World Journal of Agricultural Research, 2014, Vol. 2, No. 6, 285-290
Available online at http://pubs.sciepub.com/wjar/2/6/7

DOI:10.12691/wjar-2-6-7

Control of *Oryctes Monoceros* on Date Palm Field in Sudan-Savannah Vegetative Zone of Nigeria

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Received October 20, 2014; Revised November 28, 2014; Accepted December 14, 2014

Abstract *Oryctes monoceros* is a serious pest of Date palm (Phoenix dactylifera L.*)* and accounts for 40% of losses in production every year. Because of the seriousness of the damage caused by this pest much time, energy, labour, money and other resources are employed to control the pest throughout the year. In addition to these losses, when these resources are quantified, it reduces the income that accrued to the farmers thereby making the Date palm industry unattractive. This research was designed to determine the frequency and distribution of *O. monoceros* infection in a year, so that a better pest management practice can be put in place to arrest the situation and also reduce the resources used to control the pest thereby increasing the farmers' income. The research was conducted in NIFOR, Date palm Sub-station, Dutse, Jigawa State, Nigeria. The result shows two peaks from April to June and the other from August to November with the crest occurring in October. With this kind of graph, the farmer can concentrate his/her energy and resources at these two peak periods and relaxed at other lower level of the graph that coincided with the period between December to March and the month of July every year. This will help the farmers to plan a better *Oryctes monoceros* management thereby reducing the damage caused by *O. monoceros* and at the same time reduce the cost of resources used on the Date palm farm, thereby increasing the yield and income for the farmers.

Keywords: *Phoenixdactylifera, Oryctes monoceros, production, resources, pest management, frequency, and damage*

Cite This Article: Sanusi Mohammed Kabiru, Omokhudu Collins Abiodun, and Yahaya Sadiq Abdul Rahman, "Control of *Oryctes Monoceros* on Date Palm Field in Sudan-Savannah Vegetative Zone of Nigeria." *World Journal of Agricultural Research*, vol. 2, no. 6 (2014): 285-290. doi: 10.12691/wjar-2-6-7.

1. Introduction

The botanical name of Date palm, *Phoenix dactylifera* L, is presumably derived from a Phoenician name "*Phoenix*" which means date palm, and "*dactylifera*" derived from a Greek word daktulos meaning a finger, illustrating the fruits' form [17]. Another source refers this botanical name to the legendary Egyptian bird "phoenix", which lived to be 500 years old, and cast itself into a fire from which it rose with renewed growth [24,27]. This resemblance to the date palm, which can also re-grow after fire damage, makes the bird and the date palm share this name, while "*dactylifera*" originates from the Hebrew word "dachel" which describes the fruit's shape [25].

Date palm is one of the oldest plants cultivated by man. It is a dioecious plant: with the male and female flowers on a separate plant. The Date palm produces the economically popular fruits called 'dates' that are consumed by human beings. Its origin is said to be either Mesopotamia or the Gulf region [26]. The exact origin of date palm is not certain, but evidence of its domestication in the Middle East goes back as 4000BC. The date trees are distributed widely throughout the world, from Pakistan in the East to North and South America in the West, and are concentrated in the near East: (GCC countries, Iraq, Iran) and North Africa [29].

Date palm, *Phoenix dactylifera* L. is believed to have been introduced into Nigeria in the early (17^{th}) seventeenth century through the trans-Saharan trade route from North Africa and the Middle East by traders and Muslims pilgrims on pilgrimage to the Holy Cites of Mecca and Medina. Since then, date palm cultivation has remained restricted within compounds, homesteads and orchards in the Northern parts of the country. In the Southern part, it is mainly planted as an ornamental for aesthetic purposes. [21].

The crop thrives well in the semi-arid of the northern part of the country between latitude 10°-14°N and longitude 4°-12°E [22]. The Date palm growing belt of Nigeria includes Kaduna, Katsina, Kano, Sokoto, Kebbi, Jigawa, Yobe, Borno, Gombe, Zamfara, Adamawa, Taraba and Bauchi States. These states form the main Date palm growing belt of the country. Also, because date palm grows on a wide variety of soils, it may be found in the lower latitudes within the derived savannah areas of Plateau, Nassarawa, Niger, Kwara and Benue States. These states form the marginal Date palm growing belt of Nigeria [21].

The Date palm has been in cultivation for over 400 years in Nigeria, however, no information is available on

the production capacity as well as its cost and returns structure in the country [14].According to Omamor [20],:the area under Date palm cultivation in Nigeria may well be over 1,466.80 hectares and the estimated production values of dates are over 21,700MT from the available data from the studies conducted in the following seven states of the country, namely Jigawa, Bauchi, Adamawa, Gombe, Kano, Yobe, and Borno [1].

The economic importance of date palm in the Nigeria economy cannot be overemphasized. The fruits have significantly provided income and improved the livelihood of the growers and marketers [20]. According to Dowsonand Aten [12], 200,000 families or 1,000,000 persons are supported entirely by date palm cultivation. There are however, over an estimated 1 million people who make their living by processing, packaging, transporting and selling dates. Dates are good sources of income to farmers in the date palm growing zone of Nigeria. According to Harbo and Isiaku [13], an average fruiting female palm in Nigeria can produce 40-60kg fruits/year which translates to #2,500 - #3750/palm/year and #500,000 - #750,000/ha when using a plant population of 200 palms /ha.

Dates are nutritious, being high in carbohydrates, fibre, potassium, vitamins, and minerals but low in fat and virtually free from cholesterol and sodium. Dates are high in Magnesium content (±600mg/kg dates) which makes date consumers safe to cancer [29].All the parts of the Date palm are useful, the leaves and stalks are used for roofing, the trunk for house structures like rafters, shelters and frames, the fibres from the leaves are used for making ropes, baskets, mats, the sap used as wine and the fruits for making syrups, confectioneries and sweetening powders. According to Omamor [20], Date palm more than any other crop of the arid zone in many places like the Middle East, North Africa and Namibia has proved to be most effective in addressing rural poverty.

Despite, all the enormous benefits of Date palm to the economy of Nigeria, there are many limitations affecting the optimal production of the cash crop in the country and the inability of the date palm industry to achieve her potential and be able to perform its statutory role: of supplying raw materials to the industrial sector, providing employment, generating foreign exchange and ensuring food security as well as economic growth of the nation. Of all the limitations affecting the Date palm industry, the infestation of the pest African rhinoceros beetle *Oryctes monoceros* is a serious issue. In order for Nigeria to increase her date palm production, the control of *O. monoceros* is important.

2. *Oryctes Monoceros*

Coconut, oil palm, and date palms are attacked by various species of rhinoceros beetles (Coleoptera: Scarabaeidae: Dynastinae). Its damage directlycauses loss of production or death and can lead to lethal secondary infestation by palm weevils (*Rhynchophorus*spp.). Attacks on date palms by larvae may cause the tree to fall over [10]. *O. monoceros* is a serious pest of coconut and other palms in West Africa [11] It is a dangerous pest of coconut and other palms causing up to 40% loss on annual production yield in the tropical Africa [8]. It is also documented as a major pest of palms in Nigeria [2,3,5].

Aisagbonhi and Aneni(2009) worked on the trapping of *O. monoceros* on date palm, coconut and oil palm field using pheromone as attractant at the same period of time (Between February-May 2009) and at their respective ecological zones. It was discovered that 31, 4 and 3 *O. monoceros* were recorded in that order [4]. This shows the seriousness of the pest to date palm in Nigeria*: O. monoceros* is very aggressive on young plants of less than 5 years old [15]. They feed on the delicate soft tissues of the young date palms or other succulent part of the plant.

It bore into the stem, leaves, or flowers of the Date palm leaving a characteristic chewed frass at their point of entry. If the pest is not noticed and removed on time, it end up eating up the central spear of the plant, making it dried and can easily be pulled off [6]. When this happened, the palm die or it may take two or more years for the date palm to regenerate. The palm that recovers present scissors-like cuts or wedge shape cuts on the foliage: [6].

The followings are some of the methods used to control *O. monoceros* on the field. The frequent monitoring or survey of the field to remove and kill the adults, use of chemicals like lambda-cyhalothrin which repelled adults and pheromone which trap the adults into another substance that kill it [23]. Other traditional farming techniques used are removal of old fallen trunks by burying, collecting or incinerating. Incinerating by fire has a harmful effect on the soil and the leguminous plant *Puerariajavanica* that could recover the old fallen trunks [15,16]. This method is very difficult to apply on quaternary sands, poor inorganic matter and nutrients. Other control methods such as the digging of grub lodging, manual collection of insect pests on attacked young plants and biological control by virus *Rhabdionvirusoryctes* were proposed [16]. Likewise, the frequent use of non-systemic insecticides is not always effective because of their short action duration in rainy season (less than one week). In the same way, these insecticides pollute the environment [18].

All these methods mentioned above used in the field to control *O. monoceros* are very expensive in relation to cost, time, labour use and resources. And in some cases the introduction of such substances to the environment may have adverse effect on the environment on a long run. This work is not intended to recommend any control method over the other but to determine the time when these pests are most prevalent on the field and to recommend to the farmer in a similar zone of Sudan savannah to know the best time to attack the pests in order to reduce their damages on the field. The farmers can now know the best integrated pest management techniques to use which could be singly or in conjunction with other control methods as his resources dictates. This will also help the farmers to make better use of their time, money and other resources rather than using them to control this pest throughout the year.

3. Objectives of the Study

(i.) The study was aimed at determining the time of the year when these pests infestation are high.

(ii.) The study was aimed at determining the frequency and the distribution of the pest infestation in the year.

(iii.) The study wants to determine the best pest management practice through the wise use of energy and resources.

(iv.) The study will enable the researcher to advice the farmers on when to best apply their efforts, energy and resources in order to control *O. monoceros.*

4. Materials and Methods

A. Study Area

The research was conducted at the Nigeria Institute For Oil palm Research (NIFOR), Date palm Sub-station, Dutse, Jigawa State, Nigeria. Dutse is located on the coordinate of latitude 11°50' N of the equator and longitude 9°25' E within the Sudan savannah ecological zone of Nigeria. The area has two seasons, wet season (May-September) and dry season (October-April). The mean annual rainfall and temperature are 715mm and 32°C respectively [19]. The station has 2000 ha of land planted with different varieties of date palm found in the different parts of the country.

B. Choice of trapping technique

As earlier stated, the purpose of this research is to use the best method available to determine the frequency and distribution of the attack of *O. monoceros* on the field throughout the year. Looking at various types of control methods for instance, the use of pheromone to control *O. monoceros* has been proved to be very effective [6,8], but the cost of a sachet could be exorbitant and not readily available in the local market. Also the life span of pheromone is two month without synergetic material. [9].This method will not be used for this research because of its high cost and lack of ready availability particularly locally.

Similarly, the use of other methods of bio pesticides (virus or predators) and chemical pesticides will not give accurate number of *O. monoceros* infestation per day because some of the pests may die outside the host in places where they cannot be seen to be counted. The survey method was used in this research. The survey method involved physically catching the *O. monoceros*, killing them and recording the number caught per day. Though this method is equally expensive in term of labour cost and the time spent on the operation but it is more accurate and reliable because of human involvement. It gives fairly accurate number of count of infestation per day. Usually the adult *O. monoceros* attack at night and they are caught in the morning before they leave either to another place or back to their breeding point.

C. Procedure

Daily survey of 1 hectare of young date palm plantation sat the Nigerian Institute for Oil palm Research (NIFOR), Date palm Sub-station, Dutse, Jigawa State, Nigeria. These palms have soft stems compared with the older palms in the station thereby attracting *O. monoceros*. During the survey, the entire plot was covered and the following things were looked out for, boring on the stem or ground around the root. A characteristic frass of chewed stem at point of entry on the stem or dislodgement of the soil around the root is an indicator of infestation. In the case of the characteristic frass, the index finger will be put into the hole, a smooth or leathery feeling of the *O. monoceros* wing confirms its present. A stick was used to dig it out of the stem. Sometimes if the *O. monoceros* has eaten deep into the stem, the stick would be used to kill it inside the stem and the *O. monoceros* counted among the day's number of catch.

Similarly, in the case of hole or dislodgement of soil around the root, a hole is dug around the root area to confirm its presence. The *O. monoceros* caught were taken to the laboratory in the polythene nylon. While in the laboratory, the *Oryctes monoceros* was thrown into a small plastic bucket containing chemical Decis 12 solution which was used to kill them. The number of *O. monoceros* caught per day was recorded throughout the months for a complete year. These records were taken for consecutive four (4) years of 2009,2010,2011 and 2012.(Table 1).

5. Results and Discussion

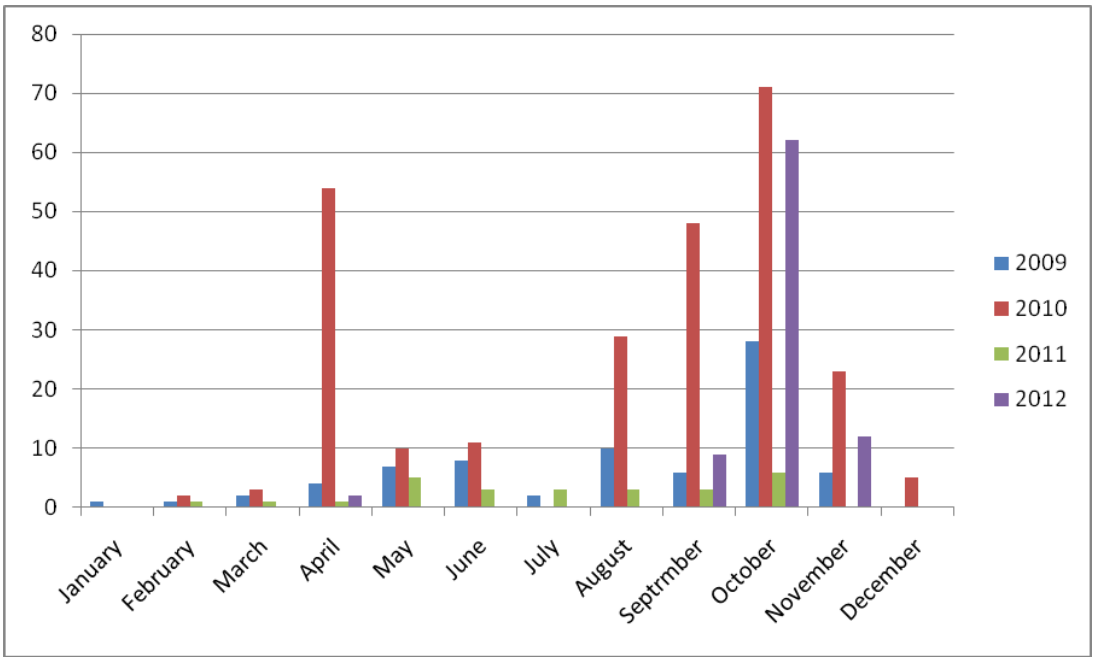
One (1) hectare of a piece of land was used for the research because of the cost of labour and the time to cover many hectare of land. The plot contains one hundred and seventy (170) young date palms at the spacing of 6m by 6m triangular. Every morning, the whole plot was surveyed from one palm to the other in an effort to physically catch and kill any *O. monoceros* found on or around the date palm. The numbers caught per day were recorded and the total numbers caught per month were also recorded for every month.

These processes continued for four (4) consecutive years (i.e. 2009, 2010, 2011 and 2012).The data obtained are presented in Table 1, showing the distribution of the number of *O. monoceros* caught for the four (4) years. Table 1, further revealed that 75, 256, 26 and 85 *O. monoceros* 2009, 2010, 2011 and 2012. Thus a total of 442 *O. monoceros* were caught throughout the four years.

Table 1. Shows number of *Oryctesmonocers* caught per month for four years

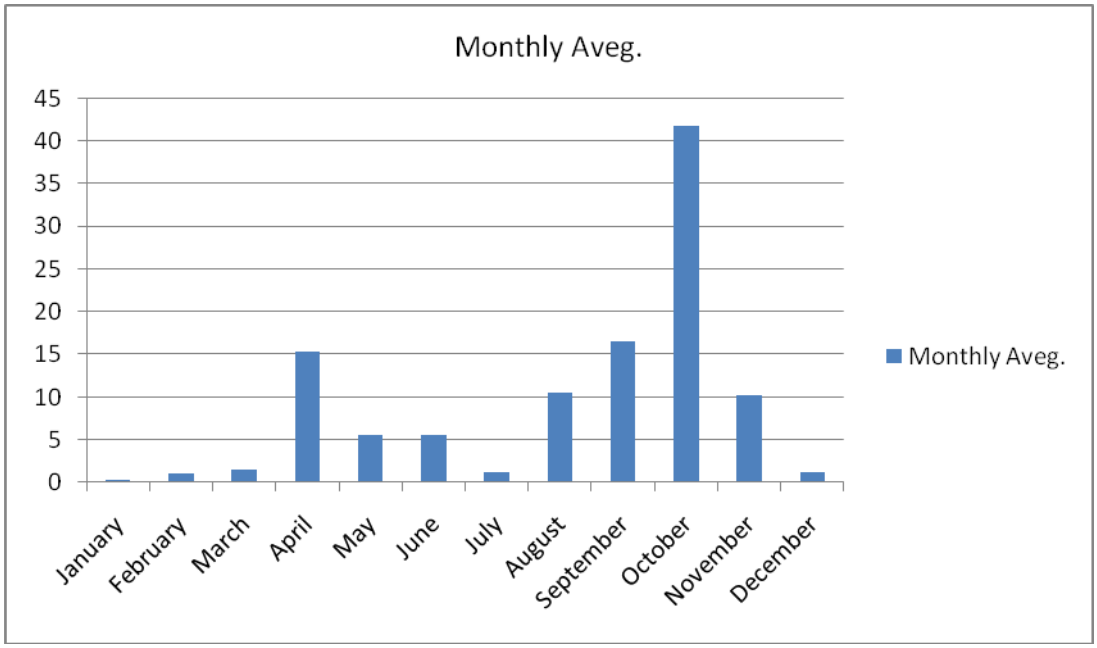
Month	2009	2010	2011	2012	Accumulative monthly total
January	1	0	0	0	1
February	1	2	1	0	4
March	2	3	1	0	6
April	4	54	1	2	61
May	7	10	5	0	22
June	8	11	3	0	22
July	2	0	3	0	5
August	10	29	3	0	42
September	6	48	3	9	66
October	28	71	6	62	167
November	6	23	0	12	41
December	0	5	0	0	5
Total yearly caught	75	256	26	85	442

Graph 1 further revealed that 2010 have the highest number of *O. monoceros* caught almost throughout the year followed by 2009,2012 and the least was 2011.



Graph 1. Shows the numbers of *Orycte monoceros* caught per month for the four years

Table 2, shows the monthly average *O. monoceros* caught for the four years period. The month of October has the highest monthly average of 41.75 per month, followed by September 16.5 per month, April 15.5 per month, August 10.5 per month, November 10.25 per month, May and June with 5.5 each per month, March 1.5 per month, December 1.25 per month, February 1.0 per month and the least January 0.25 per month. Graph 2 also shows the monthly average *O. monoceros* caught for the four years in a bar chart for better appreciation of the distribution of the *O. monoceros* infection in a year.



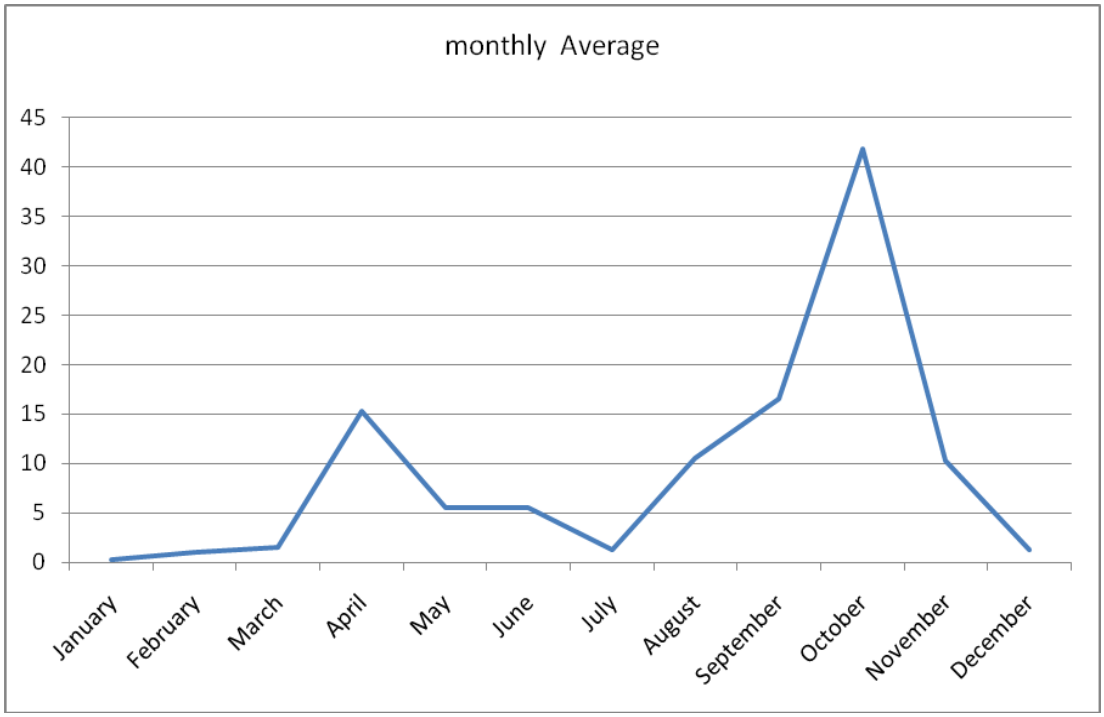
Graph 2. bar chart showing the average number of *Oryctes monoceros* caught per month

The yearly average number *O. monoceros* caught were presented in Table 3. The table revealed that 6.25, 21.33, 2.17 and 7.08 in 2009, 2010, 2011 and 2012 in that order. Thus the overall average yearly number of *O. monoceros* caught was 9.21. Using this overall average yearly number of *O. monoceros* caught of 9.21, the frequency of attack of *O. monoceros* in a year can be classified as high risk, moderate risk and low risk status. All monthly average number that are more than the overall yearly average (9.21) are considered as high risk, while monthly average number of between 4.0-9.2 are moderate risk and monthly average number less than 4.0 are low risk status. The monthly average classification goes thus:

High risk status months are: October (41.75), September (16.5), April (15.25), August (10.5) and November (10.25).

Moderate risk status months are: May (5.5), and June (5.5)

Low risk status months are: January (0.25), February (1.0), March (1.5), July (1.25) and December (1.25).



Graph 3. Shows the average number of *Oryctes monoceros* caught per month in a line form

Graph 3 revealed that we have two peaks of *Oryctes monoceros* infection in a year, that is April and October.

Table 2. Average number of *Oryctes monoceros* caught per month

Month	Average caught per month
January	0.25
February	1.00
March	1.50
April	15.25
May	5.50
June	5.50
July	1.25
August	10.50
September	16.50
October	41.75
November	10.25
December	1.25
Total Averages	109.5

Table 3. Yearly Averages number of *Oryctes monoceros* caught

Years	Yearly Average
2009	6.25
2010	21.33
2011	2.17
2012	7.08
Total	36.03
Overall Yearly average	9.21

6. Conclusion

A very good pest control technique for *O. monoceros* should start in the month of April spanning through moderate risk months of May, June and July a low risk month. Another comprehensive control starts in August when the *O. monoceros* infection begin to build up reaching its climax in October and terminating in November. The month of December to March is always at low risk. The Palms at this time of the year are at lower risk of *O. monoceros.* infestation.

Based on the analysis above, the months with low risk status can be managed with a single control method like survey method or chemical which are cheaper. For example the use of chemical to spray the farm in the month of December through to March is adequate. The month of April have high risk status, so more vigorous control methods can be used singly or in combination with other methods. The measures put in place will sustain the date palms through the moderate status months of May, June and July. Lastly, Another more vigorous control measures should start in August through the peak month of October and end in November. The research was conducted in the Sudan savannah area of Nigeria and can be used by Date palm farmer in similar geographical area.

With this knowledge of frequency of the pest infestation in the farm, the farmer can now design a better *O. monoceros* control method for the year to save cost, labour, energy, time, resources and money which can be used on other thing that will lead to the increase in the income of the farmer. Similarly, whichever *O.monoceros* control measures put in place help to reduce the destruction caused by *O. monoceros* leading to increase in Date palm production in Nigeria and the income of the farmers.

Acknowledgement

The Authors thank the Executive Director of NIFOR and the Officer in charge of NIFOR Date palm Sub-station, Dutse, Jigawa State, Nigeria for giving the trust and responsibility that led to this publication. We equally thank the entire Staff of NIFOR Date palm Sub-station, Dutse, Jigawa State, Nigeria for their support and encouragement.

Competing Interests

The Authors have no competing interest.

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