Original scientific paper
10.7251/AGSY1404473S

PESTICIDES AS POLLUTANTS OF ENVIRONMENT AND USE OF BOTANICALS AS AN ALTERNATE MANAGEMENT STRATEGY

Meera SRIVASTAVA

Laboratory of Entomology,Post Graduate Department of Zoology, Govt. Dungar College, Rajasthan, India
*Corresponding autor: meerayk@rediffmail.com

Abstract

Pesticides are intended for preventing, destroying or controlling any pest. They are unable to discriminate between the harmful and non-harmful or useful species and therefore pose severe adverse effects. Pesticide residues in food, water, soil and fodder have been resulting in poisoning of wild-life and livestock, environmental pollution and therefore ecological imbalance**.** It is high time we think for some alternates for the management of insects. The present paper throws light on the impact of pesticides/insecticides on human and animal life and suggests some alternate management strategies major being the use of botanicals especially against an insect pest of stored pulses, *Callosobruchus chinensis* Linn. (Coleoptera: Bruchidae). Plants belonging to several families were screened by employing different formulations of various plant parts of varied concentrations and documenting the mortality of the test insect. It could be concluded from the study that most of the plants screened during the present study have a potential to be used against the pest *C. chinensis* and can prove to be an alternative, cheap, eco-friendly, and non-hazardous substitute as against chemical insecticides in household and storehouses to minimize the infestation and damage caused by the bruchid.

Key words: *Pesticides, Callosobruchus chinensis, botanicals, extracts, concentrations, mortality*

Introduction

Pesticides are intended for preventing, destroying or controlling any pest but their residues in food, water, soil and fodder have been resulting in poisoning of wild-life and livestock, environmental pollution and therefore ecological imbalance. Globally, hundreds of insects face the threat of eventual extinction, two major reasons for the many threatened and endangered species of animals especially insects internationally include shrinking habitats and increased use of pesticides and other chemicals. It is high time we think for some alternates for the management of insects. Application of different cultivation practices, use of resistant varieties, use of natural enemies, predators and pathogens, **use of bio-pesticides**, application of sterility methods, use of insect sex attractants, pheromones and use of chemical alternatives to pesticide and above all educating farmers can help reduce the risks. Our laboratory, therefore, undertook work on screening of certain plants for their insecticidal efficacy against the stored grain pulse *Callosobruchus chinensis.* Plants possess secondary metabolites, which can be an effective source of insecticides and can be considered to be safe to no-target populations, biodegradable and eco-friendly, safe in handling, cost effective and easily available. Plants belonging to families Zygophyllaceae (*Peganum harmala*, *Fagonia cretica*, *Tribulus terrestris*); Leguminoseae/ Fabacae (*Tephrosia purpurea*, *Trigonella foenum graecum*, *Crotolaria burhia*, *Prosopis cineraria*, *P. juliflora*); Solanaceae (*Solanum surratense*, *S. nigrum*, *Withania somnifera*); Lamiaceae (*Mentha spicata*, *Ocimum sanctum, O. Basilicum*); Euphorbiaceae (*Euphorbia hirta, Jatropha gossiipifolia*,

Phyllanthus amarus) have been screened and of Rutaceae (*Aegle marmelos, Limonia acidissima, Murraya koenigii*) are being screened in our Laboratory of Entomology for their efficacy.

Methodology

The test insect selected for the study was *Callosobruchus chinensis* Linn. A pure line culture was raised on seeds of green gram *Vigna radiata* Linn. at 28±2^{0}C temperature and 70% relative humidity. The plant material used in the study was collected from Bikaner city and its vicinity (situated between 27^{0}11' & 20^{0}03' North latitude and 71^{0}54' & 74^{0}12' East longitude). Different parts viz., root/ stem/ bark/ leaves/ fruits were separated to prepare formulations. These were employed in the form of crude extract/ aqueous suspension/ aq. extract/ ether extract/ methanol extract/ ethanol extract at dose concentration ranging from 1.0/ 2.5/ 5 /10 / 25/ 50 % along with normal (no treatment) and control sets(treated with solvent), for comparisons. The aspect studied was adult mortality (per cent).

Results and discussion

Some salient findings based on significance level ($p<0.05$), 70% adult mortality was noted in sets treated by 10 % aqueous and ether extract of leaves of *P. juliflora*; more than 70% adult mortality by formulations of *T. purpurea* and 10% aqueous extract of pods of *C. burhia*; 80% adult mortality in sets treated with 10% ether extract and aqueous suspension of fruits of *S. surattense*; 85% by formulations of 10% ether extract of fruit of *P. harmala*; 100% adult mortality by 25% and 50% ethanol extract of leaf of *M. spicata* and also by 25 % crude extract of leaves of *P. amarus* was documented.

Earlier various plants belonging to different plant families have been suggested to possess insecticidal properties by various workers from time to time. Ofuya & Osadahun (2005) observed 100% mortality of *C. maculatus* when treated with powder from dry flower buds of *E. aromatica*. Roots of *T. minuta* were found to be more effective against *Z. subfasciatus* than flowers and leaves as observed by Weaver et al. (1994). Complete adult mortality of *C. maculatus* was also documented by Okonkwo & Okoye (1992) when treated with dried ground leaves *R. communis*. The present findings are also in conformation with the reports of Juneja & Patel (1994) who observed 100% adult mortality of *C. analis* after three days of treatments with various plant/products including leaves of mint. Other plants belonging to various families have also been screened by various workers and have been reported to be effective against different insects. These include the works of Worseley (1934), who suggested *Tephrosia vogellii* to possess insecticidal properties, Brindley et al. (1940), who found *Derris* to be effective against insects, rotenone has been reported to be effective by Huckett (1941), Rainwater & Bondey (1941), Richardson & Sciefeale (1941), Takai & Myajama (1941), Watkins (1941) and many others and these support the present observations.

Grainge et al. (1984) reported leaves of *Euphorbia splendens* and *E. poinsettiana* to possess antifeedant activity against several insect pests. The leaves and stem of four species of *Euphorbia* viz., *E. nivulia, E. pulcherrima, E. antiquoroum* and *E. tirucalli* were employed in the form of alcoholic extracts at different dose concentration against *Plutella xylostella* by Uma et al. (2009). All these reports give support to the investigations carried out during the present study. Aiyelaagbe & Gloer (2008) isolated many compounds including flavanoids, steroids, alkaloids and diterpenoids from *Jatropha podagrica*. The chemical class of diterpenes has been reported to have insecticidal activity as suggested by Medina et al. (2003), Breuer et al. (2003) and Akhtar & Isman (2004). Herota et al. (1988) reported the most important toxic compound in extracts of *J. curcas* likely to be the phorbol esters which are enriched as hydrobiomolecules by methanol extractions. According to Castagna et al.

(1982) phorbol esters are known to directly activate protein kinase-C (PKC). This key enzyme of signaling cascades plays a critical role in mainting the integretity of insect surface. Activation of PKC by phorbol esters may lead to phosphorylation of differents proteins and consequent organisation of the cell cytoskeleton as suggested by Bershadsky et al. (1990). PKC also regulates the activity of ion channels, which may lead to vesicle formation on pest surface (Xiao et al., 1984) or with a pore-forming toxin in extracts of *J. curcas* induces osmolaric instability, surface vasiculation and subsequent death of the pest. The solvent extracts could have hydrophilic components such as saponins, curcin, phytates and protease inhibitors as suggested by (Morgue et al., 1961; Stirpe, 1976). Arvinda (2009) suggested reason for the death of the insect to be due to the effect of toxic proteins in the extracts, which are ribosome-inactivating proteins. Earlier Hostettmann et al. (1982) have reported saponins to possess pesticidal properties. This could be true for the present investigations also.

Asmanizar et al. (2012) conducted a laboratory study to test the bioactivity of *J. curcas* and *Anona murieata* seed crude extract against *Sitophilus zeamais* and reported them to have contact and stomach poison activity. They further found the weevil mortality to range from 70-100% and suggested the potential of these extracts against the said pest. The present findings are in conformation with those of Stein & Klingauf (1990) who also suggested that ethanol extracts of *O. sanctum* were 60–100% effective as botanical insecticide against *M. persicae*, while, Pascual–Villalobos (1998) found polar extract of *M. longifolia* to produce 70–100% mortality when applied topically. Al Lawati et al. (2002) recorded 100% mortality of *C. chinensis* when treated with methanol and ethanol extracts within 20 and 4h of their exposure suggesting quick knockdown by ethanol. Mukherjee & Ramgovind (1954) suggested that ether extract, as contact poison was 0.8 times more toxic than petroleum ether extract and 0.9 times more toxic than alcoholic extract. Bhaduri et al. (1985) found *Tridax procumbens* extracted in petroleum ether to be most effective against pulse beetle and Teotia & Tiwari (1977), Pandey et al. (1980), Jilani & Su (1983), also reported petroleum ether extract to be more toxic, while Abdallah et al. (1988) observed ethanol extract and hexane extract to exhibit higher toxicity. Ahmed et al. (1991) using ethanol, acetone and ether solvents observed 66.66, 76.66 and 76.66% mortality respectively of insect *Ateva fabriciella* suggesting that solvents play a major role in the extraction of principal insecticidal constituents from the plant material which seems to be true for the present work also.

Earlier Pareek & Bhatta (1998) also observed highest mortality of *C. partellus* when treated with extract of various plant products at 10% concentrations. Similarly, Singh et al. (1998) also reported plant extracts of 10% concentration to be superior over others, a low dose concentration 0.2–0.5% was observed to cause mortality of *H. vigintioctopunctata*.

Conclusion

It could be concluded from the study that the plants screened have a potential to be used against the pest *C. chinensis* and can prove to be an alternative, cheap, eco-friendly, and non-hazardous substitute as against chemical insecticides in household and storehouses to minimize the infestation and damage caused by the bruchid.

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