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Susceptibility and Relative Toxicity of Certain Phyto-Extracts against Lemon Caterpillars, *Papilio demoleus* (Linn.)

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ABSTRACT: Traditional chemical insecticides (inorganic or synthetic) have an inherent toxicity which are fatal to human beings, other animals, and environment, because these chemical insecticides are non bio-degradable as they reached into the food chain and cause several disorders and diseases in human and animals. These chemical pesticides are responsible for degradation of soil structure. But toxin or bio-pesticides of plant origin are the formulations of natural derivatives from plants products that possessed insecticidal properties in them. These are risk free, eco-friendly, bio-degradable and do not reached into the food chain to cause any hazards to human and other beneficial animals. These properties of bio-pesticides lead to their utilization to the fullest in order to save the environment as well as ensuring quality of life. It is the need of today to promote the use of bio-pesticides in all kinds of agricultural practices to meet the environmental challenges particularly health related ones. No immunity can be glimpsed in insect pests against them. Several plants possess toxicity in their roots, shoots, leaves and fruits also having much susceptibility to insect pests. The susceptibility of certain plant extracts, viz. *Nicotiana tabacum* (Tobacco), *Derris elliptica* (Derris), *Ricinus communis* (Caster) and *Papaver somniferum* (Opium), isolated by Soxhlet extraction with organic solvents were tested against the larvae of lemon butterfly, *Papilio demoleus* in laboratory conditions. The results indicated that tobacco extract was found the most superior to the other plants extracts tested.

Keywords: Natural derivatives, eco-friendly, susceptibility, plants extracts, bio-degradable.

INTRODUCTION

Citrus is an important tropical and sub-tropical fruit and amongst fruit crops it occupies chief place and owing to its wide adaptability to various climatic conditions it is growing in different parts of the world (Adenaike and Onyak 2021). Citrus belongs to the family Rutaceae (Rao *et al.*, 2021). Citrus plants traditionally cultivated in fields, home gardens and as modern plantations (Saljoqui and Rafi 2006). An estimated worldwide annual production of citrus is approximately more than 120 million tonnes (Karn *et al.*, 2021). Citrus fruits used in food industry, chemical and pharmaceutical industries, perfumes, cosmetics and aroma therapy (Addi *et al.*, 2022). The most popular varieties of citrus comprise Orange (*C. Sinensis*), Lemon (*C. lemon*), Grape fruit (*C. paradise*), Lime (*C. aurantifolia*) and Mandarin (*C. reticulata*) (Hans–Jaochin, 2021). India ranks fifth in the citrus production at world level. The main citrus growing countries of the world are U.S.A., India, China, Japan, Australia, Egypt, South Africa, Argentina, Brazil, Philippines, Indonesia, Iran and Morocco etc. (Mahato *et al.*, 2019). The principal regions of citrus cultivation in India lies in Chennai, M.P., U.P, Maharasthra, Assam, Punjab, Kashmir, Delhi, Andhra Pradesh, Kerala, W. Bengal and Sikkim etc. (Pruthi and Mani 1945).

Every year several gardens of citrus plants were seriously defoliated and certain gardens reduced to more skeleton because of wide spread leaf eating citrus caterpillars (Singh and Rao 1978). It causes a serious economic losses to nursery man and citrus orchardists. It is considered that the caterpillars of *Papilio demoleus* and other species of *Papilio* as the most destructive insect pest of citrus fruits in India (Butani and Jotwani, 1975; Prakash, 2015). Great loss to agriculture economy due to insect pest infestation is a major problem of farmers around the world. Before several decades chemical based insecticides (inorganic and synthetic) evolved and developed for insect pest management (IPM). These traditional insecticides are more hazardous to human beings and the environment. Due to the non bio-degradable properties, the chemical insecticides reached into the food chain and caused many kinds of disorders in human beings and other animals (Anamika *et al.*, 2019). Among the various methods of pest controls, the biological control has unique importance because it has no hazardous impact towards beneficial insects and higher animals, as well as it is eco-friendly. Unlike organic insecticides, phyto-

extracts are comparatively safer, easily biodegradable and non- resistant.

The plant kingdom comprises a rich store house of bio-chemicals that could be tapped for use as pesticides. The plants are rich source of renewable bioactive organic chemicals. The toxic constituents present in the plants represent the secondary metabolites and have only an insignificant role in the primary physiological process in the plants that synthesized them. Over the past 50 years, more than 2000 plants species have been reported to have certain toxic principles which are effective against insect pests. The utilization of tobacco extract as an insecticide dates back and first time used in 1763 in France. Many plant products are known to have anti-feedants and insecticidal properties (Benerjee *et al.,* 1985; Rishap *et al.,* 2019). Earlier, many workers have reported various plants extract for pest control having low mammal toxicity (Sandhu and Singh 1975; Reddy *et al.,* 1990; Guddewar *et al.,* 1991; Dara, 2017). Previously, the contact toxicity of *Argemone maxicana* leaf extract against larvae of *Pieris brassicae*, the Cabbage looper has been evaluated (Atwal and Pajni 1964). The brinjal spotted leaf beetal has been successfully controlled in field conditions by using 0.1 percents leaves extract of *A. mexicana* (Chitra *et al.,* 1990, 1991). Similarly, various plants extracts have been evaluated against a variety of different insect pests (Chanke *et al.,* 1999; Hatim *et al.,* 2009; Sadavaste *et al.,* 2010; Anindita *et al.,* 2022). The plant extracts against lemon caterpillars of various stages were used and found better results to control the pest (Narayanramma *et al.,* 2003; Denalo *et al.* 2011; Rajni *et al.,* 2022).

Recently, the application of different indigenous plant extracts against aphids and other insect pests have been found highly effective to control them (Pragati and Solanki 2021). The Azadirachtin extracts were applied systematically against various aphids (Pavela *et al.,* 2007). Till date, only some botanical extracts were tested against *Papilio demoleus*, hence an effort has been made to control the lemon pest, *Papilio demoleus* larvae by using phyto-extracts of different plants. In present investigation the extracts of Tobacco, Dhatura, Derris, Caster and Opium plants were used against the Forth instar caterpillars of *Papilio demoleus* (Linn.), a voracious feeder of citrus leaves. All the experiments have been conducted in the laboratory conditions.

MATERIAL AND METHODS

The leaves and roots from Tobacco, Dhatura, Derris, Caster and Opium plants were collected. After drying under shade, the leaves and roots were crushed into a powdered form, the crude extract of powder were made in petroleum ether by using Soxhlet extractor. By adopting the w/v formula, 0.5 percent stock solutions of each tested plants were made in Aceton (AR). A soft soap solution was also mixed in extract of Tobacco, Dhatura, Derris, Caster and Opium to check out the volatility of active ingredients of each extracts. Different concentrations of plant extracts were made for application.

Female lemon butterfly laid their eggs on the fresh young twigs bearing flush of leaves and tender shoots of citrus cultivars early in the morning. Freshly laid eggs of lemon butterfly collected with leaves or tender shoots from citrus gardens and kept them in glass chimneys (20cm in height and 9cm in diameter) tied with muslin cloth on the top to allow air and laced in petridishes with moist cotton piece to maintain the humidity and watch regularly. Neonate larvae were transferred on fresh succulent citrus leaves. The fresh citrus leaves were provided daily as food and excreta of caterpillars removed regularly. The caterpillars passed through various instars stages. The rearing process was continued till the life cycle was completed. For the purpose of rearing, the standard rearing technique has been followed (Ashoken, 1997).

From the same age group, healthy Forth instar larvae were select out and exposed to various concentrations of different botanical extracts. Dry film method was adopted, ten larvae were treated in each treatment and three replicates of experiments were carried out. The treated larvae were transferred over fresh leaves of citrus plants and mortality was recorded after 24 hours. The control experiments were made on Aceton (AR) only. The data was put statistically in formulae to calculate the LC50 values of tested plant origin insecticides.

RESULTS AND DISCUSSION

The applications of plant extracts were found highly effective in controlling the forth instar larvae of citrus butterfly. Results obtained from Probit analysis (Finney, 1971) of mortality data are placed in Table 1. The results from the table revealed that Tobacco extract with 0.3865 percent of LC50 value was significantly toxic to control the tested citrus caterpillars. The results are compared with the available published literature wherein, various lepidopteran and coleopteran pests were successfully controlled by using extracts of *Nicotiana tabacum* (Pavela, 2016; Sarkar and Lim 2018; Kanmani *et al.,* 2021). The extracts of Dhatura and Derris were slightly less toxic than Tobacco with 0.442 and 0.625 percent of LC50 values, respectively. These findings are in accordance with the results of earlier workers, who applied Dhatura, Derris, Garlic, and Turmeric plant extracts against *Helicoverpa armigera* under field conditions (Shabaj Ali *et al.,* 2021). The Neem and Dhatura extracts have been applied as pesticides and found significantly effective with 52.8 percent reduced PDL against larval populations (Solanke and Deshpande 1991).

The findings are indicating that Caster was also an effective botanical insecticide having 0.7396 percent of LC50 value to kill the citrus caterpillars. The effectiveness of caster was also reported with 23.3 ppm concentration of Caster leaves extract against various larval stages of mosquitoes (Vasudevan and Sharma 1989). The infestation of *S. granaries* (L.) and *Tribolium castenum* (H.) were successfully controlled by the application of Caster leaves and some other essential oils (Singh *et al.,* 2001; Shah, 2013; Compos, 2019; Teke and Mutlu 2021). Though the treatment

with 1.176 percent of LC50 value of Opium was recorded as least effective but proven enough insecticidal activity against caterpillars of lemon butterfly. The effectiveness of Opium was also tested and established against various insect pests (Gafoor *et al.*, 2019; Samada *et al.*, 2020; Vinicius *et al.*, 2022). Inter related toxicity of used botanical insecticides exhibited in Table 2.

The findings revealed that Tobacco extract was 3.04 times more toxic than the Opium and 1.62 times higher than Derris. Dhatura extract was almost equally effective as Tobacco against lemon caterpillars. Only Tobacco was 0.87 times higher than Dhatura but rest were less susceptible to insect larvae. Previously, Dhatura leaves extract was also applied as an insecticide against the larvae of Fruit Borer in Okra (Chauhan and Quadri 1989). After assessing the above insecticidal activities of phyto-extracts it has been observed that amongst the extract treatment of the Tobacco, lowest LC50 value and highest toxicity ratio, proved highly toxic against the insects studied, followed by Dhtura, Derris, Castor and Opium, respectively. These results were very much closer to the findings of earlier workers (Desai and Patil 2000; Dubey *et al.*, 2011; Tlak Gajegar and Dar 2021; Rajni *et al.*, 2022).

Table 1: LC50 values of various phyto-extracts against forth instar larvae of *P. demoleus* (L).

Treatment	D. F.	X^2	Regression Equation	Lc50 Values %	Relative Toxicity
TOBACCO (*N. tabacum*)	3	0.189	Y=2.616+1.502X	0.3865	3.04
DHATURA (*D. stramonium*)	3	2.080	Y=2.400+1.580X	0.4420	2.66
DERRIS (D. elleptica)	3	1.054	Y=1.480+1.960X	0.6250	1.88
CASTOR (*R. communis*)	3	1.966	Y=1.860+1.680X	0.7396	1.59
OPIUM (*P. sominiferum*)	3	2.560	Y=3.390+2.270X	1.1760	1.00

X^2= Chi squire; D.F.= Degree of Freedom; Y= Probit Kill; X= Log N concentration; LC50= Concentration Calculated To Given 50% of Mortality.

Table 2: Inter relative toxicity of tested plant extracts at the level of LC50.

	TOBACCO (*N. tabacum*)	DHATURA (*D. stramonium*)	DERRIS (*D. elliptica*)	CASTOR (*R. communis*)	OPIUM (*P. sominiferum*)
TOBACCO (*N. tabacum*)	**1.00**	1.14	1.62	1.92	3.04
DHATURA (*D. stramonium*)	0.87	**1.00**	1.41	1.67	2.66
DERRIS (*D. elleptica*)	0.62	0.71	**1.00**	1.18	1.88
CASTOR (*R. communis*)	0.52	0.60	0.84	**1.00**	1.59
OPIUM (*P. sominiferum*)	0.33	0.31	0.53	0.63	**1.00**

CONCLUSIONS

From the present study it can be concluded that the hazardous impacts of using chemical insecticides badly affect the entire ecosystem since it has definite circulation in the food chain, thus reaches at all possible levels and causes significant negative impact. To meet the challenges of today, the regular utilization of bio-pesticides has to be promoted at large scale to control insect pests. As far as the susceptibility of various plant extracts against the larvae of lemon butterfly is concerned, certain plant extracts, *viz.*, *Nicotiana tabacum* (Tobacco), *Derris elliptica* (Derris), *Ricinus communis* (Caster) and *Papaver somniferum* (Opium), isolated by Soxhlet extraction with organic solvents were tested against the larvae of lemon butterfly, *Papilio demoleus* in laboratory conditions. The results indicated that tobacco extract was found the most superior to the other plants extracts tested. Lemon butterfly causes great loss to the citrus crop, therefore, as suggested by present study the regular use of various plant extracts in the form of bio-pesticide could be of great importance not only for saving this valuable crop but also to enhance economy of the nation.

FUTURE SCOPE

Due to the hazardous after effects of synthetic and chemical based insecticides on human beings, animals, soil and environment, the pesticides of plant origin are proven much eco-friendly to the nature because of their biodegradable nature and no serious after effects. Therefore, bio pesticides are recommended for the control of different insect pests. There are so many products available in the market that can be used by various farmers for significant results. It clearly indicates that the next era will be of bio-pesticides.

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REFERENCES

Addi, M. A., Elbouzi, M., Abid, D., Tungmunnithum, A., Elamrani and Hano, C. (2022). An overview of bioactive flavonoids from Citrus fruits. *Applied Sciences, 12*(1), 1-15.

Adenaike, O. and Onyukwo, A. (2021): Antioxidant compound and health benefits of citrus fruits. *Europian Jour. of Nutrition and food safety, 13*, 27-32.

Ali, S., Li, Y., Haq, I. and Ansari, M. J. (2021). The impact of different plants extracts on population suppression of *Helicoverpa armuigera* (Hub.) and tomato yield in field conditions. *Pesticides, 3*(1), 33-41.

Anamika, R. Sharma, N. and Tyagi, M. (2019). Impact of chemical pesticides v/s bio pesticides non human health and environment. *International Journal of Research Writing, 2*, 45-51.

Anindita, P., Majmumder, S. and Singh, S. (2022). Bio pesticides: A paradigm shift of pesticide development in India. *Food Sci. Rep, 3*, 22-25.

Ashoken, R. (1997). Mass rearing and additional instar of *Papilio demoleus* L. on the acid lime, *Citrus aurentifolia* (Swingle). *Insect Environment, 2*(4), 128-129.

Atwal, A. S. and Pajni, H. R. (1965). Preliminary studies on the insecticidal properties of *Melia azardiac* against caterpillars of *P. brassicae*. *Indian Journal of Entomology, 26*, 222-227.

Benerjee, R., Mishra, C. and Nigam S. K. (1985). Role of indigenous plant material in pest controls. Pesticide, *19*(3), 32-38.

Butani, D. K. and Jotrwani, M. G. (1975). Trends in the control of insect pest of fruit crops in India. *Pesticides, 9*(4), 139-149.

Campos, E. V. R., Proenca, P. L. F. and Oliviera, J. L. (2019). Use of botanical for sustainable agriculture future perspective. *Ecol. Indic, 105*, 483-495.

Chanke, R. P. (1990). Efficacy of various insecticides and plant products against the larvae of lemon butterfly. Hi-tech citrus management proceeding of the international symposium on citriculture (Nov. 23-27) held at NRC for citrus Nagpur. pp 928-930.

Chauhan, K. S. and Quadari, S. M. H. (1989). Studies on antifeedents and insecticidal activities of indigenous plant extracts against fruit borer in Okra. *Pesticides, 23*, 40-42.

Chitra, K.C., Reddy, P. and Kameswra Rao, P. (1990). Effect of certain plant extracts in the control of brinjal spotted leaf beetal. *Journal of Applied Zoological Research, 1*, 40-42.

Dara, S. K. (2017). Insect resistant to bio pesticides. *UCARI RE- Journal of Entomology, 2*(3), 55-59.

Denalo, S. L., James, P. C. and Bruce, R. S. (2011). A novel biorational pesticides. Efficacy of Methionion against Heraclides (Papilio) cersphonates, a surrogate of the invasive princeps *Papilio demolweus*. *J. Eco. Ent, 104*(6), 1986-1990.

Desai, S. and Patil, R. (2000). Antifeedants properties of some plants material extracts against Spodoptera litura. *Journal of Pestology, 24*, 62-64.

Dubey, N., Shukla, R., Singh, P. and Prakash, B. (2011). Global scenario on the application of natural products in IPM programme.

Finney, D. J. (1971). Probit analysis. Cambridge University Press Cambridge, pp 333.

Gafoor, H. A., Afzal, M., Riyaz, M. A. and Majeed, M. Z. (2019). *In vitro* toxicity evaluation of some phyto-extracts against mealy bug *Drosicha mangiferae* infesting citrus orchards in Pakistan. *Pakistan Journal of Zoology, 51*, 1815-1822.

Guddewar, M. B., Shukla, A. and Pandey, S. (1991). Assesment of insecticidal, ovicidal properties of I. Coronaria against red cotton bug. *Indian Journal of Entomology, 53*(2), 311-315.

Hans–Jaochim, E. (2021). Taxonomic notes on the Rutaceae of Thailand. *The Forest Bulletin, Botany, 49*(1), 27-31.

Hatim, G., Mardi, Rehab, E. and Idriss (2009). Effect of nimmbecidin 0.03% and argin on the larvae of lemon butterfly. *Journal of Science and Technology, 10*(2), 100-104.

Karn, A., Zhao, F. Yang, J., Cui, Z., Gao, M., Wang, F., Wang, H., Xiao and Zheng, J. (2021). In-vivo bio-transformation of citrus functional components and their effects on health. *Critical Review in Food Science and Nutrition, 61* (5), 756-776.

Kanmani, S., Kumar, L. Raven, R., Tennyson, S., Arivoli, S. and Jay Kumar, M. (2021). Toxicity of Tobacco leaf extract to the rice weevil, *S. oryzae* (L). *Journal of Basic and Applied Zoology, 82*(10), 113-124.

Mahato, M., Sinha, M., Sharma, K., Koteswararao, R. and Cho, M. H. (2019). Modern extraction and purification techenique for obtaining high purity food grade bioactive compounds and value added products from citrus wastes. *Foods, 8*, 1-81.

Narayanramma, V.L. Savithri, P. and Rao, R. (2003). Evaluation of bio-pesticides against citrus butterfly on sweet orange. *Indian Journal of Plant Protection, 31*(2), 105-106.

Pavela, R., Barnet, M. and Kocourek, F. (2007). Effect of Azadirachtin applied systematically through root of plant on the death, development and fecundity of the cabbage aphid. *Phyt. Parasitica, 32*, 286-294.

Pavela, R. (2016). History presence and perspective of using plants extracts as commercial botanical insecticide and farm product for protection against insects. *A Review Plant Protection Science, 52*, 229-241.

Pragati, N. and Solanki, H. (2021). Pesticide and Indian agriculture–A Review of *Int. J. Res. Granthalayah, 9*, 250-263.

Prakash, O. (2020). IPM Schedule for citrus pests. National Horticulture Mission, Ministry of Agriculture, Department of Agriculture and cooperation. Kirshi Bhawan. New Delhi. *Hotr.*, 1-33.

Pruthi, H. and Mani, M. S. (1945). Our knowledge of insects and mites pests of citrus in India and their control. *Imperical Council of Agric. Res. Sc. Monograph, 16*, 42.

Rajni, Y., Singh, S. and Singh, A. N. (2022). Bio pesticides: current status and future prospects. *Proc. Int. Accad. Ecol. Environ. Sci., 12*, 211-233.

Rao, M. J., Hao, Z. and Qiang, X. (2021). Genomics insights into citrus domestification and important agronomic traits. *Plant Com, 2*(1), 1-16.

Reddy, P. C., Venkatarami, Chitra and Rao, P. K. (1990). Field evaluation of certain plants extracts for the control of brinjal spotted leaf beetle. *Journal of Insect Science, 3*(2), 194-195.

Rishap, D. and Singh, D. N. (2019). Bio pesticides: A key to sustainable agriculture. *Int. J. Pure. Applied Biosciences*, (7), 391-396.

Sadavaste, A. K., Giri, G. K. and Jayawar, N. E. (2010). Biointensive management of citrus butterfly, *P. demoleus*. National seminar on citrus biodiversity of

livehood and nutritional security (4-5 October) Nagpur, Maharashtra. pp 393.

Saljoqui, N. and Rafi, M. A. (2006). Biology and host preferences of lemon butterfly. *Environ. Mon, 6*, 40-43.

Samada, L.H. and Tambunam, U.S.F. (2020). Biopesticides as promising alternatives to chemical pesticides. A review of their current and future status. *J. Biol. Sci, 20*, 66-76.

Sandhu, C. S. and Singh, D. (1975). Studies on antifeedent and insecticidal properties of Neem, Dharek, Kernl to *P. brassicae* larvae. *Indian Journal of Plant Protection, 3*(2), 177-180.

Sarkar, S. and Lim, U. T. (2018). Extracts of *Nicotiana tabacum* as a botanical control agent of *Grapholita molesta* (Lepidoptera). Ed by Lopez- Ferbar M. *Plos One. 13,* 198-302.

Shah, J., Inaytulla, M., Sohail, K., Shah, S. and Iqbal, T. (2013). Efficacy of botanical extracts and chemical pesticides against tomato fruit worm, *H. armigera* (Hub.): *Sarhad J. Agric., 29*(1), 93-96.

Singh, I., Singh, K. and Singh. H. (2001). Relative efficacy of certain plant extracts as antifeedants against gram pod borers, *H. armigera* (Feb.). *J. Bio., 12*(1-2), 41-44.

Singh, R., Mahalaxmi, R. and Vijaychandran, S. N. (1996). Potential pest of Aegle marmelos Corr. In nursery and its management with neem. *Insect. Enviro, 2*(3), 70.

Singh, S. P. and Rao N. S. (1978). Comperative efficiency and active residual toxicity of some insecticides to the citrus butterfly caterpiullars, *Papilio demoleus*. *Entomology, 3*(1), 51-56.

Solanke, B.R. and Desh Pandey, S. V. (1991). Studies on use of plant products for the control of lemon butterfly larvae. *Journal of Maharashtra Agriculture University, 16*(2), 302-303.

Teke, M. A. and Mutlu, C. (2021). Insecticidal and behavioural effects of some plants essential oil against *S. granarius* (L) and *Tribolium casteneum* (H). *Journal of Plant Disease and Protection,* 1*28*(1), 109-119.

Tlak Gajeger, I. and Dar, S.A. (2021). Plant allele chemicals as source of insecticides. *Insect, 12*, 189.

Vasudevan, P. and Sharma, S. (1989). Larvicidal properties of castor. *Pesticides, 23*, 36-39.

Vinicius, F. N., Alexander, M. A., Tiago, T. R., Amenda, J. M. V. and Marcelle, L. D. (2022). Insecticidal activity of aquous extracts of plant origin on *M. Spectabilis* (Hemiptera: Cercopidae). *Agronomy, 12*(4), 947-953.

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