Vol. 12(1), pp. 1-6, January-June 2020
DOI: 10.5897/JABSD2019.0353
Article Number: 52ADD9563199
ISSN: 2141-2340

http://www.academicjournals.org/JABSD

Journal of Agricultural Biotechnology and Sustainable Development

Full Length Research

Laboratory evaluation of some botanicals and fermented cow urine against *Chilo partellus* (Swinhoe) (Lepidoptera: Crambidae)

Adem Nega and Emana Getu

Department of Zoological Sciences, College of Natural and Computational Sciences, Addis Ababa University, Ethiopia.

Received 14 May, 2019; Accepted 2 September, 2019

Chilo partellus **(Swinhoe) is the most important destructive pest of sorghum in Africa which results in complete crop loss. Currently the management strategies rely heavily on chemical insecticides, which do not provide effective control. The uses of bio-pesticides are encouraging over chemical pesticides. The study was carried out to identify effective plant and animal products and optimum concentrations against *C. partellus*. 7 treatments each at 3 concentrations (2.0, 2.5 and 3.0 g and 1.0, 1.5 and 2.0 ml) were applied on 2nd and/or 3rd instars larvae. The untreated check was used for comparison. The experiment was laid out in a completely randomized design with 3 replications for each concentration. Result revealed among the treatments *Milletia ferruginea* Hochst seed powder and aqua extract caused the highest (100%) mortality at 3 g and 2.0 ml concentration on the 2nd day. Cow urine and the mixture (*M. ferruginea*+cow urine) were recorded higher efficacy mean mortality (86.7 and 93.3%) at 3.0 ml concentration within 3 days respectively. *Phytolacca dodecandra* L. seed powder, aqua extract and the mixture (*P. dodecandra*+cow urine) showed significantly lower efficacy mean mortality. In conclusion, *M. ferruginea* powder and aqua extract, cow urine and combination of *M. ferruginea* with cow urine were identified as good alternatives to chemical pesticides against *C. partellus.***

Key words: *Chilo partellus*, cow urine, *Milletia ferruginea*, *Phytolacca dodecandra,* sorghum.

INTRODUCTION

Chilo partellus (Swinhoe) (Lepidoptera: Crambidae) is considered to be the most important pest of sorghum in sub-Saharan Africa including Ethiopia (Damte and Chichaybelu, 2002; Tesfaye and Gautam, 2003). Application of chemical insecticides has been recommended to protect sorghum from *C. partellus* attack. However, chemicals are too expensive and are the cause of environmental and health hazards if not used judiciously (Gupta et al., 2010). Pesticide that have a sub-lethal toxicity to target pests, but still kill natural enemies of the pests may cause target pests to increase, resulting in even higher yield losses (Islam et al., 2013;

*Corresponding author. E-mail: adem.nega1@gmail.com

Table 1. Treatments used in the management *of C. partellus* on sorghum.

S/N	Treatment	Common/local name	Concentration		
			Day 1	Day 2	Day 3
1	*M. ferruginea* powder	Birbira	1.0 mg	1.5 mg	2.0 mg
2	*P. dodecandra* powder	Endode	1.0 mg	1.5 mg	2.0 mg
3	*M. ferruginea* aqua extract	-	1.0 ml	1.5 ml	2.0 ml
4	*P. dodecandra* aqua extract	-	1.0 ml	1.5 ml	2.0 ml
5	Fermented cow urine	Cow urine	1.0 ml	1.5 ml	2.0 ml
6	*M. ferruginea* aqua extract + FCU	-	1.0 ml	1.5 ml	2.0 ml
7	*P. dodecandra* aqua extract + FCU	-	1.0 ml	1.5 ml	2.0 ml
8	Control (untreated check)	-	-	-	-

FCU- fermented cow urine.

Khan et al., 2015). So these facts brought the need for search alternative pest control options, especially those that are cost effective and environmentally friendly.

The use of plant and animal-based insecticides increases from time to time not only due to their availability but also their simplicity to prepare and increase quality of the crop in taste (Getu et al., 2008; Kareru et al., 2013). They are not phytotoxic, easy to grow, cause no hazard to non-target organisms, wild life, humans or the environment (Islam et al., 2013; Tilahun and Azerefegne, 2013). In most cases their bioactive compounds are fairly complex groups; thereby making it more difficult for the pest to develop resistance (Wahedi et al., 2016). However, there is no or less study carried out, or documented report regarding plant and animal-based insecticides efficacy test for managing *C. partellus*. Therefore, screening the effective plant and animal-based insecticides is crucial against this pest. Thus, this study was conducted to determine the efficacy of specific plant and animals-based insecticides and determine the best product that controls *C. partellus*.

MATERIALS AND METHODS

The study was conducted at Kombolcha Plant Health Clinic, Ethiopia, under ambient laboratory conditions in 2016/17. Eggs were collected from field 1 to 3 weeks after plants emergence. After 5 to 11 days, the newly hatched larvae were reared in a 600 ml rearing plastic beakers the top of which was covered with nylon mesh. Larvae were supplied pesticide free fresh sorghum leaves and stems. Seeds of *M. ferruginea* Birbira and *P. dodecandra* Endod were collected from Addis Ababa University, Arat-kilo Campus and road sides grown voluntarily plantations at Dessie town, Ethiopia. Cow urine was collected from the local dairy farm in the morning into a plastic container. Seeds were washed, dried and grounded into fine powder manually using home-made mortar and pestle (Jembere, 2002). The powder was kept separately in packed plastic bags in a refrigerator at 4°C until needed for its crude extractions. Each sample of 50 gm powder was weighed separately and mixed with 100 ml water in a separate flask for crude extractions (Venkat et al., 2012). The mixtures were stirred for 15 min using a magnetic stirrer until homogenous solutions was formed and then left to stand.

Each mixture was filtered through double folds Muslin cloth. After evaporating the solvent the solid extract was then used to prepare the serial dilutions. Each serial concentration was prepared by dissolving 100, 150 and 200 mg of each fine powder with 100 ml of distilled water (that is, to form 1, 1.5 and 2 ml concentrations) levels respectively. Cow urine was left 6±1 days in the shade at room temperature for fermentation; it was sieved and diluted with water at the ratio of 1:3 (v/v) (Verena, 2007). Treatment combinations were prepared by mixing equal volumes of cow urine with equal volume of each extracts. Treatments were applied on the 10, 2nd and/or 3rd instars larvae per Petri dish, and preserved food with pieces of sorghum stalk. Water was used as a control and all treatments were compared with the untreated check. All treatments each at 3 concentrations levels were laid out in a complete randomized design (CRD) with 3 replications for each concentration (Table 1). The numbers of larvae were recorded before spray and every 24 h after treatment applications till 3 days.

Data analysis

Data were subjected to analysis of variance (ANOVA) and significant means were separated by Least Significant Difference (LSD) at 0.05 level, using SAS program version 9.1 (SAS, 2009).

RESULTS

The effect of biopesticides on larval mortality of *C. partellus* after 1 day of treatment application

Effect of bio-pesticides on larvae of *C. partellus* showed that in all the rates, significant (P<0.05) differences were found among the treatments (Table 2). After 1-day treatment application, about 0.3 to 86.6% mortality was observed due to application of different bio-pesticide when compared to untreated control (0.3%). All treatments caused rate dependent mortality. The highest percent (86.6%) larval mortality was recorded on *M. ferruginea* aqua extract at the higher (2.0 ml) rate and the lowest percent (0.3%) mortality was observed at the lower (2 g and 1 ml) rates of *P. dodecandra* powder, aqua extract and cow urine + *P. dodecandra* respectively, however mortality at these treatments was not

Table 2. Mean percentage (±SE) of cumulative mortality of *C. partellus* larvae at different application rates of bio-insecticides.

Botanical	1 day after treatment application		
	Rates (g) and ml/lt		
Powder (g)	**2.0**	**2.5**	**3.0**
M. furrgunea powder	33.3±8.8[Cab]	53.3±3.3[Bab]	73.3±3.3[Abc]
P. dodecandra powder	0.3±0.3[Cf]	16.6±3.3[Bcd]	26.6±3.3[Bef]
Aqua extracts and mixtures (ml)	**1.0**	**1.5**	**2.0**
M. ferruginea aqua extracts	26.6±12.0[Dbc]	53.3±8.8[Cab]	86.6±3.3[Bac]
P. dodecandra aqua extracts	0.3±0.3[Cf]	16.6±6.6[Acd]	20.0±5.7[Afg]
Cow urine	16.6±6.6[Dcd]	30.0±5.7[Cb]	50.0±5.7[Bde]
Cow urine + *M. ferruginea*	13.3±3.3[Dde]	26.6±0.3[Bbc]	56.6±8.8[Abd]
Cow urine + *P.dodecandra*	0.3±0.3[Cf]	20.0±5.7[Bcd]	26.6±8.8[Aef]
Control (Untreated check)	***0.3±0.3**[Af]*	***0.3±0.3**[Af]*	***0.3±0.3**[Af]*
SE±	***4.2***	***4.2***	***4.2***
CV (%)	7.8	7.8	7.8
LSD at 0.05	12.2	12.2	12.2

Means followed by upper letter across row and lower letter within column are not significantly different at 5% level, LSD.

statistically different from the control.

The effect of biopesticides on larval mortality of *C. partellus* after 2 days of treatment application

Data on the mortality of the 2nd and 3rd instar larvae of *C. partellus* showed that all the treatments were highly significant (P<0.05) and superior over the control after 2 days treatment application (Table 3). All botanical treatments showed significantly (p< higher mortality) at the 2nd days of exposure time compared to the control. The highest larval (100%) mortality was recorded on *M. ferruginea* powder and aqua extract at the higher (3 g) rate. Mortality at this rate was not statistically different from 2.5 g powder. The highest larval mortality recorded for *M. ferruginea* aqua extract was at 2.0 ml. *P. dodecandra* aqua extracts caused significantly lower (20.3%) mortality at the lower (1.0 ml) rate of application (Table 3).

The effect of biopesticides on larval mortality of *C. partellus* after 3 days of treatment application

Significant lethal effects of all the treatments on *C. partellus* larvae were found 3 days after treatment compared with the control. Mortality was increased as the rate of the extract applied increased in concentration. All botanical treatments showed significantly (p< higher mortality) at 3 days of exposure time compared to the control. The highest (100%) larval mortality was recorded on *M. furrgunea* powder and aqua extract at the higher rates. Mortality at the lower rates was not statistically different from the higher rates applications. The other treatments showed the highest larval mortality at the higher rates of applications. The lowest (26.6%) mortality was recorded in aqua extracts of *P. dodecandra* at the rate of 1.0 ml (Table 4).

DISCUSSION

Result of the laboratory experiment indicated that all treatments significantly resulted in *C. partellus* larval mortality compared to the untreated check. These results are in agreement with previous work of Shiberu et al. (2013) who reported that botanical products like water extracts of Birbira, Endode, Neem and Pyrethrum gave good control of Termites pests.

There were high significant (P<0.01) difference among treatments in laboratory after exposure of 72 h. Among all the treatments used *M. ferruginea* powder and aqua extract were found to be the most toxic and caused the highest (86.67-100%) mortality within 48 h at the higher rate of applications. *M. ferruginea* seeds powder and aqua extract have been reported to have insecticidal properties. For example, *M. ferruginea* seed powder extracts resulted in a 96% mortality rate of maize weevils, *Sitophillus zeamais* 72 days after treatment application (Jembere, 2002).

The toxicity of the plant can be attributed to rotenone which is one of the dominant compounds found in the seed and stem bark of *M. ferruginea* and is a well-known botanical insecticide through contact and stomach poisoning (Gupta et al., 2010). Damte and Chichaybelu (2002) also tested the toxicity of Milletia seed against Adzuki bean beetle, *Callsobruchus chinunesis* and found that it gave complete protection of stored chickpea for six months in the laboratory.

Table 3. Mean percentage (±SE) of cumulative mortality of *C. partellus* larvae at different application rates of bio-insecticides.

Botanical	2 days after treatment application		
	Rates (g) and ml/lt		
Powders (g)	**2.0**	**2.5**	**3.0**
M. furrgunea powder	70.0±5.7^{Ca}	86.6±3.3^{Ab}	100.0±0.0^{Aa}
P. dodecandra powder	50.0±5.7^{Cac}	56.6±8.8^{Bc}	60.0±11.5^{Ab}
Aqua extracts and mixtures (ml)	**1.0**	**1.5**	**2.0**
M. ferruginea aqua extracts	53.3±8.8^{Dab}	66.6±3.3^{Cbc}	100.0±0.0^{Ba}
P. dodecandra aqua extracts	20.3±5.4^{Dcd}	23.3±3.3^{De}	36.6±12.0^{Cd}
Cow urine	33.3±8.8^{Fbc}	56.6±3.3^{Ec}	63.3±8.8^{Dab}
Cow urine + *M. ferruginea*	33.3±6.6^{Dbc}	50.0±10.0^{Cd}	63.3±3.3^{Bab}
Cow urine + *P. dodecandra*	23.3±0.3^{Bbc}	26.6±6.6^{Bde}	43.3±8.8^{Ac}
Control (Untreated check)	3.3±0.8^{Af}	3.3±0.8^{Af}	3.3±0.8^{Af}
SE±	5.1	5.1	5.1
CV (%)	9.4	9.4	9.4
LSD at 0.05	13.7	13.7	13.7

Means followed by upper letter across row and lower letter within column are not significantly different at 5% level, LSD.

Table 4. Mean percentage (±SE) of cumulative mortality of *C. partellus* larvae at different application rates of bio-insecticides.

Botanical	3 days after treatment application		
	Rates (g) and ml/lt		
Powders (g)	**2.0**	**2.5**	**3.0**
M. furrgunea powder	83.3±6.6^{Ba}	93.6±3.1^{Abc}	100.0±0.0^{Ab}
P. dodecandra powder	53.3±3.3^{Ddc}	56.6±8.8^{Ce}	73.3±5.7^{Bcd}
Aqua extracts and mixtures (ml)	**1.0**	**1.5**	**2.0**
M. ferruginea aqua extracts	80.0±5.7^{Bb}	90.0±5.7^{Ac}	100.0±0.0^{Ab}
P. dodecandra aqua extracts	26.6±3.3^{Def}	46.6±8.8^{Cde}	53.3±3.3^{Bde}
Cow urine	53.3±5.7^{Ddc}	56.6±3.3^{Ce}	86.6±6.6^{Bc}
Cow urine + *M. ferruginea*	60.0±5.7^{Dc}	70.0±5.7^{Cd}	93.3±3.3^{Ab}
Cow urine + *P. dodecandra*	46.6±12.0^{De}	43.3±8.8^{Cdf}	60.0±11.5^{Bd}
Control (Untreated check)	3.3±0.8^{Ef}	3.3±0.8^{Ef}	3.3±0.8^{Ef}
SE±	5.4	5.4	5.4
CV (%)	14.5	14.5	14.5
LSD at 0.05	11.5	11.5	11.5

Means followed by upper letter across row and lower letter within column are not significantly different at 5% level, LSD.

Laboratory study on the toxicity of cow urine against *C. partellus* larvae caused high mortality (86.67%) as compared to the control. Similar result was reported in India by Tesfaye and Gautam (2003) who reported that cow urine caused 80% mortality of Welo bush cricket (WBC), *Decticoides brevipennis* (Raggea) in 12 h after treatment and reached 90% after 24 h and was at par with neem leaf extract. They also reported 79.6% *Drosophila melanogaster* (Meigen) mortality as compared with 2.8% in control and it was at least 3 times more effective than neem. Effect of the mixture (*M. ferruginea* aqua extract and fermented cow urine) was not significantly different from *M. ferruginea* powder and aqua extract (93.0%) at the higher rate of application, 2.0 ml after 72 h. Powder and aqua extracted of *M. ferruginea* caused significant larval mortality followed by the mixture (*M. ferruginea* aqua extract and fermented cow urine) at the lower rates. The other treatments show larval mortality at the higher rates of applications. This showed that from the different treatments used powder and aqua extracts of *M. ferruginea* found to be the most effective as compared to all other treatments.

High mortality due to *M. ferruginea* when compared to other plant products could be attributed to the presence of bioactive and other bitter compounds responsible for anti-feeding activity that result in the starvation and death of insects. Comparison of this result with previous work has shown consistency with Jembere et al. (2002) where water extracts of *M. ferruginea* caused higher toxicity to all the castes of termites in which 93 to 100% mortality was recorded at all concentration levels. *M. ferruginea* powder and seed kernel aqua extracts have been reported to be effective against various species of insects and are considered safe for human health and environments (Jembere, 2002; Muzeyi and Jembere, 2005; Taddese et al., 2010).

In contrast, *P. dodecandra* aqua extract and the mixture (*P. dodecandra* and fermented cow urine) were least active as compared with the other treatments. Significant lethal effects of the treatments on larvae of *C. partellus* were found three days after treatment applications compared with the control. The assumption for this may be that the active compounds present in these treatments were less in amount. However, larval mortality due to these treatments was observed to increase as the exposure time of the pest to the treatment increased. As exposure time extends there was a progressive increase in the toxicity of these treatments to the test insect registering appreciable mortality of *C. partellus* larvae.

The present result clearly showed that *P. dodecandra* aqua extract and the mixture (*P. dodecandra* and cow urine) required three days to kill 53.3 and 60.0% of *C. partellus*. This implied mortality increases due to these treatments at the higher rates. Hence the days to higher larval mortality took significantly longer periods and required higher rates of applications. The probable assumption might be due to the slow acting effect of the potent insecticides present in these treatments. Comparison of this result with previous work has shown consistency to Shiberu (10) who reported that mortality of *B. fusca* increases at the concentrations of the treatments and exposure time of the insect increases.

Thus these treatments are less effective against *C. partellus* larvae compared to other treatments tested within three days, however they were considered as moderately effective treatments on *C. partellus* control. *C. partellus* is an internal feeder and when the larvae grow to be mature normally develops successfully inside the stem. Therefore, botanical extracts and fermented cow urine as a traditional pest control will completely increase the mortality rate of spotted stem borer, *C. partellus* when applied in the early stages of this pest.

Conclusion

The study concluded that many of the treatments tested appear to be quite effective as local source of insecticides. The efficacy of these treatments varied with different concentrations, time intervals and length of exposure time. However, all the treatments tested showed significant insecticidal property against *C. partellus*. Out of the 7 treatments tested, *M. ferruginea* powder and aqua extracts were having acute toxicity. *P. dodecandra* powder, cow urine and the mixture of *M. ferruginea* aqua extract with fermented cow urine were observed to relatively had high insecticidal activity. *P. dodecandra* aqua extract and its combination with cow urine were observed to have low insecticidal activity. Therefore, from the current study powder and aqua extract of *M. ferruginea*, cow urine and combination of *M. ferruginea* aqua extract with cow urine are identified as good alternatives to chemical pesticides in controlling *C. partellus*. However, further study is needed on this regard to confirm the efficacy of these plant and animal-based insecticides and their practical effectiveness under natural conditions against *C. partellus* without any side effects on none target organisms and the environment.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Damte T, Chichaybelu M (2002). Efficacy of some botanicals in controlling Adzuki bean Beetle, *Callsobruchus chinunsis* (Coleoptera: Bruchidae) in stored Chickpea. In: Abstracts of 10th Annual Conference of Crop Protection Society of Ethiopia. Addis Ababa.

Getu E, Tadesse A, Dejen A, Negeri M, Tadele T (2008). Review of entomological research on maize, sorghum and millet. **In:** Abrham (ed.), *Increasing Crop Production through Improved Plant Protection* in Addis Ababa, Ethiopia, Institute of Agricultural Research, Addis Ababa pp. 167-244.

Gupta S, Handore K, Pandey IP (2010). Effect of insecticides against *Chilo partellus* (Swinhoe) damaging *Zeamays* (Maize). International Journal of Parasitological Research 2:4-7.

Islam MdS, Das S, Islam KS, Rahman A, Huda MdN, Dash PK (2013). Evaluation of different insecticides and botanical extracts against yellow stem borer, *Scirpophaga incertulas* in rice field. International Journal of Bioscience 10:117-125.

Jembere B (2002). Evaluation of the toxicity potential of *Milletia ferrginea* (Hochst) Baker against *Sitophillus zeamais* (Motsch.). International Journal of Pest Management 1:29-32.

Kareru P, Rotich ZK, Maina EW (2013). Use of botanicals and safer insecticides designed in controlling insects: The African Case: **In**: Stanislav Trdan (ed), Insecticides - development of safer and more effective technologies. Intech, Vienna.

Khan IU, Nawaz M, Said S, Sohail K, Subhanullah (2015). Integrated pest management of maize stem borer, *Chilo partellus* (Swinhoe) in maize crop and its impact on yield. Journal of Entomological and zoological studies 5:470-472.

Muzeyi SS, Jembere B (2005). Effects of botanicals, a synthetic insecticide and an insect growth regulator on survival and development of the parasitoid wasp *Cotesia flavipes* parasitizing the stem-boring moth *Chilo partellus*. International Journal of Pest Management 51(1):25-30.

Statistical Analysis System (SAS) (2009). Statistical Analysis System Software. Ver. 9.1. SAS Institute In C., Carry.

Shiberu T, Ashagre H, Negeri M (2013). Laboratory evaluation of different botanicals for the control of Termite, Microterms spp (Isoptera: Termitidae). 2:696 doi:10.4172/scientificreports.696

Taddese E, Azerfagan F, Alemu T, Addis T, Blomme G (2010). Studies on the efficacy of some selected botanicals against inset root Mealbug (*Cataenococcus ensete*) Williams and *Matile-Fererro* (Homoptera: Pseudococcidae). Tree and forestry Science and Biotechnology 2:91-94.

Tesfaye A, Gautam RD (2003). Traditional pest management practices and lesser exploited natural products in Ethiopia and India: Appraisal and revalidation. Indian Journal of Traditional Knowledge 2(2):189-201.

Tilahun B, Azerefegne F (2013). Efficacy of the aqueous crude seed extract of *Millettia ferruginea* (Fabaceae) on the maize stem borer *Busseola fusca* (Lepidoptera: Noctuidae) in the field. International Journal of Tropical Insect Science 33:256-263.

Venkat R, Devi S, Vishnu R, Reddy DV (2012). Evaluation of botanical and other extracts against plant hoppers in rice. Journal of Biopesticides 5:49-57.

Verena UP (2007). Bean pest management in east Africa: A scientific evaluation of organic insect control practices used by Tanzanian farmers. A dissertation submitted to the Swiss Federal Institute of Technology.

Wahedi JA, David DL, Danba EP, Yisa S, Zakariya R (2016). Yield Performance of Maize Treated with Neem Seed extracts against stem borers. American Journal of Experimental Agriculture 12(6):1-8.