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FIELD EFFICACY OF PLANT EXTRACTS AGAINST TOMATO FRUIT BORER *HELICOVERPA ARMIGERA*

K. S. MATHARU* AND P. K. MEHTA
Department of Entomology,
CSK, Himachal Pradesh Krishi Vishvavidyalaya, Palampur - 176 062
e-mail: matharu38@rediffmail.com

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***Corresponding author**

ABSTRACT

Field efficacy of botanical insecticides obtained from *Acorus calamus* (rhizome), *Vitex negundo* (leaves), *Adhatoda vasica* (leaves) and *Dioscorea deltoidea* (tuber) was tested against *Helicoverpa armigera* (Hüb) on tomato. Amongst the all tested extracts, hexane extract of *Acorus calamus* caused 48.91% mortality followed by hexane extract of *Vitex negundo* (42.75%), ethyl acetate extract of *Acorus calamus* (36.54%) and hexane extract of *Adhatoda vasica* (36.14%) at 5% concentration. In other tested concentration, a conclusion difference in efficacy was found after 15 days of application. No phytotoxicity symptoms were observed at 5 % concentration of rhizome extract of *Acorus calamus*. This concentration can be used for the management of *Helicoverpa armigera* under field conditions.

INTRODUCTION

Tomato fruit borer, *Helicoverpa armigera* (Hüb) (Lepidoptera: Noctudiae) is the key pest of tomato crop in India. This pest is widely distributed throughout the world on food, fiber, oilseed, fodder, horticultural and ornamental crops (Reena *et al.*, 2006). This pest is responsible to cause yield loss in tomato ranging from 18 to 55% in India (Yankanchi and Patil, 2009). Synthetic insecticides have been one of the most potent weapons for controlling insect-pests for the past several decades. Although these are very effective, however, their frequent and arbitrary use is also responsible for environmental pollution, health hazards to human beings, toxic to pollinators, pest resurgence, development of resistance in insect-pests, outbreak of secondary pest and residue in food (Singh *et al.*, 2001; Dubey *et al.*, 2011). An eco and user friendly pest control approach against tomato fruit borer is the stipulation of present time to safeguard the human health. The use of Botanical insecticides has a long-term tradition in Europe; the first known written references to the application of botanical insecticides against pests come from Rome and date back to about 400 B.C. (Dayan *et al.*, 2009). Botanical insecticides are an important group of naturally occurring, often slow-acting crop pro-tectants that are usually safer to humans and the environment than conventional pesticides (Chauhan *et al.*, 2013; Mehta and Sood, 2010). Therefore, the use of botanical insecticides has been recommended ever more as a suitable alternative of plant protection with minimum negative risks (Isman, 2006; Pavela, 2007). Especially botanical insecticides have long been a subject of research in an effort to develop alternatives to conventional insecticides. At present, several dozens of botanical insecticides are used worldwide, based on various plant extracts, especially of the families Rutaceae, Lamiaceae, Meliaceae and Asteraceae.

Although botanical insecticides have been studied in many laboratory tests (Chandler, 1951; Mor-gan, 2009), very few studies are available that present results from practical use and there is a great lack of biological efficiency against tomato fruit borer. Keeping the above facts in mind the present investigation was undertaken with objective to evaluate the field efficiency of plant extracts.

MATERIALS AND METHODS

Healthy rhizomes of *Acorus calamus* L. (Araceae), leaves of *Vitex negundo* L. (Verenaceae) and *Adhatoda vasica* L. (Acanthaceae) were collected from mid hill area of Palampur (32º10′84′′ N and 76º53′56′′ E) and tubers of *Dioscorea deltoidea* Wall (Dioscorea) was purchased from the local market of Palampur, Himachal Pradesh. All plant parts were washed three times in tap water and dried under shade for a week and were pulverized by using electric grinder. Powder from each plant species was extracted by soaking in methanol, hexane, ethyl acetate and aqueous for 48 hrs, then filtered by Whattman filter paper No-1 and all solvents except aqueous were then evaporated using a rotary evaporator under reduced pressure (38-40ºC) to give crude extract. All extracts were stored at 4ºC in a refrigerator until use. The crude extracts of different plant parts obtained above were further diluted with respective solvents to make the desire concentrations and emulsifier (Triton X-100 and Tween 80) was added to it (Yankanchi and Patil, 2009).

A field experiment was carried out during rabi season, 2013-14 at research farm of department of entomology, university campus in Palampur. The tomato variety Palam Pink was raised by transplanting method with a gross plot size of 4.0 m x 3.0 m. The trials were laid out in Randomized Block Design (RBD) with fourteen treatments and three replications. All the pre and post-sowing agronomical practices were adopted to raise the healthy crop. Considering the pest pressure the spray was given at 50 days after transplanting. The spray fluid was applied after 15 days interval with the help of Knapsack sprayer. For recording the observation, five plants were selected randomly from net plot area of each plot and tagged. The observations on tomato fruit borer population were recorded before and after 3, 7, 10 and 15 days after application of different plant extracts spray. The data thus, obtained were statistically analyzed after suitable transformation. The reduction in population of tomato fruit borer was worked out by adopting following formula of per cent corrected mortality (Henderson and Tilton, 1955).

$$\text{Corrected mortality\%} = \left(1 - \frac{\text{N in Co before treatment} * \text{N in T after}}{\text{N in Co after treatment} * \text{N in T before treatment}}\right) * 100$$

Where, N = Insect Population, T = Treatment, Co = Control

RESULTS AND DISCUSSION

Field efficacy of different plant extracts was evaluated against *H. armigera* infesting tomato under field conditions (Table 4.1). Data obtained on this aspect revealed that at the time of initiation of experiment, the population of tomato fruit borer varied from 1.8 to 3.4 larvae per plant. Observations recorded on 3, 7, 10 and 15 days after treatment (DAS) revealed among the tested botanical insecticide @ 5% level of concentration, hexane extract of *V. negundo* to be superior to all other treatments in reducing the mean population of tomato fruit borer larvae (43.68%) followed by hexane extract of *A. calamus* (41.97 %). The findings of the present study revealed a maximum reduction (29.69%) in population on 3 DAS in the ethyl acetate extract of *A. calamus* differing significantly to other botanicals. On 7 DAS, hexane extract of *A. calamus* was found superior and significantly different to other botanicals in reducing (63.94%) the population. On 10 DAS, hexane extract of *A. vasica* was significantly superior in reducing the population (61.54%) being at par to hexane extract of *V. negundo* (59.28%) differing significantly to others. Further, observations recorded on 15 DAS revealed a maximum reduction (43.28 %) in population in hexane extract of *V. negundo* followed by hexane extract of *A. calamus* (39.73%) which in turn was at par to ethyl acetate extract of *A. calamus* (33.04%).

Efficacy after second round of spray

Field efficacy of different plant extracts after second round of spray revealed that at the time of initiation of experiment, the population of tomato fruit borer varied from 1.6 to 3.6 larvae per plant (Table 4.2). Observations revealed that botanical insecticide @ 5% level of concentration, hexane extract of *A. calamus* to be superior to all other treatments in reducing the mean population (48.91%) of tomato fruit borer larvae followed by hexane extract of *V. negundo* (42.75%). The observations found hexane extract of *A. calamus* to be superior amongst the botanicals in reducing population (40.00%) on 3 DAS. Further, observations recorded on 7 DAS revealed a maximum reduction (53.13%) in population in hexane extract of *A. calamus* followed by hexane extract of *V. negundo* (46.43%) which in turn was at par to hexane and methanol extracts of *A. vasica* (41.41% and 40.34%, respectively). On 10 DAS, hexane extract of *A. calamus* was significantly superior in reducing the population (62.50%) being at par to hexane extract of *V. negundo* (53.13%) and *A. vasica* (53.13%) and was found significantly different to others. Further, observations recorded on 15 DAS revealed a maximum reduction (42.86 %) in population in the hexane extract of *V. negundo* followed by hexane extract of *A. calamus* (40.00%) and ethyl acetate extract of *A. calamus* (38.46%) which in turn was at par to methanol extract of *D. deltoidea* (33.33%). Yankanchi and Patil (2009) reported that leaf extract of *V. negundo* (1%) significantly reduced 40 per cent larval population of *H. armigera* in cabbage. Sahare *et al.,* (2008) observed using thin layer chromatography that alkaloids, saponin and flavonoids are present in the leaf of *V. negundo* which are responsible for the insecticidal properties. Previous studies show that rhizome of *A. calamus*, leaves of *V. negundo* and *A. vasica* extracts posses alkaloid, tannins, saponins, phenolics and flavonoids due to these chemicals extract from these plants are effective against *H. armigera* (Sahayaraj and Paulraj, 2001; Sahayaraj and Tirkey, 2006; Balasubramanian *et al.*, 2008; Kumar *et al.*, 2013; Singh and Nongmaithem, 2013; Patil and Chavan, 2010). Thakur *et al.*, (1998) also reported that neem seed kernel extract (NSKE) @ 5% gave an effective control of *H. armigera*. Mallapur and Ladaji (2010) reported that the 56 per cent reduction of *H. armigera* population in the treatment of *V. negundo*, *A. indica* and *Aloe vera* extract. Yankanchi and Patil (2009) found that leaf extract of *V. negundo* @ 1% significantly reduce the larval population of *H. armigera*. In, our studies botanical insecticides based on extracts from rhizome of *A. calamus*, leaf of *V. negundo* and *A. vasica* showed to be a significant better botanical insecticides as compared to the tuber extract of *D. deltoidea*. Kumar and Prasad (2002) similarly reported the 5% extracts of *A. indica*, *A. calamus*, *V. negundo* and *A. vasica* caused high mortality against *H. armigera*. Raja *et al.* (2005) found that β-asarone, cis-asarone, trans-asarone and acoramone are biological activity of active substances present in the rhizome extract of *A. calamus*. Similarly vitricin, flavonoid-penducularisin, negundoside and adhavasinone active ingredient found in leave extract of *V. negundo* and *A. vasica* by Rastogi and Mehrotra (1993). Beside this insecticidal, feeding deterrent and growth inhibiting effects were found such effects that increase the persistence of the product have been known in BI based on *A. calamus* and *V. negundo* (Mehta and Sood, 2010). Generally *A. calamus* is critical for antifeedance, repellence or deterrence for pest species. For example extracts from seed of *A. calamus* showed an antifeedant effect on *Spodoptera litura* F. (Desai and Patil, 2000). Repellent and antifeedant effects are often connected with pest reduction or

Table 4.1: Evaluation of field efficacy of different plant extracts against *Helicoverpa armigera* (first round of spray)

Plant extracts	Concentration (%)	Pre count 1DBS	Per cent reduction in population over untreated check 3DAS	7DAS	10 DAS	15 DAS	Mean
Acorus calamus methanol	5.0	3.0	20.00(26.40)	32.31(34.57)	38.46(38.28)	25.71(30.36)	29.12(32.40)
Acorus calamus hexane	5.0	3.2	21.88(27.75)	63.94(53.12)	42.31(40.54)	39.73(39.03)	41.97(40.11)
Acorus calamus ethyl acetate	5.0	3.2	29.69(32.93)	42.31(40.54)	49.52(44.70)	33.04(35.03)	38.64(38.30)
Acorus calamus aqueous	5.0	2.6	13.46(21.28)	28.99(32.50)	37.87(37.93)	17.58(24.63)	24.48(29.09)
Vitex negundo methanol	5.0	3.8	21.0527.19()	33.20(35.12)	39.27(38.69)	21.05(26.83)	28.64(31.96)
Vitex negundo hexane	5.0	3.4	26.47(30.65)	45.70(42.49)	59.28(50.50)	43.28(41.06)	43.68(41.17)
Vitex negundo ethyl acetate	5.0	3.4	11.76(18.76)	18.55(24.92)	25.34(29.88)	24.37(29.22)	20.01(25.69)
Vitex negundo aqueous	5.0	2.8	19.64(25.77)	34.07(35.54)	42.31(40.50)	15.82(22.66)	27.96(31.11)
Adhatoda vasica methanol	5.0	2.0	12.50(20.00)	30.77(33.54)	42.31(40.52)	25.00(29.78)	27.65(30.96)
Adhatoda vasica hexane	5.0	1.8	16.67(23.15)	35.90(36.62)	61.54(51.86)	28.57(31.97)	35.67(35.90)
Adhatoda vasica ethyl acetate	5.0	2.4	16.67(23.15)	32.69(34.62)	42.31(40.48)	19.64(25.59)	27.83(30.96)
Adhatoda vasica aqueous	5.0	3.4	19.12(25.18)	25.34(29.78)	32.13(34.27)	24.37(29.10)	25.24(29.58)
Dioscorea deltoidea methanol	5.0	2.2	20.45(26.57)	26.57(30.83)	37.06(37.41)	12.34(19.85)	24.11(28.66)
Mean			19.18(25.52)	34.64(35.47)	42.29(40.25)	25.42(30.05)	
Untreated check		2.4	2.4	2.6	2.6	2.8	

CD (P=0.05): Extract (A) = 3.77; Days after spray (B) = 2.02; AxB = 7.55; Figures in parentheses are arc sine transformed value; DBS = Day before spray; DAS = Days after spray

Table 4.2: Evaluation of field efficacy of different plant extracts against *Helicoverpa armigera* (second round of spray)

Plant extracts	Concentration (%)	Pre count 1 DBS	Per cent reduction in population over untreated 3DAS	7DAS	10 DAS	15 DAS	Mean
Acorus calamus methanol	5.0	2.8	14.29(21.93)	33.04(35.01)	46.43(42.92)	28.57(32.22)	30.58(33.02)
Acorus calamus hexane	5.0	2.0	40.00(39.18)	53.13(46.78)	62.50(52.26)	40.00(39.18)	48.91(44.35)
Acorus calamus ethyl acetate	5.0	2.6	23.08(28.58)	35.10(36.28)	49.52(44.70)	38.46(38.28)	36.54(36.96)
Acorus calamus aqueous	5.0	2.8	28.57(32.23)	33.04(35.03)	39.73(39.03)	14.29(21.99)	28.91(32.07)
Vitex negundo methanol	5.0	3.0	26.67(31.01)	37.50(37.71)	37.50(37.63)	20.00(26.04)	30.42(33.10)
Vitex negundo aqueous	5.0	3.0	20.00(26.04)	25.00(29.65)	43.75(41.35)	26.67(30.79)	28.86(31.96)
Vitex negundo ethyl acetate	5.0	3.6	16.67(23.38)	27.08(31.06)	27.08(31.06)	27.78(31.52)	24.65(29.26)
Vitex negundo hexane	5.0	3.6	28.57(32.04)	46.43(42.92)	53.13(46.85)	42.86(40.81)	42.75(40.66)
Adhatoda vasica methanol	5.0	2.4	27.27(31.29)	40.34(39.36)	48.86(44.33)	18.18(24.86)	33.66(34.96)
Adhatoda vasica hexane	5.0	3.4	25.00(29.55)	41.41(39.95)	53.13(46.85)	25.00(29.55)	36.14(30.75)
Adhatoda vasica ethyl acetate	5.0	1.6	16.67(23.15)	29.69(32.70)	37.50(37.60)	25.00(29.55)	27.22(30.75)
Adhatoda vasica aqueous	5.0	2.8	17.65(23.98)	28.31(31.79)	39.34(38.71)	29.41(32.52)	28.68(31.75)
Dioscorea deltoidea methanol	5.0	2.2	16.67(23.66)	29.69(32.86)	37.50(37.67)	33.33(35.14)	29.30(32.33)
Mean		2.0	23.16(28.02)	35.37(36.21)	44.31(41.59)	28.43(31.82)	
Untreated check		2.8	3.0	3.2	3.2	3.0	

CD (P=0.05): Extract (A) = 3.66; Days after spray (B) = 1.95; AxB = 7.32; Figures in parentheses are arc sine transformed value; DBS = Day before spray; DAS = Days after spray

oviposition deterrence effect (Deka *et al*., 1998, Pavela and Herda, 2007). No phytotocity symptoms were observed in the any treatment.

REFERENCES

Balasubramanian, R., Selvaraj, P. and Sahayaraj, K. 2008. Partial purification and characterization of phytoecdysone from *Chrystella parasitica* (L.) and screening its pesticidal properties on lepidopteran pests. *J. Biopesticides*. **1:** 201-205.

Chandler, E. S. 1951. Botanical aspects of pyrethrum. General considerations: the seat of the active princi-ples. *Pyrethrum Post*. **2:** 1-8.

Chauhan, M. S., Shukla, J. P., Pandey, U. K. and Bhadauria, S. 2013. Efficacy of some plant products as repellent to control *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae) feed on tomato (*Lycopersicon esculentum*). *International J. Research in Botany*. **3:** 37-43.

Dayan, F. E., Cantrell, C. L. and Duke, S. O. 2009. Natural products in crop protection. *Bioorganic and Medicinal Chemistry*. **17:** 4022-4034.

Deka, M. K., Singly, K. and Handique, R. 1998. Anti-feedant and repellent effect of pongam (*Pongamia pinnata*) and wild sage (*Lantana camarata*) on tea mosquito bug (*Helopeltis theivora*). *Indian J. Agricultural Sciences*. **68:** 274-276.

Desai, S. K. and Patil, R. S. 2000. Antifeedant properties of some plants material extracts against *Spodoptera litura*. *Pestology*. **24:** 62-64.

Dubey, N. K., Shukla, R., Kumar, A., Singh, P. and Parkash, B. 2011. Global Scenario on the application of natural products in integrated pest management programmes. *In: Natural products in plant pest management (NK Dubey, eds), India*. pp. 1-20.

Henderson, C. F. and Tilton, E. W. 1955. Tests with acaricides against the brow wheat mite. *J. Economic Entomology*. **48:** 157-161.

Isman, M. B. 2006. The role of botanical insecticides, deterrents, and repellents in modern agriculture and an increasingly regulated world. *Annual Review of Entomology*. **51:** 45-66.

Kumar, M., Kumar A., Sukumar, D. and Sinha, M. P. 2013. Phytochemical screening and antioxidant potency of *Adhatoda vasica* and *Vitex negundo*. Supplement on Medicinal Plants. *The Bioscan*. **8:** 727-730.

Kumar, B. and Prasad, D. 2002. Evaluation of neem based insecticides and biopesticides against *Helicoverpa armigera* infesting chickpea. *Indian J. Entomology*. **64:** 411-417.

Mallapur, C. P. and Ladaji, R. N. 2010. Management of chickpea pod borer, *Helicoverpa armigera* (Hubner) using indigenous materials. *International J. Plant Protection*. **3:** 194-196.

Mehta, P. K. and Sood, A. K. 2010. Feeding and growth deterrent activity of some indigenous plant extracts against the diamondback moth. In: National symposium on Perspective and Challenges of Integrated Pest Management for Sustainable Agriculture, Solan, Himachal Pradesh, India.

Morgan, E. D. 2009. Azadirachtin, a scientific gold mine. *Bioorganic and Medicinal Chemistry*. **17:** 4096-4105.

Patil, D. S. and Chavan, N. S. 2010. Repellency and toxicity of some botanicals against *Spodoptera litura* Fab on Soyabean. *The Bioscan*. **5:** 653-654.

Pavela, R. 2007. Possibilities of botanical insecticide exploitation in plant protection. *Pest Technology*. **1:** 47-52.

Pavela, R. and Herda, G. 2007. Repellent effects of pon-gam oil on settlement and oviposition of the common greenhouse whitefly *Trialeurodes vaporariorum* on chrysanthemum. *Insect Science*. **14:** 219-224.

Raja, N., Venkatesan, A. J. and Ignacimuthu, S. 2005. Efficacy of *Hypitis suaveoleus* against lepidpteran pests. *Current Science*. **88:** 220-222.

Rastogi, R. P. and Mehrotra, B. N. 1993. Compendium of Indian Medicinal Plants, Volume 1-4, C.D.R.I. Lucknow and Publicaton and Information Directorate, New Delhi.

Reena, S., Basavana, G. K. and Sinha, K. 2006. Insecticide use pattern against diamondback moth, *Plutella xylostella* in three cabbage growing districts of north Karnataka. *Indian J. Applied Entomology*. **20:** 125-128.

Sahare, K. N., Anandhraman, V., Meshram, V. G., Meshram, S. U., Reddy, M. V. R., Tumane, P. M. and Goswami, K. 2008. Anti-microfilarial activity of methanolic extracts of *Vitex negundo* and their phytochemical analysis. *Indian J. Experimental Biology*. **46:** 128-131.

Sahayaraj, K. and Paulraj, M. G. 2001. Efficacy of chosen plants against gram pod borer *Helicoverpa armigera* Hubner (Lepidoptera: Noctuidae). *J. Advanced Zoology*. **22:** 8-14.

Sahayaraj, K. and Tirkey, P. 2006. Autochthonous gut bacterial population of *Helicoverpa armigera* and *Spodoptera litura* and their modulations by plant biopesticide. *J. Applied Biosciences*. **32:** 59-63.

Singh, I. B., Singh, K. and Singh, H. N. 2001. Relative efficacy of certain plant extracts as antifeedants against gram pod borer, *Heliothis* (*Helicoverpa*) *armigera* (Hub.). *Bioved*. **12:** 41-44.

Singh, S. and Nongmaithem, D. 2013. Growth attributes and rhizome yield of sweet flag (*Acorus calamus* L.) as influenced by spacing. *The Bioscan*. **8:** 2007-2009.

Thakur, R. C., Neem, K. K. and Kango, K. N. 1988. Comparative efficacy of neem seed kernel and some insecticidal formulation against the gram pod borer, *Heliothis armigera* (Hubner). *Legume Research* **11:** 114-116.

Yankanchi, S. R. and Patil, S. R. 2009. Field efficacy of plant extracts on larval populations of *Plutella xylostella* L. and *Helicoverpa armigera* Hub. and their impact on cabbage infestation. *J. Biopesticides*. **2:** 32-36.