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Evaluation of Seedling Establishment Palatability and Acceptability Tests of Groundnut Seeds as Influenced by Levels of Whole Powder of *Hyptis suaveolens* L. Poit and Climatic Conditions

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Abstract

The tests for the evaluation of seedling establishment, palatability and acceptability were carried out at the Teaching and Research Farm of the Department of Agricultural Technology and the Food Laboratory of the Department of Home and Rural Economics, Adamawa State College of Agriculture, Ganye, Adamawa State. The experimental designs used were Randomized Complete Block Design and the Completely Randomized Design. Some of the parameters measured were percentage seedling establishment, palatability, and acceptability tests. The highest mean percentage seedling establishment was observed in 12.00g levels of H. *suaveolens* whole powder treated shelled groundnut seeds (97.67, 97.00, and 94.00) at the three periods of storage. Percentage seedling establishment decreased with a decrease in levels of H. *suaveolens* whole powder. One of the major constraints to the use of plant materials as an alternative to synthetic insecticides is the issue of standardization in dosage of application. This work has suggested that, if groundnut seeds are to be used for sowing, they should be stored with a 12.00g level of H. *suaveolens* whole powder for every 300.00g for three months. However, if they are to be used for consumption, they could be stored with a 6.00g level of H. *suaveolens* whole powder for every 300.00g for at most three months. There was no significant difference between treated and untreated shelled groundnut seeds at the three periods of storage on the acceptability and palatability score of cooked groundnut at all dosages of application. All treatments were within the acceptable score rates even though the two rates of the synthetic insecticides, actellic dust were at the lowest acceptable score rate. The finding also showed that acceptability and palatability decreased with an increase in dosage of application. The periods of storage also had a significant impact on the mean percentage seedling establishment. It was observed that there was a higher percentage of seedling establishment when shelled groundnut seeds were stored from November- January. At this period of the year, the temperature and humidity are usually low and this might have necessitated the high state of inactivity and low performance of the bruchids compared to other periods of storage within the year.

Keywords: *Hyptis*; Groundnut; Palatability; Establishment; Acceptability; Climate; Powder.

1. Introduction

Groundnut (*Arachis hypogeae* Linn) also known as 'peanut', 'earthnut', 'gobbers', 'pinders', 'manilanuts', belongs to the family leguminosae (Fabacea) [1]. Other members of this family include cowpea, soyabeans, peageon pea, melon etc. [2, 3]. Groundnut originated from South America (Brazil) and was introduced in Nigeria by the Portuguese after the 16th century and its production spread to the Northern part of the country [4]. According to them, the crop has become an important cash crop used for export since the colonial era. Its production in Africa has been estimated at 4.6 million metric tons, with Senegal, Nigeria, Gambia, Democratic Republic of Congo (DRC) and Sudan being the major producers in Africa [2, 5]. According to [6], Nigeria's production of unshelled nut is about 2.6 million metric tons annually from a land area of approximately 2.5 million hectares. Groundnut yield obtained by farmers in Nigeria range from 950-1000kg/ha [6]. Groundnut thrives best on a well-drained sandy-loam soil, this type of soil facilitates easy penetration of pegs and their development, hence their harvesting [7].

Weiss [8] suggested that, temperature range of 25-30^{0}C, rainfall of 500- 1000mm and a pH range of 6.0-6.5 is considered optimum for groundnut production. Groundnut is a major cash crop which serves as a foreign exchange earner prior to the petroleum boom in Nigeria [9]. According to Aribisala [9], Musa, *et al.* [10], the crop is an important source of protein, fats, vitamins and dietary oil for most Nigerians. The unusually high nutritional value of the seeds and their pleasant flavour, made groundnuts one of the most important food crops in the tropics and sub-tropics [10, 11]. Shelled groundnuts are fried, roasted and salted which is eaten as snacks and the crop also serves as raw materials for some food industries and as feed concentrates for livestock [7, 12].

The extent of post-harvest crop losses and the need to shift emphasis from the excessive use of conventional synthetic insecticides for the control of *C. serratus* on shelled groundnut seeds and tamarind whole (fruits and seed) in the store prompted this work. Therefore, a curious search for natural-product based agrochemicals that are biodegradable, eco-friendly, sustainable and safe to humans and the environment has intensified [13]. There is also the need for cheaper and safer alternative control practices.

Hyptis suaveolens (L.) Poit, a potential anti-feedant plant product belongs to the family laminaceae [14]. Ethnobotanical studies conducted in Kenya on *H. suaveolens* showed that, the plant can repel mosquitoes effectively when burned overnight in rooms [15]. Duke [16], also in his phytochemical and Ethnobotanical database refers to the plant as insect repellant.

The knowledge of chemical constituent of the plant is desirable because such information aided in determining the quantity or the dosage of application of the *H. suaveolens* whole powder which has been a major limitation to the use of bio-pesticides especially in the rural communities. This knowledge was also instrumental in evaluating the effect of *H. suaveolens* whole powder on the survival and reproductive potential of the groundnut bruchid, *C. serratus* on stored shelled groundnut seeds and tamarind whole pods, in the search for alternative control method instead of the use of expensive, toxic, harmful and imported synthetic insecticides. However, the chemical analysis of the powder of *H. suaveolens* was not determined from the individual parts of the plant (leaves, seeds, stems, flowers and roots). Field experiment was carried out to evaluate the effect of levels of *H. suaveolens* whole powder on seedling percentage establishment of groundnut seeds stored at different periods of the year for the control of groundnut bruchid *C. serratus* Olivier since farmers in the rural communities are more interested in seedling establishment.

Moreover, the acceptability and palatability test for shelled groundnut seeds stored with varying levels of the plant material, *H. suaveolens* whole powder and rates of actellic dust was also determined.

2. Materials and Methods

2.1. Study Areas

The percentage seedling establishment, palatability and acceptability test were carried out at the Teaching and Research Farm of the Department of Agricultural Technology and the Food Laboratory of the Department of Home and Rural Economics, Adamawa State College of Agriculture, Ganye respectively. The College is located at Gangwokki Village, Ganye Local Government Area within longitude 8^{o} 16" North and latitude 12^{o} East of the equator in the Northern Guinea Savannah agro- ecological zone of Nigeria [17]. The seedling establishment percentage for shelled groundnut seeds treated with varying levels of plant material, *H. suaveolens* whole powder for the control of the bruchid, *C. serratus* at different periods of the year was carried out in 2016 during the raining season.

2.2. Test for Field Seedling Establishment Percentage for Shelled Groundnut Seeds Stored with Varying Levels of *H. suaveolens* L. Poit Whole Powder

The land was cleared, ploughed using tractor and harrowed into a very fine tilt. The land was divided into the required plots. The size of the land was 280.00m^2. There were seven (7) treatments replicated three (3) times making a total of twenty one (21) experimental plots or units in a Randomized Complete Block Design (RCBD).

Shelled groundnut seeds treated with varying levels of *H. suaveolens* L. Poit whole powder (0.00g, 2.00g, 4.00g, 6.00g, 8.00g, 10.00g and 12.00g) stored for three months were sown on the already prepared experimental plots at two (2) seeds per hole 23cm within the rows and spaced 40cm apart. The seeds were sown at the depth of 2-3cm and were lightly pressed. The groundnut seeds began to emerge after seven (7) days of sowing and establishment count was taken at fourteen (14) days after sowing, calculated and expressed as percentage using the appropriate formula.

2.3. Palatability and Acceptability Test for Shelled Groundnut Seeds Stored with Varying Levels of *Hyptis suaceolens* L. Poit Whole Powder

Shelled groundnut seeds stored for three months with varying levels of Wild Spikenard, *H. suaveolens* whole plant powder at three periods of the year (November-January; March-May; July-September). The stored groundnuts seeds were rinsed several times and cooked in water for 15 minutes without flavouring materials. Ten (10) respondents were identified as panel members. These were randomly selected from the staff and students of the Department of Agricultural Technology, Adamawa State College of Agriculture, Ganye- Nigeria. The cooked shelled groundnut seeds stored with varying levels of *H. suaveolens* whole plant powder at three periods of the year (November-January; March-May; July-September) were served to the panelists for palatability and acceptability test/evaluation in randomized manner. Each respondent rinsed his or her mouth three or more times between samples [18]. The panel of respondents rated the palatability/acceptability of the cooked shelled groundnut seeds on taste characteristics on a scale from 1-4: Where 1: Highly unacceptable, 2: unacceptable, 3: marginally acceptable and 4: acceptable [18-20].

2.4. Data Collection

The data collected include the following:

2.4.1. Percentage Seedling Establishment

Estalishment percentage was calculated using the formula below as reported by Oaya and Jada [21].

$$\text{Percentage establishment} = \frac{\text{Number of established plants}}{\text{Number of seeds sown}} \times 100$$

2.4.2. Palatability and Acceptability Test

Highly unacceptable, unacceptable, marginally acceptable and acceptable

2.5. Statistical Analysis

Data for percentage establishment were collected and subjected to the analysis of variance (ANOVA) appropriate to Completely Randomized Design (CRD) and Randomized Complete Block Design (RCBD) according to Gomez and Gomez [22]. The treatment means were separated using the Student Newman Keuls (SNK) at $P \leq 0.05$ level of probability. The data obtained for palatability and acceptability test were statistically analyzed as a Completely Randomized Design experiment. Treatment means were separated by Student Newmans- Keuls at $P \geq 0.05$ using the SAS software 2000.

3. Results

3.1. Percentage Seedling Establishment

The results of mean percentage seedling establishment of groundnut seeds stored with varying levels of the plant material, Wild Spikenard (*H. suaveolens*) whole powder for the control of the bruchid, *C. serratus* are presented in Table 1. The seedling establishment percentage was carried out for shelled groundnut stored at three different periods of the year respectively (November-January; March-May and July-September). The results showed that, the highest mean percentage seedling establishment of shelled groundnut seeds stored from November-January was recorded in 12.00g level of *H. suaveolens* whole powder (97.67) followed by 10.00g level of *H. suaveolens* whole powder (94.33), 8.00g level of *H. suaveolens* whole powder (88.33), 6.00g level of *H. suaveolens* whole powder (76.67), 4.00g level of *H. suaveolens* whole powder (67.33), 2.00g level of *H. suaveolens* whole powder (50.00) and the least was reported in the control, 0.00g (30.00) at $P \leq 0.05$ level of probability. There was significant difference among the levels of the control measures compared to the control.

Similarly, the highest mean percentage seedling establishment for the period of storage from March-May was observed in 12.00g level of *H. suaveolens* whole powder (97.00) followed by 10.00g level of *H. suaveolens* whole powder (93.33), 8.00g level *H. suaveolens* whole powder (87.33), 6.00g level of *H. suaveolens* whole powder (75.33), 4.00g level of *H. suaveolens* whole powder (66.33), 2.00g level of *H. suaveolens* whole powder (49.00) and the least was seen in the controls, 0.00g (25.10) as shown in Table 1. There was significant difference among the levels of control measures compared to the control. Moreover, the highest mean percentage seedling establishment for the period of storage from July-September was recorded in 12.00g level of *H. suaveolens* whole powder (94.00) followed by 10.00g level of *H. suaveolens* whole powder (90.00), 8.00g level of *H. suaveolens* whole powder (85.00), 6.00g whole plant powder (74.67), 4.00g level of *H. suaveolens* L. Poit whole powder (62.67), 2.00g level of *H. suaveolens* whole powder (47.00) and the least was observed in the control, 0.00g (22.35) at $P \leq 0.05$ level of probability. There was high significant difference among the levels of the powder and compared to the control. The result also showed that, the period of storage from November-January recorded the highest mean percentage seedling establishment of shelled groundnut seed compared to other periods of storage as shown in Table 1.

Table-1. Mean Percentage Seedling Establishment as Affected by Varying Levels of *H. suaveolens* Stored at three Periods of Storage on Stored Groundnut

Levels of *H. suaveolens* powder	Periods of Storage November-January	March-May	July-September
0.00	30.00^{f}	25.10^{f}	22.35^{f}
2.00	50.00^{e}	49.00^{e}	47.00^{e}
4.00	67.33^{d}	66.33^{d}	62.67^{d}
6.00	76.67^{c}	75.33^{c}	74.67^{c}
8.00	88.33^{b}	87.33^{b}	85.00^{b}
10.00	94.33^{ab}	93.33^{ab}	90.00^{ab}
12.00	97.67^{a}	97.00^{a}	94.00^{a}
P<F	0.01	0.01	0.01
C. V.	1.40	0.90	0.60
S. E.	1.21	1.58	1.57
LSD	2.20	2.87	2.85

Means followed by the same letter (s) in the same column are not significantly different at $P \leq 0.05$ level of probability using the Student Newman-Keuls (SNK) method of mean separation.

3.2. Acceptability and Palatability of Cooked Shelled Groundnut Seeds Stored with Varying Levels of *H. suaveolens* whole Plant Powder at three Different Periods

The results of the effect of varying levels of Wild Spikenard, *H. suaveolens* and rates of actellic dust (Primiphous methyl) on mean acceptability and palatability of of cooked shelled groundnut seeds stored from November-January, March-May, July-September for control of groundnut bruchid, *C. serratus* are presented in Table 2. The results showed that, all the levels of of *H. suaveolens* did not leave any flavor strong enough to influence non-acceptance of cooked shelled groundnut seeds store at three periods of storage. The highest acceptability score was recorded in 2.00g level of plant material, *H. suaveolens* whole plant powder at the three periods of storage, November-January (3.80), March-May (3.82), July-September (3.75) followed by 4.00g of *H. suaveolens*, November-January (3.69), March-May (3.71); July-September (3.66); 6.00g of *H. suaveolens*, November-January (3.61), March-May (3.64), July-September (3.60); 8.00g of *H. suaveolens*, November-January (3.55), March-May (3.57); July-September (3.51); 10.00g of *H. suaveolens*, November-January (3.50), March-May (3.54), July-September (3.47); 12.00g of *H. suaveolens*, November-January (3.30), March-May (3.35), July-September (3.26); 2.00g of actellic dust, November-January (3.20), March-May (3.23), July-September (3.10); 4.00g of actellic dust, November-January (3.15), March-May (3.17), July-September (3.05) and the least was reported in controls, 0.00g, November-January (3.00), March-May (3.10), July-September (2.95) respectively at $P \leq 0.05$ level of significance.

Table-2. Effect of Varying Levels of *H. suaveolens* and Rates of Actellic Dust on Acceptability and Palatability of Groundnut Seeds stored at Different Periods

Treatments	November-January Hyptis Actellic Dust		March-May Hyptis Actellic Dust		July-September Hyptis Actellic Dust	
0.00g	3.00^{cd}	-	3.10^{cd}	-	2.90^{cd}	-
2.00g	3.80^{a}	-	3.82^{a}	-	3.75^{a}	-
4.00g	3.69^{ab}	-	3.71^{ab}	-	3.66^{ab}	-
6.00g	3.61^{ab}	-	3.64^{ab}	-	3.60^{ab}	-
8.00g	3.55^{bc}	-	3.57^{bc}	-	3.51^{bc}	-
10.00g	3.50^{bc}	-	3.54^{bc}	-	3.47^{bc}	-
12.00g	3.30^{c}	-	3.35^{c}	-	3.26^{c}	-
2.00g AD	-	3.20^{a}	-	3.23	-	3.10^{a}
4.00g AD	-	3.15^{ab}	-	3.17	-	3.05^{ab}
S. E.		0.16	0.17	0.14	0.15	0.13

Mean followed by the same letter (s) in the same column is not significantly different at $P \leq 0.05$ level of probability using the Student Newman-Keuls (SNK) method of mean separation.

4. Discussion

4.1. Effect of Wild Spikenard (*H. suaveolens*) Whole Powder on Percentage Seedling Establishment of Shelled Groundnut Seeds Stored at Different Periods

Most farmers in the rural areas do not know the difference between germination, emergence and seedling establishment. Their main interest is in whether what they sow establishes or not. Shelled groundnut seeds stored with 12.00g level of plant material, *H. suaveolens* whole powder for the control of the bruchid, *C. serratus* in the store gave the highest mean percentage seedling establishment for the three periods of storage. Beyond this level of the plant material, *H. Suaveolens* whole powder, there was decrease or decline in groundnut seedling establishment sown on the field. Since at this level (12.00g) of the plant material whole powder and at the three periods within which the storage test was carried out higher seedling establishment was recorded, it is suggested that if shelled groundnut seeds are to be used for sowing, they could be stored with 12.00g level of *H. suaveolens* whole powder for every 300g shelled groundnut seeds for the period of three months. However, if they are to be used for consumption, storage of groundnut seeds (300g) at 6.00g and above for at most three months is suggested since at this level of the plant material, *H. suaveolens* whole powder, the degree of damage, eggs laid, adults alive and weight loss of stored produce was at an average. Therefore, the stored produces were not damaged or destroyed beyond which they could not be consumed even though they may not be good for sowing.

The periods of storage also had significant impact on mean percentage seedling establishment. This is in consonance with Ofuya and Lale [23] who elucidated that, all insects or microorganisms have a characteristic optimal growth temperature at which they exhibit their highest growth and reproduction rate. They further suggested that, temperature and humidity can influence the rate of germination, seedling establishment and growth of insects and other microorganisms as individual isolates, species and genera differ in their response to storage conditions. It was observed that, there was higher percentage seedling establishment when shelled groundnut seeds were stored from November- January. At this period of the year, the temperature and humidity are usually low and this might have necessitated the high state of inactivity and low performance of the bruchids compared to other periods of storage within the year. This agrees with Atlas and Bartha [24] who stated that, insect pests and also have minimal growth temperatures and conditions below which they are metabolically inactive and do not demonstrate any synergy for growth and development.

4.2. Effect of Varying Levels of Control Measures on Mean Acceptability and Palatability of Shelled Groundnut Stored at Different Periods

The degree of seed damage was significantly lower than the treatments (levels of *H. suaveolens* and rates of actellic dust) compared to the control at the three periods of storage (November-January; March-May; July-September). This agrees with Oparaeke and Daria [25] who stated that, stored produce treated with either plant materials or synthetic insecticides against storage insect pests may have been protected from damage probably because the control measures could have blocked or interfered with the cuticle of the insect resulting in increased mortality, reduced oviposition and infertility of the eggs.

There were no significant difference between treated and untreated shelled groundnut seeds at the three periods of storage on the acceptability and palatability score of cooked groundnut at all dosages of application. All treatment were within the acceptable score rates even though the two rates of the synthetic insecticides, actellic dust were at the lowest acceptable score rate. The finding also showed that, acceptability and palatability decreased with increase in dosage of application. This corroborates with Ashiru [26], Ogunwolu and Odunlami [20], Yusuf, *et al*. [18], who reported that, the insecticidal constituents in some plant materials could be responsible for reduced palatability when grains preserved or stored with these materials are consumed.

5. Conclusion

The period of storage between November and January was observed to be favourable for storage of stored produce as virtually all the climatic factors were friendly for storage and the insect pests might not have been at their best. The work also observed that establishment percentage of seedlings increased with increase in dosage of application of plant material, *H. suaveolens* whole powder. The work has suggested that, if groundnut seeds are to be used for sowing, 12.00g/kg level of plant material *H. suaveolens* whole powder could be used to treat or store 300.00g/kg of stored shelled groundnut seeds. However, the work has also suggested that if the groundnut seeds are to be used for consumption, storage of groundnut seeds (300.00g/kg) with 6.0g/kg level of the plant material *H. suaveolens* whole powder for at most three months is suggested since at this level of the powder and above the stored produce were not damaged beyond which they could not be consumed even though they may not be good for sowing.

The test for acceptability and palatability of shelled groundnut seeds stored with varying levels of Wild Spikenard, *H. suaveolens* and actellic dust did not interfere or influence the non-acceptance of cooked groundnut seeds. All treatments were within the acceptability and palatability score rate.

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