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Evaluation of integrated pest management based techniques against insect pests associated with tomato at Uthal Balochistan, Pakistan

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Authors' Contribution Research experiment was conducted by **Magsi Z.**, research experimental was designed by **A. Ali** and **S. A. Memon**, **D. M.** Baloch analyzed Data.

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ABSTRACT

Insect pests are soft-bodied and tiny creatures with plant sap sucking habits that devastate various agricultural crops, fruit trees, ornamental plants and several vegetables. To control these insect pests four IPM techniques were used in tomato field with an aim to minimize the use of synthetic pesticides. Five colours of sticky traps (yellow, green, blue, black and red), Five different colours light trap (red, blue, yellow, green and white), three botanical insecticides (bitter Apple, tobacco, and neem seed extract) with 30% concentration and three synthetic insecticides (emmamectin benzoate, profenophos and bifenthrin) along with water as a control were used. A maximum pest population of jassid, whitefly, thrips, leaf minor, psyllid and flea beetle was observed on yellow sticky traps, while a minimum pest population of jassid, whitefly, thrips, leaf minor, psyllid and flea beetle was noticed on black and red sticky trap. However a highest pest population of fruit borer, psyllid, blister beetle, asparagus beetle, white fly, flea beetle and fruit fly was observed on white and yellow light colour as compared with others lights. However, no statistically significant differences were observed in jassid and earwings pest population on all given colure of lights. The minimum decreased population of white fly, Jassid, thrips and aphids was observed on all three inorganic pesticides as compared with all three organic pesticides and control group. Similarly pest populations reductions of white white fly, Jassid, thrips and aphid was found on all three organic pesticides neem seed, tobacco and bitter apple as compared to control group. We concluded that use of IPM techniques may be encouraged to suppress the insect pest population of tomato crop which could be ultimately positive for the environment.

Keywords: Tomato, sticky traps, light traps, synthetic insecticides, non-synthetic insecticides.

INTRODUCTION: Vegetables are the vital components of balance diet, which are grown in almost 200 countries of the world that protect the humans from the diseases due to their high nutritional values particularly vitamins, minerals, fiber and phytochemicals (Wargovich, 2000). The production of vegetables have been intensified over the years, however, yields of tomato continue to be low due to several biotic and abiotic factors (Deshmukh and Badgujar, 2017; Naveed *et al.*, 2019; Asiry *et al.*, 2022). Among biotic factors, diseases caused by fungi (Irshad and Naz, 2014), virus (Abbas *et al.*, 2012), bacteri (Ahmad and Ahmad, 2022), namatodes (Parveen *et al.*, 2013) and insect pest (Terefe *et al.*, 2022) demages has caused significant yield losses in Pakistan. Insects can significantly affect the overall profitability of crop, reducing both yield and seed quality (Petre *et al.*, 2014). Most of the insect pests are managed by using synthetic insecticides due to their reliance on chemicals which regulate the population dynamics of different insect pests (Naranjo, 2001). Yet injudicious and indiscriminative application of these chemicals leads to cause many problems including food, soil and ground H_2O, lakes, rivers, oceans and air contamination with toxins that affect beneficial insects and other organisms. In the 21st century, one of the chronic and pressing problems is imposed by the malnutrition on agriculture and human health. Pest resurgence occurs frequently due to the continuously use of insecticides that may also develop resistance among pests against these chemical pesticides (Naranjo, 2001). Hence, there is dire need to screen out the existing synthetic insecticides especially the new chemistry bio-rational insecticide formulation and find out other alternative bio-rational techniques like botanical insecticides against insect pests of okra and other vegetables (Javed *et al.*, 2018). Botanical pesticide as natural compounds from plants has been used to protect the damage caused by several insect pests and plants have evolved a variety of defense mechanisms to protect themselves from predators (Nisha *et al.*, 2012). Botanical pesticides are suitable alternatives to conventional pesticides and sub group of bio pesticides in agricultural pest management. Ligt traps and sticky traps, method can be used as a component of integrated pest management and determination of color preference of crop pests may help develop pest traps using such attractive colors, thus providing opportunities for pest control by integrating specific colors into crop management methods (Khuhro *et al.*, 2020). This helps either to reduce or avoid the use of synthetic pesticides and hence helping to avoid the buildup of pesticide residues in the environment and food. Lights and sticky coloure traps could be a simple and low cost method for determining the relative abundance of insects (Devi and Roy, 2017). Both traps are a usually used technique for population monitoring of several insect pests. Light have ability to decrease insect longevity and cause oxidative stress and antioxidant enzymes (Ali *et al.*, 2016; Ali *et al.*, 2017). Both traps are reasonably priced due to their less charge and less necessity of scientific labor and as well safer for natural habitats (Khuhro *et al.*, 2020).

OBJECTIVES: The present study is aimed to integrate and

evaluate several techniques under Integrated Pest Management (IPM) of insect pests associated with tomato crop at Uthal, Balochistan, Pakistan.

MATERIALS AND METHODS: The study was carried out in tomato crop at an experimental area of Lasbela University of Agriculture, Water and Marine Sciences, Uthal, Lasbela, Balochistan (25°50'30"N & 66°37'46"E). The tomato variety roma was sown (29th November 2021) with appropriate plant to plant (5 inch) and row to row distance (6 inch). All the other agronomical practices were conducted where applicable. Four integrated pest management techniques were used in tomato field to minimize the use of inorganic pesticides. Sticky traps (yellow, green, blue, black, and red) and light traps (red, blue, yellow, green, and white) installation methods in the field crop were used according to Khuhro *et al.* (2020). The botanical plant extract (bitter apple, tobacco, and neem seed extract) with 30% concentration methods were used according to (Rajput *et al.*, 2017). Pesticide company recommended dose were used in all 3 inorganic pesticides (emmamectin benzoate, profenophos and bifenthrin). Water was used as control group and the experiment was conducted in Randomized Complete Block Design (RCBD). Sticky traps and light traps data were collected interval until crop harvesting and organic and inorganic pesticides data were collected under 4 days. One Way Analysis of Variance (ANOVA) was used with the help of SPSS software and treatment means were compared with Tukey test at $p<0.05$ probability level.

RESULTS AND DISCUSSION: A statistically significantly ($p<0.05$) increase pest populations of jassid, whitefly, thrips, leaf minor, psyllid and flea beetle was observed on yellow sticky traps, while a significantly decrease pest populations of jassid, whitefly, thrips, leaf minor, psyllid and flea beetle was noticed on black and red sticky trap. While statistically no significantly difference was observed between black and red sticky trap on all insect pests (table 1).

Treatments	Jassid	Whitefly	Thrips	Leaf miner	Psyllid	Flea beetle
Yellow sticky trap	45.80±5.50^{a}	99.53±13.75^{a}	58.90±2.13^{a}	36.93±2.8^{a}	20.76±1.7^{a}	31.23±2.2^{a}
Blue sticky trap	11.06±1.62^{b}	11.96±1.75^{b}	22.10±0.5^{b}	29.86±0.82^{b}	18.00±0.55^{a}	15.26±1.43^{b}
Green sticky trap	9.60±0.20^{b}	8.86±1.24^{c}	16.63±1.03^{c}	8.63±0.52^{c}	7.76±0.97^{b}	5.83±0.66^{c}
Black sticky trap	3.40±0.36^{c}	3.70±0.81^{d}	3.73±0.49^{d}	4.53±0.92^{c}	3.76±0.27b^{c}	5.43±0.69^{c}
Red sticky trap	4.10±0.58^{c}	3.03±0.52^{d}	3.83±0.24^{d}	5.16±0.49^{c}	3.30±0.15^{c}	4.16±0.75^{c}

Table 1: Effect of different colours of sticky traps on the insect pest population of tomato crop.
Values (Mean ± S.E) given in the column letters are significantly different by Tukey test (P<0.05).

Statistically significant ($p<0.05$) increased pest populations of fruit borer, psyllid, blister beetle and asparagus beetle was observed on white light colour as compared with other lights, Similarly, statistically significant ($p<0.05$) increased pest population of white fly, flea beetle and fruit fly was observed in yellow light coloure. However, no statistical significant differences were observed in jassid and earwings pest population on all given coloure of lights (table 2).

Treatments Lights	White fly	Jassid	Fruit borer	psyllid	Flea beetle	Blister beetle	Asparagus beetle	Earwigs	Fruit fly
Green	0.66±0.2b	2.06±1.1a	2.26±0.4bc	9.53±2.2c	1.86±0.4b	4.80±1.1b	3.13±0.7b	2.0±0.5a	1.66±0.4b
White	0.93±0.3b	1.86±0.5a	7.93±1.0a	34.8±3.5a	5.80±1.0b	24.6±3.8a	26.0±4.1a	2.06±0.3a	1.33±0.2b
Blue	1.00±0.2b	1.46±0.3a	5.00±0.7b	22.7±3.4b	6.20±1.3b	4.66±1.0b	7.20±2.1b	3.6±0.7a	1.80±0.3b
Red	1.13±0.3ab	1.86±0.5a	5.00±0.7bc	6.40±1.9c	3.20±0.8b	4.66±1.4b	5.20±1.4b	3.06±1.3a	2.20±0.4b
Yellow	2.46±0.4a	1.46±0.3a	2.26±0.4c	5.20±0.9c	14.7±1.7a	5.46±1.1b	5.66±0.8b	2.4±0.6a	10.9±1.5a

Table-2 Effect of different colours of light on the insect pest population of tomato crop.
Values (Mean ± S.E) given in the column letters are significantly different by Tukey test (P<0.05).

Significantly ($p<0.05$) decreased pest populations of white fly, Jassid, thrips and aphids were observed on inorganic pesticides bifenthrin, profenophos and emmamectin as compared with all organic pesticides and control group. Similarly, in organic pesticides neem seed, tobacco and bitter apple was found significantly ($p<0.05$) different which reduced pest population of white white fly, jassid, thrips and aphids as compared to control group. Whereas, no significant differences was observed between neem seed and tobacco plant extract against all sucking insect pests of tomato crop (table 3). Management of insect pests of vegetables especially in tomato traditionally based on the application of synthetic and non-selective pesticides. Injudicious and indiscriminate uses of Chemical insecticides impose the harmful effects on human beings and the environment. Aragón *et al.* (2022) reported that yellow sticky traps can be used as an effective method for the control of whiteflies in the green house and field crop. Yellow sticky traps are a commonly used method for population monitoring of many pests. In recent decades, studies of these traps mainly focused on how to use them to monitor populations of pest species such as whiteflies, leafminers, jassid, thrips and aphids (Qiu and Ren, 2006; Lobin *et al.*, 2022; Wankhede *et al.*, 2022). Similar results were also observed in present result the maximum pest population of jassid, whitefly, thrips, leaf minor, psyllid and flea beetle was observed in yellow sticky traps as compared with others sticky traps (table-1). Light trap is used to determine seasonal pattern of insect pest fluctuations in the all major crops, vegetables and orchards and It is very effective tool for the monitoring and controlling of both sexes insect pests which resultantly reduces the pest pressure on crop (Dent and Binks, 2020). Briscoe and Chittka (2001) investigated that insects typically have photoreceptor that react to ultraviolet, blue and green lights. A number of insects have blue, green and UV photoreceptor in their eyes. In present experiment we observed a highest pest population of fruit borer, psyllid, blister beetle, asparagus beetle, white fly. Flea beetle and fruit fly was observed on white and yellow light colour as compared with green, blue and red colure lights (table-2).

Treatments	White fly before treatment	White fly after treatment	Jassid before treatment	Jassid after treatment	Thrips before treatment	Thrips after treatment	Aphid before treatment	Aphid after treatment
Bitter apple	16.7	0.5±0.9b	16.6	14.06±1.2b	16.00	12.80±0.8b	18.8	13.5±1.2b
Tobacco	16.00	6.6±1.3c	13.9	9.5±0.9c	16.1	8.56±1.3c	15.5	8.81±1.1c
Neem seed	12.9	7.1±1.0c	15.7	9.32±1.2c	13.5	7.74±1.5c	13.1	7.22±1.2c
Emmamectin	8.8	4.2±0.8d	9.3	4.3±0.8d	7.6	3.5±0.5d	10.5	4.54±1.0d
Profenophos	8.7	4.1±0.2d	8.9	4.66±0.4d	9.1	4.52±0.9d	8.8	4.66±0.9d
Bifenthrin	9.4	3.6±0.2d	9.8	5.48±0.2d	10.5	4.08±0.7d	9.5	5.16±0.7d
Control	16.6	21.1±1.0a	16.5	21.92±1.7a	18.5	22.58±1.6a	21	17.2±1.2a

Table- 3 Effect of different organic and inorganic pesticides on the sucking insect pests of tomato crop.
Values (Mean ± S.E) given in the column letters are significantly different by Tukey test (P<0.05).

Various colors of lights have significantly effect on orientation, locomotion, feeding, mating, ovipositor, adult emergence, and the development of insects (Ahmed *et al.*, 2021; Khan *et al.*, 2021). Semeao *et al.* (2011) found that factors such as light intensity in contrast with color background may have impact on level of adults captured. The chemical pesticides always remained first choice of the formers for instant insect control. In the present study 3 different chemical pesticides were used to evaluate their efficacy on s insect pests of tomato. Results suggested that all chemical pesticide showed good control against insects of tomato and significantly reduced the insect population (table 3). Good synthetic pesticides proved to be the most efficient chemical against sucking and chewing type of insect pests (Hemadri *et al.*, 2018). Due to highly toxic effects of synthetic pesticides on insect pest and environmental contamination need to find safest methods. A variety of plant species carry chemical substances, including alkaloids, phenolics and terpenoids etc. which may contribute to the control of insect pests (Banu *et al.*, 2010). The extract of *Azadirachta indica* carrying a variety of biological activities including anti-feedant, insect repellent, growth regulating and anti-ovipositional properties against insect pests and mites (Adel and Zaki, 2010). The neem seed extract and other botanical plants extract have been used many times by various scientists under vivo and vitro conditions against many arthropods. Present findings showed that neem seed and tobacco extract have lethal insecticidal properties on sucking insect pests of tomato crop (table-3). Neem and tabbaco plant extract reduced the pest population of vegetable insect pest (Maheswari and Govindaiah, 2017; Mostafa *et al.*, 2018).

CONCLUSION: It was concluded that yellow color) sticky trap and white and yellow color light traps proved more effective for the management of insect pests of tomato. Whereas, neem seed and tobacco extract as botanical insecticides performed better than bitter apple extract. While all 3 synthetic insecticides proved effectively against all sucking and chewing type insect pests of tomato crop.

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