ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 8, Issue, 5, pp. 17179-17182, May, 2017

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

IMPACT OF FOUR PLANT POWDERS ON THE DEVELOPMENT OF THE RICE MOTH, *CORCYRA CEPHALONICA* STAINTON IN RICE GRAIN

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DOI: http://dx.doi.org/10.24327/ijrsr.2017.0805.0299

ARTICLE INFO

Article History:

Received 15th February, 2017
Received in revised form 25th March, 2017
Accepted 28th April, 2017
Published online 28th May, 2017

Key Words:

Corcyra cephalonica, *Hemidesmus indicus*, integrated pest management, plant powder, stored grain insect pest.

ABSTRACT

Laboratory studies were conducted on the insecticidal effect of four plant powders *Biophytum sensitivum* (whole plant), *Theobroma cacao* (leaf), *Pandanus amaryllifolius* (leaf), *and Hemidesmus indicus* (root) on rice moth *Corcyra cephalonica* Stainton infesting stored food products. The experiment was conducted in a completely randomized design (CRD) with six replications. The treatment dose ranged from 2 to 20% (w/w) of plant powder in rice grain. A control treatment having no botanical was set up to compare the results in order to choose effective plant powder to control rice moth in storage. Ten fourth instar larvae of rice moths were introduced to each treatment. The cumulative mortality percentage of larvae in different botanical treatments was recorded at two weeks interval. It was revealed that the use of powders from the selected indigenous plants increased larval mortality of the rice moth. Among the plant powders studied *Hemidesmus indicus* root powder recorded 86.4% mortality of the larvae at the end of the experiment and showed significantly ($p<0.05$) high effectiveness in inhibiting pupation and thus the adult emergence.

INTRODUCTION

Stored grains form bulk of the food worldwide. In India around 70% of stored grains are for personal use of farmers. But poor storage techniques had lead to great financial loss to the farmers. To avoid this loss chemical pesticides are extensively used in storage techniques. Mostly these chemical pesticides are administered in dust form and are mixed with the grains. These chemicals will control insect infestation to a greater extent, but they are toxic to mammals also.

Studies conducted by researchers all over the world have identified thousands of plant processing insect deterrent or toxic properties. When compared to the conventional chemical pesticides which are mostly neurotoxic, botanical pesticides are safer (Balmain *et al* 2001). Botanical pesticides or phytopesticides are more target species specific and safe for non-target insects. Even though hundreds of plant powder have been reported to control pest insects in the laboratory only two new botanical insecticides have been commercialized in the past 15 years (Isman 2006). These products are based on limonoid and azadirachtin as their active ingredient (Isman 2008 and Schmutterer 2002). More than 10% of the post harvest damage in warehouse and granaries occurs due to pest and mites infestation (Tooba *et al*., 2005) and 5-10% of the stored grains in India are lost due to insect pests (Frenemore and Prakash, 1992).

The rice moth, *Corcyra cephalonica* (Stainton) (Lepidoptera Pyralidae) is one of the most destructive insect pests of the stored grains including paddy grains, rice, jowar and other cereals and is widely distributed in India and many parts of the world (Osman, 1984). *Corcyra cephalonica*, the so far known only living member of the genus *Corcyra*. The larvae of *Corcyra* feeds on almost all sorts of stored food commodities like cereals, cereal products, oilseeds, pulses, spices, dried fruits, nuts, and biscuits. Rice moth is an external feeder of all kinds of grains. The life cycle shows complete metamorphosis. The damage is mainly caused by the larvae which feed on grains under silken webs and render them useless for human consumption (Frenemore and Prakash, 1992). Controlling them is done using chemicals pesticides, as it leads to environmental contamination and health hazards it is a serious concern (Tillman and Mulrooney, 2000).

MATERIALS AND METHODS

Rearing of test insect

The unsterilized eggs of *Corcyra cephalonica* (National Accession No: NBAII-MP-PYR-01) obtained from National

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Beauro of Agricultural Insect Repository (NBAIR) Bangalore, Karnataka were cultured under laboratory conditions at Department of Zoology, University College, Thiruvananthapuram, Kerala. The culture was maintained on rice grains, kept in plastic jars of 10kg capacity. Each 0.5 cc of eggs were reared on a newly formulated medium consisting of the 2.5kg of crushed sterilized rice grain, yeast powder (1gm), crushed groundnut (100gm), streptomycin (0.5gm) sprinkled over the rice and jar was covered with muslin cloth.

Plant material for the studies

The plant parts selected for studying insecticidal potential include *Biophytum sensitivum* (shoot), *Theobroma cacao* (leaf), *Pandanus amaryllifolius* (leaf), *and Hemidesmus indicus* (root). Plant materials were washed thoroughly and shade dried. The respective parts of each plant were ground to fine powder using a mixer grinder. Powders were stored in separate air tight containers and labeled accordingly and kept aside for further studies using plant powder.

Effect of plant powders on larval development

The first and the fourth instar larvae of *Corcyra cephalonica* were used for the studies on larval mortality. Ten gram of rice was taken in plastic containers. Plant powder were mixed with rice at different concentration 2%, 4%, 6%, 8% 10%, 15% and 20% w/w. The container was agitated continuously to ensure complete mixing up of the powder and kept idle to let the powder settle down. Ten fourth instar larvae were introduced into the separate containers. A control set of experiment without plant powder was also kept for each replicate. The experiment was replicated six times. The total number of larval mortality was noticed until all larvae in the control set pupated. The number of pupae formed and adult emerged from each set was counted for two more weeks after adult emergence stopped from the control.

Statistical Analysis

All data were subjected to analysis of variance (ANOVA) and probit analysis to calculate EC50.

Results with $p<0.05$ in Tukey's HSD test were considered statistically significant. Statistical analysis was carried out using statistical software IBM SPSS version 20

RESULT

In the present investigation effect of powder of *B. sensitive shoot, T. cacao leaves, P. amaryllifolius leaves and H. indicus* root on the development of *Corcyra cephalonica* larvae were studied. The result shows an increased rate of inhibition of larval development with an increase in the concentration of leaf powders treated. The corrected mortality percentage (Table 1) shows a dose-depended increase in larval mortality. *Hemidesmus indicus* root proved to be most effective in controlling the larval development. There was a concomitant decrease in pupation and adult emergence in all treatment groups. Again *H. indicus* root powder showed the highest rate of inhibition of pupation and adult emergence (Table 2 and 3).

Among the plants studied *H. inidicus* root was found to be more effective in controlling the larval development. When fourth instar larvae were reared on *Hemidesmus indicus* root powder mixed diet there was 86.4% larval mortality at the higher dose (20%). There was a significant reduction in pupation (13.3%) and adult emergence (11.67%) from fourth instar larvae after rearing on *H. indicus* root powder treated diet (20%) at the end of the experiment. EC50 value for inhibiting larval development after treatment is given in Table 4.

DISCUSSION

Hundreds of plants are known to possess insecticidal properties and as such they have been used in protecting the grains against the damage of a number of stored grain pests in different parts of the country according to local availability of such materials. Plant-based pest control measures are a safer alternative to synthetic pesticides (Anyanga *et al*., 2013; Amoabeng *et al*., 2014 and Stevenson, 2012).

Table 1 Effect of plant powders on percentage corrected mortality of fourth instar larvae of *Corcyra cephalonica*. * P<0.05

Plant powder	Dose(%w/w)						
	2	4	6	8	10	15	20
B. sensitivum	03.39 ± 0.5	3.9 ± 0.5	5.08 ± 0.47	6.78 ± 0.89	11.86 ± 0.75*	13.56 ± 0.5*	16.95 ± 0.37*
T. cacao	1.7 ± 0.47	8.5 ± 0.82	11.86 ± 0.47*	11.86 ± 0.74*	13.56 ± 0.96*	12.25 ± 0.47*	22.03 ± 0.47*
P. amaryllifolius	0	10.17 ± 0.67*	13.56 ± 0.76*	15.25 ± 0.47*	18.64 ± 0.57*	20.33 ± 0.37*	25.24 ± 0.47*
H. indicus	8.47 ± 0.58	15.26 ± 0.47*	22.03 ± 0.47*	33.9 ± 0.5*	54.24 ± 0.76*	72.22 ± 0.76*	86.44 ± 0.5*

Table 2 Effect of plant powders on percentage pupation of fourth instar larvae of *Corcyra cephalonica* * P<0.05

Plant powder	Dose(%w/w)						
	2	4	6	8	10	15	20
B. sensitivum	95 ± 0.5	95 ± 0.47	93.33 ± 0.47	91.67 ± 0.89	86.67 ± 0.75*	85 ± 0.5*	81.67 ± 0.37*
T. cacao	96.67 ± 0.47	90.00 ± 0.82	86.67 ± 0.47*	86.67 ± 0.75*	85.00 ± 0.96*	83.33 ± 0.47*	76.67 ± 0.47*
P. amaryllifolius	98.33 ± 0.37	88.33 ± 0.69*	85.00 ± 0.76*	83.33 ± 0.47*	80 ± 0.58*	78.33 ± 0.37*	73.33 ± 0.47*
H. indicus	90.00 ± 0.58	83.33 ± 0.47*	76.67 ± 0.47*	65.00 ± 0.5*	45.00 ± 0.76*	25.00 ± 0.5*	13.33 ± 0.75*
Control	98.33 ± 0.37	98.33 ± 0.37	98.33 ± 0.37	98.33 ± 0.37	98.33 ± 0.37	98.33 ± 0.37	98.33 ± 0.37

Table 3 Effect of plant powders on percentage adult emergence of fourth instar larvae of *Corcyra cephalonica* * P<0.05

Plant powder	Dose(%w/w)						
	2	4	6	8	10	15	20
B. sensitivum	95 ± 0.5	95 ± 0.47	93.33 ± 0.47	91.67 ± 0.89	86.67 ± 0.75*	83.33 ± 0.75*	80 ± 0.58*
T. cacao	96.67 ± 0.47	90.00 ± 0.82	85 ± 0.76*	85 ± 0.5*	83.33 ± 0.75*	81.67 ± 0.69*	75 ± 0.5*
P. amaryllifolius	98.33 ± 0.37	88.33 ± 0.69*	85.00 ± 0.76*	83.33 ± 0.47*	80 ± 0.58*	76.67 ± 0.47*	71.67 ± 0.37*
H. indicus	88.33 ± 0.37	81.67± 0.37*	75 ± 0.5*	63.33 ± 0.47*	41.67 ± 0.37*	23.33 ± 0.47*	11.67 ± 0.69*
Control	96.67 ± 0.47	96.67 ± 0.47	96.67 ± 0.47	96.67 ± 0.47	96.67 ± 0.47	96.67 ± 0.47	96.67 ± 0.47

Table 4 Effective concentrations (EC50) of different plant powders in inhibiting the development of fourth instar larvae of *C. cephalonica.*

Plant powder	EC50 %(w/w) 95% Confidence Limits for Dose	Chi-square*
B. sensitivum	171.36(66.36-2124.485)	1.98
T.cacao	121.84(53.65-918.78)	2.77
P.amaryllifolius	60.549(35.841-173.61)	6.42
H. indicus	9.363(7.57-11.94)	16.22

*High Chi-square value suggests a rise in growth inhibition values at higher concentrations.

The results of the present study are in agreement with various studies on insecticidal properties of plants (Rajendran and Sriranjini, 2008; Anyanga *et al*., 2013; Iram *et al*., 2013Amoabeng *et al.,* 2014; Stevenson, 2014;; Akunne *et al*., 2014 Aziza and Asma, 2015 and Kamran *et al*., 2015)

Use of plant material as grain protectant is one of the age-old and indigenous practices adopted by the farmers globally. Plant natural products that constitute effective safer alternatives to synthetic insecticides without producing adverse effects on the ecosystem have been tested in the management of stored-product pests (Mohaptra and Gupta 1998, Dubey *et al* 2008, 2009; Isman, 2006; Ukeh *et al*., 2009; Mao and Henderson, 2010). Many workers (Miah *et al*., 1993; Zibokere, 1994; Pandey and Singh, 1997; Patel and Patel, 2002; Meena and Bhargava, 2005; Righi Assia *et al*., 2010; Yadav *et al*., 2011; Pathak and Tiwari, 2012) have used products from several plant species for the protection of stored grains from insect pests. Use of edible or medicinal plants as insecticides, insect repellent or feeding deterrents not only ensures the safety of the environment and consumption of the treated produces, it is economical also to the farmers as they are easily available.

The present study reveals that *Hemidesmus indicus* root powder has the potential to be used as a safe grain protecting agent. There was a reduction in larval development and thus adult emergence in other plant powder treated diet also. Based on the results we recommend that powdered root of *Hemidesmus indicus* root is a strong candidate for integrated pest management strategies. Further studies are needed to be carried out to isolate and identify the bioactive component responsible for the insecticidal potential in the root of *Hemidesmus indicus*.

Acknowledgement

Staff and members of National Bureau of Agricultural Insect Resources (NBAIR), Bangalore, Karnataka, National Institute of Interdisciplinary Sciences and Technology (NIIST), Thiruvananthapuram, Kerala and University of Kerala, Thiruvananthapuram, Kerala.

References

1. Akunne, C. E.; Ononye, B. U and Ojemro, R. T. (2014). Mixed Application of Peel and Leaf Powders of Two Common Fruits as Wheat Grain Protectant against *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae). *Discourse Journal of Agriculture and Food Sciences*, 2(12): 309-313.
2. Amoabeng BW, Gurr GM, Gitau CW, Stevenson PC (2014) Cost benefit analysis of botanical Insecticide use in Cabbage: Implications for smallholder farmers in developing countries. *Crop Prot*. 57:71-76.
3. Anyanga, O.M., Muyinza, H., Hall, D.R., Porter, E., Farman, D.I. Talwana, H., Mwanga, R.O., Stevenson, P.C., (2013). Resistance to the weevils *Cylas puncticollisand Cylas brunneus* conferred by sweetpotato root surface compounds. *Journal of Agricultural and Food Chemistry* 61, 8141-8147.
4. Aziza S., Asma E., (2015). Evaluation of some plant essential oils against the black cutworm *Agrotis ipsilon*. *Global Journal of Advance Research* 2(4), 701-711
5. Balmain, S.R., Neal, G.E, Ray, D.E and Golop, A. (2001): Insecticidal and vertebrate toxicity associated with ethnobotanicals used as postharvest protectants in Ghana. *Food Chemistry and Toxicology* 39:287-291
6. Dubey NK, Bhawana S, Kumar A (2008). Current Status of Plant Products as Botanical Pesticides in Storage Pest Management. *Journal of Biopesticides*; 1(2):182- 186. 12.
7. Dubey NK, Kumar A, Priyanka S, Shukla R (2009). Exploitation of Natural Compounds in Eco-Friendly Management of Plant Pests. In Recent Developments in Management of Plant Diseases (Ulrich Gisi, I. Chet and Maria Lodovica Gullino (eds.), Springer Netherlands, 181-198
8. Frenmore, P.G. and A. Prakash, (1992). *Applied Entomology*, 1st edition. Wiley Eastern Ltd., New Delhi, IndiaKambham Venkateswarlu, N.Devanna; Pharmacological Evaluations (Analgesic Activity) of *'Piper betle'; International Journal of Pharmamedix India;* 2014, 2(2),688-93.
9. Iram, N., Arshad M. and Akhter, N. (2013). Evaluation of Botanical and Synthetic Insecticide for the Control of *Tribolium castaneum* (Herbst.) (Coleoptera: Tenebrionidae). BioAssay, 8(3):1-10
10. Isman MB. (2006). Botanical insecticides, deterrents, and repellents in modern agriculture and an increasingly regulated World. *Annual Rev. Entomol*., 51:45-66.
11. Isman, M. (2008). Botanical insecticides: for richer, for poorer. *Pest Management of Science*, 64: 8-11.
12. Kamran S., Salim J., Amjad U., Syed F.S., Muhammad U., Maqsood S., Manzoor A.M., Amjid M., (2015). Evaluation of some botanical and chemical insecticides against the insect pests of okra. *Journal of Entomology and Zoology Studies* 3 (2), 20-24
13. Mao L., and Henderson G. (2010). Evaluation of potential use of nootkatone against maize weevil (Sitophilus zeamais Motschulsky) and rice weevil [S. oryzae (L.)] (Coleoptera: Curculionidae). *Journal of Stored Products Research,* 46:129-132.
14. Meena, B.L. Bhargava, M.C. (2010). Effect of plant powders on reproductive potential of *Corcyra cephalonica* Stain-ton (Lepidoptera: Pyralidae) on sorghum seeds. *Journal of Insect Science*, 23: 441-446.
15. Miah, M.R.U., Elias, M., Torofder, G.S., Islam, B.N., Sardar, M.A. and Karim, M.A. (1993). Evaluation of local plant material against the pulse beetle (*Callosobruchus chinensis* L.) on chickpea. *Bangladesh Journal of Zool*-ogy, 21: 151-153
16. Mohapatra GK, Gupta GP. Pesticide induced resurgence. Pestology (1998); 22(12):14-20.11. Dubey NK,

Bhawana S, Kumar A. Current Status of Plant Products as Botanical Pesticides in Storage Pest Management. *Journal of Biopesticides* 2008; 1(2):182- 186. 12.

17. Osman, N. (1984). Assessment of damage by rice moth, *Corcyra cephalonica* Stain ton, on different grains at four levels of moisture. Presented at seminar on health and ecology in grains post-harvest technology. ASEAN Crops Post-Harvest Programme, 21-24 August 1984, Kuala Lumpur
18. Pandey, N.K. and Singh, S.C. (1997). Effect of neem bark powder on infestation of pulse beetle, *Callosobruchus chinensis* Linn. in stored chickpea. *Indian Journal of Entomology*, 59: 161-163.
19. Patel, R.A. and Patel, B.R. (2002). Evaluation of certain plant products as grain protectants against the rice moth, *Corcyra cephalonica* Staint in stored rice. *Pest Management and Economic Zoology*, 10: 121-124.
20. Pathak, C.S. and Tiwari, S.K. (2012). Insecticidal action of neem seed (*Azadirachta indica* A. Juss) acetone extract against the life-cycle stages of rice-moth, *Corcyra cephalonica* staint. (Lepidoptera: Pyrali-dae). *World Journal of Agricultural Sciences*, 8: 529-536.
21. Rajendran, S., Sriranjini, V. 2008. Plant products as fumigants for stored-product insect control. *Journal of Stored Products Research,* 44(2): 126–135.
22. Righi-Assia A, Khelil M, Medjdoub-Bensaad F, Righi K (2010). Efficacy of oils and powders of some medicinal plants in biological control of the pea weevil (*Callosobruchus chinensis* L.) *Afr. J. Agric. Res*. 5:1474-1481.
23. Schmutterer, H., (1990). Properties and potential of natural pesticides from the neem tree Azadirachta indica. Annual Rev. *Entomol.* 35, 271-297.
24. Stevenson, P.C., Nyirenda, S.P., Mvumi, B., Sola, P., Kamanula, J.M., Sileshi, G. and Belmain, S.R. (2012) Pesticidal Plants: A Viable Alternative Insect Pest Management Approach for Resource-Poor Farming in Africa. In: Koul, O., Khokhar, S., Dhaliwal, D.S. and Singh, R., Eds., Biopesticides in Environment and Food Security, Scientific Publishers, Jodhpur, 212-238.
25. Tillman P. G., Mulrooney J. E., (2000).- Effect of selected insecticides on the natural enemies *Coleomegilla maculata* and *Hippodamia convergens* (Coleoptera: Coccinellidae), *Geocoris punctipes* (Hemiptera: Lygaeidae), and *Bracon mellitor*, *Cardiochiles nigriceps*, and *Cotesia marginiventris* (Hymenoptera: Braconidae) in cotton.- *Journal of Economic Entomology*, 93 (6): 1638-1643.
26. Tooba h., Usmani n. F., Abbas. T., (2005).- Screening of plant leaves as grain protectants against *Tribolium castaneum* during storage.- *Pakistan Journal of Botany,* 37 (1): 149-153.
27. Ukeh DA.,. Birkett MA, Pickett JA., Bowman AS., and Luntz AJ (2009). Repellent activity of alligator pepper, *Aframomum melegueta*, and ginger, *Zingiber officinale* against the maize weevil, *Sitophilus zeamais*. *Phytochemistry* 70:751-758
28. Yadav, R., Srivastava, S.K., Yadav, N., Yadav, R. and Kumar, M. (2011). Insecticidal properties of some natural pesticides against storage pest, *Corcyra cephalonica*. *Journal of Experimental Zoology*, 14: 259-260.
29. Zibokere, D.S. (1994). Insecticidal potency of red pepper (*Capsicum annum*) on pulse beetle (*Callosobruchus maculates*) infesting cowpea (*Vigna unguiculata*) seeds during storage. *Indian Journal of Science*, 64: 727-728.

How to cite this article:

Maya G Pillai *et al*.2017, Impact of Four Plant Powders on The Development of The Rice Moth, Corcyra Cephalonica Stainton In Rice Grain. *Int J Recent Sci Res.* 8(5), pp. 17179-17182. DOI: http://dx.doi.org/10.24327/ijrsr.2017.0805.0299

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