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Developing an Integrated Pest Management for the Control of Groundnut Aphid (*Aphis craccivora* Koch) [Homoptera: Aphididae] in Ganye Area Adamawa State-Nigeria

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Abstract

Field experiment was carried out under rain-fed conditions during the 2013 and 2014 cropping seasons at the Teaching and Research Farm of the Department of Agricultural Technology, Adamawa State College of Agriculture, Ganye, solely to develop an integrated pest management for the control of groundnut Aphid (*Aphis craccivora* Koch) [Homoptera: Aphididae]. The experimental Design used was the Randomized Complete Block Design (RCBD). Parameters measured were, average number of leaves per plot at 6 weeks after sowing, number of branches at 3 weeks after sowing, number of branches at 6 weeks after sowing, number of pods per plot, weight of harvested seeds per plot. The result obtained shows that, there was significant difference among the treatments in all the parameters measured at 0.05 level of probability using the Least Significant Difference (LSD). According to the results recorded, the highest mean yield of groundnut was obtained on plots treated with the combination of chemical and physical control methods (1444g) followed by plots treated with physical, chemical and cultural control methods combined (1296g). The highest mean number of pods per plant was recorded in the combination of physical, chemical and cultural control methods (18.00) followed by chemical and physical control methods as combined (15.00). The work shows that, the cultivation of groundnut with the control of groundnut Aphid (*Aphis craccivora* Koch) using integrated pest control applied as recommended facilitates better growth and guarantees good crop yield. The use of physical, chemical and cultural control method is profitable in Ganye Area of Adamawa State and is therefore suggested for use to local farmers.

Keywords: Aphid; Groundnut; Pest; Integrated; Control; Management; Yield.

1. Introduction

Groundnut is a leguminous crop believed to have originated from South America and cultivated groundnut is known to have been grown in both North and South America before the first European exploration of Americas in 1492 [1]. Today, Asia and Africa produce more than half of the groundnut produced in the world [2]. In Nigeria, it is produced in commercial quantity especially in the Northern part of the country mostly in states like Adamawa, Bauchi, Benue, Borno, Kano and Taraba [3]. Before the oil boom of the seventies, groundnut was one of the major export cash crops in the country [4]. Groundnut is one of the most nutritious leguminous crops with half of its seed oil, giving it a very high protein value [1]. Groundnut provides the required raw materials for making margarine, biscuits, cooking oil, animal feeds, local cake, husk for animal bedding and it's a potential for earning foreign exchange [5, 6].

Groundnut is susceptible to a wide range of insect pests in the field which causes moderate to severe damage throughout the developmental stage of the crop and among them Aphid, *Aphis craccivora* Koch (Homoptera: Aphididae) is one of the most destructive insect pests of groundnut [7]. Aphids not only cause loss in yield but also serve as a vector of diseases [8]. Both nymphs and adults suck the cell of the sap in groups and on leaves, shoots and reproductive parts. It also feed on the phloem sap causing malformations, stunting and even drying up of the plant parts and it is a potential vector of some diseases [9].

The need for an integrated approach for the control of this destructive insect pest prompted this work, taking into account the innermost damage and loss caused by the insect pest. Other methods have been used singly to combating the insect pest but there has been a high degree of resistance on the part of the insect pest. The present study was therefore designed with the aim of developing an integrated pest management for the control of the Aphid (*A. craccivora* Koch) [Homoptera: Aphididae] in the field.

2. Materials and Methods

2.1. Location of the Study Area

Field experiment was carried out at the Teaching and Research Farm of the Department of Agricultural Technology, Adamawa State College of Agriculture, Ganye during the 2013 and 2014 cropping seasons to develop an integrated pest management for the control of Aphids (*A. craccivora* Koch) [Homoptera: Aphididae].

2.2. Land Preparation and Experimental Design

The land was cleared, plough using tractor and harrowed into a very fine tilt. The plots were divided into the required plots. There were seven treatment replicated three times making a total of twenty one experimental plots prepared in a Randomized Complete Block Design (RCBD).

2.3. Source of Groundnut Seeds and Sowing

The groundnut seeds sown were bought from the Ganye main market and were properly sorted out for infested and damaged ones. The seeds were also dressed with Apron Plus before sowing to prevent activities of soil born pest. The seeds were sown on the flat surface two seeds per hole at the depth of 2cm.

2.4. Procedure for Integrated Insect Pests Control

Chemical control: Save application of karate was done at the recommended rate.

Physical control: Hand picking of the insects was done.

Cultural control: This was done by the manipulation of the various farming practices especially the practice of close-season and close-spacing.

Chemical and Physical control: Here, minimal amount of chemical was applied and later hand-picking of the insects was done.

Chemical and Cultural control: In this case, minimal application of chemical was carried out and the manipulation of the various farming practices such as close-season and close-spacing was done.

Physical and Cultural control: Hand-picking of the insects was done and at the same time various cultural practices were manipulated.

Zero Control: Here, no control measures were applied.

2.5. Data Collection

Number of leaves per plot at 2 weeks after sowing.

Average number of leaves per plot at 6 weeks after sowing.

Average number of branches at 3 weeks after sowing.

Average number of branches at 6 weeks after sowing.

Average number of pods per plot.

Average weight of harvested seeds per plot.

2.6. Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) appropriate to Randomized Complete Block Design (RCBD) according to Gomez and Gomez [10]. The treatment means were separated using the Least Significant Difference (LSD) method of mean separation at $P \leq 0.05$ level of probability.

3. Results

The highest average number of leaves at 3 weeks and at 6 weeks after sowing (Table 1) for both 2013 and 2014 cropping seasons were observed on plots applied with chemical alone (41.00 and 65.50; 44.10 and 64.00) followed by chemical and cultural control method (41.00 and 63.90; 44.00 and 63.50), chemical and physical control method (41.00 and 62.50; 42.00 and 62.50), cultural and physical control method (40.60 and 64.00; 42.50 and 62.50), cultural control method (40.10 and 62.10; 42.10 and 60.00), physical control method (40.00 and 61.00; 41.20 and 59.50) and the least was seen in the control (40.00 and 60.30; 40.00 and 59.00) at $P \leq 0.05$ level of significance using the LSD.

Table-1. Average Number of Leaves at 3 and 6 Weeks Per Plant Per Plot After Sowing

Treatments	3WAS		6WAS	
	2013	2014	2013	2014
Control (Untreated plots)	40.00^{ab}	40.00^{c}	60.30^{c}	59.00^{bc}
Chemical control	41.00^{a}	44.10^{a}	65.50^{a}	64.00^{a}
Physical control	40.00^{ab}	41.20^{b}	61.00^{bc}	59.50^{b}
Cultural control	40.10^{ab}	42.10^{ab}	62.10^{b}	60.00^{b}
Chemical and Physical control	41.00^{a}	42.00^{ab}	62.50^{b}	62.50^{ab}
Chemical and Cultural control	41.00^{a}	44.00^{a}	63.90^{ab}	63.50^{a}
Cultural and Physical control	40.60^{ab}	42.50^{ab}	64.00^{a}	62.50^{ab}

Means with the same letter(s) are not significantly different at $P \leq 0.05$ using the LSD.

The average number of branches per plant per plot at 3 and 6 weeks after sowing was reported in Table 2 for both 2013 and 2014 cropping seasons and it was observed that, chemical control method gave the highest results (30.30 and 10.00; 28.10 and 10.50) followed by chemical and cultural control method (28.10 and 9.50; 26.30 and 9.50), chemical and physical control method (28.00 and 9.00; 26.00 and 9.50), cultural and physical control method (27.00 and 9.00; 25.50 and 9.00), cultural control method (26.50 and 9.00; 24.90 and 8.50), cultural control method (26.50 and 9.00; 24.90 and 8.50), physical control method (24.60 and 8.50; 23.00 and 7.50) and the least was observed in the control (21.60 and 8.00; 20.00 and 6.00) at P≤ 0.05 level of significance using the LSD.

Table-2. Average Number of Branches Per Plant Per Plot at 3 and 6 Weeks After Sowing

Treatments	3WAS		6WAS	
	2013	2014	2013	2014
Control (Untreated plots)	21.60^{d}	20.00^{d}	8.00^{b}	6.00^{c}
Chemical control	30.30^{a}	28.10^{a}	10.00^{a}	10.50^{a}
Physical control	24.60^{c}	23.00^{c}	8.50^{b}	7.50^{b}
Cultural control	26.50^{b}	24.90^{c}	9.00^{ab}	9.50^{a}
Chemical and Physical control	28.00^{ab}	26.00^{ab}	9.00^{ab}	9.50^{a}
Chemical and Cultural control	28.10^{ab}	26.30^{ab}	9.50^{a}	9.50^{a}
Cultural and Physical control	27.60^{b}	25.50^{b}	9.00^{ab}	9.00^{ab}

Means with the same letter(s) are not significantly different at P≤ 0.05 using the LSD.

The average number of pods per plant and average weight of harvested seeds per plot is presented in Table 3. The results obtained shows that, the highest was recorded on plots treated with chemical (14.00 and 11.00; 13.60 and 10.10) followed by chemical and cultural control method (13.00 and 10. 50; 13.00 and 9.50), chemical and physical control method (12.00 and 9.50; 12.10 and 8.90), cultural and physical control method (11.50 and 9.50, 11.00 and 9.30), cultural control method (10.00 and 9.80; 9.00 and 8.50), physical control method (9.00 and 8.00; 9.00 and 8.20) and the least was reported in the controlled plots (6.00 and 4.50; 6.50 and 4.00) at P≤ 0.05 level of significance.

Table-3. Average Number of Pods Per Plant and Average Weight of Seeds Per Plot

Treatments	Average Number of Pods Per Plant		Average Weight of Seeds Per Plot	
	2013	2014	2013	2014
Control (Untreated plots)	6.00^{c}	6.50^{c}	4.50^{c}	4.00^{b}
Chemical control	14.00^{a}	13.60^{a}	11.00^{a}	10.10^{a}
Physical control	9.00^{b}	9.00^{b}	8.00^{b}	8.20^{ab}
Cultural control	10.00^{b}	9.80^{b}	9.00^{ab}	8.50^{ab}
Chemical and Physical control	12.00^{ab}	12.10^{ab}	9.50^{ab}	8.90^{ab}
Chemical and Cultural control	13.00^{a}	13.00^{a}	10.00^{a}	9.50^{a}
Cultural and Physical control	11.50^{ab}	11.00^{ab}	9.50^{ab}	9.30^{ab}

Means with the same letter(s) are not significantly different at P≤ 0.05 using the LSD.

4. Discussion

The results obtained clearly shows that, chemical control method against the effect of Aphid (*Aphis craccivora* Koch) is still the most effective method of insect pests control due mostly to its quick action and knock-down effect which is in consonant with Lale [11] who reported that synthetic insecticides are toxic to their target organisms at some stages of their life cycle. According to them, chemicals (synthetic insecticides) are compounds with repellant effects and may not necessarily be actively poisonous but render the stored produce unattractive and inaccessible to the insect pests by virtue of their odour, taste or physical properties. However, Oaya, *et al.* [12] observed that, with the fear of the negative effects of synthetic insecticides on the health of humans, livestock and the environment, these outstanding results may not be seen as positive and sustainable. The use of synthetic chemical in an integrated combination with cultural, physical control methods and also the use of cultural and physical control methods both in combinations and singly against the menace of Aphids gave good results close to that obtained when chemical was used alone as shown by the results. This is in agreement with Gill [13] who reported that, the harmonious use of various components of integrated pest management in a compatible manner guarantees a control that is save, cheap, harmless, biodegradable and eco-friendly.

It is also evident from the results obtained that, there is a serious need to make provision for the control of Aphids (*Aphis craccivora* Koch) especially in the study area as the result of the untreated plots (control plots) have shown. There was significant difference between the treated and the untreated plots, meaning that Aphid is one of the major insect pests of groundnut in Ganye. This assertion agrees with Oaya and Malgwi [14] who reported that leguminous crops are highly susceptible to insect pest infestation and therefore requires the application of control measures especially in an integrated means taking into cognisance the health of the humans, livestock and the protection of the environment.

5. Conclusion

It can be deduced from the results obtained that, the integration and combinations of minimal use of synthetic insecticides with either cultural, physical control methods gave considerable and sustainable results close to results obtained from plots treated with synthetic insecticide alone and better than when the control methods were used singly. With better and strict adherence to the recommended practices of integrated pest management or control, better performance and high yield in groundnut production could be achieved in Ganye area.

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