Efficacy of Various Botanicals against Maize Weevil (*Sitophilus Zeamays*) in Laboratory Condition

D. Regmi[1*], R. Pudasaini[2], D. Bastola[3]

[1]Institute of Agriculture and Animal Science
[2]Department of Horticulture and Plant Protection, Institute of Agriculture and Animal Science, Lamjung Campus
[3]Institute of Agriculture and Animal Science

Abstract— *Maize weevil, Sitophilus zeamays (Motschulsky) is one of most important economic pest that causes severe economic damage to store grain and its management at the farmers level is must. To determine the efficacy of different botanicals against maize weevils in stored maize a study was carried out at the laboratory of IAAS, Lamjung Campus at room temperature from January to April. Nine treatments were laid out in Completely Randomized Design with four replications. Number of infected seeds, dead weevils, number of exit holes and live weevils were recorded at every 30 days intervals till four months . Analysis of variance showed significant effect of all botanicals on weevil mortality compared to untreated check, but not as effective as liquid extracts as Cinnamomum (9.75), citronella (9.75), mentha (9) and lemon grass (9) were significantly more effective than the rest botanicals (P <0.05). Upto 90 days statically lower numbers of infected seeds were seen at Cinnamomum, Mentha, Lemon grass, Titepati, and Citronella while on 120th day Cinnamomum showed best results. Among all treatments, Cinnamomum oil was found to be better on every parameter thus can solve poor farmer's problems by integrating them with other cultural measures. However further research are needed to fix the rate graph and the long term effect in large stores of farmers conditions.*

Keywords— Botanicals , Maize (Zea mays), Maize weevil (Sitophilus zeamays Mots), Mortality.

I. INTRODUCTION

Maize (Zea mays L. Gramineae) is one of the major cereal crops produced worldwide (Blackie & Jones, 1993). Maize is the second most important staple food crops in hills of Nepal (Upadhya et al., 2007). Maize can be grown in all kinds of agro-ecological zones irrespective of land type and seasons because it is widely adaptable to different stress environments and is widely grown from the terai to high mountains in Nepal (Adhikari,2007).It is also known as queen of cereal crops and has high potential in terms of yield and production (Singh, 2002). Maize is cultivated in an area of 891583ha with the production of 2231517Mt and total yield is 2503kg/ha (MOAD, 2015/2016). It contributes about 30% of the total cereal production in the high hills and 40% in the mid-hills and plays important role in the food supply as well as regarding major staple food in the remote area of Nepal (Pandey et al., 2001). In the last decades, annual growing demand of maize production is increasing constantly at the rate of 5% (Sapkota & Pokhrel, 2010). According to Ranum, Pena Rosas, Garcia-Casal (2014) per capita maize consumption in Nepal is 98 g/person/day.

Different insect pest attacked crops both in the field and in the storage condition (Neupane et al., 1991). That attacks may range from sap sucking or leaf damaging or ear damaging insects. Overall 60-70% reductions in the final yield of maize production have been reported due to insect pest hazards (Sharma, 2009). Such attacks are not only confined to the developmental stage of the plant but also continue in the storage period.

On an average about 20-30% yield losses after post harvest of maize due to pest infested have been seen by scatter and accidental (GC, 2006) The major reasons for post harvest losses are ;inadequate knowledge about post harvest losses, careless after harvest or post harvest losses, unavailability of synthetic pesticides in time, misuse of pesticides, poor economic condition, unavailability of improved storage structures, careless and ignorance about importance of botanical pesticide for controlling stored pests, etc.

Several researchers have evaluated insecticide, repellent or antifeedent and development inhibiting effects of various plant parts and plant products on *S. zeamays* with varying degree of success. Among the botanicals used sweet flag rhizome, neem oil, neem seed powder timur, (*Zantthoxylum armatum* DC.) and mugwort (*Artimisia vulgaris*) have been reported to be superior to control the maize weevils (Paneru, Duwadi, Khanal, and Bhandari, 1996; Anonymous, 1988). Some of the metabolites of plants are toxic such as pyrethrum, nicotine, rotenone etc. and some are repellents, antifeedants like azadirachtin, rape seed extract and others, like Acorus calamus act as sterilants *(Ignatowicz and Wesolowska, 2015*). Asian countries have abundantaly used of these plant products which are traditionally used by the rural people for preparations against insect control (*Talukder and Howse, 1993*). Thus,these plant products can be utilized either alone or mixed for controlling stored pest. So, with an objective To develop effective management technique for storage insect pests and particularly, assess damage by maize weevil in storage and identify the effective management option against maize weevil this experiment was performed.

II. MATERIALS AND METHODS

The experiment was carried out in the Entomology Laboratory of IAAS, Sundarbazar, Lamjung at an altitude of about 650 masl with Longitude of 84o 11'- 84o 38' E and Latitude of 28^o 3'- 28^o 30' N. The research was conducted in Completely Randomized Design (CRD) with 4 replications and 9 treatments. The research was conducted with 9 treatments consisting of 8 botanicals in which four of liquid extracts i.e. Cinnamomum Oil, Citronella Oil, Mentha Oil and Lemon Grass Oil and four botanicals Neem, Titepati, Mustard Kati (Biproduct) and Turmeric and Untreated Check (control)

Treatment	**Description**
T1	Turmeric (10gm/kg) + 500g maize, T2 Cinnamomum Oil (2 ml/kg) + 500g maize
T3	Citronella Oil (2 ml/kg) + 500g maize, T4 Mentha Oil (2 ml/kg) + 500g maize
T5	Lemon Grass Oil (2 ml/kg) + 500g maize, T6 Mustard Kati (10gm/kg) + 500g maize
T7	Titepati (10gm/kg) + 500g maize, T8 Neem (10gm/kg) +500g maize
T9	Control (500 g maize)

Liquid Extacts Oil were used in the experiment namely Cinnamomum Oil, Citronella Oil, Mentha Oil and Lemon Grass Oil was obtained from National Herbs Processing Center ,Jadibuti ,Kathmandu and botanicals Turmeric, Mustard Biproduct (Kati), Neem and Titepati were prepared by self.

Fresh leaves of Neem, Titepati , Turmeric and Mustard Biproduct(Kati) were collected from respective plant of Lamjung campus. Leaves were washed and shed dried for 15 days and then crushed by using blender. The powders of leaves were kept in polythene bags until it was used.

The maize weevil (irrespective of sex) were made available from Nepal Agriculture Research Council, Entomology division where they were cultured for research.

500 gm of sun dried maize sample at 12% moisture were taken in each plastic bin of capacity 1000 gm. The samples were then mixed thoroughly with different treatments and 10 maize weevils (irrespective of sex) were released in each bin. The bin then covered with muslin clothes and tightened with rubber band and kept for observation.

Following observations were taken:

Weight loss of the grain at every 30, 60, 90 and 120 days after treatment application

Parameters recorded throughout the experiment period were tabulated in MS-Excel and finally analyzed using RSTAT software and the mean comparisons were done by Duncan test at 5% and 1% level of significance.

III. RESULT AND DISCUSSION

3.1 Effect of treatments on number of infected seeds:

TABLE 1
EFFECT OF TREATMENTS ON NUMBER OF INFECTED SEEDS IN LABORATORY OF IAAS LAMJUNG CAMPUS, SUNDARBAZAR LAMJUNG, 2018

S.N.	Treatment	30 DAT	60 DAT	90 DAT	120 DAT
1	Turmeric	17.5a	19.75ab	19.5ab	20.75a
2	Cinnamomum	12abc	12.25abc	12.25b	12.25b
3	Citronella	14.5ab	17.5abc	19ab	21.75a
4	Mentha	14.75ab	20.5a	20.75ab	21.75a
5	Lemon Grass	17a	14.5abc	23.25a	23.5a
6	Kati	5.25c	10.5bc	12.75b	21.5a
7	Tite pati	7.5bc	18.25abc	17.75ab	20a
8	Neem	6c	9.25c	18.75ab	22a
9	Control	18.25a	15abc	21.25ab	26.25a
	F-Test	0.001**	0.105	0.145	0.00643
	Mean	12.52778	15.27778	18.36111	21.08333
	CV(%)	37.59298	38.19428	30.65929	24.09187
	LSD	6.872123	-	-	-

There were significant differences ($p<0.05\%$) among the treatments on the extent of infection by the weevil. 30 days after the application of treatment high extent of infection (18.25) was seen in control as compared to botanicals but still control it was significantly at par along with turmeric (17.5), cinnamomum (12), citronella (14.5), menthe (14.75) and lemon grass(17) treatments. The second reading after 60 days of treatment application revealed highest extent of infection in menthe treated seeds (20.5) but it was at par with other botanicals treatments like turmeric, cinnamomum, citronella, lemon grass, titepati and with control. After 90 days of treatment application, highest extent of infection was seen in lemon grass treated seeds (23.25) which was significantly at par with all other botanicals treatments and control except for citronella and kati. After 120 days of treatment application, highest extent of seed infection was shown by control (26.25) that was significantly at par with all other treatments except for cinnamomum.

3.2 Effect of treatments on weevil mortality:

TABLE 2
EFFECT OF TREATMENTS ON WEEVIL MORTALITY IN LABORATORY OF IAAS LAMJUNG CAMPUS, SUNDARBAZAR LAMJUNG, 2018

S.N.	Treatment	30 DAT	60 DAT	90 DAT	120 DAT
1	Turmeric	3de	7b	5.25c	6.25d
2	Cinnamomum	9.75a	10a	11a	11ab
3	Citronella	9.25ab	10a	11.5a	11.75a
4	Mentha	9ab	9a	9.75ab	10abc
5	Lemon Grass	9ab	9.5a	10.5a	10.25ab
6	Kati	7.5bc	9.25a	11a	10.5ab
7	Tite pati	6.75c	5.75bc	7.5bc	8.5bcd
8	Neem	4.25d	4c	6.5c	7.25cd
9	Control	2.5e	4.5c	5.75c	5.75d
	F-Test	4.65e-10 **	0.000 **	0.000 **	0.000**
	Mean	6.777778	7.666667	8.75	9.027778
	CV(%)	16.36309	15.96428	19.91	20.09782
	LSD	1.618549	1.786196	2.54245	2.64791

The treatments were significantly different ($p<0.05\%$) on the basis of weevil mortality. 30 days after treatment application highest weevil mortality was seen in cinnamomum (9.75), citronella (9.75), menthe (9) and lemon grass (9) treatments. As obvious it is, the least effectiveness was shown by control (2.5). After 60 days, the highest mortality was shown by cinnamomoum (10), citronella (10), menthe (9) and lemon grass (9). After 90 days, the same four treatments were found significantly superior as compared to other botanicals. The same result was seen in 120 days of counting with the significant result also shown by kati. The least significant result was shown by control.

Among all the treatments, the action of cinnamomum was found to be superior on an average in terms of least seed infection and higher weevil mortality. This is mainly due to the chemical constituents of the essential oils. The main compounds of essential oil from cinnamomum were characterized by more than 94% of monoterpenes. Cinnamomum leaves oil were composed by 68% of camphor and 9% of linalool. These essential oils are similar to the most common compositions described in the literature (Fujita et al., 1974; Dung et al., 1993). Linalool was shown to exhibit fumigant toxicity against S. zeamais (Wang et al. 2011; Liu et al., 2013; Yildirim et al., 2013) and the C. camphora, with camphor as major component, showed repellent activity (Liu et al., 2006) and high insecticidal activity against S. oryzae (Hamed et al., 2012).

The highly toxic and repellent effects of main constituents of these oils, camphor and linalool, have been demonstrated by other researchers also Chen et al., 2013; Ajayi et al., 2014). The cinnamon methanol extract showed the highest repellent activity for S. zeamais adults at all time intervals. Piperine, a pungent substance in black pepper and cinnamaldehyde, a principal component of cinnamon flavour, are reported to possess insecticidal activities (Huang & Ho, 1998; de Paula et al., 2000). These findings indicate that such active compounds may play a role in the repellent activity against S. zeamais and show their potency at much lower concentrations. (Takahiro Ishii et al., 2007) Cinnamon powder also was showed generally a more repellent effective on adults of Sitophilus granarius. Rhyzopertha dominica and T. castaneum. The powders of Piper nigrum, Capsicum annuum and C. zeylanicum (Cinnamon plant) showed a repellent effect on Sitophilus zeamais.

In most of the cases the results shown by turmeric and neem is not so promising so it can be assumed that the pest has already developed resistance to this botanicals since they have been used for a long time in our culture for similar purposes. Similarly, the above result clearly shows that with the increasing number of days the action or effectiveness of botanicals starts to decrease significantly. Within the botanicals those that are applied in volatile form like oil start to loose their effectiveness with the increasing days as compared to that which area applied in powdered form. So, while performing similar experiments this fact should also be kept in mind.

IV. CONCLUSION

The study on "Efficacy of various botanicals against maize weevil (sitophilus zeamais m.) in laboratory condition" was carried out in Entomology Laboratory of IAAS, Lamjung from January to April, 2018. The present study has shown the effectiveness of some botanicals at different rate in controlling maize weevil on stored maize grains. This result shows that the action of cinnamomum was found to be superior on an average in terms of least seed infection, less number of exit holes and higher weevil mortality because chemical constituents of the essential oils which can solve poor resource farmers' problems by integrating them with other cultural measures. However further research are needed to fix the rate graph and the long term effect in large stores of farmers conditions. More research is required in differed climatic conditions and in different ecological zones to draw the conclusion about the effectiveness of botanicals.

REFERENCES

[1] Adhikari, K. 2000. Maize research strategy in Nepal. In; Proceedings of the 22nd National Summer Crops Workshop. Rampur/ Chitwan, Nepal: National Maize Research Program. pp. 25-36.

[2] Blackie, M.J., & Jones, R. B. 1993. Agronomy and increased maize productivity in Eastern and Southern Africa. Biological Agriculture & Horticulture, 9 no.2, pp 147- 160.

[3] GC, Y. D. 2006. Efficacy of indigenous plant materials and modified storage structures to insect pests of maize seed during on-farm storage, Journal of the Institute of Agriculture and Animal Science, 27, pp 69-76.

[4] MoAD. 2013. Statistical Information on Nepalese Agriculture 2012/13. Government of Nepal, Ministry of Agriculture and Cooperatives. Agri- Business Promotion and Statistics Division. Singha Durbar, Kathmandu, Nepal. pp 10.

[5] MoAD. 2014. Statistical information on Nepalese agriculture 2070/71. Agri-business Promotion and Statistics Division. Ministry of Agriculture Development, Kathmandu, Nepal.

[6] Neupane, F. P. 1999. Jadibutidwara Kira Niyantran. A manuscript accepted for publication by Sajha Prakashan, Pulchowk, Lalitpur (in Nepali)

[7] Pandey, M. P., Pandey, R. P., & Sharma, D. 2002. Farmers' assessment of improved maize varieties in the hills of western Nepal. Sustainable maize production systems for Nepal (No. 631.536 RAJ. CIMMYT.).

[8] Sapkota, D., & Pokhrel, S. 2010. Community based maize seed production in the hills and mountains of Nepal: A review.Agronomy Journal of Nepal, (Agron JN) Vol. 1

[9] Singh, C. 2002. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, India.