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Efficiency of botanical extract against maize weevil *Sitophilus zeamais* (Motschulsky, 1855) (Coleoptera: Curculionidae)

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ABSTRACT

With the objective of studying the efficiency of locally available botanical extract on maize weevil, a lab experiment was conducted from February 3 to February 20, 2017, at the entomology lab of Gokuleshwor Agriculture and Animal Science College, Gokuleshwor, Baitadi. The design setup was a completely randomized design, with 10 treatments, each treatment replicated thrice. Two varieties of maize local and a commercial hybrid were treated with five locally available botanical extracts, i.e. *Acorous*, Rittha, Neem, Asuro and wood ash, to examine the efficiency of these on maize weevil. One kilogram of maize grains adjusted to 14% MC was placed in 20 cm high × 8 cm diameter plastic buckets. 10 g of the powdered botanical pesticides of each as the test material was then thoroughly mixed with the grains in each bucket. The mortality rate was recorded at 24 hours interval. Herein, *Acorou*s showed the highest mortality rate in both local and hybrid varieties. The order of efficiency was found to Bhojo, Ritha, Ash, Neem and Asuro.

***Keywords*:** Biopesticides, *Sitophilus oryzae*, maize, *Zea mays*, storage pest, *Acorous*, *Sitophilus zeamais*

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1. INTRODUCTION

Maize (*Zea mays* L.) is the most important cereal crop of Nepal, ranked second position after rice in terms of area (891,583 ha) and production (2,231,517 Mt) with the productivity of 2.5 $Mt \cdot ha^{-1}$ [1]. Maize can be grown in all kinds of agro-ecological zones, irrespective of land types and season. Due to heterogeneous gene accumulation in this crop, it is widely adaptable to different stress environments and is widely grown from the terrases to high hills in Nepal, where it is considered a major food crop. Maize is the main in hilly areas where it is rainfed crop in (bari) condition. It is a staple crop of hilly region, which occupies about 80% of the total maize area and contributes more than 75% to the total production in the country. In stored maize, heavy infestation of this pest may cause weight losses of as much as 30-40%, although losses are commonly 4-5%. The chewing damage, caused by the insect brings about increased respiration in the cereal (hot spots), which promotes evolution of heat and moisture, and in turn, provides favorable living condition for molds, leading to production of alfatoxin. Subsequently, at very high moisture levels, bacterial growth is favored, which ultimately gives rise to depreciation and finally total loss. *Sitophilus zeamais* which causes both, quantitative and qualitative damage in storage maize, loss ranges from 20% up to 90% [2-4]. Produce considerable amount of grain dust, mixed with frass [5]. Controlling stored pests is not an easy job, although synthetic chemicals are apparently available for use. Effective pest control is no longer a matter of heavy application of pesticides, partly because of rising cost of petroleum – derived products, but largely because excessive use of pesticide promotes faster evolution of resistant form of pests, destroys natural enemies, turns formerly innocuous species into pests, harms other non-target species, and contaminates food. There is, thus, an urgent need for control agents, which are less toxic to man and more readily degradable, among which is the use of botanical pesticides with low mammalian toxicity. They can effectively prevent and/or suppress insect pests, especially in stored condition. The use of botanical pesticides to protect plants from pests is very promising because of several distinct advantages. Pesticidal plants are generally much safer than conventionally used synthetic pesticides. Pesticidal plants have been in nature as its component for millions of years without any ill or adverse effect on the ecosystem. In addition, plant-based pesticides are renewable in nature and cheaper. Also, some plants have more than one chemical as an active principle responsible for their biological properties. These may be either for one particular biological effect or may have diverse ecological effects. The chances of developing quick resistance to different chemicals are highly unlikely. This research was conducted in order to find out the efficiency of locally available botanical extract on maize weevil at the laboratory condition [6-18].

2. MATERIALS AND METHOD

The research was carried out at Entomology laboratory condition of Gokuleshwor Agriculture and Animal Science College, Baitadi during 3rd to 20 th February in 2017 at an altitude of 6,936 ft masl with 29°19” to 29°40” north latitude and 80 degree 22” to 80 degree 50” longitude in east and elevation. Ten newly emerged adult of *S. zeamais* were introduced in each treatment. The experiment was conducted in the laboratory condition and the mortality rate of adult weevil was determined. The experiment was laid out into Complete Randomized Design (CRD) with ten treatments, each replicated in three times.

2. 1. Collection and preparation of test materials

Fresh leaves of *Justica adhatoda*, rhizome of *Acorus calamus* (Bojho), fruit of *Sapindus mukorossi* (Ritha) and wood ash were gathered and brought immediately to the laboratory from the vicinity of Gokuleshwor, Baitadi. *Azadiracta indica* (Neem) powder was brought from Agriculture store of Kathmandu. The leaves were air dried in the laboratory until crispy. The dried leaves were pulverized using a micropulverizer and were sieved through a 0.5 mm size mesh to obtain uniform particle size. The resulting powders were kept separately in glass containers with a screw cap and stored at room temperature prior to use.

2. 2. Mass rearing of *Sitophilus zeamais* Motsch

The material for research, such as maize seed hybrid (Maduri) and local variety was selected. 20 cm high × 8 cm diameter plastic jars were thoroughly cleaned and dried in the sun for 2 to 3 hours to ensure the absence of insects, mites or disease-causing microorganisms. The sealed plastic jars were allowed to equilibrate to the ambient temperature before they were opened to avoid excessive loss or gain of moisture.

Corn grains were adjusted to 14% moisture content (MC) prior to use. 1 kg maize grains of both, hybrid and local were placed in each plastic jar and the temperature, and RH of the lab was maintained for weevil culture. Male and female adult maize weevils secured from the National Agriculture Research Centre, NARC were introduced in each jar. After introduction of the Weevil in the medium, the top of the jar was covered with muslin cloth. The jars were arranged 6 cm apart in a laboratory table. Daily observation was made for mortality of maize weevil.

2. 3. Bioassay Procedure

2. 3. 1. Anti-oviposition / growth inhibition test

Two fifty grams of maize grains adjusted to 14% MC were placed in 20 cm high × 8 cm diameter plastic jars. Two and half grams (2.5 g) of the powdered botanical pesticides of each of the test materials were thoroughly mixed with the grains in each jar. Three replicates were provided for each treatment and treated grains were placed separately in the plastic jar. Male and female maize weevils were introduced in each jar which was airtight with the jar cover. The female adults were allowed to oviposit on the seeds for 24 hours. Since the eggs of weevil cannot be determined, the presence of larval tunnel indicates weevil egg deposition, whereas absence of larval tunnel means no egg was deposited, hence, this was the basis for anti-oviposition effect of the test materials although it was not considered in our research but observation was made on these above bases.

2. 3. 2. Adult mortality test

Two fifty grams of maize grains each of hybrid and local which were adjusted to 14% moisture content, male and female weevil in number of 10 were introduced in plastic jar of 20 cm high 8 cm diameter and kept for 24 hours and it was mixed with two and half (2.5 g) powdered of each of the botanical pesticides on very next evening and kept it gently on the laboratory table. The plastic jars were air tightly covered. The adult mortality was monitored or observed daily on the interval of 24 hours. The percentage of adult mortality was determined by counting the number of dead insects divided by the total number of insects introduced, multiplied by 100.

2. 3. 3. Treatments combination

Table 1. Treatment combination of the experiment

S.N.	Variety	Botanicals	Treatments combination	Treatment no.
1	Local	Bhojo	Bojho + Local (BL)	T1
2	Local	Neem	Neem + Local (NL)	T2
3	Local	Asuro	Asuro + Local (AL)	T3
4	Local	Rittha	Rittha + Local (RL)	T4
5	Local	Ash	Ash + Local (ASL)	T5
6	Hybrid	Bhojo	Bhojo + Hybrid (BH)	T6
7	Hybrid	Neem	Neem + Hybrid (NH)	T7
8	Hybrid	Asuro	Asuro + Hybrid (AH)	T8
9	Hybrid	Rittha	Rittha + Hybrid (RH)	T9
10	Hybrid	Ash	Ash + Hybrid (ASH)	T10

2. 4. Data recording

Daily data were recorded on the mortality rate of maize weevil at the interval of 24 hours for 16 days but 100% mortality was observed on the 6th day of the treatment.

2. 5. Analysis of data

The collected data were entered in Excel sheet and analyzed with the help of computer software R-package and SPSS.

3. RESULT AND DISCUSSION

Among the botanicals, at 1 DAT maximum weevil mortality was found to be (0.42%), which was caused by Bojho hybrid, followed by Bojho local which was followed by Neem local and minimum was caused by Asuro local, Rittha local, Ash local, Neem hybrid, Asuro hybrid respectively, presented in **Table 1**.

All botanicals treatments revealed significantly ($P<0.05$) at 2 days after treatment. Higher mortality caused by Bojho local which was followed by Bojho hybrid, Neem local, Neem hybrid, Asuro hybrid, Rittha hybrid and minimum, was found in Asuro local, Rittha local, Ash local, respectively. Efficacy of Bhojo local and Bojho hybrid was increased in 3 DAT but Bojho local is more effective than Bhojo hybrid. Mortality rate was increased in rate concerning Bojho hybrid, Neem local, Neem hybrid, Asuro hybrid, Rittha hybrid in 3 DAT, and minimum was found in the case of Asuro local and Ritha local.

Significant difference (<0.05) was found in mortality rate of different biopesticides in 4 DAT. Bojho hybrid is more effective than Bojho local, which was followed by Neem hybrid, Rittha hybrid, Ash hybrid, Neem local, Ash local, Asuro hybrid and Rittha local, and minimum was found in case of Asuro local.

Significant difference (<0.05) was found in the studies. The highest weevil mortality was caused by Bojho hybrid, followed by Bojho local, but they are statistically at par to each other. Mortality rate of Neem hybrid, Rittha hybrid, Ash hybrid, Neem local, Ash local, Asuro hybrid, Rittha local and Asuro local were increased in rate, but all had the lowest mortality as compared to other.

Significant difference (<0.05) was found: At 6 DAT Bojho local and Bojho hybrid were equally effective for weevil mortality. Mortality rate for the remaining botanicals was on increase in rate. Mallah *et al*. [6] reported that Bhojo rhizome power was significantly more effective than neem, titetapati, which was in accordance to our findings.

Table 2. Weevil mortality at different date

Treatments	**1DAT**	**2DAT**	**3DAT**	**4DAT**	**5DAT**	**6DAT**
BL (T1)	0.36	0.67	0.77	0.87	0.90	1.05
NL (T2)	0.10	0.36	0.40b	0.43	0.56	0.58
AL (T3)	0.00	0.00	0.00	0.10	0.16	0.16
RL (T4)	0.00	0.00	0.00	0.20	0.25	0.30
ASL (T5)	0.00	0.00	0.10	0.40	0.50	0.62
BH (T6)	0.42	0.61	0.73	0.92	1.04	1.05
NH (T7)	0.00	0.36b	0.52	0.67	0.76	0.78
AH (T8)	0.00	0.21b	0.30	0.36	0.42	0.51
RH (T9)	0.10	0.11d	0.55	0.58	0.82	0.87
ASH (T10)	0.00	0.00e	0.30	0.48	0.60	0.72
Mean	0.10	0.22	0.37	0.50	0.60	0.66
$LSD_{0.05}$	0.15*	0.16**	0.16**	0.24**	0.26**	0.30**
CV (%)	92.00	40.1	25.8	27.9	25.2	26.0

DAT = Days after treatment, BL = Bhojo local, NL = Neem local, RL = Ritha local, ASL = Ash local, BH = bhojo hybrid, NH = Neem hybrid, AH = Ashuro hybrid, RH = Ritha hybrid, ASH = Ash hybrid, CV = Coefficient of variance, LSD = least square design, ** = highly significant

4. CONCLUSION

The result on the preference study shows that after 1 day of treatment, bojho seems more effective than other extracts as the mortality rate of weevil is the highest in bojho. Later on effectiveness of neem, rittha, ash and asuro extract also increased with increasing days after treatment. Overall experiment signifies that bojho is the best and is most effective against maize weevil, and asuro is the least effective against maize weevil. On the basis of mortality of maize weevil by botanical extracts it was found that 100% mortality was recorded on 6 DAT by bojho on both, local and hybrid variety and the least mortality was found by asuro. Effectiveness of bojho was the highest in local variety, followed by neem, ash, rittha, and asuro. Effectiveness of bojho was also the highest in hybrid variety, followed by neem, rittha, ash, and asuro.

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