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The Effect of Groundnut Sucking Bug *(Rhyparochromus littoralis* Dist.*)* on the Oil Content of Groundnut Kernels on Two Groundnut Cultivars in Northern Nigeria

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Abstract
Field experiments were conducted in Kano and Yola in order to expose two (2) groundnut cultivars (Kampala(V_1) and KwachambaV_2) to the ravaging groundnut sucking bug (*Rhyparochromus littoralis* Dist.). The experiments were laid in a split plot design. This was done in order to determine how long it takes the bug to cause damage on the groundnut pods. Groundnuts were left on the field for 3, 7, 9, 14, 21 and 35 days before it was decorted. It was observed that the higher the numbers of days the pods were left on the field, the higher the level of infestation. To determine the effect of the suck on the oil content of the infested groundnuts, the Soxhlet Fat Extraction Method was used to extract oil from both infested and non infested groundnut in order to compare the oil content percentage based on the number of days each sample was exposed to the pest on the field. Results showed that percentage reduction in the oil content increases with increasing number of days the pods were exposed to the pest. Overall, the average of results obtained revealed that up to 90% loss in oil content occurred due to the effect of *R. littoralis* which occurred on the 21 and 35 days the groundnuts were left on the field in both cultivars, as obtained in both locations where the field experiments were conducted.
Key Words: Groundnut, Infestation, Decorted, Damage, Oil content, Cultivars.

1. Introduction

Groundnut (*Arachis hypogea* Linn) belongs to the family Leguminosae and is one of the most important oil seed crop in the world (Brink and Belay, 2006; ICRISAT, 2009). The groundnuts have been recognized around the world by an assortment of colourful names. While Americans call it peanut, it is known by several other names such as African nut, Chinese nut, Manila nut, Kipper nut, Hawks nut, Jarnut, Earth chestnut, Monkey nut, Goobers pear, Ground pea, and Ground bean (Johnson *et al.,* 1981). Locally in Nigeria especially in the north where it is cultivated it is known as *'gyada'* in Hausa, '*okpa'* in Igbo, '*epa'* in Yoruba (Wood and Ambridge, 1996) while it is also known as *'wada'* in Kilba and Bura and the Yungur speaking people refer to it as *'shiyara'* (Samaila and Malgwi, 2012).

Although peanut have relatively gained importance recently, the origin of the crop dates back to 350 B C (Hammons, 1994). With a humble beginning, groundnuts have gained prominence for their economic importance and nutritional value on a global scale and are now cultivated throughout the world (Shakarappa, *et al.,* 2009). The main use of groundnut is as a source of edible oil, but it is an important food crop to man, however in spite of its importance to man, groundnut has a lot of pests in the field.

Groundnut remains an extremely useful crop, providing food, oil, fodder and fuel to households and is also an important source of additional income as a cash crop. Important problems in groundnut cultivation in tropical Africa are low yields and its susceptibility to diseases (Dwivedi *et al.,* 2003). Worldwide, more than 50% of groundnut production is crushed into oil for human consumption or industrial use (e.g. in cosmetics). In countries such as Senegal, Gambia and Nigeria oil extraction has been an important cottage industry for years (ILDIS, 2005). The use of groundnut in confectionery and for oil and meal production is increasing, and there is gradual shift taking place from oil and meal to confectionery use, especially in Latin America and the Caribbean. In South America groundnut seeds are fermented into alcoholic drinks (Dwivedi *et al.,* 2003*).*

Almost every part of the groundnut plant is used in some way. While the kernels are used for human consumption, it's vines are used as fodders for cattle in many African and Asian countries (Shankarappa *et al,*2009). Groundnut roots left behind in the soil add valuable nutrition to the soil, while groundnuts are used primarily for vegetable oil in most of the world. In U.S.A groundnut are grown mainly for food including peanut butter, roasted-in-the-shell, candy and as shelled whole seeds that are salted or dry-roasted (Isleib and Wynne, 1992). Groundnut (*Arachis hypogea* Linn.) is one of the most important cash and food crop in Nigeria and other parts of the tropics particularly in the semi arid areas (ICRISAT, 1987; Sajo and Kadams, 2000). Its importance arises from the abundance of vast land for its production, low moisture requirement and high percentage of active population that engages in the production (Aribisala, 1993; Samaila and Malgwi, 2012).

Groundnut is a major cash crop in the country and serves as a foreign exchange earner prior to the petroleum boom in Nigeria (Adeyemi, 1968 and Aribisala, 1993). The crop is highly nutritious containing proteins, fats and oil, carbohydrates; minerals and vitamins. The oil is of high quality and best used as frying oil and preparation of hydrogenated cooking fats. In Nigeria it is also cultivated for desert consumption as food and for industrial or exported while the other 25% is exported or domestically consumed either as roasted groundnut or peanut candy (Pompeu, 1980; Samaila and Malgwi, 2012).

There is paucity of details on the history and effect of *R. littoralis, which* were found in large chambers, under harvested groundnuts left to dry before picking (decorting) on the field. Such groundnuts, when left after harvesting for a week turns out to have small, shrunken seeds, the testa often turning yellow, which directly affects quality of the kernels as well as its oil content (Malgwi and Onu, 2004; Samaila and Malgwi, 2012). This study is aimed at determining the effect of *R. littoralis* on the oil content of two (2) cultivars popularly ground in Northern Nigeria, with the hope of establishing the best practice in handling groundnut at harvest.

2. Determination of Oil Content of Infested Groundnut

The Soxhlet Fat Extraction Method as recommended by Onwuka, (2005) was used. This method was carried out by continuously extracting a food with a non-polar organic solvent such as petroleum ether for 4 hours after which another process was repeated. This was done successfully for over two weeks with quiet challenges of power source.

2.1 Procedure

According to Onwuka (2005) and Ilesanmi (2009), the following steps were taken to extract oil in order to determine the percentage (%) loss of oil. Dry 250 ml clean boiling flasks in oven at 105 – 110^{0}C for about 30 minutes. Samples were then transferred into a desicator and allowed to cool. Two (2) g of samples was accurately weighed into the labeled thimbles and correspondingly labeled the cooled boiling flasks. The boiling flask was filled with about 399 ml of petroleum ether (boiling point 40 – 60^{0}C). The extraction thimble was plugged lightly with cotton wool.

The soxhlet apparatus was assembled and allowed to reflux for about 6 hours, while the thimble was removed with care. Petroleum ether was collected in the top container for re-use. Once the flask became free of petroleum ether, it was removed and dried at 105^{0}C – 110^{0}C for 1 hour and then transferred from the oven into desiccators and allowed to cool and then weighed.

2.3 Calculations

Oil content loss

$$\%\text{ loss oil content} = \frac{\text{harvested (fresh)g/nut (A)} - \text{Harvested g/nutB}}{\text{Harvested (fresh) G/nut}} \times \frac{100}{1}$$

- In each of the number of harvesting days for C,D,E,F,G, & H

Where:

A - H	=	Groundnuts freshly harvested and dried properly outside the field according to the number of days exposed to the pest on the field.
DAH	=	Days after harvest.
HANGED	=	Harvested Groundnuts hanged above ground level and left to dry before decorting.

3. Yield Loss

There are several acceptable methods of estimating the loss to stored products. To estimate the damage (%), each sample was divided into damaged and undamaged pods or kernels and the per cent damage was calculated using the following formula by Dick (1987b):

$$\text{Damage (\%)} = \frac{\text{Number of damaged pods} \times 100}{\text{Total number of pods}}$$

$$\text{Weight loss (\%)} = \frac{(UNd) - (DNu) \times 100}{U(Nd + Nu)}$$

Where:
Nu = No. of undamaged pods; Nd = No. of damaged pods; U = Dry mass of undamaged pods; D = Dry mass of damaged pods.

4. Results

4.1 Extraction of Oil Content of the Infested and Non-Infested Groundnuts harvested

The soxhlet extraction apparatus was used in the extraction of oil. The results presented in Table 2, revealed that the oil content of groundnut reduced significantly from that which was harvested from the HANGED sample with 58.0% to that of 0DAH of 55.0-% oil content and a continuous decrease in oil content continued dropping until it reduced to 10.7% for Kampala (V_1) of the sample taken from Kano.

Similarly, in Kwachamba (V_2) the same order of decrease at the Kano location with the HANGED recording the highest (40.0%) followed by 0DAH (34.7%) and they are significantly different from each other with increasing number of days it was left on the field to dry, with increasing number of pest infestation. However, there was no significant difference between 3DAH and 7DAH and between 28DAH and 35DAH.

The same trend was observed with the samples collect at the Yola research field with increasing number of days the samples were left on the field, the oil content dropped significantly. it is evident that the longer groundnut is left on the field, the more the bugs sucks oil and the lesser the oil content percentage with increasing number of days it remained in the field, the decrease in all cases were directly proportional to the moisture content of each sample as shown in Table 1. Within 35 days with different harvesting days, they were significantly different at $P<0.05$ in oil content loss percentage as presented in the combined analysis of both locations in Table 2. Similarly the grand means of the percentage oil loss and that of the moisture content also proved the same trend as presented in Table 2. Generally, from the pooled analysis, the same trend is confirmed for both locations with both varieties with HANGED having the highest (58.5) and (41.2) oil content percentage followed by 0DAH (55.7) and (34.3), which were not significantly different from each other, however, significant differences existed in 3, 7, 9, 14, 21, 28 and 35DAH (Table 1).

5. Discussion

The significant loss of oil content of groundnut is directly related to the number of days the groundnut is left on the field and the level of pest infestation. This implies that, the lesser the number of days groundnuts are left on the field, the lesser the loss in oil content. It is therefore, opined that, the present study has increased greatly the basic knowledge on the biology of the groundnut sucking bug "Sha mai" or "offa" (*R. littoralis)* thus paving way for a concerted effort in the formation of a strategic management principles for its control and which will, in turn help in controlling other pests of groundnut, as well.

Insect infestation adversely affected yield and resulted in tremendous reductions of quality and quantity with increasing number of days left on the field to dry. Up to 72% loss in weight/yield was recorded in Kwachamba (V2) at 35DAH while 68% of loss weight was recorded in Kampala (V_1) at 35DAH. The least loss in weight of 23.4% and 24.2% were recorded in Kwachamba and Kampala respectively. The difference in results of Kano and Yola locations could be due to the variations in climate and weather for both locations, which are quite different from each other. Although *R. littoralis* is a small bug whose activity is nocturnal, working on it, was somewhat very difficult as economic importance is yet to be determined, but this study is a step towards actualizing it, since its abundance and the time it occurred in the year and at the stage of groundnut production has been identified.

Up to 68 - 72% loss in weight/yield was recorded. The least loss in weight of 23 – 35% in both cultivars planted and at both locations is pointer to the fact that this pest is an emerging threat to groundnut production. The difference in results of Kano and Yola locations could be due to the variations in climatic or weather conditions of the two locations, which are known to belong to different agro ecological zones. However, the heavy presence of this bug could suggest that *R. littoralis* might have been in existence in these areas for a very long time, but was not just given much attention as a threatening pest until now. Although no work has been carried out on *R. littoralist* alternate feeding sources, findings in this study could serve as an eye opener on its possible alternate hosts. There is also the need to thoroughly investigate this insect pest which will help in developing a comprehensive control of *R. littoralis*, because the pest appears to survive for longer periods on some yet un identified crops or plants apart from the few identified in this study. The families of the weeds that could serve as alternate host plants has to be put into consideration as most of them other than those found, could be potential host plants or alternate host plants where *R. littoralis* is a dormant pest. Care should be taken that such weeds and crop plants are not planted or rotated on the same field, mix farming or inter cropping where *R. littoralis* is a major pest as stated earlier. The biology of *R. littoralis* on groundnut revealed that it does not complete its life cycle on groundnut alone, since it migrates to some other plants. This makes it difficult, and since plant debris and other alternate host plants are central to its life cycle, it is expedient that a thorough study on the bio-ecology of this dangerous pest be carried out.

The significant loss of oil content of groundnut is directly related to the number of days the groundnut is left on the field and the level of pest infestation. This implies that, the lesser the number of days groundnuts are left on the field, the lesser the loss in oil content. It is therefore, opined that, the present study has increased greatly the basic knowledge on the biology of the groundnut sucking bug "Shamai" or "offa" (*R. littoralis)* thus paving way for a concerted effort in the formation of a strategic management principles for its control and which will, in turn help in controlling other pests of groundnut, as well.

6. Conclusion

In conclusion, the significant loss of oil in the groundnut is directly related to the number of days the groundnut was left on the field and the level of pest infestation, which implies that, the lesser the number of days groundnuts are left on the field, the lesser the loss in oil content. Farmers are therefore advised to either pile their groundnuts or hang them with ropes on the field or decort same day the groundnut is dug from the soil since these two methods were free from infestation. It is therefore, opined that, the present study has increased greatly the basic knowledge on the devastation of the groundnut sucking bug "Shamai" or "Offa" (*R. littoralis)* on groundnut, thus paving way for a concerted effort in the formation of a strategic management principles for its control and management.

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Table 1: Mean Oil Content Percentage Loss of Kennels from Kano and Yola

Period of Observation	Kano Kampala	Kano Kwachamba	Yola Kampala	Yola Kwachamba
HANGED	58.0^{ab}	40.0^{a}	58.9^{a}	42.4^{a}
0DAH	55.0^{b}	34.7^{b}	53.4^{b}	33.9^{b}
3DAH	43.3^{c}	23.3^{c}	41.8^{c}	24.9^{c}
7DAH	37.5^{c}	18.3^{c}	36.2^{d}	21.0^{d}
9DAH	35.8^{c}	14.5^{c}	34.7	$16.^{3}$
14DAH	32.3^{c}	12.2^{d}	32.4^{de}	13.7^{de}
21DAH	27.3^{cd}	7.3^{de}	27.6^{f}	7.5^{f}
28DAH	21.5^{d}	3.3^{e}	23.0^{f}	4.1^{f}
35DAH	10.7^{e}	2.3^{e}	11.0^{g}	2.8^{g}
Mean	27.4	17.32	27.1	16.2
C.V.(%)	15.6	11.8	13.9	12.1

Means with the same letters within the same column are not significantly different at $P < 0.05$ using student Keuls-Newman (SNK) test for variables. C.V.=Coefficient of variability and S. E. Standard Error. DAH = days after harvest, HANGED = Groundnut hanged above ground level for observation

Table 2: Mean Moisture Content of Kernel before Extraction at Kano and Yola

Period of Observation	Kano Kampala	Kano Kwachamba	Yola Kampala	Yola Kwachamba
0DAH	12.7^{a}	12.7^{a}	14.0^{a}	12.0^{a}
HANGED	12.0^{b}	12.0^{b}	10.0^{c}	10.0^{c}
3DAH	10.0^{c}	10.3^{c}	10.0^{c}	10.0^{c}
7DAH	11.0^{c}	10.0^{c}	10.0^{c}	10.0^{c}
9DAH	9.0^{d}	9.0^{d}	9.0^{d}	9.0^{d}
14DAH	9.0^{d}	9.0^{d}	9.0^{d}	9.0^{d}
21DAH	8.0^{e}	8.0^{e}	8.0^{e}	8.0^{e}
28DAH	8.0^{e}	8.0^{e}	8.0^{e}	0.0^{e}
35DAH	0.0^{f}	0.0^{f}	0.0	0.0
Mean	8.8	8.8	8.3	7.6
C.V.(%)	4.7	4.2	0.0	1.0

Means with the same letters within the same column are not significantly different at $P < 0.05$ using student Keuls-Newman (SNK) test for variables. C.V.=Coefficient of variability and S. E. Standard Error. DAH = days after harvest, HANGED = Groundnut hanged above ground level for observation

Table 3: Combined Analysis Percentage Loss oil content of Kernels at Kano and Yola in a combined analysis

Period of Observation	Kano/Yola (Oil Content) Kampala	Kano/Yola (Oil Content) Kwachamba	Kano/Yola (Moisture Content) Kampala	Kano/Yola (Moisture Content) Kwachamba
0DAH	55.7^{a}	34.3^{a}	12.3^{a}	12.3^{a}
HANGED	58.5^{a}	41.2^{a}	12.0^{b}	12.0^{b}
3DAH	42.6^{b}	24.1^{b}	10.0^{c}	10.2^{c}
7DAH	36.9^{c}	19.7^{c}	10.5^{c}	10.0^{c}
14DAH	32.4^{d}	13.0^{d}	9.0^{d}	9.0^{d}
21DAH	27.5^{e}	7.4^{e}	8.0^{e}	8.0^{e}
28DAH	22.3^{f}	3.7^{f}	8.0^{e}	4.0^{e}
35DAH	10.8^{g}	2.6^{g}	0.0	0.0
Mean	27.2	16.22	8.6	7.3
C.V.(%)	14.8	14.8	3.4	3.0

Means with the same letters within the same column are not significantly different at $P < 0.05$ using student Keuls-Newman (SNK) test for variables. C.V.=Coefficient of variability and S. E. Standard Error. DAH = days after harvest, HANGED = Groundnut hanged above ground level for observation