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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-176062
e-mail: matharu38@rediffmail.com

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***Corresponding author**

ABSTRACT

Four plants viz., *Acorus calamus* L. (Bare), *Vitex negundo* L. (Banah), *Adhatoda vasica* (Basuti) and *Dioscorea deltoidea* (Tardi) were evaluated for their field efficacy againsttomato fruit borer, *Helicoverpa armigera* (Hüb) under filed conditions. Hexane extract of *Acorus calamus* (rhizomes) proved significantly superior in causing high mortality (48.91 %) of larvae followed by hexane extract of *Vitex negundo* (leaves) (42.75%) and ethyl acetate extract of *Acorus calamus* (36.54%) and hexane extract of *Adhatoda vasica* (36.14 %). Rest of the extracts showed moderate response, where aqueous extract of *Adhatoda vasica* (leaves) was least effective after second spray.

INTRODUCTION

Tomato fruit borer, *Helicoverpa armigera* (Hüb) is widely distributed agricultural pest occurring throughout the world. Being highly polyphagous, it collectively attacks a wide range of food, fiber, oilseed and fodder crops as well as many horticultural and ornamental crops. In the pre-fruiting stage, the caterpillar feeds on tender foliage including leaves, flowers and buds thereby resulted in perforated look of the crop. After fruiting, it bores large, clear, circular hole into fruit and feeds on the pulp that makes fruit unfit for consumption. It inflicts heavy damage to fruits leading to 18-55 per cent yield loss in tomato (Selvanarayanan, 2000). Synthetic insecticides have been one of the most potent weapons for controlling insect-pests for the past several decades. Although these are highly effective, however, their repeated and indiscriminate use resulted in development of resistance to pesticide and resurgence of treated populations and outbreak of secondary pests (Dubey *et al*., 2011). Pest resistance to synthetic insecticides is major disadvantage of these chemicals, *H. armigera* has gained resistance to many insecticides which earlier were reported to be effective, thus making it the most difficult pest to control (Indira, 2013). The misuse and extensive use of synthetic insecticides cause undesirable effects not only to the agricultural ecosystem but also to human health due to the insecticide residues in food. Insecticide residues in agricultural products, particularly in vegetable and fruit products is a growing concern for producers, traders and consumers in many parts of the world. The growing awareness of the environment protection and escalating human population has also necessitated the need for evolving an effective and safe method to control these pests with minimum damage to the environment. The natural chemicals obtained from the plants are known to exhibit selective action against pests through a variety of biological activities including the repellent, antifeedant, direct toxicant and growth regulator especially for lepidopteran insect-pests (Chauhan *et al*., 2013; Mehta and Sood, 2010). This study was conducted to evaluate the field efficacy of extracts of four indigenous plants against *Helicoverpa armigera* infesting tomato.

MATERIALS AND METHODS

Healthy rhizomes of *Acorus calamus*, leaves of *Vitex negundo* and *Adhatoda vasica* were collected from immediate area of Palampur and tubers of *Dioscorea deltoidea* 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, filtered by Whattman filter paper No-1 and all solvents except aqueous were then evaporated using a rotary evaporator under reduced pressure (38-40 ºC) to give crude extract. All extracts were stored at 4 ºC 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.

For evaluation of field efficacy of plant extracts, Tomato (Cv: Palam Pink) crop was raised in Research Farm of Department of Entomology, following all the recommended agronomic practices during April 2013 except application of insecticides. Spraying of plant extracts was done twice after 15 days interval.

The experiment was conducted in randomized block design with 14 treatments including untreated check, replicating thrice. Observations were recorded one day prior to initiating the experiment and after 3, 7, 10 and 15 days of foliar spray on the number of tomato fruit borer larvae. All the data on field efficacy of botanicals against the test insects were subjected to randomized block design (RBD). The significance of each treatment was calculated by comparing with untreated check.

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 3,7,10 and 15 days after treatment (DAS) revealed among the tested botanical insecticide at 5 per cent level of concentration, hexane extract of *V. negundo* (43.68%) to be superior to all other treatments in reducing the mean population of tomato fruit borer larvae 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 [1]per plant (Table 4.2). Observations recorded 3,7,10 and 15 days after treatment (DAS) revealed the botanical insecticide at 5 per cent 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%)

Table 4.1: Evaluation of efficacy of different plant extracts against *Helicoverpa armigera* during 2013 (first round of spray)

Plant extracts	Concen tration(%)	Pre count* 1DBS	Per cent reduction in population over untreated 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 efficacy of different plant extracts against *Helicoverpa armigera* during 2013 (second round of spray)

Plant extracts	Conce ntration (%)	Pre count* 1 DBS	3DAS	Per cent reduction in population over untreated 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 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%). Thakur *et al*., (1998) in field experiments observed that neem seed kernel extract at 5 per cent gave an effective and economic control measure of *H. armigera* on chickpea. Kumar and Prasad, 2002 observed that neem based formulations effectively reduced *H. armigera* population on chickpea and yield was increased from 54 to 61 per cent over untreated check. Besides, Mallapur and Ladaji, 2010 reported that leaf extracts of *P. pinnata*, NSKE, *Aloe vera* extract and cow urine in combination reduced 55.71-56.11 per cent larval population of *H. armigera*. Treament with leaf extract of *V. negundo* and *L. camara* significantly reduced the larval density of *P. xylostella* and *H. armigera* on cabbage at 1 per cent concentration Yankanchi and Patil, 2009. The difference in reduction of population might be due to difference in tested plant extracts, agro-climatic conditions and geographical locations of the tested trials. As our trial was performed in mid-hills of Western Himalaya at 1290 m above sea level. These reasons might have been associated with less reduction of population of both test pests as compared to other locations.

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