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Individual and Composite Effects of Chili pepper (Capsicum frutescens) and Neem (Azadirachta indica) Based Botanical Powdered Formulations Against Stemborer Damage on Sorghum in North Eastern Nigeria

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Abstract
This experiment examines the use of chilli pepper and neem based botanical formulations which are being promoted more intensively in Africa due to their effectiveness and safety in application. This study was therefore aimed at comparatively assessing the efficacy of chili pepper and neem based botanical formulations in controlling sorghum stemborer damage. Pure Neem Kernel Powder (NKP), Pure Chili Pepper Powder (CPP); 1:1, w/w: NKP + Finesand, CPP + Finesand and Carbaryl dust (a recommended synthetic insecticide) were evaluated for control of sorghum stemborers. The result shows that sorghum stemborer damage symptoms were significantly ($p<0.05$) controlled by the treatments when compared with the control. NKP + Finesand however, gave the best result with lowest percentage (%) of dead heart (0.03) at 35DAS, 0.05 at 45DAS and stem tunneling length percentage (6.03). NPK + Finesand also gave the highest grain yield (6.39kg/plot)
Keywords: Stemborer Botanicals Deadheart Finesand Chilli

INTRODUCTION

Sorghum bicolor (L) Moench is the most widely cultivated cereal crop in North Eastern part of Nigeria (Ajayi, 1998). In West Africa, Nigeria is the largest sorghum producer accounting for about 71% of the total regional sorghum output. Nigeria is also the third largest world producer of sorghum after the United States and India. However, 90% of sorghum produced by United States and India is used as animal feed, making Nigeria the world leading country for food grain sorghum production (MAFAP, 2013). Sorghum has traditional (variety of foods, beverages, drinks, thatching of roofs and fencing of compounds) and industrial uses (brewing and confectionaries) (MAFAP, 2013).

Lepidopterous stemborers are the major insect pests of sorghum in West Africa causing yield loss of between 10% to 80% (Kfir *et al.,* 2002). The lepidopterous stemborer species are found virtually everywhere sorghum is grown and they cause deadheart formation, stem/peduncle tunneling, production of chaffy panicles and a characteristic leaf damage (Mathieu *et al.,* 2006). Synergistic interactions between stem borer (*Stomopteryx nertaria*) and root knot nematode (*M. javanica*) showed that nematode together with the insect caused more damage (Prasad *et al.*, 1971). Therefore, the management of stemborer remains a key aspect of sorghum production as it remains one of the few challenges over which the farmers have some level of direct control.

Although synthetic insecticides can help alleviate these problems; complete control is seldomly achieved. The arbitrary use of synthetic insecticides has generated much health and environmental challenges and coupled with the requirement of some countries for no pesticide residues in agricultural products; the need to develop techniques to either eliminate or reduce the current level of chemical inputs in agricultural activities has been strengthened (Nancy and Wendy, 1991; Pavela, 2008, Okrikata and Oruonye, 2012). Cases of insect resistance have also been documented and resource constrained subsistence farmers cannot afford expensive chemicals, hence, a large number of these farmers do not attempt to manage stemborers, resulting in high grain yield loss and food insecurity (Oswald, 2005).

Some plants has been reported to contain chemicals that are toxic to insects and when extracted; these are called Botanicals. Generally, botanicals breakdown more rapidly than most conventional synthetic pesticides. Therefore, they are considered relatively environmentally safe and less likely to kill natural enemies than synthetic insecticides with longer residual activity. Available records shows the efficacy of neem and chili pepper based botanicals in insect pest management with oviposition deterrent, antifeedant, repellent, development inhibiting, reduced insect resistance and broad spectrum properties (Asawalam *et al.,* 2007, Okrikata and Anaso, 2008).

However, there is paucity of documented information on the use of these plant materials in the control of sorghum stemborer species. This study is therefore aimed at comparatively assessing the efficacy of chili

pepper and neem based botanical dust formulations in controlling sorghum stemborer damage.

MATERIALS AND METHODS

The experimental design was Randomised Complete Block Design (RCBD) in which the land was demarcated into four (4) blocks (replicates) and each block had six (6) plots with a size of 5m x 5m ($25m^2$). A recommended high-yielding sorghum cultivar (KSV4) was sown at 75cm x 40cm intra- and inter-row spacing, respectively. Before sowing, the seeds were dressed with metalaxyl (Apron Star 42 WS) to control pre- and post-emergence damping-off of seedlings and to prevent birds and ants from picking the seeds or destroying the seedlings. The treatments evaluated were;

1. Untreated Control
2. Treated Control (Carbaryl)
3. Pure Neem Kernel Powder (NKP)
4. NKP + Finesand
5. Pure Chili Pepper Powder (CPP)
6. CPP + Finesand

Air dried neem kernels were pounded with wooden mortar and pestle and then pulverised with the Molinex brand blender (MX-795N) to obtain the pure neem kernel powder (NKP). Again, to obtain the pure chili pepper powder; Chili Pepper fruit was air dried and ground into powder using the electric powered blender. Sand was collected from the river bank. Each of the diluents; the pure neem kernel powder, the pure chili pepper powder and, sand were seived with the Suplex Standard Test Sieves (Grade 250µm) to smoothen the powder by removing larger particles.

A thorough mixture (1:1 weight basis) of NKP + Finesand and CPP + Finesand was done in a wide container. The individual mixtures were further ground in the electric blender to ensure homogeneity of the mixture. For the purpose of comparison, Carbaryl (Sevin 85) was used as treated control. Meanwhile, in order to ensure good stemborers population build-up, the crops were sown a few weeks after rain establishment.

At twenty (20) days after sowing (DAS), the treatments were applied by introducing approximately 5g of each pesticide formulation into the whorl of sorghum plants. This was repeated at ten (10) days intervals; four (4) such applications were made until 50% booting stage.

The data collected were % deadhearts at 35 and 45 DAS, % stem tunneling length, % incidence of chaffy panicles, % stem breakage and Grain yield (kg/plot).

The data collected were subjected to Analysis of Variance (ANOVA) and Means separated by Least Significance Difference (LSD) using the Statistical software SPSS Version 16.

RESULTS

The results presented in Tables 1 and 2 shows the effect of the treatments on Deadheart formation, stem tunneling length, incidence of chaffy panicles, and incidence of stem breakage which are all stemborer damage symptoms and the attendant effect of these on grain yield.

Plates 1a, 1b, 2a and 2b shows deadhearts, stem tunneling, chaffy panicle and stalk breakage caused by stemborers, respectively.

The results which are presented in Tables 1 and 2 evidently shows that the different botanical treatments were significantly ($p<0.05$) effective in managing stemborer attack when compared to the untreated control and that there is no significant difference ($p<0.05$) between the botanical formulations and carbaryl (a synthetic insecticide) in stemborer management.

Table 1. Effect of Treatments on the incidence of Deadhearts and Stem Tunneling caused by Sorghum stemborers

Treatments	Deadhearts at 35 DAS (%)	Deadhearts at 45 DAS (%)	Stem Tunneling Length (%)
Untreated Control	1.84a	9.17a	27.13a
Carbaryl dust	0.08b	0.11b	6.13b
NKP	0.06b	0.10b	6.17b
NKP + Finesand	0.03b	0.05b	6.03b
CPP	0.07b	0.10b	6.12b
CPP + Finesand	0.05b	0.07b	6.11b
Mean	0.36	1.60	9.61
SE±	0.36	0.36	1.90

1. NKP = Pure Neem Kernel Powder
2. CPP = Pure Chili Pepper Powder
3. Values with identical alphabets do not differ significantly at $p>0.05$

Plate 1a: Deadheart resulting from borers killing the central leaves by cutting the growing point

Plate 1b: Stem tunneling by stemborers.

Table 2. Effect of Treatments on the incidence of Chaffy Panicles and Stem Breakage caused by Sorghum stemborers

Treatments	Incidence of Chaffy Panicles (%)	Stem breakage (%)	Grain Yield (Kg/Plot)
Untreated Control	2.03a	1.84a	4.95a
Carbaryl dust	0.30b	0.22b	6.19b
NKP	0.12b	0.33b	6.34b
NKP + Finesand	0.27b	0.41b	6.39b
CPP	0.07b	0.22b	6.32b
CPP + Finesand	0.24b	0.33b	6.33b
Mean	0.51	0.56	6.09
SE±	0.74	0.15	0.13

1. NKP = PureNeem Kernel Powder
2. CPP = Pure Chili Pepper Powder
3. Values with Identical Alphabets do not differ significantly at p>0.05

Plate 2a: Incidence of Chaffy Panicle

Plate 2b: Stalk breakage due to stalk weakening as a result of extensive tunneling of stem by borers coupled with wind action

DISCUSSION

The results of the research shows that the botanical formulations were effective in controlling stemborer damage symptoms (deadhearts, stem tunneling, incidence of chaffy panicles and stem breakage) in sorghum which also improved yield. This agrees with the observation of Okrikata and Anaso, 2008 who reported a significant ($p<0.05$) reduction on stemborer damage and an increase in grain yield of sorghum plots treated with neem based botanicals when compared with untreated control.

Aside having insecticidal, repellent, insect growth regulatory, sterility induction, and oviposition inhibiting properties (Satti *et al*., 2013), neem based insecticides have been discovered to have systemic action (Mordue and Blackwell, 1993). Chili pepper based insecticides on the other hand have also been reported to have insecticidal, stomach poison, repellent, antifeedant and fumigant effect on a wide array of insect pests (Adedire and Ajayi, 1996, Asawalam *et al.,* 2007)

While there was no perfect trend observed in the ability of the pesticides used in controlling stemborer damage symptoms, and while also noting that there was no significant difference ($p>0.05$) between the botanicals used and carbaryl (synthetic insecticide); it was observed that overall, NKP + finesand was quite outstanding in checking stemborer damage which resulted in the highest grain yield per plot.

The overall effectiveness of the botanicals used over the synthetic (carbaryl) also agrees with the findings of Seshu Reddy, 1988, Mailu, 1997, Rensburg and Hamburg, 1975;Danka, 2000, Asawalam *et al.,* 2007, Okrikata and Anaso, 2008 who all reported that botanicals gave similar and sometimes even better level of control when compared synthetic insecticides.

CONCLUSION

The research findings shows that the plant based pesticide formulations used were significantly ($p<0.05$) effective when compared with the untreated control in checking stemborer damage symptoms with a resultant high yield. The results also shows that, there is no significant difference between the plant based pesticide used and carbaryl (a recommended synthetic insecticide). While we do not suggest that these botanicals replace carbaryl or any other recommended synthetic insecticide against sorghum stemborers, they can be adopted as useful components of the Integrated Pest Management (IPM) for sorghum stemborers.

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