International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(6): 1443-1445

Received: 10-09-2019
Accepted: 12-10-2019

Sangavi R
Ph.D. Scholar, Department of Agricultural Entomology, Navsari Agricultural University, Navsari, Gujarat, India

Thangaraj Edward YS
Professor, Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Jeyarajan Nelson
Professor, Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Meenambigai C
Ph.D. Scholar, Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India

Corresponding Author:
Sangavi R
Ph.D. Scholar, Department of Agricultural Entomology, Navsari Agricultural University, Navsari, Gujarat, India

Anti-insect activities of solvent extracts of *Sesbania grandiflora* on the diamondback moth, *Plutella xylostella* (L.)

-10-2019

Sangavi R, Johnson Thangaraj Edward YS, Jeyarajan Nelson S and Meenambigai C

Abstract
Diamondback moth, *Plutella xylostella* (Linnaeus.) is a key pest on *Brassicaceae* crops causing severe yield loss worldwide. Despite of such efforts, growers are unable to control the damage. Its regular incidence often incited the farmers to spray insecticides. Due to ineffectiveness of insecticides, impelled the growers in India towards organic farming. Present study was designed to study the efficacy of the anti-insect activities of hexane, ethanol and ethyl acetate extract against diamondback moth, *Plutella xylostella* (L.) (Lepidoptera: Plutellidae), as an alternative to insecticides**.** Among the extracts tested, Cent per cent mortality was observed in hexane and ethyl acetate extracts of *P. juliflora* at 0.6 per cent concentration, and 80 per cent mortality was observed in ethanol extract at 0.6 per cent concentration respectively.

Keywords: Diamondback moth, hexane extract, ethanol extract, ethyl acetate extract

Introduction
Cruciferous vegetables are the important dietary source of vitamins (A, B1 and C) and minerals like phosphorus, potassium, sodium, calcium and iron which are essentially needed as supplement in human diet. India is second largest producer of cruciferous vegetables in the world. The varied agro-climatic condition prevailing in India are able to produce variety of vegetables throughout the year. It is grown over an area of 3.12 million ha in the world and 0.331 million ha in India. However, the average productivity of cabbage in India is about 22.0 metric tonnes/ha which is less than World's productivity of 22.3 million tonnes/ha (NHB, 2017) [1]. The crop is prone for infestation by a number of insect pests consisting of sucking and defoliating insects starting from germination to harvesting stage of the crop. Many species of insects attack the commonly growing cruciferous vegetables like cabbage (*Brassica oleracea* L. *var. capitata*), cauliflower (*Brassica oleracea* L.var. *botrytis*), turnip (*Brassica rapa* L.), carrot (*Daccus carota* L.) and mustard (*Brassica campestris* L. var. *toria* and *Brassica campestris* L. var. *sarson*). In India, a total of 37 insect pests have been reported to feed on cabbage, of which the DBM causes the loss of about 35 per cent with intensive control measures (Mohan and Gujar, 2003) [2]. Among several species of insects, diamondback moth (DBM), *Plutella xylostella* (L.), Lepidoptera: Plutellidae is the most revenging pest identified by Fletcher on cruciferous vegetables (Fletcher, 1914) [3]. Estimated total costs associated with damage and management of DBM worldwide was 4-5 billion US dollers per annum (Zalucki *et al*., 2012) [4] and in India, the estimated cost for the control of DBM is about 16 million US$ per annum. Utilization of conventional synthetic insecticides posed certain problems such as adverse effects on natural enemies, development of resistance in target pests and pest resurgence. Hazardous implications of these pesticides and their residue at various trophic levels have also caused incalculable damage to every aspect of environment, globally. In India, the first report of *P. xylostella* resistance to insecticides (DDT and parathion) was made by Verma and Sandhu (1968) [5] in Ludhiana (Punjab). Subsequently this was confirmed by Deshmukh and Saramma (1973) [6], to fenitrothion and malathion (Chawla and Kalra, 1976) [7]; cypermethrin, decamethrin and quinalphos (Saxena *et al.,* m1989) [8] and quinalphos (Chawla and Joia, 1992) [9]. Some population of *P. xylostella* developed resistance to new generation insecticides such as spinosad, avermectins, indoxacarb, emamectin benzoate and *Bacillus thuringiensis, B.t.* Cry toxins in the field (Zhao *et al.,* 2002; Sayyed and Wright, 2006; Zhao *et al.,* 2006; Li *et al.,* 2007 and Pu *et al.,* 2010) [10, 11, 12, 13, 14]

Materials and Methods

Soxhlet extraction

The powdered leaf of *S. grandiflora* (100g) was sequentially extracted with 700 ml of hexane (non-polar), ethyl acetate (medium polar) and ethanol (high polar) solvent on soxhlet's extraction apparatus for 24 - 72 hours according to the plants used. The solvents were evaporated in a rotary vacuum evaporator at 40 °C. The obtained extracts were pale yellow to pale brown in colour, viscous liquid, having a pleasant woody and spicy odour.

Evaluation of Solvent Extracts

The leaf dipping bioassay method described by Tabashnik and Cushing (1987) [15] was adopted to evaluate the insecticidal action of solvent extract against *P. xylostella* larvae. Cabbage leaves were washed with distilled water and dried for about 10 minutes. Solvent extract of *S. grandiflora* were tested at three concentration *viz.,* 0.2, 0.4 and 0.6 per cent along with NSKE 5 per cent as standard check. Completely untreated leaves and ethyl acetate treated leaves were used as control. Fresh cabbage leaf discs (7.5 cm diameter) were cut from fully expanded cabbage leaves. The discs were dipped for 60 seconds in the test solutions. These treated and air-dried leaves were placed in a petriplates lined with moist filter paper. In each petriplate 10 third instar larvae was released using a camel hair brush and allowed to feed for 48 hours. After 48 hours, treated leaves were removed and fresh untreated leaves were given. Three replications of each of the treatment with 10 larvae per replicate were maintained. Readings were taken at 24 hours intervals up to adult emergence for larval mortality, pupal mortality and adult emergence. Any malformation in the treatments was also observed.

$$\text{Mortality (\%)} = \frac{\text{Number of insects died}}{\text{Total number of insects released}} \times 100$$

Statistical analysis

The data collected in the experiments were analysed by Completely Randomized Block Design (Gomez and Gomez, 1985) [16]. The data on per cent values and numbers were transformed into arcsine and square root values, respectively before subjecting them to statistical analysis.

Result and Discussion

Effect of hexane extract of *S. gradiflora* on growth and development of *P. xylostella*

Maximum mortality (40.00%) was recorded in the 0.6 per cent concentration of hexane extract of *S. gradiflora* on 1 DAT (Table 1). On 5 DAT, cent percent mortality was observed in 0.6 per cent concentration which was significantly higher than mortality at 0.2 and 0.4 per cent (60.00 and 75.00% respectively) which was found to be on par with hexane control (60%). The maximum pupal mortality was observed at 0.2 percent (20.00%) followed by 0.4 per cent (15.00%). No adult emergence was observed in 0.6 per cent which was significantly lower than the hexane control (40.00%) (Table 1).

Effect of ethanol extract of *S. grandiflora* on growth and development of *P. xylostella*

Maximum mortality (15.00%) was recorded at 0.6 per cent concentration of *S. grandiflora* ethanol extract on 1 DAT (Table 2). The other concentrations *viz*., 0.2 and 0.4 per cent recorded 0.00 and 5.00 per cent mortality. On 5 DAT, the mortality of *P. xylostella* due to *S. grandiflora* at 0.2, 0.4 and 0.6 per cent concentrations increased gradually to 10.00, 45.00 and 40.00 per cent, respectively. The maximum pupal mortality was observed in 0.6 (15.00%) followed by 0.4 per cent (10.00%). Lowest adult emergence was observed at 0.4 and 0.6 percent (45.00%) while highest in ethanol control (100%) followed by 0.2 per cent (90.00%) and NSKE (50.00%).

Effect of ethyl acetate extract of *S. grandiflora* on growth and development of *P. xylostella*

The results of insecticidal action of ethyl acetate extract of *S. grandiflora* are furnished in Table 3. On 1 DAT, maximum mortality was caused by *S. grandiflora* 0.6 per cent concentration followed by ethyl acetate (50.00%). On 2 DAT, 60.00, 45.00 and 40.00 per cent mortality was exhibited at 0.6, 0.4 and 0.2 per cent concentration of *S. grandiflora* respectively. On 5 DAT, mortality recorded in 0.6 and 0.4 per cent was 85.00 and 75.00 per cent, respectively. Highest pupal mortality was observed in 0.4 percent (20.00%) followed by 0.2 per cent (5.00%). Minimum adult emergence was showed in 0.4 and 0.6 per cent (5.00 and 10.00% respectively). Malformed adult was observed only in 0.6 per cent concentration of *S. grandiflora* (5.00%) (Table 3) Maximum larval mortality observed in hexane, ethanol and ethyl acetate extract of *S. grandiflora* was 100, 45 and 85 per cent respectively, at different concentrations. *S. grandiflora* contains plenty of sterols, saponins and tannins which are responsible for its insecticidal property (Wagh *et al.,* 2009) [17]. Elango *et .al* (2011),[18] reported that crude leaf hexane, ethyl acetate, acetone, and methanol extracts of *S.gradiflora* caused mortality of subterranean termite, *Coptotermes formosanus* with LD50 value of LC50 = 2.53, 2.82, 2.31, 2.56, and 2.08 mg/mL.

Table 1: Effect of hexane extract of *S. gradiflora* on the growth and development of the diamondback moth, *P. xylostella*

Treatments	Larval mortality (%)					Pupal mortality (%)	Adult emergence (%)	
	1 DAT	2 DAT	3 DAT	4 DAT	5 DAT		Normal	Malformed
Hexane extract (0.2%)	25.00 (29. 98)^{b}	20.00 (26. 55)^{c}	55.00 (47. 85)^{b}	60.00 (50. 75)^{c}	60.00 (50. 74)^{c}	20.00 (26. 55)^{a}	20.00 (26. 55)^{d}	-
Hexane extract (0.4%)	15.00 (22. 77)^{d}	50.00 (44. 98)^{a}	50.00 (44. 98)^{c}	70.00 (56. 77)^{b}	75.00 (59. 97)^{b}	15.00 (22. 77)^{b}	10.00 (18. 42)^{e}	-
Hexane extract (0.6%)	40.00 (67. 18)^{a}	40.00 (39. 21)^{b}	90.00 (71. 53)^{a}	100.00 (89. 96)^{a}	100.00 (89. 96)^{a}	0.00 (4. 05)^{c}	0.00 (4. 05)^{f}	-
NSKE (5%)	20.00 (26. 91)^{c}	20.00 (26. 91)^{c}	25.00 (29. 98)^{d}	30.00 (33. 19)^{d}	30.00 (33. 19)^{d}	0.00 (4. 05)^{c}	70.00 (56. 77)^{b}	-
Hexane control	0.00 (4. 05)^{e}	0.00 (4. 05)^{d}	25.00 (29. 98)^{d}	60.00 (50. 75)^{c}	60.00 (50. 74)^{c}	0.00 (4. 05)^{c}	40.00 (39. 21)^{c}	-
Untreate control	0.00 (4. 05)^{e}	0.00 (4. 05)^{d}	0.00 (4. 05)^{e}	0.00 (4. 05)^{e}	0.00 (4. 05)^{e}	0.00 (4. 05)^{c}	100.00 (89. 96)^{a}	-
SE CD (0.05)	0.22 0.48	0.34 0.72	0.62 1.31	0.51 1.07	0.46 0.97	0.09 0.19	0.06 0.13	

Table 2: Effect of ethanol extract of *S. grandiflora* on the growth and development of the diamondback moth, *P. xylostella*

Treatments	Larval mortality (%)					Pupal mortality (%)	Adult emergence (%)	
	1 DAT	2 DAT	3 DAT	4 DAT	5 DAT		Normal	Malformed
Ethanol extract (0.2%)	0.00 (4. 05)^{c}	0.00 (4. 05)^{d}	0.00 (4. 05)^{d}	0.00 (4. 05)^{c}	10.00 (18. 43)^{d}	0.00 (4. 05)^{c}	90.00 (71. 53)^{b}	-
Ethanol extract (0.4%)	5.00 (12. 91)^{b}	25.00 (29. 98)^{b}	30.00(33. 19)^{c}	45.00 (42. 11)^{a}	45.00 (42. 11)^{b}	10.00 (18. 42)^{b}	45.00 (42. 11)^{d}	-
Ethanol extract (0.6%)	15.00 (39. 21)^{a}	20.00 (26. 55)^{c}	40.00(39. 21)^{a}	40.00 (39. 22)^{b}	40.00 (39. 21)^{c}	15.00 (22. 77)^{a}	45.00 (42. 11)^{d}	-
NSKE (5%)	15.00 (22. 77)^{a}	30.00 (33. 19)^{a}	35.00 (36. 25)^{b}	45.00 (42. 11)^{a}	50.00 (44. 98)^{a}	0.00 (4. 05)^{c}	50.00 (45. 27)^{c}	-
Ethanol control	0.00 (4. 05)^{c}	0.00 (4. 05)^{d}	0.00 (4. 05)^{d}	0.00 (4. 05)^{c}	0.00 (4. 05)^{e}	0.00 (4. 05)^{c}	100.00 (89. 96)^{a}	-
Untreated control	0.00 (4. 05)^{c}	0.00 (4. 05)^{d}	0.00 (4. 05)^{d}	0.00 (4. 05)^{c}	0.00 (4. 05)^{e}	0.00 (4. 05)^{c}	100 (89. 96)^{a}	-
SE CD (0.05)	0.18 0.39	0.25 0.53	0.29 0.60	0.22 0.46	0.22 0.48	0.11 0.23	0.19 0.41	

Table 3: Effect of ethanol extract of *S. grandiflora* on the growth and development of the diamondback moth, *P. xylostella*

Treatments	Larval mortality (%)					Pupal mortality (%)	Adult emergence (%)	
	1 DAT	2 DAT	3 DAT	4 DAT	5 DAT		Normal	Malformed
Ethanol extract (0.2%)	0.00 (4. 05)^{c}	0.00 (4. 05)^{d}	0.00 (4. 05)^{d}	0.00 (4. 05)^{c}	10.00 (18. 43)^{d}	0.00 (4. 05)^{c}	90.00 (71. 53)^{b}	-
Ethanol extract (0.4%)	5.00 (12. 91)^{b}	25.00 (29. 98)^{b}	30.00 (33. 19)^{c}	45.00 (42. 11)^{a}	45.00 (42. 11)^{b}	10.00 (18. 42)^{b}	45.00 (42. 11)^{d}	-
Ethanol extract (0.6%)	15.00 (39. 21)^{a}	20.00 (26. 55)^{c}	40.00 (39. 21)^{a}	40.00 (39. 22)^{b}	40.00 (39. 21)^{c}	15.00 (22. 77)^{a}	45.00 (42. 11)^{d}	-
NSKE (5%)	15.00 (22. 77)^{a}	30.00 (33. 19)^{a}	35.00 (36. 25)^{b}	45.00 (42. 11)^{a}	50.00 (44. 98)^{a}	0.00 (4. 05)^{c}	50.00 (45. 27)^{c}	-
Ethanol control	0.00 (4. 05)^{c}	0.00 (4. 05)^{d}	0.00N (4. 05)^{d}	0.00 (4. 05)^{c}	0.00 (4. 05)^{e}	0.00 (4. 05)^{c}	100.00 (89. 96)^{a}	-
Untreated control	0.00 (4. 05)^{c}	0.00 (4. 05)^{d}	0.00 (4. 05)^{d}	0.00 (4. 05)^{c}	0.00 (4. 05)^{e}	0.00 (4. 05)^{c}	100 (89. 96)^{a}	-
SE CD (0.05)	0.18 0.39	0.25 0.53	0.29 0.60	0.22 0.46	0.22 0.48	0.11 0.23	0.19 0.41	-

Conclusion

Cent per cent mortality of *P. xylostella* larvae was observed in 5 DAT in 0.6 per cent concentration of hexane extract of *S. grandiflora* and 85.00 and 40.00 per cent mortality was observed in 0.6 and 0.4 per cent concentrations of ethyl acetate and ethanol extracts, respectively.

Acknowledgement

The authors are grateful to the Department of Entomology, Tamil Nadu Agricultural University for providing facilities to conduct this research.

References

1. Horticultural Statistics at a Glance 2017. National Horticulture Board. 2017, 148.
2. Mohan M, Gujar GT. Local variation in susceptibility of the diamondback moth, *Plutella xylostella* (L.) to insecticides and role of detoxification enzymes. Crop. Prot. 2003; 22(3):495-504.
3. Fletcher TB. Some South Indian Insects. Superintendent Government Press, Madras, 1914, 565.
4. Zalucki MP, Shabbir A, Adamson D, Shu-Sheng L. Estimating the economic cost of one of the world's major insect pests, *Plutella xylostella* (Lepidoptera; Plutellidae): just how long is a piece of string. J. Econ Entomol. 2012; 105:1115-1129.
5. Verma AN, Sandhu GS. Chemical control of diamondback moth, *Plutella xylostella* (Curtis). J. Res. Punjab Agric. Univ. 1968; 5:420-423.
6. Deshmukh SN, Saramma PU. Comparative susceptibility of *Plutella maculipennis* (Curtis) collected from Ludhiana and Jalandhar districts to some insecticides. Pesticides. 1973; 7(1):21-22.
7. Chawla RP, Kalra RL. Studies on insecticide resistance in *Plutella xylostella* Linn. (Diamondback moth). Indian J. Plant. Protect. 1976; 4:170-179.
8. Saxena JD, Rai S, Srivastava KM, Sinha SR. Resistance in the field population of the diamondback moth to some commonly used synthetic pyrethroids. Indian J Entomol. 1989; 51:265-268.
9. Chawla RP, Joia BS. Studies on the development of resistance in the diamondback moth, *Plutella xylostella* (L.) to quinalphos in Punjab. J Insect Sci. 1992; 5:106-108.
10. Zhao JZ, Li YX, Collins HL, Gusukuma-Minuto L, Mau RFL, Thompson GD. *et al* Monitoring and characterization of diamondback moth (Lepidoptera: Plutellidae) resistance to spinosad. J Econ. Entomol. 2002; 95: 430-436.
11. Sayyed AH, Wright DJ. Genetics and evidence for an esterase-associated mechanism of resistance to indoxacarb in a field population of diamondback moth (Lepidoptera: Plutellidae). Pest Manage Sci. 2006; 62:1045-1051.
12. Zhao JZ, Collins HL, Li YX, Mau RFL, Thompson GD, Hertlen M. *et al* Monitoring of diamondback moth (Lepidoptera: Plutellidae) resistance to spinosad, indoxacarb and emamectin benzoate. J Econ. Entomol. 2006; 99: 176-186.
13. Li XC, Schuler MA, Berenbaum MR. Molecular mechanisms of metabolic resistance to synthetic and natural xenobiotics. Ann. Rev. Entomol. 2007; 52:231-253.
14. Pu X, Yang Y, Wu Y. Characterization of abamectin resistance in a field evoloved multiresistant population of *Plutella xylostella*. Pest Manag. Sci. 2010; 66: 371-378.
15. Tabashnik BE, Cushing NL. Leaf residue vs. topical bioassays for assessing insecticide resistance in diamond back moth, *Plutella xylostella* L FAO Plant Prot Bull. 1987; 35:11-14.
16. Gomez KA, Gomez AA. Statistical procedures for Agricultural research. John wiley and sons, Newyork, 1985, 680.
17. Wagh VD, Wagh KV, Tandale YN, Salve SA. Phytochemical, pharmacological and phytopharmaceutics aspects of *Sesbania grandiflora* (Hadga). J Pharm. Res. 2009; 2(5):889-892.
18. Elango G, Rahuman AA, Kamaraj C, Bagavan A, Zahir A. Screening for feeding deterrent activity of herbal extracts against the larvae of malaria vector *Anopheles subpictus*. Parasitol Res. 2011; 109:715.