JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Use of smoke of plant *Prosopis*: An effective traditional control method employed against insect pest *Callosobruchus chinensis* Linn.

Shailja Negi & Meera Srivastava*

*Ex-Head, Department of Zoology, Govt. Dungar College,

Bikaner 334001, Rajasthan, India

Abstract

Production of food grain has been the endeavour of human race since the ushering in of civilization. A very important aspect of food production is its proper conservation during and after harvest, so that crop losses during storage are reduced. With time, the ill effects associated with heavy and indiscriminate use of pesticides started becoming visible. The present investigation was therefore carried out to study the efficacy of two plants viz. *Prosopis juliflora* and *Prosopis cineraia* on adult mortality of pulse beetle *Callosobruchus chinensis* Linn. (Coleoptera: Bruchidae). by employing bark, fruit, leaf and their combinations (*P. juliflora* leaf + *P. cineraria* leaf and *P. juliflora* bark + *P. cineraria* fruit), by treating the pest insect with the smoke produced by incinerating the different parts of the two plants separately, and in combination. The results reveal that the highest bruchid mortality of 70% resulted after 48 h with treatment of smoke of fruit and leaf of *P. juliflora*, while smoke of bark of *P. juliflora* resulted in lowest mortality of only 14%. Bark after 24 h fruit after 48 h or treatment of *P. cineraria* resulted in significant mortality.

Introduction

Production of food grain has been the endeavour of human race since the ushering in of civilization. The increasing population pressure since then has resulted in ever-increasing need for agricultural produces. It has been possible to partially fulfill the increasing needs by improved agricultural practices like intensive farming, mechanized tools, high yielding varieties. A very important aspect of food production is its proper conservation during and after harvest, so that crop losses during storage are reduced. Thus the protection of stored grain from insect pest is of considerable importance owing to chances of severe infestation and damage in a short period. Heavy reliance on modern pesticides and their increased use has its apparent benefits. With time, the ill effects associated with heavy and indiscriminate use of pesticides started becoming visible. The adverse side effects, development of resistance in some pests and environmental and health hazards, have been of such magnitude and lasting that there has been a universal appreciation of the problem.

Thus in recent years, an impetus has been on developing and evaluating botanical insecticides in view of their relative safety to the environment. The present study has focused attention on the pulse beetle *Callosobruchus chinensis* Linn. (Coleoptera: Bruchidae), which has widely been acclaimed to be one of the major pest causing significant damage to stored pulses resulting in heavy losses to public exchequer annually. It has been found to cause weight loss, decreased germination potential and reduction in commercial value of the seeds (Booker, 1967; Caswell, 1981).

A number of plants have been identified in several developing countries for their pesticidal activities. In view of this, during the present study, it was thought appropriate to screen certain plants belonging to family leguminosae. Leguminosae is a wide and chemically rich family (Pascual, 1978). The major alkaloids present were discovered to be rotenoids, which were one of the first insecticides discovered (Ahmed et al.1989).

The family probably contains the largest number of plants, poisonous to fishes and many of the genera viz. *Butea, Millettia, Mundulea, Pongamia, Sophora* and *Tephrosia* have been recorded as poisonous to insects (Chopra et al., 1965). Uddin & Khanna (1978) have identified rotenones in *Crotolaria* through tissue culture studies. Besides this compound deguelin, tephrosin, cytesine are some other toxic substances which have been reported from the members of this family (Chopra et al. 1965). Silva et al. (2007) reported alkaloids from *P. juliflora* to be cytotoxic. Plant growth inhibitory alkaloids were extracted from *P. juliflora* leaves by Nakano (2004). Certain biologically active alkaloids from the aerial parts of five Argentinian *Prosopis* species were studied by Tapia et al. (2000) and the main active constituent was identified as catechin. The alkaloids obtained from *P. juliflora* have also been tested against plants and have been found to inhibit growth by Nakano et al. (2004). *Prosopis* has been found to contain 5-hydroxytryptamine, apigenin, isorhamnetin-3-diglucoside, 1-arabinose, quercetin, tannin and tryptamine. Tapia et al. (2000) reported that aerial parts of *P. alpataco, P. argentina, P. chilensis* and *P. pugionata* contain tryptamine and phenethylamine derivatives. Muhammad & Amusa (2005) reported medicinal properties in *P. africana* and suggested the bark and root to help improve immunity. Besides, the plant *P. juliflora* has been found by Oliveira et al. (2002) and Franko et al. (2002) to contain proteinase inhibitors that could impede the digestion process of the pest insects. Sivakumar et al. (2005) purified this component from *P. juliflora* seeds and found a remarkable in-vitro activity against *T. castaneum* and *C. maculatus*.

Material and method

The present investigation was carried out in the Department of Entomology, Dungar College, Bikaner to study the efficacy of two plants viz. *Prosopis juliflora* and *Prosopis cineraia* on adult mortality of the pulse beetle *Callosobruchus chinensis* (Coleoptera: Bruchidae) by employing bark, fruit, leaf and their combinations (*P. juliflora* leaf + *P. cineraria* leaf and *P. juliflora* bark + *P. cineraria* fruit) by treating the pest insect with the smoke produced by incinerating the different parts of the two plants separately, and in combination as was employed traditionally against insects.

The test insect selected for the study was *Callosobruchus chinensis* Linn. The seeds of cowpea *Vigna radiata*, were cleaned and disinfested by exposing them to 60^0c for 4 h. The insects were reared on these grains kept in glass jars covered with muslin cloth. The jars were kept in BOD incubator maintained at 28 ± 2^0c temperature and 70% relative humidity.

The plant material used in the study was collected from Bikaner city and its vicinity (situated between 27^011' & 20^003' North latitude and 71^054' & 74^012' East longitude). The plant parts used were bark, leaf and fruit. The plant parts were picked from the tree. After washing they were shade dried for 10 – 15 days and were ground separately in electric grinder and kept in air tight plastic containers for further use.

Different parts namely bark, fruit and leaf of the two plants were used separately and in combination (*P. juliflora* leaf + *P. cineraria* leaf and *P. juliflora* bark + *P. cineraria* fruit). Only two combinations were selected for the present study based on the preliminary findings. The powdered plant powders were used in the form of smoke by incineration.

The smoke treatment was given to insects by an arrangement as shown in Fig. 1. The powdered plant material weighed as 10 g was placed in an incineration flask from which a tube led to fumigation chamber measuring 10 l by volume. The contents of flask were heated causing incineration of the plant material producing smoke, which was allowed to fill the chamber. 50 adult insects were placed in a beaker with host grains. The beaker was covered with muslin cloth and placed in the lower chamber of fumigation chamber. Ten experimental replicas were taken for observations and mortality of the bruchid was noted after 24 and 48 hours of treatment.

Observation and result

The results of smoke treatment of different plant parts of the two plants on mortality of *C. chinensis* have been presented in Table 1 and Figs. 1 to 3. When the effect of smoke of the two plants used during the present study was compared it was observed that highest bruchid mortality of 70% resulted after 48 h with treatment of smoke of fruit and leaf of *P. juliflora*, while the smoke of bark of the same plant resulted in lowest mortality of only 14%.

The smoke of fruits of *P. juliflora* after 24h and leaf after 48h was found to result in more than 50% mortality of the test insect while, the smoke of bark of *P. cineraria* after 24h and of fruit after 48h was found to result in more than 50% mortality. The smoke of both the combinations viz. *P. juliflora* leaf and *P. cineraria* leaf and *P. juliflora* bark and *P. cineraria* fruit after 48h resulted in more than 50% adult mortality.

Discussion

During present work, the adult mortality was recorded after exposing the adults to smoke produced by incinerating different plant parts. The results reveal that the highest bruchid mortality of 70% resulted after 48 h with treatment of smoke of fruit and leaf of *P. juliflora*, while smoke of bark of *P. juliflora* resulted in lowest mortality of only 14%. Bark after 24 h fruit after 48 h or treatment of *P. cineraria* resulted in significant mortality.

There is not much of information on the use of smoke of plants/plant products in pest management. Chopra et al. (1965) reported the smoke of plant *Peganum harmala*, used in Punjab, as disinfectant and keep off mosquitoes. Mann (1997) observed *R. dominica* to be most sensitive to the smoke of *Aerva* leaves and to some extent to the smoke of roots of *Fagonia* and stems of *Tribulus*. Further, upto 70% mortality of *c. chinensis* was observed when these were exposed to the smoke of roots of *Peganum* and fruits of *Tribulus*. Burnings of dried neem leaves to produce smoke to repel mosquitoes in households has been a traditional technique. The mosquito coil which are widely being used in present days to ward off mosquitoes also seem work on the same principle of producing smoke. Mosquito coils with natural pyrethrum obtained from *Chrysanthemum* have been suggested to be effective by Palsson & Jaenson (1999). They further observed that the burning of *H. suaveolens* (Lamiaceae) and the bark of *D. oliveri* (Caesalpinioideae) significantly reduced the number of mosquitoes which indicated that they possess mosquito repellent properties. They also showed that biting by *C. quinquefasciatus* was reduced significantly by smoke produced by burning young *H. suaveolens*. Ghei (2001) observed that smoke of pods of *Tephrosia, Trigonella* and *Crotalaria* was found to be effective in causing significantly high mortality (66.66 – 100%) of *C. chinensis*.

Smoke from pellets made from pulverized waste wood, palm-kernel cake, dried “Kuka” (*Adansonia digitata*) leaves and d-allethrin 90 EC, were assayed against adults of *Anopheles gambiae* Giles, (0-3 day-old) *Musca domestica* Linnaeus (0-3 day-old) and *Periplaneta americana* Linnaeus (0-7 day-old) in the laboratory for their toxicity and repellency. All the pellet grades caused mortality of *A. gambiae* and *M. domestica* but not *P. americana*. *Anopheles gambiae* was more susceptible to pellet smoke than other insects as suggested by Denolye et al. (2006). Don Pedro (1985) and Malaka (1996) reported that night guards and rural folks in Nigeria burn some plants for their smoke that prevents attack by insects. It is therefore possible that plants alone can be burnt and their smoke used to effectively deter insects without the addition of synthetic insecticides.

The repellency effect of smoke from burning *Azadirachta indica, Eucalyptus camaldulensis* and *Ocimum forskolin* plants to reduce human-mosquito biting activity has also been studied by Wendimu & Tekalign (2021). Ground mixed powders of the plant leaves produced smoke by direct burning and thermal expulsion on the traditional stoves in experimental huts against *An. arabiensis* and *Ae. Aegypti* was employed for the purpose by them. Overall, plant mixed powders tested by both methods of application offered significant protection (>90%) against both mosquito species tested and has the potential to be used as an alternative mosquito control method was suggested.

Gupta (2004) studied the efficacy of *S. nigrum*, *S. surattense* and *W. sominifera* and found that the fruit of *S. nigrum* resulted in maximum adult mortality (85%) of *C. chinensis* after 24 hours. More than 60% adult mortality was observed when the insects were treated with the smoke of leaves of *S. surattense,* root, stem and leaves of *S. nigrum* and root of *W. somnifera* after 48 hours.

It could be concluded from the study that the traditional methods even today are of great significance and applicability, if employed in an appropriate manner and can be used as a cheaper alternate as compared to costlier synthetic chemicals.

References

Ahmed M., Shineen, K.F., Rashid, M.A. and Ameen, M. 1989. A further rotenoid from *Derris elliptica. Planta Medica,* 55: 207-208.

Booker, R.H. 1967. Observation on three bruchids associated with cowpea in Northern Nigeria. *J. Stored Products Res.*, 3: 1-15.

Caswell, G.H. 1981. Damage to stored cowpea in northern part of Nigeria. *Samaru J. Agric. Res.,* 5: 4-5.

Chopra, R.N., Badhwar, R.L. and Ghosh, S. 1965. *Poisonous Plants of India, Ind. Coun. Argic. Res*., New Delhi, pp. 631.

Denloye A.A.B., K.O. Teslim and O.A. Fasasi 2006. Insecticidal and Repellency Effects of Smoke from Plant Pellets with or Without D-allethrin 90 EC Against Three Medical Insects. *Journal of Entomology*, 3(1):9-15.

Don-Pedro, K.N., 1985. Toxicity of some citrus peels to *Dermestes maculatus* Deg. and *Callosobruchus maculatus* (F). *J. Stored Prod. Res*., 21: 31-34.

Franco, O.L., Grossi de sa' M.F., Sales, M.P., Oliveira, A.S. and Rigden, D.J. 2002. Overlapping binding sites for trypsin and papain on a Kunitz-type proteinase inhibitor from P*rosopis juliflora. Proteins,* 49 (3) : 335 – 341.

Ghei, Meenakshi. 2001. Screening of certain leguminous plants for their insecticidal efficacy against pulse beetle *Callosobruchus chinensis* Linn. (Coleoptera : Bruchidae). Ph.D. Thesis, MDS University, Ajmer (India).

Mann, Amandeep Kaur 1997. Evaluation of pesticidal efficacy of certain desert plants against some stored grain pests. Ph.D. Thesis, M.D.S. University, Ajmer (India), p. 197.

Malaka, S.L.O., 1996. Termites in West Africa. University of Lagos Press, USA.

Muhammad, S., and Amusa, N.A. 2005. The important food crops and medicinal plants of North-western Nigeria. *Research Journal of Agriculture and Biological Sciences*. 1 (3): 254 – 260.

Nakona, H., Nakajima, E., Hiradate, S., Fujii, Y., Yamada, K., Shigemori, H. and Hosegawa, K. 2004b. Growth inhibitory alkaloids from mesquite (*Prosopis juliflora* (SW.) DC.) leaves. *Phytochemistry,* 65 (5): 587 – 591.

Oliveira, A.S., Pereira, R.A., Lima, L.M., Morais, A.H.A., Melo, F.R., Franco, O.L., Bloch Jr., C., Grossi-de-Sa', M.F. and Sales M.P. 2002. Activity towards Bruchid pest of a Kunitz-Type inhibitor from seeds of the Algaroba tree (Prosopis juliflora D.C.). *Pesticide Biochemistry and Physiology* 72: 122 – 132.

Palsson, K. & G.T. Jaenson 1999. Comparison of plant products and pyrethroid treated bed nets for protection against mosquitoes (Diptera : Culicidae) in Guinea Bissau, West Africa, *Journal of Medical Entomology*. 36 (2).

Pascual, H. 1978. *Leguminosas de la Peninsula Ibericay Baleares. Instituto Nacional de Investigation Agraria*. MAPA Madrid, p. 207.

Silva, A.M.M., Silva, A.R., Pinheiro, A.M., Freitas, S.R.V.B., Silva, V.D.A., Souza, C.S., Hughes, J.B., El-Bacha, R.S., Costa, M.F.D., Velozo, E.S., Tardy. M. and Costa, S.L. 2007. Alkaloids from *Prosopis juliflora* leaves induce glail activation, cytotoxicity and stimulate NO production. *Toxicon*, 49 (5): 601 – 614.

Sivakumar, S., Franco, O.L., Tagliari, P.D., Bloch Jr.C., Mohan, M. and Thayumanavan, B. 2005. Screening and purification of a novel trypsin inhibitor from *Prosopis juliflora* seeds with activity toward pest digestive enzymes. *Protein and Peptide Letters*. 12 (6): 561 – 565.

Tapia, Alexandro, Feresin, Gabridela Egly, Bustos, Daniel, Astudillo, Luis, Thedulon Cristina and Hirschmann, Schmeda. 2000. Biologically active alkaloids and a free radical scavanger from *Prosopis species*. *Journal of Ethnopharmacology*. 71 (1–2): 241 – 246.

Uddin, A. and Khanna, P. 1978. Ascorbic acid metabolism and growth of in vitro tissue culture of *Crotolaria burhia*. Buch. Mam. *Bangladesh J. Bot*., 7: 17 –19.

Wendimu Abenezer & Tekalign Wondimagegnehu 2021. Field efficacy of ethnomedicinal plant smoke repellency against *Anopheles arabiensis* and *Aedes aegypti.* Heliyon, 7(7).

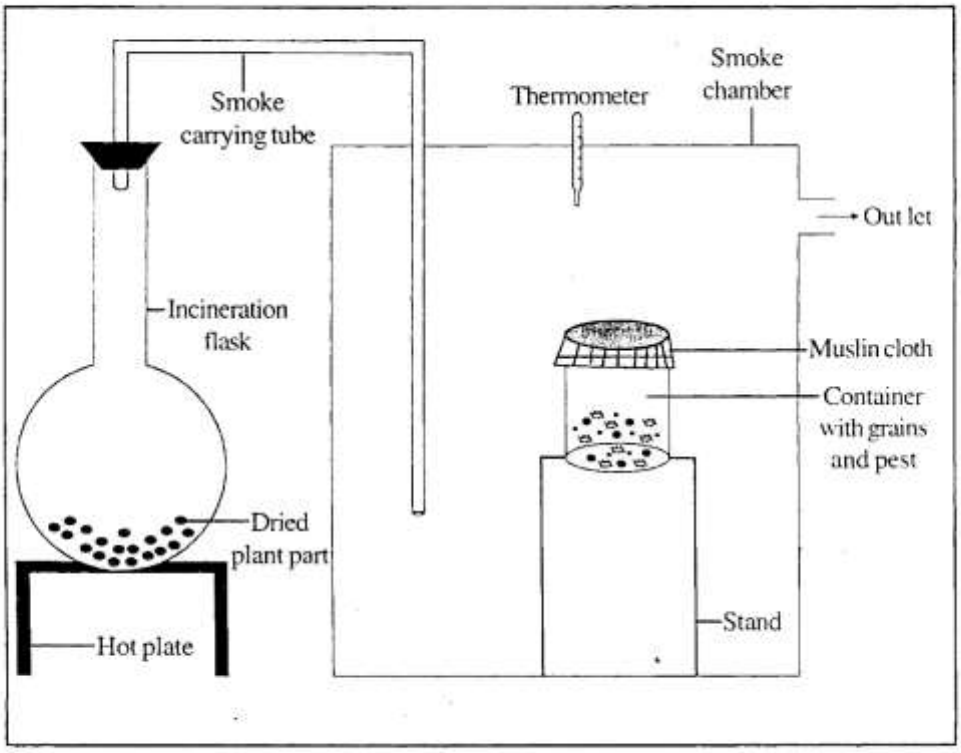

Fig. 1 Schematic diagram of smoke treatment

Table 1. Adult mortality (%) of *C. chinensis* under smoke treatment

	24 h	48 h
P. juliflora		
Bark	14.00	20.00
Fruit	54.00	70.00
Leaf	20.00	70.00
P. cineraria		
Bark	50.00	60.00
Fruit	20.00	54.00
Leaf	20.00	34.00
***P. juliflora* leaf + *P. cineraria* leaf**	40	56
P. juliflora* bark + P. cineraria *fruit	46	62

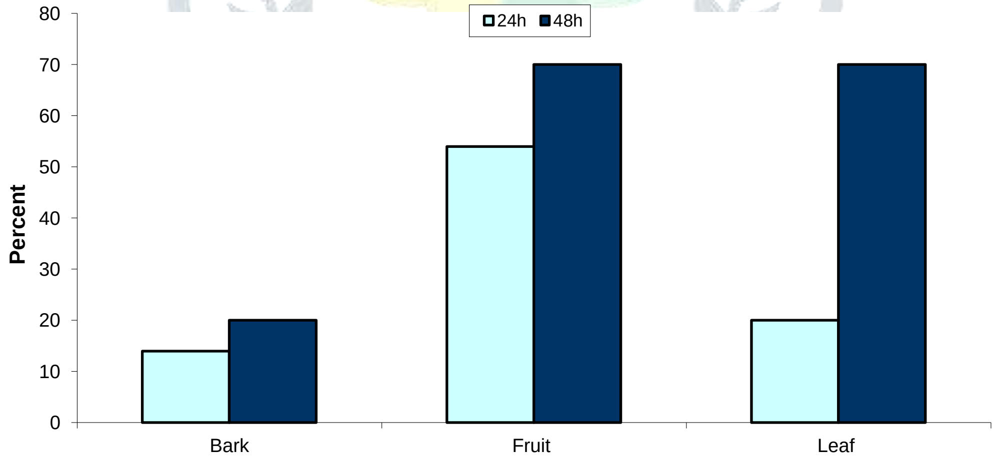

Fig. 1. Adult mortality (%) of *C. chinensis* under smoke treatment of different parts of plant *P. juliflora*

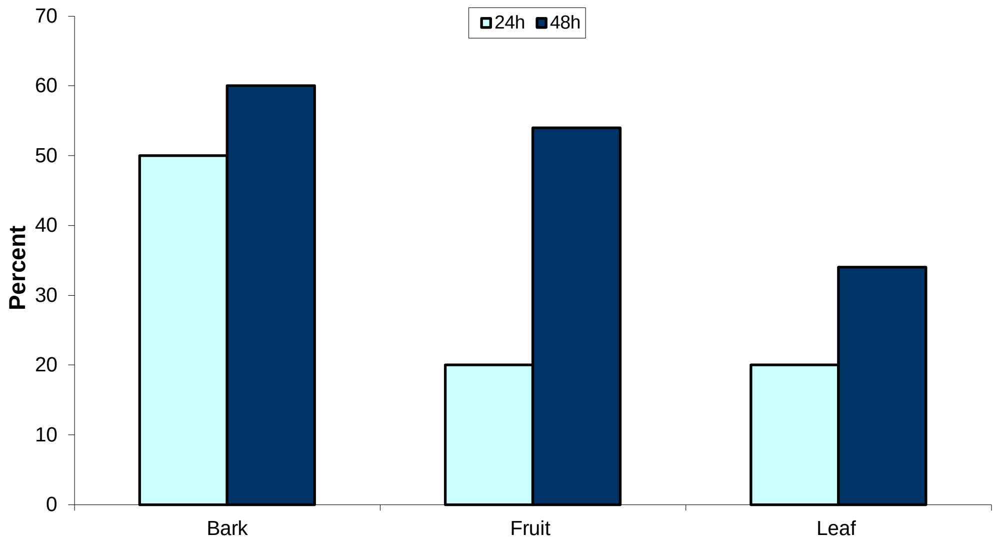

Fig. 2 Adult mortality (%) of *C. chinensis* under smoke treatment of different parts of plant *P. cineraria*

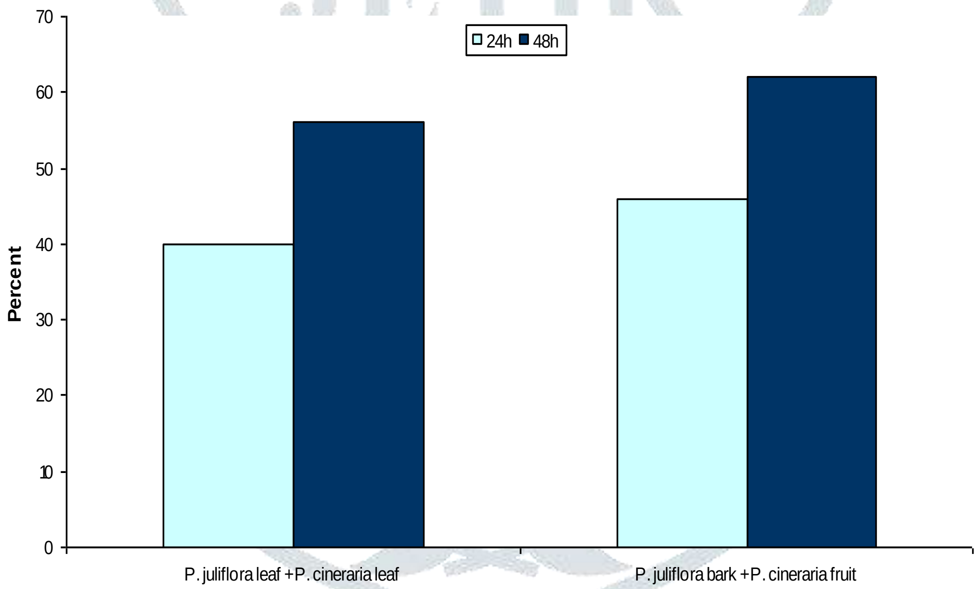

Fig. 3. Adult mortality (%) of *C. chinensis* under smoke treatment in combination of some parts of plant *P. juliflora* and *P. cineraria*