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Management of *Sitophilus oryzae* (L.) on maize grains by using botanicals in Talwandi sabo, Punjab

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Abstract : The present studies were carried on *S. oryzae* L. (Coleoptera: Curculionidae), as it is considered the most destructive pest of cereals like maize, wheat, pea and rice under storage condition. The effects of crushed leaves of *Ocimum sanctum* (L.), *Clerodendrum inerme* (L.) and *Azadirachta indica* (L.) was recorded against Sitophilus oryzae The relative performance of different treatments with regards to their grain protection effect at all selected dosage was as follows: *Azadirachta indica* (L.) >*Ocimum sanctum* (L.) >*Clerodendrum inerme* (L.). Hence these findings will prove helpful for using cost effective control measures against this serious pest. Moreover, the botanicals are biodegradable, pest specific & leaving no toxic residue in environment.

Index Terms **– Biology, Plant Protection, Agriculture**

I. INTRODUCTION

Maize or corn (*Zea mays* L.) native of America is third staple cereal crop, widely grown in temperate, subtropical and tropical parts. The one of the major pest of maize *Sitophilus oryzae* L. (Coleoptera: Curculionidae). It considered as most destructive pests of cereals such as maize, wheat, peas and rice under storage condition. It can able to cause absolute damage to stored grain if not proper control measures are taken. This pest infestation also increases the growth of pathogens and secondary insect pests. *Sitophilus zeamais* (Motsch) and *Sitophilus oryzae* (L.) causes 18.30 per cent losses to stored corn. In world, damage is 92.40 to 98.30 per cent in different areas; in India *S. oryzae* causes massive losses up to 100 percent in maize under storage condition (Kaur & Singh, 2023). For controlling stored grain pests the use of fumigant compounds like methylbromide and phosphine are in trend. But due to its highly toxic properties it's use become limited (Bell and Wilson, 1995). Even the development of insect resistant strain to phosphine and other fumigant were reported from many countries (Rachid *et al.*, 2006). These constrain of pesticides leads towards the use of less toxic plant products. These botanical products are showing promising results for control of stored grain systems (Tatun *et al*., 2014).

II. Literature review

According to Jilani and Su (1983) three plant materials rhizomes of *Curcuma longa* (L.), leaves of *Azadirachta indica* A. Juss., and leaves of *Trigonella foenum-graecum* L., for their repellency against the adults *Tribolium castaneum* (Herbst), *Sitophilus granarius* (L.), and *Rhyzopertha dominica* (F.). Shaaya *et al.*, (1991,1997) evaluated fumigant toxicity of 28 essential oils extracted from various spice and herb plants on adult *Rhyzopertha dominica*, *Oryzaephilus surinamensis*, *Tribolium castaneum*, and *Sitophilus oryzae*. the fumigant toxicity of a large number of essential oils extracted from various spices and herb plants against many store grain pests. The result revealed that *Tribolium castaneum* was most resistant, compared with *Sitophilus oryzae* (L.), *Rhyzopertha dominica* (F.) and *O. ephilussurinamensis* (L.), to most essential oils tested.
Tripathi *et al*. (2003) reported that *S. oryzae*, adults were highly susceptible by contact to l-carvone, d-carvone, and dihydrocarvone when compared with the *Rhyzopertha dominica*, adults and *Tribolium castaneum* (Herbst.). *R. dominica* adults >*T. castaneum* larvae.

Athanassiou *et al*. (2005) the experiment was conducted to evaluate the insecticidal effect of the azadirachtin-based insecticide (NeemAzal), was examined against adults of *Rhyzopertha dominica*, *Sitophilus oryzae* , and *Tribolium confusum* in rye, whole oats, and peeled oats.

Kavallieratos *et al*. (2007) recorded effect of two azadirachtin-based insecticides (NeemAzal-T/S and Oikos 32 EC), was examined against adults of *Sitophilus oryzae* and *Tribolium confusum* on wheat and maize.

Abdelgalil *et al*. (2009) conducted comparative study to assess the contact and fumigant toxicities of eleven monoterpenes on *Sitophilus oryzae* and *Tribolium castaneum*.
Fang *et al*. (2010) was conducted chinese medicinal herbs and wild plants, the essential oil of *Carumcarvi* fruits was found to possess strong contact toxicity against *Sitophilus zeamais* and *Tribolium castaneum* Stefanazzi *et al*. (2011) reported essential oils from *C. citratus* and *E. muticus* as contact poison on *S. oryzae*. All essential oils produced: (a) repellency on larvae and adults of *T. castaneum* and adults of *Sitophilus oryzae* (b) post-ingestive toxicity on *T. castaneum* larvae and *S. oryzae* adults and alteration of nutritional index on *T. castaneum* and *S. oryzae* adults. Wang *et al*. (2015) have determined the insecticidal activity of *Dahlia pinnata*, against *Sitophilus zeamais* and *Sitophilus oryzae*. Kim *et al*. (2016) evaluated the fumigant toxicity of eight Lamiaceae essential oils and their constituents against the adult rice weevil *Sitophilus oryzae*. Chang *et al*. (2017) studied the anti-insect pest activities of essential oils (EOs) from garlic (*Allium sativum*), ginger (*Zingiber officinalis*), black pepper (*Piper nigrum*), onion (*Allium cepa*), and fennel (*Foeniculum vulgare*) as well as major compounds. (allyl disulfide, AD; allyl mercaptan, AM) isolated from of garlic and onion fumigant insecticidal activities.

III. Material and methods

To check out the Efficacy of botanical leaf powder on *Sitophilus oryzae* (L.) following steps are follows:
Experiments were conducted in maize grains to study the efficacy of different botanicals on the larval and adult mortality of *S. oryzae*. The experiment was laid out was set as per randomized block design with six treatments and with four replications. Botanicals used for treatments are *Ocimum sanctum* (L.) (Lamiaceae) Tulsi, (Myrtaceae), *Clerodendrum inerme* (L.) (Lamiaceae) wild jasmine leaves powder and *Azadirachta indica* (L.) (Meliaceae) neem leaf powder each @5 gms/kg of seed. A control was maintained so as to compare the efficacy of botanicals.

To assess the larval mortality of *S. oryzae*, about hundred grams of maize disinfested seeds were taken in zip lock polythene bags (10x15cm) and 30 numbers of adults were released in containers. Then seeds were treated with botanicals dust as above mentioned quantity. Observation on adult emergence was taken from 7th day after treatment until adult emergence not stopped. The per cent larval mortality was calculated according to Howe, 1971. The analysis of collected data was done by completely randomized design (CRD) method.

$$\text{Per cent larval mortality} = 100 - \text{Percent larval survival}$$

$$\text{Per cent larval survival} = \frac{\text{No. of adults emerged in treatment}}{\text{Total no. of adults emerged in control}} \times 100$$

To find out the effect of botanicals on adult mortality of *S. oryzae*, in maize about hundred grams of disinfested seeds were treated with botanicals and taken in zip lock polythene bags. Twenty numbers of adults were released. Percent mortality of adults was recorded on 4th, 8th and 12th day after treatment. The per cent adult mortality was calculated (Howe, 1971) based on the number of adults dead Rajeswari & Srinivasan, 2019.

$$\text{Per cent adult mortality} = \frac{\text{No. of adults dead}}{\text{Total no. of adults released}} \times 100$$

IV. RESULTS AND DISCUSSION

The results pertaining to the efficacy of different botanicals as seed treatment materials on rice weevil, *Sitophilus oryzae* are presented below.
The effect of crushed leaves of *Ocimum sanctum* (L.), *Clerodendrum inerme* (L.) and *Azadirachta indica* (L.) was recorded against Sitophilus oryzae. The efficacy of *Azadirachta indica* is 96.8±1.77 followed by *Ocimum* 81±4.63 and *Clerodendrum* is 61.8±6.7 respectively.The result revealed that with 0.5 g treatment minimum grain damage percentage was reported in T 9: 0.5g *A. indica* (18.02 per cent) followed by T5: 0.5g *C. inerme* (37.00 per cent), and T1: 0.5 g *Ocimum sanctum* (53.00 per cent) treated maize grains when compared to T0: control (95.33 per cent). With 1 g treatment of all selected leaves result revealed that the minimum grain damage percentage was reported in T9: 1g *A. indica* (18.02 per cent) followed by T6: 1g *C. inerme* (27.67 per cent), T2: 1g *Ocimum sanctum* (35.00 per cent), when compared to control. With 2 g treatment of all selected leaves result revealed that the minimum grain damage percentage was reported in T10: 2g *A. indica* (26.67 per cent) followed by T7: 2g *C. inerme* (22.41 per cent), T3: 2g *Ocimum sanctum* (12.67 per cent), when compared to control. In 5 g treatments minimum grain damage percentage was reported in T12: 5g *A. indica* (3.33 percent) followed by T8: 5g *C. inerme* (20.01 percent) and T4: *Ocimum sanctum* (6.00 per cent) when compared to T0: control.

Many scientists worked with botanicals to control store grain pests. According to Athanassiou *et al*. (2005) reported effectiveness of azadirachtin against rice weevil on whole rye and oats, where absolute mortality was recorded after 7 and 14 day of exposure, respectively. Kavallieratos *et al*. (2007) recorded the effect of NeemAzal-T/S and Oikos 32 EC (Neem based), against adults of *S. oryzae* and *Tribolium confusum* on wheat and maize. The result revealed that NeemAzal-T/S was more effective than Oikos 32 EC at all the tested combinations. Aktar *et al*. (2015) reported that neem based products i.e. neem oil, neem leave powder, neem seed kernel dusts, Neem leaves extracts are effective in management of S. oryzae. In 2006, Facknath reported that neem leaf and seed extracted oil can able to control the population of *S. oryzae* when combined with rice and dried beans. Similarly, Mishra and Pandy (2014) also reported neem leaf powder as grain protectant against rice weevil. In 2017 Singh *et al*. also observed neem seed powder at 2% causing very less grain damage (3.84 percent). Yankanchi and Gadache (2010) reported the effectiveness of *Clerodendrum*

inerme on mortality and progeny production of *S. oryzae*. **Yankanchi** *et al.* (2014) also reported crude methanol extract of *C. serratum* against the rice weevil, *S. oryzae*.

Ouko *et al*. (2017) Tulsi plant extracts in different solvent blend found to be toxicities, repellent and adult emergence inhibiter of Maize weevil, *Sitophilus zeamais*. Kerdchoechuen *et al.* (2010) also reported different species *Ocimum* spp. was effective against *Sitophilus zeamais*. Similarly Asawalam *et al.* (2008) *Ocimum grattissimum* was found effective as repellent for *Sitophilus zeamais*. Karemu *et al*. (2013) reported the positive effect of eucalyptus oils in the protection of maize against weevils. Mishra *et al.* (2012) reported *Ocimum basilicum* leaves as good repellent against *S. oryzae*. *Bhavya et al. (2015) also reported O. tenuiflorum* oil exhibited insecticidal activity against weevil. Adesina *ET AL*. (2019) REPORTED *C. capitatum* ethyl extract as strong repellent against adults of *Sitophilus oryzae.*

Table 1 Efficacy of *Azadirachta indica*, *Ocimum sanctum C. inerme* leaf powder against *S. oryzae* in maize grains

Treatment	Dose used gm/kg on seed 7th day onwards	Percent larval mortality*
Untreated seed	All doses	0
***A. indica* leaf powder**	0.5	47.4±11.0
	1.0	63±8.20
	1.5	74.4±6.8
	2.0	85±4.51
	5	96.8±1.77
***O.sanctum* leaf powder**	0.5	17.2±5.26
	1.0	47±5.76
	1.5	59.4±5.67
	2.0	75.6±4.88
	5	87±4.63
***C. inerme* leaf powder**	0.5	15.4± 6.86
	1.0	26±5.18
	1.5	40.6±7.27
	2.0	48.8±9.0
	5	61.8±6.7

*Larval mortality worked out based on reduction in adult emergence in treatment compared to untreated control

Figure: 1 Leaves Powder of *A. indica* , *O. sanctum* & *C. inerme*

V. CONCLUSION

In the present study, Neem leaves powder and *Ocimum* leaves powder showed good effect adult mortality. It was 35% after 12 day treatment.The efficacy of mortality at various stages of rice weevil showed, *Azadirachta indica* is 96.8±1.77 followed by *Ocimum Sanctum* 81±4.63 and *Clerodendrum inerme* is 61.8±6.7 respectively. In management the positive effect of *Ocimum sanctum*(Tulsi), *Clerodendrum inerme* (Wild jasmine)and *Azadirachta indica*(Neem) leaf powders against rice weevil in maize grains was evaluated which showed the highest seed protection efficiency in *Azadirachta indica* with minimal followed by >*Ocimum sanctum* (L.) >*Clerodendrum inerme* (L.) Leaves powder. Hence the study will be helpful to people for using cost effective control measure against this serious pests. Moreover, the botanicals are biodegradable, pest specific & leaving no toxic residue in environment.

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