

Original Article

Evaluation of Aqueous Extracts of Neem kernels and leaves for the control of spotted stem borer *Chilo partellus* Swinhoe, in sorghum at New Halfa, Sudan

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Abstract: A field experiment was conducted to study the effect of different concentrations of aqueous extracts of Neem kernels (NK) and Neem leaves (NL) on the incidence and damage of spotted stem borer in sorghum during 2011/12-2012/13 seasons at New Halfa Research Station farm. Sorghum variety Tabat was used. The experiment was laid in a RCB design with four replicates and seven treatments. These were: NK at kg/ 30 and 40 Liter of water, NL at kg/15 and 20 Liter of water, Furadan 10% G at 15kg/F and Malathion 57% EC at 2L/F as standard and the untreated control. A liquid soap was added to Neem treatments as an emulsifying agent. Three sprayings were applied using knapsack sprayer starting two weeks after emergence with 10 days intervals. Data on percent deadheart, percent leaf damage plants, percent stem tunneling, number of borer holes per plant and grain yield were recorded. Results indicated that, all treatments were highly significantly ($P < 0.001$) reduced stem borer damage and increased the grain yield compared to the untreated one. NK at kg/ 40 L of water was the best in reducing stem borer damage and increasing grain yield comparable to the standard treatment Furadan 10% G at 15 Kg/F.

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INTRODUCTION

It was reported by (Schmutterer, 1969) in Sudan that cereals are often badly infested by stem borers, namely *Sesamia cretica* Led., *S calamistis* Hmps., *Busseola fusca* (Full.) and the spotted stem borer *Chilo partellus* (Swinh.). The later is the most serious pest that severely attacks sorghum, maize, wheat and a number of wild grasses of the genus *Sorghum* resulted in stunted and grain reduced plants. Recently it has been considered as the major constraint to sorghum production in New Halfa scheme. Reliable data on yield loss caused by stem borers are not available. However, a field farmers survey was conducted during 2010/2011 season revealed that severely infestation and damage which was reached to 100% in some surveyed fields was occurred. It was reported that chemical control of *C. partellus* is rather difficult and may perhaps often be uneconomic if the treatment has to be repeated several times in order to obtain satisfactory results although some insecticides were found to be successful when applied as granules in the funnel of sorghum and maize young plants at the beginning of the stem borer attack (Schmutterer, 1969). In addition to their serious health hazard and environmentally destructive it can result in the accumulation of

residues of the harvested produce. To overcome these problems one of the best control measures is the use of plant origin products because of their biodegradability, least persistence and least toxic to non-target organisms, economic and easy availability. Among the natural plant products, neem and its derivatives which have been recently reported by many workers to be effective for control of stem borers on different crops particularly sorghum and maize (Ahmed et al., 2002; Spurthi and Shekharappa, 2007; Khan et al., 2007; Jose et al. 2008; Aboubakary et al., 2008; Anaso, 2008; Gupta et al., 2010 and Debashri, M. and Tamal, M.(2012). The present study was conducted to evaluate the effectiveness of aqueous extracts of neem kernel and leaf on the management of spotted stem borer *C. partellus*, on sorghum.

MATERIALS AND METHODS

Field experiment was conducted during 2011/12-2012/13 seasons at New Halfa Research Station farm. Land preparation and sowing was carried out using the recommended agronomic practices released by Agricultural Research Corporation, Sudan. Sorghum variety Tabat was planted on 17th July, 2011 and 18th July, 2012. The plot size was 20

m², consisted of 5 ridges, 0.8 m apart x 5 m long. The treatments were consisted of four Neem extracts with two synthetic insecticides and the untreated control. The seven treatments were laid out in randomized complete block design replicated four times.

Preparation of Neem extracts

Mature Neem (*Azadirachta indica*) seeds were collected and their outer coat is removed and pounded using an electric blender to obtain the fine Neem kernel powder (NKP). Fresh Neem leaves were collected and dried under shed for about 7 days then prepared as fine powders using an electric blender to obtain the fine Neem leaf powder (NLP). Prepared powders were then poured into glass bottles tidily covered and stored under room conditions until ready to use. Specific weight of each powder, as shown below in tables 1 - 5, was put into plastic pots, one liter of water was added into each pot. The soaked powders were left overnight in the laboratory for 24 hours at room temperature. Next day three liters of water were added to make four liters of each mixture. The mixtures were hand stirred, filtered separately with a muslin cloth. 25 ml of washing liquid soap (Sheek, 2011 product) was added and into each filtrate as an emulsifying agent. The aqueous extracts were then ready to use. Furadan 10% G and Malathion 57% EC purchased from local market were used as standard checks at recommended rates. The insecticide Malathion and the aqueous extracts were applied as sprays using knapsack sprayer starting at two weeks after emergence with ten days intervals. Three sprayings were done for each treatment. While Furadan as a granule was applied once by introducing the calculated amounts into the whorl of sorghum plants at two weeks after plants emergence.

In each plot the three inner ridges were used to take the following data:

- i. Percentage dead-heart: The number of plants with deadhearts were recorded two times, at 25 and 35 days after emergence (DAE). The percentage deadheart was calculated by dividing the number of plants with deadhearts by the total number of plants in the three inner ridges and multiplied by hundred.
- ii. Percentage leaf infested plants: The number of plants with infested leaves were recorded at 35 days after emergence (DAE). The percentage infested plants was calculated by dividing the number of infested plants by the total number of plants in the three inner ridges and multiplied by hundred.

iii. Number of exit and entry holes/meter plant height: After harvest, five plants were randomly selected from each plot, the leaf sheath was removed, the stem length (cm) of each plant was measured, the number of exit and entry holes per each plant were counted, later on they were divided by the stem length and multiplied by hundred to give the number of holes/meter plant height.

iv. Percentage stem tunneling: The same selected plants for exit and entry holes were used. Each plant was dissected longitudinally and tunneled length was measured in centimeters. Then the tunneled length was divided by the stem length (cm) and multiplied by hundred to give the percentage stem tunneling.

v. Grain yield kg/feddan. The grain yield in kg per the three inner ridges were converted to yield kg/feddan.

Data were transformed when needed to appropriate transformation and subjected to analysis of variance (ANOVA) using an MSTATC program. Later on means were separated according to Duncan's Multiple Range Test (DMRT). Combined analysis was carried out for two seasons.

RESULTS AND DISCUSSION

All treatments were highly significantly ($P < 0.001$) reduced percent dead heart at 25 and 35 DAE and percent infested plants compared to the untreated control (Table 1). The percent dead heart ranged from 1.3 to 5.2 and 0.9 to 8.3 at 25 and 35 DAE, respectively. While percent infested plants ranged from 6.6 to 22.2. No differences between treatments were found. However, at 35 DAE among the four neem treatments NK (kg/30L water) was found to be superior with respect to reduction of percent dead heart (2.7%) due to stem borer and it was on par with the standard check Malathion 57% EC (2.2%). However, Furadan 10% G was recorded least (0.9%) percent dead heart and ranked first in reducing damage among all the treatments.

These results are in conformity with the findings of Spurthi and Shekharappa (2007) and Jose et al. (2007) who have reported that aqueous extracts of neem seed kernel was effective in reducing *Chilo partellus* (Swinhoe) damage in sorghum and the least percent damage and percent dead heart were recorded on Carbofuran 3G which has the same active ingredient as in Furadan 10% G.

Percent stem tunneling ranged from 86.8 to 96.0 percent among all treatments without any significant differences between them (Table 2).

These findings are disagree with those of Jose et al. (2007) who reported that tunneling was least in NSKE 5% among different bio-pesticides tested and it was on par with the standard checks endosulfan 35EC and carbofuran 3G and that all bio-pesticides treatments were found effective in preventing tunneling due to stem borer compared with the untreated control. The number of exit holes/plant due to stem borer damage ranged from 26.7 to 32.2 and also there was no significant difference among them (Table 2). This result is in disagree with that obtained by Anaso (2008) who stated that diluted NKP and Carbaryl significantly ($P < 0.01$) reduced stalk and peduncle boring below the untreated check.

Due to highly significant reduction of symptoms of deadheart and leaf infested plants attacked by *C. partellus* in all different neem based formulations and insecticides evaluated, there were highly

significant grain yield increase above the untreated control (Table 2). Among different neem based formulations evaluated, NK at (kg/40L water) recorded maximum percent yield increase over control (34.7%) which was on par with standard check Furadan 10%G which recorded (39.2%) yield increase over control. This results are in close agreement with Spurthi and Shekharappa (2007) who reported that among different bio-pesticides tested in sole sorghum *B. thuringiensis* and NSKE have recorded higher grain yield of 13.0 and 12.5 q/ha, respectively, while the standard check insecticide endosulfan was superior to all treatments (13.5 q/ha). It was concluded from the study that NK aqueous extracts spraying at (40k/L water) and Furadan 10% G at 15kg/feddan as granular application can be used for the effective management of *C. partellus* on sorghum due to their best efficacy and higher returns specially in small areas such as the experimental plots.

Table 1: Effect of aqueous Neem seed and leaf extracts on % dead heart and % infested plants due to spotted stem borer *Chilo partellus*, on sorghum during 2011/2012 and 2012/2013 seasons

Treatments (Dosage rate)	Mean % dead heart		Mean % infested plants
	25 DAE	35 DAE	
Neem kernel (kg/30L water)	1.4 (1.9) b	1.7 (2.7) bc	3.4 (11.8) b
Neem kernel (kg/40L water)	1.4 (1.7) b	1.8 (2.8) b	3.2 (10.6) b
Neem leaf (kg/15L water)	1.5 (2.1) b	2.0 (3.8) b	3.3 (11.1) b
Neem leaf (kg/20L water)	1.5 (2.1) b	2.0 (3.5) b	3.7 (13.3) b
Furadan 10% G at 15kg/fed	1.2 (1.3) b	1.2 (0.9) c	2.6 (06.6) b
Malathion 57% EC at 2L/fed	1.4 (1.7) b	1.5 (2.2) bc	3.2 (10.7) b
Untreated (control)	2.3 (5.2) a	2.9 (8.3) a	4.7 (22.2) a
Grand mean	1.5	1.9	3.5
SE $\pm$	0.19 ***	0.15 ***	0.27 ***
C.V%	24.3	16.1	15.6

DAE = Days After Emergence.

Data were transformed to $\sqrt{X}$. Actual means in brackets.

*** = Significant at 0.001 levels of probability. Means within the same column followed by the same letter(s) are not significantly different according to DMRT at 0.05 level of probability

Table 2: Effect of aqueous Neem seed and leaf extracts on mean % stem tunneling, number of exit holes/meter plant height and sorghum grain yield during 2011/2012 and 2012/2013 seasons.

Treatments (Dosage rate)	%stem tunneling	No. of exit holes/ meter plant height	Grain yield (kg/fed.)	% yield increase above control
Neem kernel (kg/30L water)	9.4 (88.2)	28.7	859.5 ab	30.1
Neem kernel (kg/40L water)	9.8 (95.1)	26.7	919.3 a	34.7
Neem leaf (kg/15L water)	9.4 (86.8)	29.4	823.3 ab	27.0
Neem leaf (kg/20L water)	9.4 (88.3)	28.4	761.6 ab	21.1
Furadan 10% G at 15kg/fed	9.7 (93.2)	31.4	988.0 a	39.2
Malathion 57% EC at 2L/fed	9.8 (96.0)	30.3	877.1 ab	31.5
Untreated (control)	9.5 (90.7)	32.2	600.6 b	-
Grand mean	9.6	29.6	832.8	
SE $\pm$	0.3 ns	2.5 ns	73.8 ***	
C.V%	5.7	17.0	17.7	

Data were transformed to $\sqrt{X}$. Actual means in brackets.

*** = Significant at 0.001 levels of probability, ns = not significant.

Means within the same column followed by the same letter(s) are not significantly different according to DMRT at 0.05 level of probability

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