Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2016; 4(6): 92-96

Received: 12-09-2016
Accepted: 13-10-2016

Nilesh Jawalkar
Department of Zoology,
Dr. Babasaheb Ambedkar
Marathwada University,
Aurangabad (MS), India

Sureshchandra Zambare
Department of Zoology,
Dr. Babasaheb Ambedkar
Marathwada University,
Aurangabad (MS), India

Sunita Zanke
Department of Zoology,
Dr. Babasaheb Ambedkar
Marathwada University,
Aurangabad (MS), India

Correspondence
Nilesh Jawalkar
Department of Zoology,
Dr. Babasaheb Ambedkar
Marathwada University,
Aurangabad (MS), India

Insecticidal property of *Datura stramonium* L. seed extracts against *Sitophilus oryzae* L. (Coleoptera: Curculionidae) in stored wheat grains

Nilesh Jawalkar, Sureshchandra Zambare and Sunita Zanke

Abstract
The insecticidal property of *Datura stramonium* seed extracts against the rice weevil, *Sitophilus oryzae* was tested in the laboratory. The experiments were conducted at (28±3) ^{0}C and (78±3) % relative humidity. It was observed that Soxhlet's extracted extracts of *D. stramonium* seed in ethanol, chloroform and acetone were very effective to control the pest while extracts in methanol and n-hexane gave poor results. The probit analysis of data demonstrated that LD_{10}, LD_{50} and LD_{90} values for ethanol, chloroform and acetone extracts was LD_{10} = 2.962, 3.080, 0.4752 ml/Kg, LD_{50} = 8.594, 7.379, 1.185 ml/Kg and LD_{90} = 24.94, 17.67, 2.957 ml/Kg respectively for 96 hrs. These results suggest that the mortality increased with increase in concentration as well as exposure time and the extracts of *D. stramonium* seed may be of high value in grain storage against *S. oryzae*, especially in subsistence agriculture where the plants are locally available to farmers with little resources. Hence, we conclude that extracts of *D. stramonium* seed served as being a potential insecticidal agent can be used against rice weevil, *S. oryzae* after proper dose formulation to prevent infestation in wheat and even other grains during storage.

Keywords: *Datura stramonium, Sitophilus oryzae,* insecticide, stored grains, mortality

1. Introduction
Particularly in developing countries, 5-10% loss of cereal grains in temperate and 20-30 % loss in tropical countries is a serious problem due to the insect infestation during storage [1-4]. The cereals are badly infested by the stored grain weevil, *Sitophilus oryzae* which is the primary stored-grain insect in warm climate areas. It causes up to 30-40% cereal grain loss in India at conditions favorable to their development, 25–35 ^{0}C and low RH and also in other countries [5, 6]. The pest prefers soft varieties of wheat grains [7].

Control of infestation of stored grains by insect pests is primarily achieved by the use of synthetic chemical insecticides, like methyl bromide and phosphine. In most the countries, due to environmental concerns and human health hazards, several chemical insecticides have been either banned or restricted [8]. The adverse effects of most novel chemical insecticides have led researchers to find new avenue of insect control, which has led to the discovery of products from plants, as an alternative way of controlling insects [9, 10]. Chemical pesticides are toxic to us as they have high toxicity and residual value and hence are not suitable to treat the pests in stored grains.

In the protection integrated stored-product, phytochemicals may be used for (i) pest prevention, repelling pests from goods, (ii) early pest detection, attracting pests to lures or (iii) pest control by using toxic compounds [11]. Basic knowledge is required to aid future commercial developments in this field.

Datura stramonium is one of the widely distributed well-known folklore medicinal herb. An extract made from the leaves is taken orally for the treatment of sinus infections, asthma and stripped bark are applied externally to treat swelling, burns and ulcers. The growing plant repels insect, which protects neighboring plants from insects [12]. The phytochemical screening revealed that it contains phenols, flavonoids, tannins, saponins, alkaloids, steroids and glycosides [13]. All parts of the plant are toxic, but the ripe seeds contained the highest amount of alkaloids [13, 14].

Moreover, tropical regions are supposed to be endowed with many plant species having insecticidal properties and some of them with medicinal properties [3]. Very little information

is available on the use of plant extracts against insect pests of stored grains, especially on the *Sitophilus oryzae*.

2. Materials and Methods

2.1 Extraction of *D. stramonium* seeds

Datura stramonium seeds were collected from rural area of Aurangabad (MS), India. All seeds were washed with tap water and dried in shade and powdered in grinder. Each powder was packed in filter paper and extract was extracted in Soxhlet's apparatus in 1:10 ratio i.e. 20 g powder in 200 ml of solvent. After eight hrs. of continuous extraction, the final extract was filtered by Whatman filter paper no. 1 and the filtrate was collected and kept open to evaporate the solvent. Remaining extract as a stock solution was stored at 4 ^{0}C in refrigerator until use. Extract of plant materials was extracted in chloroform, acetone, methanol, ethanol and n-hexane and were stored after evaporation of solvent in refrigerator.

2.2 Toxicity of plant extracts to adult insects

The stock culture of weevils, *Sitophilus oryzae* reared in laboratory condition were used for experimentation. 25 gm of the pest free whole wheat grains were taken in each of the plastic bottle. One was maintained as control, another were labeled and were used for experiment. The seed extract of *Datura stramonium* was dissolved in respective solvent to make 10 ml volume and from this diluted extract (4ml/Kg, 8ml/Kg, 12ml/Kg, and 16ml/Kg) was added in each bottle containing 25 gm of whole wheat grains. The bottles were kept open for 48 hours in well ventilation room to evaporate the solvent. After 48 hour 5 pairs (one week old) of *Sitophilus oryzae* adult from stock culture were released in each of the control and experimental bottles. The bottles were completely covered with a piece of muslin cloth and fixed with the help of rubber band to prevent escapes. The treatments were arranged in plastic bottles in laboratory maintained at a temperature of (28±3) °C and (78±3) % relative humidity. The whole experiment was repeated thrice. The mortality of *Sitophilus oryzae* adults was recorded after every 24 hours and percentage (%) data collected was analyzed. The determination of LD_{10}, LD_{50} and LD_{90} values for 96 hrs. was done by using probit analysis [15].

3. Observation and Results

Longer intervals are required to the satisfactory level of mortality. The findings of this study agree with the earlier reports that most of the extracts from plants have insecticidal properties and control pest through affecting the biological activities **[16]**.

The *D. stramonium* seed extract has strong toxicity against *S. oryzae* adults. The mortality increased with raising concentration from 4 to 16 ml/Kg and with exposure times of 24 and 96 h. The range of statistical calculations and determination of LD_{10}, LD_{50} and LD_{90} values as per [15] Finney's (1971) are showed in (Table No.1). The comparison of LD_{10}, LD_{50} and LD_{90} values calculated for ethanol extract were 2.962 ml/Kg, 8.594 ml/Kg and 27.94 ml/Kg respectively. Similarly, the LD_{10}, LD_{50} and LD_{90} values calculated for chloroform extracts were 3.080 ml/Kg, 7.379 ml/Kg and 17.67 ml/Kg respectively. For acetone extracts it was 0.4752 ml/Kg, 1.185 ml/Kg and 2.957 ml/Kg respectively.

The graph regarding empirical/improved expected probit against the log of concentration are given in (Figure 1, 2 and 3) as Regression and Provisional lines for LD_{10}, LD_{50} and LD_{90} values of *Sitophilus oryzae* after the exposure to ethanol, chloroform and acetone extract of seed extracts of *Datura stramonium* for 96 hours.

Table 1: Comparison of LD_{10}, LD_{50} and LD_{90} values and regression equation of seed extracts of *Datura stramonium* to *Sitophilus oryzae*

Name of plant	Solvent	Time of exposure in hrs.	Regression equation $Y = \bar{y} + b(x - \bar{x})$	LD_{10} values in ml/Kg	LD_{50} values in ml/Kg	LD_{90} values in ml/Kg
Seed extract of *Datura stramonium*	Ethanol	96	$Y = 2.7704x - 0.3585$	2.962	8.594	24.94
	Chloroform	96	$Y = 3.3785x - 1.3110$	3.080	7.379	17.67
	Acetone	96	$Y = 3.2280x - 1.5334$	0.4752	1.185	2.957

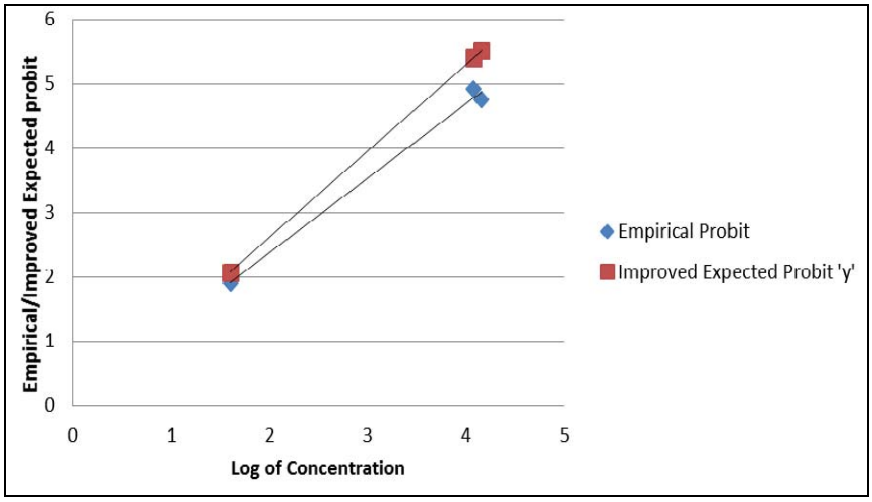

Fig 1: Regression and Provisional line for LD_{10}, LD_{50} and LD_{90} values of *Sitophilus oryzae* after the exposure to Ethanol extract of seeds of *Datura stramonium* for 96 hours

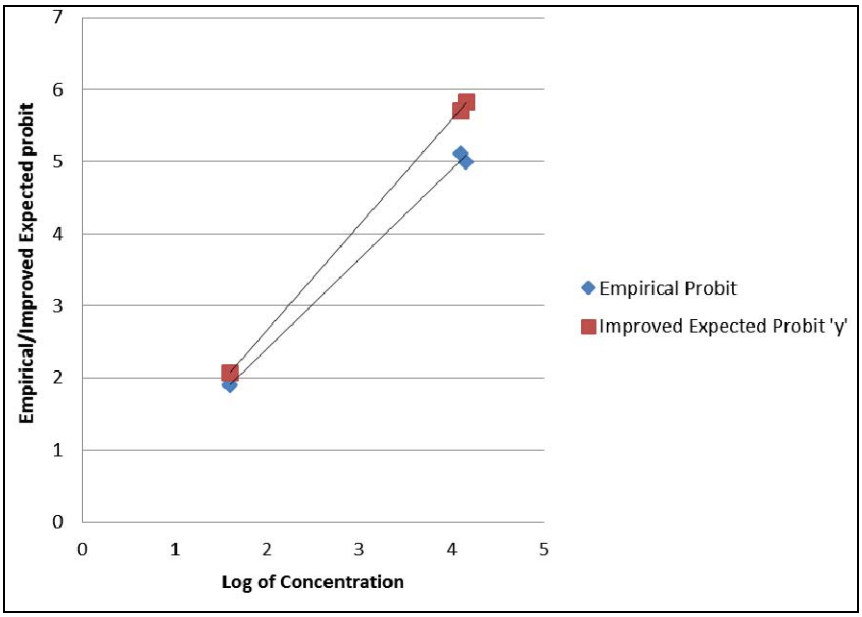

Fig 2: Regression and Provisional line for LD_{10}, LD_{50} and LD_{90} values of *Sitophilus oryzae* after the exposure to Chloroform extract of seeds of *Datura stramonium* for 96 hours

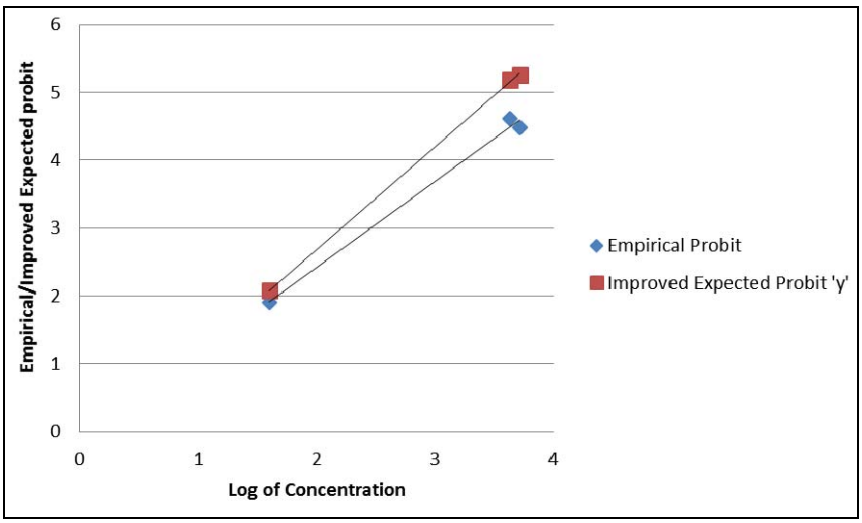

Fig 3: Regression and Provisional line for LD_{10}, LD_{50} and LD_{90} values of *Sitophilus oryzae* after the exposure to Acetone extract of seeds of *Datura stramonium* for 96 hours.

4. Discussion

The present results indicated that the ethanol, chloroform and acetone extract of *D. stramonium* seeds was effective against *S. oryzae*. Result of the present study is in agreement with the result of [17] Abbasipour *et al.,* (2011a), who reported that the acetone leaf extract of *D. stramonium* shows toxic effect on *Callosobruchus maculatus* adult. The LC_{50} and LC_{90} values are 1680 and 534.62 ppm for 24 and 48 hours, respectively. [18] Abbasipour *et al.,* (2011b), reported that the seed and leaves extract of *D. stramonium* also used to control of *Tribolium castaneum*. They also reported that with the increase in concentration, mortality of adults also increased, and the highest mortality was seen at a concentration of 5000 mg L^{-1}. LC_{50} and LC_{90} values for *T. castaneum* adults after 24 h of exposure to *D. stramonium* extract were 3936 and 15373 mg L^{-1}, respectively. [19] Derkyi *et al.,* (2010) recorded *Datura innoxia* plant extract were active against *Callosobruchus maculatus* with the LC_{50} value 31.7 ppm. [20] Derbalah *et al.,* (2012), reported that the extracts from the plant *Caesalpinia gilliesii* (100%) was the most effective against the pests *Sitophilus oryzae* adults followed by *Chrysanthemum frutescens* (95.6%), *Thespesia populnea var. acutiloba* (88%), *Euonymus japonicus* (85%), *Bauhinia purpurea* (75%), *Cassia senna* (80%) and *Cassia fistula* (70%) respectively. [21] Rajashekar *et al.,* (2010), reported that the methanolic root extract of *Decalepis hamiltonii* was effective against the *Rhyzopertha domonica, Sitophilus oryzae, Stegobium paniceum, Tribolium castaneum* and *Callosobruchus chinensis* with the LC_{50} values 0.119 (0.0729, 0177) mg/cm^2, 0.119 (0.0918, 0.145) mg/cm^2, 0.117 (0.0749, 0.158) mg/cm^2 and for *Callosobruchus chinensis* it was 0.115 (0.0742, 0.156) mg/cm^2, respectively. [22] Khani *et al.,* (2011) reported that the petroleum ether and chloroform extracts of *P. nigrum* and petroleum ether extracts of *J. curcas* caused highest mortality rates for *Sitophilus oryzae* based on LC_{50} values after 72 h. The LC_{50} of petroleum ether extracts of *P. nigrum* was (1.61 µl/g), similarly, LC_{50} of chloroform extract of *P. nigrum* (1.70 µl/g) and petroleum ether extract of *J. curcas* (6.82 µl/g). Petroleum ether and chloroform extracts of *P. nigrum* L. were more toxic with 99.56, 93.56% mortality rates than petroleum

ether extract of *J. curcas* with 66.00% mortality rate, respectively [22].

According to [23] Saljoqi *et al.,* (2006) the effect of ethanolic extracts of Bakain drupes (*Melia azedarach*), Leaves of habulas (*M. communis*), Leaves of mint (*Mentha longifolia*), Bakain leaves, Harmal shoots and seeds (*P. harmala*) and Roots of lemon grass (*C. citratus*) had repellent and lethal effects against rice weevil, *Sitophilus oryzae.* **[24]** Ileke and Ogungbite, (2014) reported that powders and extracts of *Azadirachta indica, Zanthoxylum zanthoxyloides, Anacardium occidentale* and *Moringa oleifera* has high mortality effect against *Sitophilus oryzae, Oryzaephilus mercator* and *Rhyzopertha dominica*. All the extracts, at all tested concentrations, achieved 100% mortality of *S. oryzae* within 72 hrs. of exposure except extract of *M. oleifera* at 2 and 4 % which achieved 72% and 87.59% mortality, respectively **[24]**.

5. Conclusion

The results obtained from this assay revealed that all extracts of *Datura stramonium* seeds have shown varying levels of insecticidal property against *Sitophilus oryzae.* The importance of *Datura stramonium* for the control of storage pest such as *S. oryzae* has been proved. This can be used as an alternative for the chemical methods and with this the safer storage of wheat grains will be ensured. Further work on the identification of bio-insecticide from different plants is utmost needed.

6. Acknowledgement

The authors express their gratitude to Department of Science & Technology (DST), Government of India, New Delhi for providing financial assistance and Department of Zoology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (MS) for providing laboratory facilities.

7. References

1. Dubey NK, Srivastava B, Kumar A. Current status of plant products as botanical pesticides in storage pest management. Journal of Biopesticides. 2008; 1(2):182-6.
2. Rajashekar Y, Shivanandappa T. A novel natural insecticide molecule for grain protection. Julius-Kühn-Archiv. 2010; 20(425):910.
3. Ileke KD, Oni MO. Toxicity of some plant powders to maize weevil, *Sitophilus zeamais* (Motschulsky) [Coleoptera: Curculiondae] on stored wheat grains, (*Triticum aestivum*). African Journal of Agricultural Research. 2011; 6(13):3043-8.
4. Akinneye JO, Ogungbite OC. Insecticidal activities of some medicinal plants against *Sitophilus zeamais* (Motschulsky) (Coleoptera: Curculionidae) on stored maize. Archives of Phytopathology and Plant Protection. 2013; 46(10):1206-13.
5. Almaši R, Mastilović JS, Bodroža-Solarov M. Influence of rice weevil, (*Sitophilus oryzae* L.) and lesser grain borer, (*Rhizopertha dominica* F.) population density on quality and flower backed goods according to cereal grain storage time. Žito-hleb. 2003; 30(6):235-40.
6. Baloch UK. Integrated Pest Management in Food Grains. Food and Agriculture Organization of the United Nations and Pakistan Agricultural Research Council, Islamabad, Pakistan. 1992, 117.
7. Zakladnoi GA, Ratanova VF. Stored-grain pests and their control. Stored-Grain Pests and Their Control. 1987, 268.
8. Tapondjou LA, Adler CL, Bouda H, Fontem DA. Efficacy of powder and essential oil from Chenopodium ambrosioides leaves as post-harvest grain protectants against six-stored product beetles. Journal of Stored Products Research. 2002; 38(4):395-402.
9. Sutherland JP, Baharally V, Permaul D. Use of the botanical insecticide, neem to control the small rice stinkbug, *Oebalus poecilus* (Dallas, 1851) (Hemiptera: Pentatomidae) in Guyana. Entomotrópica: Revista internacional para el estudio de la entomología tropical. 2002; 17(1):97-101.
10. Zibaee A. Botanical insecticides and their effects on insect biochemistry and immunity. InTech Open Access Publisher; 2011, 55-68.
11. Adler C, Žd'árková E, Hubert J, Lukáš J. Phytochemicals for stored product protection-chances and limitations. In COST Action 842 (1999-2004). Biological control of pest insects and mites, with special reference to entomophthorales. Proceedings of the First Meeting of Working Group 4: Bio-control of arthropod pests in the stored products, Lisbon, Portugal, 6-7th September Research Institute of Crop Production. 2001, 2002, 24-28.
12. Das S, Kumar P, Basu SP. Phytoconstituents and therapeutic potentials of *Datura stramonium* Linn. Journal of Drug Delivery and Therapeutics. 2012; 2(3):4-7.
13. Shagal MH, Modibbo UU, Liman AB. Pharmacological justification for the ethnomedical use of *Datura stramonium* stem-bark extract in treatment of diseases caused by some pathogenic bacteria. International Research of Pharmacy and Pharmacology. 2012; 2(1):016-9.
14. Oseni OA, Olarinoye CO, Amoo IA. Studies on chemical compositions and functional properties of thorn apple, (*Datura stramonium* L.) Solanaceae. African Journal of Food Science. 2010; 5(2):40-44.
15. Finney DJ. Probit Analysis: 3d Ed. Cambridge University Press; 1971, 333.
16. Tinzaara W, Tushemereirwe W, Nankinga CK, Gold CS, Kashaija I. The potential of using botanical insecticides for the control of the banana weevil, *Cosmopolites sordidus* (Coleoptera: Curculionidae). African Journal of Biotechnology. 2006; 5(20).
17. Habib A, Fahimeh R, Mohammad M, Mohammad HH. Insecticidal activity of extract from *Datura stramonium* against *Callosobruchus maculatus*. Integrated Protection of Stored Products. IOBC/WPRS Bull. 2011a; 69:251-6.
18. Abbasipour H, Mahmoudvand M, Rastegar F, Hosseinpour MH. Bioactivities of jimson weed extract, *Datura stramonium* L. (Solanaceae), against *Tribolium castaneum* (Coleoptera: Tenebrionidae). Turkish Journal of Agriculture and Forestry. 2011b; 35(6):623-9.
19. Derkyi NS, Acquaah SO, Owusu-Akyaw M. Bioactivity of some natural products against the cowpea storage weevil, *Callosobruchus maculatus* L. International Journal of Biological and Chemical Sciences. 2010; 4(3):616-623.
20. Derbalah AS, Hamza AM, Gazzy AA. Efficacy and safety of some plant extracts as alternatives for *Sitophilus oryzae* control in rice grains. Journal Entomology. 2012; 9(2):57-67.
21. Rajashekar Y, Gunasekaran N, Shivanandappa T. Insecticidal activity of the root extract of *Decalepis hamiltonii* against stored-product insect pests and its application in grain protection. Journal of Food Science and Technology. 2010; 47(3):310-314.

22. Khani M, Awang RM, Omar D, Rahmani M, Rezazadeh S. Tropical medicinal plant extracts against rice weevil, *Sitophilus oryzae* L. Journal of Medicinal Plants Research. 2011; 5(2):259-265.
23. Saljoqi AU, Afridi MK, Khan SA. Effects of six plant extracts on rice weevil, *Sitophilus oryzae* L. in the stored wheat grains, Journal of Agricultural and Biological Science, 2006; 1:4.
24. Ileke KD, Ogungbite OC. Entomocidal activity of powders and extracts of four medicinal plants against *Sitophilus oryzae* (L.), *Oryzaephilus mercator* (Faur) and *Rhyzopertha dominica* (Fabr.). Jordan Journal of Biological Sciences. 2014; 7(1):57-62.