INSECTICIDAL EVALUATION OF AQUEOUS EXTRACT OF INDIGENOUS PLANTS IN COMPARISON WITH SYNTHETIC INSECTICIDE FOR THE MANAGMENENT OF THRIPS *Scirtothrips dorsalis* (Thysnaoptera; Thripidae) IN TOMATO CROP

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Abstract

Insecticidal evaluation of aqueous extracts of indigenous plant extracts in comparison with synthetic insecticide against Thrips (*Scirotothrips dorsalis)* on tomato was conducted under natural field condition during spring 2019. Experiment consisted of 8 treatments (neem extract, tobacco extract, garlic extract, datura extract, lantana extract, eucalyptus extract, flonicamid (synthetic insecticide) and control followed RCB Design with 3 replications. Treatments were applied thrice after 15 days interval. Results revealed that the three times application of the tested treatments showed varying toxicity against *S. dorsalis* 24, 48, 72 hours and 7 days after spray applications while ladybird beetle and green lacewing were also significantly affected when recorded 7 days after spray application. However, Flonicamid 50%WG proved to be the most effective till 7th and had lowest pest population followed datura and neem extract. neem extract in all the three spray application . Garlic and eucalyptus also produced significant results compared to control. Neem, tobacco, datura and flonicamid were found comparatively more hazardous to ladybird beetle and green lacewing population compared to eucalyptus, garlic and lantana to in all three spray application. Tomato yield was highest with flonicamid (12533 kg/ha) followed by datura and neem (11810 kg/ha and 11300 kg/ha) respectively, while lowest (8133 kg/ha) in control. It is concluded from the current research that flonicamid performed better against *S. dorsalis* but comparatively more hazardous to natural enemies however lantana, garlic and eucalyptus extract showed better result against *S. dorsalis* and comparatively safe towards natural enemies thus recommended to be incorporated in IPM program.

Keywords: *Scirotothrips dorsalis* infestation, Botanical extracts, Synthetic insecticide

Citation: Gul , H.; A. Usman; Karishma and S. Zubair. 2021. Insecticidal Evaluation Of Aqueous Extract Of Indigenous Plants In Comparison With Synthetic Insecticide For The Managmenent Of Thrips Scirtothrips Dorsalis (Thysnaoptera; Thripidae) In Tomato Crop. *Pak. J. Weed Sci. Res*., 27 (3):431-441

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INTRODUCTION

Insect pests and diseases are among the most limiting factors that hampered tomato yield (Charles and Harris, 1972). Tomato crop is attacked by number of insect pest including whitefly, thrips, and aphids, cut worm and tomato fruit worm at various stages of plant growth (Sri *et al.,* 2017).

Among the insect pest attacking tomato crop, thrips (Thysanoptera; Thripidea) is an important polyphagus sucking pest of tomato. Besides tomato, cotton, chilli, onion, garlic are also the favorite host of thrips in Pakistan (Retiz and Tallahassee, 2009; Diaz *et al.*, 2011). Thrips both at nymphal and adult stage cause direct damage to the host plant by sucking the cell sap. In case of sever infestation, the plant become wilt and causes complete failure of crop. Besides the direct damages, it also served as a vector of many plant viral diseases such as capsicum chlorosis and scape blight of onion (Mumfort *et al*., 1996; Ullman *et al*., 1997; Jones, 2005).

Once tomato plants become infected by viral pathogen it is difficult to control so the management strategy should be focused on vector rather than disease management. Use of pesticide is the most common control practice by the farmer for instant pest control (Noonari, 2016). Furthermore, pesticide causes several health and environment problems. The most alarming is the decline of natural enemies. Thus attention should be focused to search out alternative control measure that not only reduce pest infestation but is friendly to environment, human, natural enemies and plants itself. Use of plant extract is one of the best alternatives to toxic chemical as they are safe to human, environment and natural enemies. Effectiveness of various indigenous plants like Neem, garlic, tobacco, eucalyptus, lantana and datura have also have been reported earlier to manage sucking insect pest in different crops (Mohamed and Khalid, 2011). Flonicamid is a systematic insecticide it disrupt insect chordotonal organs that can affect hearing, balance and movement to cause cessation of feeding. It exhibits excellent performance for control of almost all sucking insects specially aphids, whiteflies and thrips by their rapid feeding inhibition effect in variety of crops and has better action through ingestion than by contact. Flonicamid has little negative impact on pollinating insects and natural enemies and thus flonicamid will provide a new option for integrated pest management programs. (Roditakis *et al*. 2014).

In Pakistan, limited work on Thrips (*S. dorsalis*) in tomato crop has been reported so the present study is an attempt to find out the most effective botanical as alternative to conventional insecticide for the sustainable management of *S . dorsalis* in tomato.

MATERIAL AND METHODS

Insecticidal evaluation of aqueous extract of indigenous plants in comparison with synthetic insecticide for the management of *S. dorsalis* in tomato crop was carried at Horticulture Farm, The University of Agriculture Peshawar, in spring 2019. Seeds of tomato hybrid Galaxy F1 were purchased from local market and sown in pots for nursery raising in 2nd week of February and covered with plastic sheet to protect them from severe cold. Healthy tomato seedlings (about 3-4˝ tall) were transplanted on ridges in separate plots, each measuring 5.5 x 2.5 m. Plants were spaced 45 cm apart and there was 90 cm distance between rows. The experiment was laid out in Randomized Complete Block Design with three replications. Standard agronomic practices were performed uniformly in all experiment units. Leaves of the selected plants (Datura, eucalyptus, Lantana, tobacco) were collected and washed with tape water dried in shady place. The dried leaves were then grinded to get powder form. Known weights (2gram) of the each tested samples including garlic were soaked overnight in 1 liter of water. The extracts were than sieved to get the extract ready for treatment application. Experiment consist of 7 treatments including control Viz. Datura leaves extract 2%, eucalyptus leaves extract 2%, garlic bulb extract 2%, Lantana leaves extract 2%, Tobacco leaves extracts 2%, Flonicamid 50%WG (Synthetic insecticide) and Control. Treatments were applied thrice through Knapsack sprayers at 15 days interval .in their assigned plots except control which was left untreated. *S. dorsalis* density were estimated on randomly selected 5 plants in each experimental plot 24 hours before spray application then after 24, 48, 72 and 7 days interval while data on insect predators (ladybird beetle and green lacewing) were recorded 24 hours before and then after 7 days of each spray applications. Tomato yield of each plot were recorded by using electric balance. Total yield was determined by adding yield of all picking then converted to kg ha^{-1}

Data recorded on all parameters was subjected to ANOVA by using software Statistics 8.1. Means was separated using LSD test at P (0.05).

RESULTS

S. dorsalis population plant^{-1}

The analysis of variance showed that tested treatments against *S. dorsalis* varied significantly (P<0.05) over control after 1st spray at 24 hours (F= 21.80; P= 0.000), 48 hours (F=30.33; P=0.000), 72 hours (F=22.28; P=0.000); 7 days (F=13.49; P= 0.000) and non-significant (P>0.05) when monitored for pre-treatment (F=0.13, P=0.9948).

Results in Table 1 showed that all the tested treatments significantly effective throughout the observational period of one week after 1st spray against *S. dorsalis* in tomato crop. Application of flonicamid 50% WG resulted in lowest *S. dorsalis* population 1.20, 1.53, 1.73 and 3.80 plant^{-1} followed by datura (1.66, 2.06, 2.93 and 4,53 plant^{-1}), neem (2.00, 2.66, 3.20 and 5.20 plant^{-1}) after 24,48, 72 and 7 days respectively. While eucalyptus was found least effective had 3.13, 4.40, 4.93 and 8.26 *S. dorsalis* population plant^{-1} which was found to be at par with garlic extract at 24 and 48 hours, garlic and lantana at 72 hours, garlic and control at 7 days after 1st spray application.

It was also found that 2nd spray application significantly affected *S. dorsalis* population (P<0.05) after 24 hours of second spray (F= 41.22; P= 0.000), 48 hours of spray application (F=45.23; P=0.000), 72 hours of spray application (F=44.68; P=0.000); 7 days of spray (F=11.47; P= 0.0001). Uala 50% WG found to be the most effective had lowest *S. dorsalis* population 0.80, 0.66, 0.60 and 1.66 plant^{-1} followed by datura (2.06, 1.80, 2.20 and 4.66 plant^{-1}), neem (2.80, 1.93, 2.53 and 5.66 plant^{-1}) after 24, 48, 72 and 7 days respectively. While eucalyptus was found least effective had 7.66, 4.66, 5.13 and 7.53 *S. dorsalis* population plant^{-1} which was found to be at par with garlic at 24 and 48 hours, garlic and lantana at 72 hours, garlic and control at 7 days after 2nd spray application.

Similarly *S. dorsalis* population was significantly affected by 3rd spray application when observed after 24, 48, 72, 7 days (F= 54.28; P= 0.000), (F=56.71; P=0.000),(F=105.82; P=0.000) and (F=231.53; P= 0.000) respectively. Again application of flonicamid 50% WG resulted in lowest *S. dorsalis* population 0.50, 0.23, 0.11 and 0.00 plant^{-1} followed by datura (1.30, 1.03, 1.00 and 1.26 plant^{-1}), neem (2.56, 1.56, 1.43 and 1.90 plant^{-1}) after 24, 48, 72 and 7 days respectively. While eucalyptus was found least effective had 6.16, 4.16, 4.23 and 4.76 *S. dorsalis* population plant^{-1} which was found to be at par with garlic at 24 and 48 hours, garlic and lantana at 72 hours, garlic and control at 7 days after 1st spray application.

Ladybird beetle plant^{-1}

Pre spray data of 1st spray and 2nd spray was non-significant ranging from (1.37 to 1.84 plant^{-1}) and (1.33 to 1.79 plant^{-1}) respectively. While ladybird beetle population was significantly different before 3rd spray application ranging from (0.46 to 1.40 plant^{-1}). Ladybird beetle population was significantly affected by treatments application when compared with control. Neem extract was found to be more hazardous resulting in maximum reduction(89.40, 90.96 and 79.7%) of ladybird beetle after 1st, 2nd and 3rd spray application followed by tobacco and datura with % reduction of (86.93,87.86 and 69.62%) and (87.50, 91.06 and 71.42%) respectively. Whereas eucalyptus and lantana were comparatively less hazardous in all three sprays application resulted in the minimum reduction of 46.31-67.76% (Table 2).

Table No. 1. *S. dorsalis* density on tomato crop before and after 1st, 2nd and 3rd spray application of different botanical extracts and synthetic insecticide during 2019

Treatments	***S. dorsalis* plant^{-1}**				
	Before spray application	**After spray application**			
		24 hours	**48 hours**	**72 hours**	**7days**
Datura 2%	3.63 a	1.66 ef	2.06 fg	2.93 e	4.53 e
Eucalyptus 2%	3.76 a	3.13 b	4.40 b	4.93 b	8.26 ab
Garlic 2%	3.86 a	2.66 bc	4.00 bc	4.53 bc	6.33 cd
Lantana 2%	3.66 a	2.40 cd	3.46 cd	4.20 bc	6.80 bc
Neem 2%	3.60 a	2.00 de	2.66 ef	3.20 de	5.20 de
Flonicamid 50% WG	3.93 a	1.20 f	1.53 g	1.73 f	3.80 e
Tobacco 2%	3.80 a	2.06 de	3.00 de	3.86 cd	6.20 cd
Control	3.83 a	3.80 a	5.13 a	5.80 a	9.40 a
2nd Spray					
Datura 2%	5.33 d	2.06 de	1.80 ef	2.20 e	4.66 c
Eucalyptus 2%	8.26 b	7.66 ab	4.66 b	5.13 b	7.53 b
Garlic 2%	8.13 b	6.40 b	4.06 bc	4.53 bc	7.00 b
Lantana 2%	7.53 bc	3.53 c	3.33 cd	3.93 cd	6.40 bc
Neem 2%	6.06 cd	2.80 cd	1.93 e	2.53 e	5.66 bc
Flonicamid 50% WG	3.33 e	0.80 e	0.66 f	0.60 f	1.66 d
Tobacco 2%	6.93 bc	3.66 c	2.60 de	3.20 de	6.13 bc
Control	9.80 a	9.00 a	8.20 a	8.00 a	11.66 a
3rd Spray					
Datura 2%	3.66 c	1.30 e	1.03 ef	1.00 d	1.26 f

Eucalyptus 2%	6.60 ab	6.16 b	4.16 b	4.23 b	4.76 a
Garlic 2%	6.26 b	3.56 cd	3.63 bc	3.36 c	3.83 c
Lantana 2%	6.06 b	3.83 c	3.30 e	2.70 c	2.80d
Neem 2%	4.93 bc	2.56 d	1.56 de	1.43 d	1.90 e
Flonicamid 50% WG	1.56 d	0.50 e	0.23ef	0.11 e	0.00 g
Tobacco 2%	5.40 bc	2.63 d	2.23 d	1.50 d	1.93e
Control	8.13 a	9.00 a	6.76 a	7.56 a	7.70 a

Means with different letters are significantly different at p 0.05 using LSD test

Table No. 2. Ladybird beetle population on tomato crop before and after spray application of different botanical extracts and synthetic insecticide during 2019.

	Lady bird beetle plant^{-1}					
Treatments	**1st Spray**		**2ndspray**		**3rdspray**	
	Before	**After**	**Before**	**After**	**Before**	**After**
Datura 2%	1.76 a	0.23 d	1.73 a	0.21 e	0.79 bc	0.24 d
Eucalyptus 2%	1.67 a	0.56 b	1.37 a	0.39 c	0.95 b	0.51 b
Garlic 2%	1.75 a	0.31 c	1.54 a	0.33 d	0.96 b	0.33 c
Lantana 2%	1.45 a	0.49 b	1.52 a	0.49 b	1.00 b	0.38 c
Neem 2%	1.51 a	0.16 d	1.66 a	0.15 f	0.74 c	0.15 d
Flonicamid 50% WG	1.37 a	0.34 c	1.46 a	0.20 ef	0.46 d	0.27 d
Tobacco 2%	1.84 a	0.23 d	1.79 a	0.16 ef	0.84 bc	0.24 d
Control	1.46 a	0.71 a	1.33 a	0.64 a	1.40 a	0.65 a
LSD $_{(0.05)}$	**0.556**	**0.075**	**0.500**	**0.058**	**0.222**	**0.062**

Means with different letters are significantly different at p 0.05 using LSD test

Green lacewing population plant^{-1}

As presented in Table 3. Green lacewing population was significantly affected by all the tested treatments when compared to control in all three spray application. Flonicamid was found to be more hazardous had maximum reduction ranging from 75-88.77% in green lacewing population in all three spray application. Where as lantana and tobacco were found to be less hazardous to green lacewing with % reduction ranging from 7.5 to 41.93.

Table 3. Green lacewing before and after spray application of different botanical extracts and synthetic insecticide on tomato crop during 2019.

Treatments	Green lace wing plant^{-1}					
	1stspray		2ndspray		3rd spray	
	Before	**After**	**Before**	**After**	**Before**	**After**
Datura 2%	0.86 ab	0.77 b	1.87 ab	0.53 d	0.86 ab	0.26 de
Eucalyptus 2%	0.93 ab	0.69 b	1.77 ab	0.87 b	0.92 a	0.43 c
Garlic 2%	0.86 ab	0.51 c	1.85 ab	0.70 c	0.79 ab	0.31 d
Lantana 2%	0.80 b	0.74 b	1.79 ab	0.92 b	0.73 bc	0.51 b
Neem 2%	0.87 ab	0.39 d	1.52 b	0.49 d	0.59 cd	0.21 e
Flonicamid 50% WG	0.98 a	0.11 e	0.32 d	0.08 e	0.47 d	0.10 f
Tobacco 2%	0.93 ab	0.73 b	0.93 c	0.54 d	0.73 bc	0.23 e
Control	0.98 a	1.11 a	1.99 a	2.11 a	0.93 a	0.63 a
LSD $_{(0.05)}$	**0.166**	**0.084**	**0.374**	**0.119**	**0.156**	**0.060**

Means with different letters are significantly different at p 0.05 using LSD test

Yield

Significantly highest yield was achieved in Flonicamid 50%WG treated plot (12533 kg ha^{-1}) followed by plot treated with datura (11810 kg ha^{-1}) and neem (11300 kg ha^{-1}). While lowest tomato yield (8133 kg ha^{-1}) was obtained in the control. Yield obtained in Eucalyptus (10000 kg ha^{-1}) was at par with garlic (10167 kg ha$^{-1)}$ and lantana (10267 kg ha^{-1}) (Table 4).

Table No.4 Effect of different botanicals extracts and synthetic insecticide on tomato yield crop during 2019

Treatments	**Yield ($kgha^{-1}$)**
Datura 2%	11810 ab
Eucalyptus 2%	10000 c
Garlic 2%	10167 c
Lantana 2%	10267 c
Neem 2%	11300 a-c
Flonicamid 50% WG	12533 a
Tobacco 2%	10800 bc
Control	8133 d
LSD $_{(0.05)}$	**1408**

Means with different letters are significantly different at p 0.05 using LSD test

DISCUSSION

In the present study six botanicals (neem, datura, tobacco, lantana, garlic and eucalyptus) were tested in comparison with synthetic insecticide (Flonicamid) against *S. dorsalis* in tomato. All the tested treatments datura extract, neem extract, garlic extract, tobacco extract, lantana extract, eucalyptus extract and synthetic insecticide (flonicamid) were found better than control in reducing *S. dorsalis* density. Some earlier researchers Oparacke *et al.* (2006), Shah *et al.* (2005), Kuganathan, *et al.* (2008). Singh *et al.* (2014) and Din *et al.* (2016) has also indicated the effectiveness and insecticidal potential of neem, tobacco, garlic, lantana and eucalyptus used alone or in combination against various insects.

Present study showed that insecticide flonicamid found better that significantly reduced *S. dorsalis* infestation up to7 days. Present finding are also supported by Golmohammadi and Mohammadipour (2015) that synthetic insecticide Flonicamid performed better in comparison with botanicals. The better performance of flonicamid against *S. dorsalis* population could be due to its systemic, rapid and knock down effect as compared to botanicals. Among botanicals, datura, neem and tobacco extract efficiently suppressed *S. dorsalis* infestation in all the three spray applications. Liyanage *et al.* (2009) also found neem extract at par with datura extract against different sucking insect pests under laboratory conditions. Khaliq, et al. (2014) reported 60 % reduction in thrips population up to 7 days by spraying datura, neem and bitter apple. Similarly Aalew (2005) found that the ethanol extracts of neem seed also remained effective against thrips under field condition. In the present study garlic, lantana and eucalyptus were found least effective in suppressing thrips infestation when compared with other botanicals and synthetic insecticide. Similar results were also reported by Khan et (2013) that garlic extracts was the most effective against other sucking insect but least effective against thrips in cotton.

Observation on natural enemies showed the presence of two insect predators (ladybird beetle and green lace wing) in tomato field. Usman *et al*. (2018) also reported the presence of ladybird beetle and green lace wing in tomato. Challan (1943), Higgins (1992), Messelink *et al.* (2008), Synder *et al.* (2004) and Karuppuchamy (2016) reported predatory mites, minute pirate bugs, ladybird beetle, green lacewing, *Dasyscapus paravipennis, F. vespiformis* and chrysopids as natural enemies of thrips. While Smith and Chaney (2007) and Hameed *et al.* (2013) reported only syrphid fly, a predator of sucking insect pest thrips, whiteflies and aphids. Variation in the presence of natural enemies could be due to difference in the ecological condition and the presence of alternate crop. In this study, reductions in ladybird beetle and green lace wing populations were observed. This shows that all the tested treatments were not completely safe but comparatively a little bit harmful to lady bird beetle and green lacewing when compared with control. Eucalyptus, lantna and garlic extract were found to be comparatively safer while Neem, Tobacco, Datura and Flonicamid a synthetic insecticide were found to be comparatively harmful to both the predators. Dodia et al. (2008) reported that nicotine is not selective insecticide and is highly toxic to a range of species including predatory insects. Diraviam and Viraktamath (1993) mentioned nicotine is a safer insecticide for higher animals and safer to *Curinus coeruleus* and other predators. Saxena (1987)reported that *neem* is harmless to ladybird beetles that consume aphids and wasps that act as parasites on various crop pests. Some contrary results have also been reported by Rao *et al.* (2007), Khan *et al.* (2013) reported that datura and neem are ecofriendly and have no effect on natural enemies of *S. dorsalis*. Toxicity may depend on the predator species used. However, it needs further studies to confirm the effectiveness of theses botanicals in lab conditions. Hoelmer et al. (1990) discovered that a commercial neem insecticide was not toxic to adult coccinellid predators. Azadirachtin was virtually nontoxic to larvae of *C. septempunctata* (seven-spot ladybird) exposed to direct sprays in the laboratory (Banken and Stark, 1997). Jones et al. (2005) observed that bacteria and neem based insecticides were harm less to natural predatory fauna. However, Tunca et al. (2012) commented that no pesticide is 100% safe and non toxic to natural enemies. Nevertheless, the margin of safety for botanical pesticides is generally much higher than synthetic chemical pesticides. The results of the present study are in agreement with those of Tunca et al. (2012) reporting that new chemistry insecticides and botanicals are relatively safe for natural predators.

Tomato yield was significantly higher in plots treated with botanicals as well as synthetic insecticide compared to control. Results also showed that plants with higher thrips density gave the lower yield and vice versa. The nature of damage of thrips that affects photosynthesis process resulting in affecting the tomato yield might be one of the reasons for low yield.

CONCLUSION AND RECOMMENDATIONS

It was concluded that synthetic insecticide and all the tested botanical extracts have the potential to control *S. dorsalis* and enhanced tomato yield. Although Flonicamid 50%WG control the target pest but significantly reduced the population of beneficial insects. However, botanicals datura, eucalyptus, tobacco and lantana found to be less hazardous to the beneficial insects than synthetic insecticide would fit well in IPM practice as one of the insecticidal component for sustainable management of *S. dorsalis*.

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