated at fortnightly intervals for storage duration of 12 weeks in 2019.

Effects of application rate on postharvest decay

In 2018, roots treated with extracts of high rate formulation of the extracts (100g/ml) recorded significantly better protection from post-harvest decay than those treated with medium (60g/ml) rate formulation while those with medium rate formulation on the other hand did same to those with low (20g/ml) rate formulation from beginning to end of the study (Table 2).

In 2019 however, whereas a similar record of protection was experienced from the beginning of study to storage week eight, the protection provided by formulations of medium and low rates at the 10^{th} and 12^{th} week's storage recorded no significant variation from each other. High rate formulation however maintained significantly higher protective ability to the end of the study.

Table 2 Responses of different application rates on control of post-harvest decay of stored sweet potato roots in 2018 and 2019

App. Rate	2wks	4wks	6wks	8wks	10wks	12wks
2018						
High(100g/ml)	1.70c	3.48c	5.24c	7.40c	9.92c	12.20c
Medium(60g/ml)	1.91b	4.20b	5.82b	8.28b	10.86b	13.25b
Low (20g/ml)	2.02a	4.70a	6.26a	8.88a	11.38a	13.84a
2019						
High(100g/ml)	0.65c	0.50c	3.18c	4.89c	6.91b	7.14b
Medium(60g/ml)	0.84b	0.66b	3.70b	5.47b	7.66a	7.86a
Low (20g/ml)	1.07a	0.87a	4.34a	6.00a	8.49a	8.72a

Means followed by the same alphabet in each year and weeks are not significantly different using DMRT at 5% probability level.

Interaction effect of application rate x treatment on Postharvest decay

At week two of the storage duration (Table 3) whereas at the high and medium application rates, the post-harvest decay of moinga treated roots significantly surpassed that from neem treated roots, this trend did not continue to the low application rate. The effectiveness of neem in controlling post-harvest decay was significantly suppressed at the low application rate such that no significant differences again were recorded between neem and moringa at this rate of control.

From four to eight weeks storage, post-harvest decays of moringa treated roots were higher than those of neem treated roots at all application rates. However, no significant differences were found between each of the extracts themselves at the medium and low application rates. At high application rate, post-harvest decay was highly suppressed and the exhibition of brotherly unity between medium and high application rates was found only at week four and eight. At week six however, the post-harvest decay of moringa treated roots at medium application rate was significantly higher than that at the high application rate.

Table 3 Interaction effects of different application rates x treatment on postharvest decay of stored sweet potato roots evaluated at fortnightly intervals from 2-12 weeks in 2019.

App. Rate	Treatments	2wks	4wks	6wks	8wks	10wks	12wks
2019							
High(100g/ml)							
	Moringa	0.79c	0.55b	4.01b	5.58bc	7.84b	8.05b
	Neem	0.50d	0.46d	2.35d	4.20d	5.97c	6.23c
Medium(60g/ml)							
	Moringa	0.87b	0.76a	4.73a	6.25ab	8.59a	8.81a
	Neem	0.82c	0.55cd	2.68cd	4.68cd	6.73bc	6.91bc
Low (20g/ml)							
	Moringa	1.24a	1.06a	5.12a	6.88a	9.54a	9.75a
	Neem	0.89a	0.69bc	3.56bc	5.13c	7.43b	7.69b

Means followed by the same alphabet in each year and weeks are not significantly different using DMRT at 5% probability level

Interaction effects of treatment x variety on Postharvest decay in 2018 and 2019

At the fourth and sixth weeks of storage in 2018, the post-harvest decays of all the moringa treated varieties and their controls were significantly higher than the neem treated varieties and their controls (Table 5).

Table 5 Interaction effects of different treatments x variety on postharvest decay of stored sweet potato roots evaluated at fortnightly intervals from 2-12 weeks in 2018 and 2019.

Treatment	Variety	2wks	4wks	6wks	8wks	10wks	12wks
2018							
Moringa							
	K.J	2.40de	3.95h	4.60cd	5.21f	6.27d	7.41d
	Cont. K.J	1.42b	5.58b	7.96b	12.37b	16.31b	20.43b
	M.D	1.39de	3.37i	4.29e	5.01f	6.07de	7.20de
	Cont. M.D	2.05b	5.33c	7.71b	12.08bc	16.24b	20.12b
	O.G	2.16de	4.48f	4.90c	6.04e	7.04d	8.12d
	Cont. O.G	2.84a	6.73a	9.34a	13.34a	17.36a	21.23a
Neem							
	K.J	1.61e	1.67j	2.30f	3.20h	4.35fg	5.45fg
	Cont. K.J	2.08c	4.81e	7.63cd	11.27c	15.16c	18.56c
	M.D	1.19e	1.00k	1.59g	2.37i	3.56g	4.67g
	Cont. M.D	1.54c	4.40g	7.26d	11.06d	14.87c	18.29c
	O.G	2.15d	2.26h	3.18f	4.09g	5.19ef	6.27ef
	Cont. O.G	1.69bc	5.91d	8.56c	12.20bc	16.21b	19.37b
2019							
Moringa							
	K.J	0.38efg	0.56de	4.09d	4.54cd	5.19cd	5.24ef
	Cont. K.J	1.47b	1.01abc	5.26bc	7.55ab	11.72ab	11.99ab
	M.D	0.38fg	0.45ef	3.25d	4.35cd	4.95cd	4.98efg
	Cont. M.D	1.33c	0.89bc	4.89bc	7.29ab	11.55ab	11.62abc
	O.G	0.49e	0.67cde	4.41d	4.97c	5.99c	6.03e
	Cont. O.G	1.76a	1.15a	5.81a	8.71a	12.55a	13.36a
Neem							
	K.J	0.29efg	0.37gh	1.75ef	2.00f	3.16e	3.21gh
	Cont. K.J	1.01cd	0.74bcd	4.16c	7.15b	10.18b	10.31cd
	M.D	0.29g	0.28h	0.81f	1.54f	2.34f	2.42g
	Cont. M.D	0.95d	0.64cde	3.95c	6.59b	9.79b	9.86d
	O.G	0.63ef	0.55fg	2.05e	3.14de	4.04de	4.09fgh
	Cont. O.G	1.23ab	0.84ab	4.44ab	7.46ab	10.76ab	11.78bcd

Means followed by the same alphabet in each year and weeks are not significantly different using DMRT at 5% probability level

Ogege variety significantly recorded higher post-harvest decays than the other two varieties with both moringa and neem treatments at these two storage durations. Whereas with moringa treated varieties, it was King J that recorded higher post-harvest decay at four and six weeks, the same record occurred with neem treated varieties only at week six but at week four, Mothers delight deteriorated significantly higher than King J variety.

In 2019, the untreated roots for all the varieties produced significantly higher post-harvest decays than their treated counterparts. Also, the post-harvest decay of varieties treated with moringa extract was higher than that treated with neem extract from week two to ten storage durations.

Effects of application rate on sprouting of sweet potato roots produced in 2018 and 2019

In 2018, significantly higher numbers of sprouts were recorded from roots that were given high application of plant extracts (Table 7). This was sequentially followed by the medium application rate while the low application rate significantly recorded the least number of sprouts.

In 2019 however, there were no significant differences in number of sprouts produced at the different application rates.

Table 7 Effects of application rate on number of sprouts produced by sweet potato roots in 2018 and 2019

Application rate	Number of sprouts
2018	
High (100g/ml)	3.67
Medium (60g/ml)	3.42
Low (20g/ml)	3.17
LSD (P=0.05)	0.16
2019	
High (100g/ml)	6.61
Medium (60g/ml)	6.33
Low (20g/ml)	6.19
LSD (P=0.05)	ns

Effects of treatments on sprouting of sweet potato roots produced in 2018 and 2019

Whereas moringa treated roots significantly outplayed neem treated roots in number of sprouts in 2018, the reverse was the case in 2019, as significantly more sprouts were recorded on neem treated roots than on moringa (Table 8). There was better sprouting in 2019 than in 2018.

Table 8 Effects of treatments on number of sprouts produced in 2018 and 2019

Treatments	Number of sprouts
2018	
Moringa	4.37
Neem	2.46
LSD (P=0.05)	0.14
2019	
Moringa	5.41
Neem	7.35
LSD (P=0.05)	0.47

Effects of variety on number of sprouts produced in 2018 and 2019

For each variety, the treated roots significantly produced higher number of sprouts than control (Figure 3). In both years, no significant differences were found in the sprouting abilities of King J and Mothers delight varieties. The varieties however sprouted significantly higher than Ogege variety. The number of sprouts produced in 2019 was generally higher than those produced in 2018.

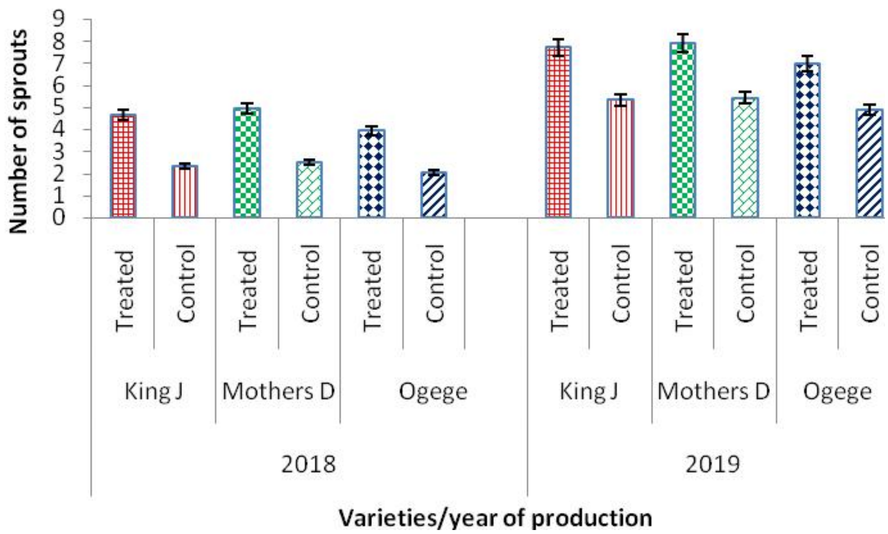

Figure 3 Variations in sprouting ability of treated and untreated varieties of stored sweet potato roots in 2018 and 2019.

Discussion

In the two years of study, sweet potato roots treated with both moringa and neem extracts significantly suppressed post-harvest decay in all the varieties studied. This is an indication that these two plant extracts have the potential to be used by farmers to extend the shelf life of stored sweet potato roots. Kator *et al.* (2019) also extolled the ability of *Moringa oleifera* leaves extracts to decrease the decay level on tomato fruits with the explanation that moringa extracts have the ability to suppress the activities of certain fungi that cause spoilage of tomato fruits in storage.

Although all rates of application offered protection to the stored roots, the protection offered by medium application rate was significantly superior to that offered by low application rate while that of high application rate was in the same vein significantly superior to that offered by medium application rate. These significant distinctions in levels of protection between different application rates continued from beginning to end of storage in 2018. In 2019 however, the distinction between each application rate and another was only pronounced at the early part of storage but as storage period advanced, post-harvest decay also increased irrespective of treatment and no significant differences were again recorded between medium and low application rates. In a study conducted to determine the post-harvest application of neem extract on shelf life of guava where Anisa*et al.* (2015) also applied two distinctive application rates (i. e. 10 and 20% concentration rates). Results revealed that fruit spoilage was lowest in treatment with 20% concentration rate. They therefore explained that reduction in spoilage due to rotting with neem extract at 20% concentration rate may be attributed to the presence of the principal compound azadirachtin which has the ability to check the growth of microbes that are responsible for causing spoilage. Sernaite *et al.* (2020) also conducted a study on the application of plant extracts to control post-harvest gray mould on apple fruits.

Three plant extracts (i.e. pimeto, cinnamon and laurel) were each formulated into three different application rates and applied. Cinnamon extract was found in conclusion to be the most effective against apple gray mould; however, higher concentrations of the extract were required for the efficient inhibition of *Botrytis cinerea* which is the major fungal pathogen during storage.

There was significant interaction of application rate and the two treatments (i.e. extracts of moringa and neem) used on post-harvest decay. When low application rates of the two treatments were applied, the percentage concentrations of the treatments were too low at that rate to effect any reasonable control. Therefore post-harvest decay continued undisturbed with uniform effects on the roots. However, when medium and high application rates were introduced, the effects of the two treatments started manifesting. It was seen at this time that, extracts of neem application exerted better control on post-harvest decay than those of moringa. This may have been because the principal compound azadirachtin found in neem which has the ability to check the growth of microbes as reported by Anisa *et al.* (2015) on guava fruits also has effects on organisms that cause decay of sweet potato roots.

The interaction of variety with application rate resulted in varying levels of post-harvest decay between each variety and another on the stored roots. The post-harvest decay of Ogege variety was significantly higher than that of the two other varieties at each application rate. The post-harvest decay rating of King J and Mothers delight was however dependent of the application rate. While King J deteriorated higher at medium application rate, Mothers delight deteriorated higher at high application rate. Brooke *et al* (2008) reported that if sweet-potatoes are allowed to remain in bright sun for several hours, before they are picked up or after they are placed in the pallet bin, they are almost sure to develop sunscald. Brooke *et al,* further stated that sunscald is unattractive and can be a site for post-harvest decay adding that some cultivars of sweet potatoes are more susceptible to sunscald than others and it is more conspicuous on light or flesh coloured cultivars.

Although both treatments (i.e. moringa and neem extracts) had some control effects on roots of the three varieties studied, varieties responded more positively to neem extracts than to moringa extracts. Also, Ogege variety was more susceptible to post-harvest decay followed by King J while Mothers delight proved to be more tolerant. Zea-Hernandez *et al.* (2016) conducted a study on three varieties of Mexican lime (i.e. Colimex, Colimon and Lise) to determine the quality and shelf life of their fruits after pre-harvest application of gibberellic acid (GA_3). The fruits of these varieties were stored for 10 days at 22 $\pm 2^oC$. Evaluation of the fruits after storage showed that GA_3 treatments decreased weight loss and delayed changes in colour, chlorophyll, TSS and citric acid with ascorbic acid remaining unchanged. This response was however more consistent in the Colimex and Lise varieties. The study therefore concluded that pre-treatment with GA_3in combination with wax maintains fruit quality for a longer period.

The responses of the three varieties studied to the different application rates and treatments varied. Although it has been observed from the study that Ogege variety is more vulnerable to post-harvest decay than the other two varieties and also the efficacy of high application rate to post-harvest decay supersede that of medium and low application rates, the effects of interaction revealed through analysis that instead of Ogege variety, Mothers delight recorded a higher post-harvest decay than the other two varieties (i.e. Ogege and King J) when roots were treated with moringa and stored at high application rate. However, with neem treated roots, Ogege variety which has been known to be more susceptible maintained her position as producing higher deterioration. The higher post-harvest decay manifested by Mothers delight to other varieties may have been because the protective effect of moringa varies between varieties.

Sprouting of sweet potato roots plays an important role in the propagation process of sweet potatoes. It is from the sprouts that the vines develop which are subsequently used as planting material. High application rate on stored roots yielded significantly higher number of sprouts followed by medium and low application rates respectively in 2018. Even as there were no significant differences in sprouting ability among the application rates in 2019, higher sprouts were recorded at high application rate than medium and low respectively. This shows that preservation against post-harvest decay using moringa and neem would be more effective with high application of the extracts.

The number of sprouts that developed from stored moringa treated roots in the 2018 planting season was significantly higher than those produced from stored neem treated roots. It is not clearly understood why the sprouting ability of the roots treated with these two plant extracts got reversed in 2019 and roots treated with neem now sprouted significantly higher than moringa treated roots. It is however noted that on the average the total number of sprouts from neem treated roots were higher than those from moringa treated roots.

The responses of the three varieties to sprouting ability differed. Apart from King J and Mothers delight producing significantly similar number of sprouts in the two years of study, their sprouting ability was also significantly higher than Ogege variety for the two years of study. Farmers usually sprout sweet potatoes under different conditions such as in direct sunlight, in a dark place such as a closet and in an ordinary room with ordinary light and temperature. Different varieties may respond in variable ways to sprouting ability under these conditions. In this study, sprouting was done in the laboratory in an ordinary room with ordinary light and temperature and under this condition Ogege variety performed poorer than the other two varieties. In an extension bulletin published to intimate farmers about the procedures of sweet potato production, Brandenberger *et.al.* (2022) stated that sweet potato varieties differ in their ability to produce sprouts but generally a bushel of sweet potatoes will produce 2000 to 2500 sprouts in two or three sprouts harvests. In a study conducted to determine the effect of variety and size of stem cutting on flesh root yield and yield components of sweet potato, Musyimi and Dau (2016) reported that all the three varieties considered in the study (i.e. SPK004, Bungoma and K135) produced significantly higher percentage sprouting than the control (Mtwapa 8). Variety SPK004 also recorded significantly higher sprouting percentage than variety K135.

Results of the study show that plant extracts of both moringa and neem are efficacious in the control of post-harvest decay. However, neem produces a higher effect than moringa and high application rates of both moringa and neem extracts produce more effective control of post-harvest decay than low rate applications. The use of these two plant extracts are therefore recommended to sweet potato farmers in order to cut down costs from use of synthetic chemicals and avoid the risk of contamination which can be injurious to human health.

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