LGJDX ISSN No: 1008-0562 Journal Of Liaoning Technical University Natural Science Edition

COMPARATIVE EFFICACY OF NATURAL AND SYNTHETIC CHEMICAL AGAINST INSECT PESTS OF TOMATO CULTIVARS AT SHINKIARI MANSERHA

Amanullah[1], Shahana Gul[1], Noor Ullah[2], Hira Sayed[3], Aziz Khan[4], Hazrat Ali[5], Hidayat Ullah[6], Mehran Ali[7], Abdullah[8], Aqil Hussain[9], Atif Ali[9]

1. *Department of Entomology, The University of Agriculture Peshawar, Pakistan.*
2. *Department of Agricultural Chemistry and Biochemistry, The University of Agriculture Peshawar, Pakistan.*
3. *Department of Zoology, University of Malakand, Pakistan.*
4. *Department of Zoology, Abdul Wali Khan University Mardan, Pakistan.*
5. *Department of Health and Biological Sciences, Abasyn University Peshawar, Pakistan.*
6. *Department of Plant Breeding and Genetics, The University of Agriculture Swat, Pakistan*
7. *Department of Entomology, Henan Academy of Agricultural Sciences, China.*
8. *Department of Plant Protection, Directorate of Agriculture Research Loralai.*
9. *Department of Plant Protection, The University of Agriculture Peshawar, Pakistan.*

Corresponding authors Hidayat Ullah email: hidayatu84@gmail.com

ABSTRACT

Tomato (*Lycopersicon escolentum L.*) belonging to Solanaceae is the most widely and popular vegetable crop grown all over the world. Field experiment was carried out at National Tea and High Value Crops Research Institute (NTHRI) Shinkiari District Mansehra Pakistan in summer 2017. Tomato seedlings were transplanted in the field in Randomized Complete Block Design (RCBD) with three replications. Five treatments were selected via Neem extract, Tobacco extract, Garlic extract, Steward 150 EC and Control. Neem extract was found best having lowest fruit borer (0.73), thrips (1.78) and white fly (1.92) population, tobacco extract was found effective against aphids (2.01) while steward effectively reduced cutworms population (2.71). The chemical poison steward was found fruitful having maximum average fruit weight (75.46), less fruit damage (11.64) and highest yield (21.85). The quality analysis indicates that minimum number of weight loss (11.16) was observed in tobacco. It was concluded from the abive findings that natural insecticides are effective, safe easy to handle and environment friendly. Natural insecticides should be used instead of synthetic chemical.

Key Words: Tomato, Solanaceae, Neem, Tobacco, Mansehra.

INTRODUCTION

Tomato (*Lycopersicon escolentum L.*) belonging to solanaceae is the most widely and popular vegetable crop grown all over the world. It is consumed on daily basis either in fresh form as a salad and cooking vegetables or in processed form like ketchup sauces, drinks, salads and main ingredient of many other dishes (Horna *et al*., 2006). Tomato has high nutritional value and plays an important role in the human diet on daily basis. It contains valuable sources of antioxidants i.e. lycopene and vitamins like vitamin B, C and A along with other essential amino acids, sugars and dietary fibers that can reduces the risk of various cardiovascular and cancer diseases (Giovannucci, 1999: Baloch, 1994).

Tomato is cultivated in 170 countries with total production of 164.49 million tones on an area of 4.672 million hectares (FAO, 2015). China is the leading country contributing 30 percent of the total production (50.66 million tons) followed by India United State, Turkey, Egypt, Iran, Italy, Brazil, Spain, and Mexico (FAO, 2015). In Pakistan it is cultivated on an area of 58.196 thousand hectares with total production of 57.4 thousand tons annually. Sindh is the leading tomato producing province in Pakistan followed by Khyber Pakhtunkhwa, Punjab and Baluchistan (Anonymous, 2014).

Tomato crop grows in wide range of climates which are susceptible to various insect pests. Insect pest is one of the major problems in tomato production. About 100 and 200 insects, pest species are renowned which attacks tomato throughout the world Waiganjo *et al*. (2006) Major insect pest of tomato are aphids, cut worm, white fly, thrips and fruit borers (Waiganjo *et al*., 2006).

Major insect pest that attacks tomato on seedling stage are cut worm, which attack on seedling stage by cutting the plant just below the soil and feed on plants roots (Waiganjo *et al*., 2006). Pests attack on foliage stages are aphid, cut worm, white fly and thrips, which suck the sap of plant and cause damage to the leaves of plant and cause damage to plants (Waiganjo *et al*., 2006). White flies act as a vector of different tomato viruses such as tomato yellow leaf cruel virus which is third among and widely known virus which cause economic loss in tomato production (Scholthof *et al*., 2011).

The use of different chemical can reduce insects' pest problem. The use of these chemical either kill the insects or reduce feeding and proper growth. The effect of these synthetic chemicals is very fast (Arela *et al*., 2003). The synthetic insecticides are pyrethroids, carbamates, organophosphates (Eldridg *et al.,* 2008). Botanical insecticides are also on the most effective control against these insect pests some of Botanical insecticides these are Garlic extract, chilly, hung and tobacco extract, Azadirchtin, obtained from neem seed is used against different insect pest (Schmutterer *et al* 2002). Application of hazardous pesticides not only results in drastic effect on human health, environment but also destroy some beneficial insects and also increase resistance of pest (Ortiz *et al*., 2007).

Tomato is (*Lycopersicon escolentum L.*) is one of the most important vegetables used throughout the world. The use of recommended dose and botanical extract can reduce the toxic chemical in fruits and vegetables Therefore it is important to evaluate other pest control strategies that are safe, effective and economic and environmentally friendly with the aim of minimizing the hazardous effects of insecticides residues (Dari *et al.,* 2016).

Therefore, it is important to evaluate other pest control strategies that are safe, effective and economic and environmentally friendly with the aim of minimizing the hazardous effects of insecticides residues. This study will be conducted on effectiveness of natural and synthetic insecticides treatment against various insect pests of tomato cultivars growth, yield and quality.

MATERIALS AND METHODS

The experiment was carried out at National Tea and High Value Crops Research Institute (NTHRI) Shinkiari District Mansehra Pakistan in summer 2017, to study the comparative efficacy of natural and synthetic chemical against insect pests of tomato cultivar. Sahil variety was sown. Size of plot for each treatment was 3x1.5m containing 10 plants. Every treatment contained two rows and each row have 5 plants. Plant to plant and row to row distance w kept 25cm and 30cm respectively.

The experiment was designed in RCBD with three replications. Five treatments via Neem extract (T1), Garlic extract (T2), Tobacco extract (T3), Steward 150EC (T4) and Control (T5) were used.

Tomato seedlings were transplanted in the field having 300 plants. On appearance of major pests such as Aphid (*Aphis gossypi*), Cut worm (*Agrotis ipsilon*), White fly (*Bamicia tabicai*), Thrips (*Thrips tabaci*) and fruit borers (*Helicoverpa armigera*), insecticides were used for the effective control of insects' pest papulation, seedling and fruit damage.

The population of aphid ahead of the spraying insecticides on tomato was recorded with magnifying glass, while after treatment observations on population of aphid, cut worm, white fly, thrips, and fruit borer were observed after 24, 48 hours, and on weekly interval.

Number of fruits per plant, percent damage of fruit, fruit weight and yield per plant were recorded. Physicochemical attributes like weight loss percentage, Total soluble solids (Brix), Vitamins-C (mg g⁻100) were calculated by chemical analysis in the laboratory.

Titratable acidity (TA) (%)

Titratable acidity (TA) was determined as stated by Hortwitz (1960). Calculations were made by the formula:

$$\text{Titratable acidity}(\%) = \frac{\text{N/10 NaOH used} \times 0.0064 \times 100}{\text{Volume of sample used}}$$

Ascorbic Acid (Vitamin C mg/100g)

The ascorbic acid or vitamin c in tomato was determined by standard method as reported in AOAC (1998). Following formula was used:

$$\text{Ascorbic Acid (mg/100g)} = \frac{D_1 \times V \times 100}{D \times A \times B}$$

D_1 = ml of dye used in titration of aliquot

D = ml of dye used in titration of 1 mL standard ascorbic acid solution prepared by adding 1 mL of 0.1% ascorbic acid + 1.5 mL of 0.4% oxalic acid

A = ml of juice used

V = volume of aliquot made by addition of 0.4% oxalic acid

Physiological weight loss (%)

Fruit weight was recorded gravimetrically using standard digital weight balance (Ohause EB30, Ohause Corp.) and physiological weight loss (PWL) was calculated the using following equation.

$$\text{Weight loss (\%)} = \frac{\text{Initial weight - Final weight}}{\text{Initial weight}} \times 100$$

Statistical Analysis

The recorded data was analyzed statistically to record the significance level for variation through statistical software statistic 8.1 at p∞ 0.05. The data observed were subjected to analysis of variance (ANOVA) to observe difference between different verities and mean were compared for the difference through least significant (LSD) test.

RESULTS

Table 1. Effect of synthetic insecticide and different bio-extracts against mean number of cutworms, fruit borer, aphids and whiteflies on tomato cultivar.

Treatments	Cutworm	Fruit borer	Aphids	Thrips	Whitefly
Neem extracts	6.01 b	0.73b	2.05b	1.78c	1.92c
Tobacco extracts	5.59 b	0.84b	2.01b	2.12b	2.10bc
Garlic extracts	5.28 b	0.80b	2.11b	1.89c	2.25abc
Steward (150EC)	2.71 c	0.75b	2.86b	1.80c	2.26ab
Control	12.33 a	1.34a	3.39a	2.81a	2.49a
LSD value	2.15	0.24	0.43	0.43	0.32

Table 1 indicated the mean population of cutworms, fruit borers, aphids, thrips and whitefly after the application of botanicals and synthetic insecticide. The mean data of cutworm after spray application showed that the maximum population was noted in control (12.33) followed by neem (6.01) which is statistically similar with tobacco (5.59) and garlic (5.28) while the lowest pest population was observed in steward (2.71). After spray application the population of fruit borer was also reduced significantly. The highest population was recorded in control (1.34) while the lowest borers population was noted in neem (0.73) which was non-significant with steward (0.75), garlic (0.80) and tobacco (0.84). Mean aphids data showed that the population was found maximum in untreated

plot (3.39) followed by plot treated with steward (2.86), garlic (2.11), neem (2.05) and tobacco (2.01) which were statistically similar. The thrips population was greatly affected by treatment application. The thrips population was noted maximum in control (2.81) followed by tobacco (2.12) while the lowest population was observed in neem (1.78), steward (1.80) and garlic (1.89) which were statistically similar. The population of whitefly was observed highest in untreated plot (2.49) while the lowest population was recorded in neem (1.92).

Table 2. Mean data on Number of fruits per plant, average fruit weight, % fruit damage and yield per hectare

Treatments	No. fruits/ plant	Average fruit weight(g)	Fruit damage (%)	Yield/hectare (Tons)
Neem extracts	63.33abc	72.00bc	10.83a	18.09b
Tobacco	56.66bcd	73.80bc	12.18b	19.02b
Garlic extracts	60abcd	68.13c	13.49b	19.62b
Steward	52.33d	75.46ab	11.64b	21.85ab
Control	54.66cd	59.40d	19.22c	18.00b
LSD	9.13	6.92	4.17	5.95

Means in columns followed by different letter(s) are significantly different at 5 % level of probability

Table 2 Showed the effect of botanical extracts and synthetic insecticide on Number of fruits/plants, Average fruit weight, percent fruit damage and yield /hectare in tomato. The data regarding Number of fruits/plants shows that highest number of fruits/plants (63.33 fruits plant$^{-1)}$ was recorded in plot treated with neem extract which was found non-significant with plot treated with garlic extract (60.00 fruits plant^{-1}). While lowest number of fruits per pant was found in Steward (52.33 fruits plant^{-1}), statistically similar with control plot (54.66 fruits plant^{-1}) and tobacco treated plot (56.66 fruits plant^{-1}). The data regarding average fruit weight indicated the dominance of steward with average fruit weight of 75.46g followed by tobacco (73.80g) which was

statistically in line with neem extract (72.00g) while the lowest fruit weight was observed in control (59.40g). After spray application, the percent fruit damage was recorded minimum in plot treated with neem (10.83) followed by steward (11.64) while the maximum fruit damage was recorded in untreated plot (19.22). Among the selected treatments, steward was found fruitful having maximum yield (21.85 tons) while the lowest yield was noted in control (18.00 tons) which was in line with neem (18.09 tons), tobacco (19.02 tons) and garlic (19.62 tons).

Table 3. Mean data regarding physiological weight loss, TSS, TA and vitamin C

Treatments	Physiological weight loss (%)	TSS (Brix) at harvest	TSS (Brix) after 7 days	A (%) at harvest	A (%) after 7 days	Vit-C at harvest	Vit-c after 7 days
Neem extracts	13.20c	2.93de	3.13c	0.83ab	0.61ab	29.24a	21.50a
Tobacco	11.16c	3.13bcd	4.12b	0.70 cd	0.48cd	19.56bc	11.82bc
Garlic extracts	17.42b	3.26ab	5.08 a	0.66d	0.45 d	22.79 b	15.05b
Steward	17.86b	3.13bcd	4.16b	0.61de	0.39 de	21.71bc	13.97bc
Control	29.84a	3.26ab	5.08 a	0.54e	0.33e	16.77 c	9.03c
LSD value	3.12	0.24	0.56	0.09	0.0995	5.24	5.24

Means in columns followed by different letter(s) are significantly different at 5 % level of probability

Table 3 showed the effect of botanical extracts and synthetic insecticide on physiological yield loss, TSS (Brix), acidity and vitamin C concentration. Data regarding physiological weight loss shows that highest physiological yield loss (29.84%) was recorded in control plots followed by plot treated with Steward (17.86%) which was statistically similar with Garlic extract (17.42%), while lowest physiological weight loss was recorded from Tobacco extract (11.16%) which is non-significant with Neem extract (13.20%). Data regarding TSS at harvest reveals that highest TSS at harvest was recorded in control plots (3.26 Brix) and Garlic extract (3.26 Brix) followed by Steward (3.13 Brix) and tobacco (3.13 Brix), while lowest TSS at harvest was recorded in neem extract (2.83 Brix) which is non-significantly lower than Steward and tobacco. Data regarding

TSS after 7days shows that highest TSS value was noted in untreated plot (5.08 Brix) and garlic extract (5.08 Brix) followed by Steward (4.16 Brix), statistically in line with tobacco extract (4.12 Brix). The lowest TSS after 7 days was recorded from neem extract (3.13Brix). The acidity at harvest shows highest acidity value (0.83%) was recorded in neem extract followed by tobacco (0.70%) which was statistically similar with garlic (0.66%) and steward (0.61%). The lowest acidity at harvest was observed in control (0.54%) which was in line with steward. The acidity offered by different treatments after 7 days showed that the highest acidity was recorded in neem extract (0.61%) followed by tobacco extract (0.48%) which is non significantly higher than garlic (0.45%) and steward (0.39%). The lowest acidity after 7 days was recorded in Control (0.33%) which is non-significantly lower than steward. Data regarding Vitamin C concentration at harvest shows that highest vitamin C value (29.24) was recorded in neem followed by garlic (22.79) which was non-significantly higher than steward (21.79) and tobacco (19.56). The lowest vitamin C value was recorded in control (16.77). The vitamin C concentration after 7 days of harvest also indicated the dominance of neem having vitamin C value (21.50) followed by garlic (15.05) while the lowest vitamin C concentration was obtained from control plot (9.03).

DISCUSSION

The study was conducted to check the efficacy of natural and synthetic insecticide against tomato insect pests. The present finding indicated that steward 150EC was effective against cutworm. Shakur *et al.* (2007) also reported the dominance of steward against cutworm. In the present study, neem extract was found best against tomato fruit borer. These findings are in line with the findings of Mustafiz *et al.* (2015) and Rahman *et al.* (2014). Data indicated that tobacco extract significantly lowered the population of aphids and was found more fruitful. Ghosh (20170 also reported tobacco extract as the most effective natural insecticide against aphids.

Thrips data indicated that natural insecticides via neem extract was found effective against the population of thrips. Stanley (2014) studied the effect of different neem concentration against thrips and conducted that neem extract was found effective against thrips. Siguna (2007) also studied cultural and botanical method for the control of thrips and found that Neem formulation is effective against thrips papulation. Neem

extract also control maximum whitefly population among the selected treatments. These finding are in line with Ali *et al.* (2017) who studied that Neem extract was most effective against sucking insect pest in brinjal crop.

Data regarding number of fruits, average fruit wait, fruit damage and yield showed that maximum number of fruit/plants was observed in Neem extract (63 fruits plant^{-1}). These findings are in line with Ali *et al* (2016) also reported maximum number of fruits plants^{-1} in neem as compared to other treatments. The minimum percent fruit damage (10.83%) was observed in Neem extract application as compared to other treatments. Shah *et al.* (2013) also reported less percent fruit damage in Neem extract after the application. The table also show the effect of natural and synthetic insecticides yield in tones. The yield was obtained maximum from Neem extract (18.09ton hac^{1}). Shah *et al.* (2013) also noticed that maximum yield was gain from Neem extract after application of different treatments.

CONCLUSION AND RECOMMENDATION

It was concluded that Natural insecticides were as effective as synthetic chemical. The synthetic chemical was found effective against cut worm infestation. Neem extract was found effective against Tomato fruit borer, Thrips and white flies papulation. Tobacco extract was found effective to control Aphids papulation. Less percent fruit damage, maximum number of fruits per plants, high yield was also obtained from Neem treated plots. From the above study it was recommended that natural insecticide should be recommended instead of synthetic chemical because it is cheap, easy to handle, easily accessible and degrades rapidly in natural and has less or no harmful effect on environment, human and other non-target species.

Conflict of interest

The authors have no conflict of interest.

REFERENCES

Adamou, H., R. Chaibou & H. A. Kadi. 2014. On-farm testing of Fyfanon 880 Ec (Malathion, 880g/L) on the major insect pests of tomato in the Kollo Region (Niger Republic). *Internat. J. Environ. Sci. Tech*. 3: 1319–1327.

Anonymous. 2014. Agricultural Statistics of Pakistan. Government of Pakistan, Statistics Division, Pakistan Bureau of Statistics, Islamabad.

Bakshi, A. K., U. Chauhan, K. C. Sharma & Y. C. Gupta. 2003. Host range of greenhouse whitefly *T. vaporariorum* (westwood) (Homoptera: Aleyrodidae) in Mid-Hill Regions of Himachal Pradesh. *Insect Environ*. 9: 55–56.

Baloch, A.F. 1994. Vegetable Crops. In: (Ed.): Malik, M.N. Horticulture. national book foundation Islamabad. 508

Barrania, A. A. & H. K. Abou-Taleb. 2014. Field efficiency of some insecticide treatments against whitefly, *bemisia tabaci*, cotton aphid, *aphis gossypii* and their associated predator, *chrysopa vulgaris* in cotton plants. *Alex. J. Agric. Res*. 59: 105–111.

Bekele, N., Mithöfer, D., Amudavi, D. and Obare, G. 2011. Integrated pest management training and information flow among smallholder horticulture farmers in Kenya. vegetable production and marketing in Africa: Socioeconomic Research, 243.

Campbell, C.D., Walgenbach, J.F. and Kennedy, G.G. 1991. Effect of parasitoid on lepidopterous pests in insecticide-treated and untreated tomatoes in Western North Carolina. J. Econ. Entom. 84:1662–1667.

Eldridge, F. B. 2008. Pesticide application and safety training for applicators of public health pesticides, vector-borne disease section.

FAO 2015. Food and agricultural organization statistics book on national crop production. Rome, Italy.

Flint, M.L. 2012. Integrated pest management in practice: principles and methods of integrated pest management 2nd Edition. University of California Agriculture and Natural Resources, Usa. Pp.2.

Giovannucci, E. 1999. Tomatoes, Tomato-Based Products, Lycospene, and Cancer: Review of the epidemiologic literature. J. Natl. Cancer Inst., 91: 317-331

Haque, M.M., A.K.M. Rehman And S.M.M. Hossain. 1998. Physiological and yield potential of some promising tomato lines at different planting times. Pak. J. Agric. Res. 9(3): 359-362

HOffmann, M.P., Wilson, L.T., Zalom, F.G., Hilton, R.J. And Weakley, C.V. 1996. Parasitoids helps control fruitworm in sacramento valley processing tomatoes. California Agriculture Journal 44: 20–23.

Horna. D., Melinda. S, And Falck-Zepeda, J. 2006. Assessing the potential economic impact of genetically modified crops in Ghana: tomato, garden egg, cabbage and Cassava. PBS Report, 1 – 2.

Maerere A.P., Mwanjombe K.K. And Sibuga K.P: 2006. Baseline survey report of tomato production in Mvomero District, Morogoro Region, Tanzania. Regional IPM Program for Uganda.

Mcgraw, D., Motes, J., Schatzer, R.J. 2007. Commercial Production of fresh market tomatoes. oklahoma cooperative extension service. Hla-6019

Muhammad Usman, Mian Inayatullah, Amjad Usman Kamran Sohail and Syed Fahad Shah. 2012. Effect of egg parasitoid, trichogramma chilonis, in combination with chrysoperla carnea and neem seed extract against tomato fruitworm, helicoverpa armigera. Sarhad J. Agric. 28(2): .

Oatman, E.R., Wyman, J.A., Van Steenwyk, R.A. and Johnson, M.W. (1983). Integrated control of the tomato fruit worm and integrated control of the tomato fruitworm (Lepidoptera: Noctuidae) and other lepidopterous pests on fresh-market tomatoes in Southern California. J. Econ. Entom. 76: 1363–1369.

Ortiz, R., Crossa, J., Vargas, M., Izquierdo, J. 2007. Studying the effect of environmental variables on the genotype × environment interaction of tomato. Euphytica 153:119–134.

Pimentel, D. And Greiner, A. 1997. Environmental and socio-economic costs of pesticide use. in: pimentel D (Ed) techniques for reducing pesticides: environmental and economic benefits, John Wiley and Sons, Uk, Pp 51-78.

Pretty, J and Bharucha, Z. P. 2015. Integrated pest management for sustainable intensification of agriculture in Asia and Africa. Insects 6: 152-182.

Garmonyou Aloysius Sam, Enoch Adjei Osekre, Moses Brandford Mochiah, Charles Kwoseh. 2014. Evaluation of insecticides for the management of insect pests of tomato, Solanum Lycopersicon L. Journal of Biology, Agriculture and Healthcare. Vol.4, No.5.

Jawad Ali Shah, Mian Inayatullah, Kamran Sohail, Syed Fahad Shah, Suleman Shah, Toheed Iqbal and Muhammad Usman 2013. Efficacy of botanical extracts and a chemical pesticide against tomato fruit worm, Helicoverpa Armigera. Sarhad J. Agric. Vol.29, No.1.

Varela, A.M., Serf, A. And Lohr, B. (2003). A guide to IPM in tomato production in eastern and Southern Africa. International centre of insect physiology and Ecology, ISBN 9290641495

Waiganjo, M., Waturu, C., Mureithi, J., Muriuki, J., Kamau, J. and Munene, R. (2011). Use of entomopathogenic fungi and neem bio-pesticides for brassica pests control and conservation of their natural enemies. East African Agricultural and Forestry Journal 77: 545-549.

Waiganjo, M.M., Wabule, N.M., Nyongesa, D., Kibaki, J.M., Onyango, I., Wepukhulu, S.B. and Muthoka, N.M. (2006). tomato production in Kirinyaga District, Kenya. A baseline survey report. Pp. 3-4.

Wheeler, W. B. (Ed.). (2002). Pesticides in agriculture and the environment. CRC Press.