Online Available at: https://www.sciplatform.com/index.php/ijcrt/article/view/1550

ISSN (Online) = 2707-5218

International Journal of Cotton Research and Technology

Research Manuscript https://www.sciplatform.com/index.php/ijcrt

Evaluation of sucking and chewing types' insect pests of cotton crop through integrated pest management (IPM) techniques

[a]Muhammad Abid Roonjha, [a]Arif Ali, [a]Ghulam Ali Bugti, [b]Shafique Ahmed Memon, [a]Abdul Hafeez Mastoi, [c]Muhammad Shahid Arain, [d] Sultan Ahmed

[a]Department of Entomology, Faculty of Agriculture, Lasbela University of Agriculture, Water and Marine Science Uthal, Balochistan, Pakistan
[b]Department of Entomology, Faculty of Crop Protection, Sindh Agriculture University Tandojam, Sindh, Pakistan,
[c]Department of Agriculture and Agribusiness Management University of Karachi,
[d]Cotton Research Station Lasbela Uthal Balochistan.

*Corresponding Author's Email Address: arifalirao@gmail.com

ReviewProccess: **Peer review**

ABSTRACT

Cotton is most important cash crop in the world and also in Pakistan. But due to attack of major insect pest of cotton crop reduce the quality and quantity. Massive use of pesticides to control these insect pest has negative impact on the environment and also expensive for the farmers community. To reduce expensive for the former in present research three IPM methods (Sticky traps, Light Traps and organic and inorganic pesticides) was used to the management of major insect pest of cotton. Five various colours (Yellow, Green, Blue, Black, and Red) sticky traps, Five different colours (Red, Blue, Yellow, Green and White) of light traps, three organic pesticides (Eucalyptus, Tobacco and Neem Seed) and three synthetic pesticides (Emmamectin, Benzoate, Profenofos and Bifenthrin) was used to compared control group. In present results we observed a maximum pest population of white fly, jassid, thrips, grasshopper and leaf hopper was found on yellow, blue and green sticky traps and minimum pest population was noticed on Red and Black sticky traps. Similarly a maximum pest population of PBW, SBW and ABW moths catch by Blue, White and Yellow light traps colours, while a lowest pest population of all three bollworm moth catch by Green and Red colure of lights. A significantly reduce pest population of, sucking and chewing insect pest was found on all three synthetic and organic pesticides as contrast with control group. We observed that sticky traps, light traps and both synthetic and non synthetic pesticides have ability to suppress the pest population of both sucking and chewing insect pest of cotton and also can minimize the use of hazard insecticides.

Keywords: Light traps, sticky traps, organic pesticides, inorganic pesticides, sucking and chewing insect pest.

INTRODUCTION: Cotton is a member of the Gossypium genus, grown worldwide in tropical, subtropical, and semi-arid climates and is considered an important fiber crop (Tarazi *et al.*, 2019). Cotton is an important crop, requiring millions of bales of cotton every year for the textile sector, which widely uses this fiber(Shahzad *et al.*, 2019). There has been an increasing demand for cottonseed meal as well as cottonseed oil for animal feed. The agriculture industry is the main driver of Pakistan's economy, accounting for 23.54% of the country's GDP, providing 37% of employment and providing livelihoods to about 70% of the people. Cotton is a key component of the country's agriculture-based economic growth. Notably, cotton crop plays a vital role in Pakistan's economy. The cotton production and processing chain accounts for nearly 60% of the country's total exports and more than 50% of its industrial employment (Abbas and Waheed, 2017). Pakistan is one of the top countries in the world in terms of cotton production, export, and consumption. Cotton is cultivated extensively across the world, with Punjab and Sindh provinces being the major production centers. Punjab is the most productive state in terms of cotton bales production and total cultivated area (Shuli *et al.*, 2018). However, cotton crops are severely affected by pest attacks, which negatively impact productivity and quality. Due to the dependence on chemicals, most pests are managed through the use of synthetic pesticides that control the population dynamics of various pests (Naranjo, 2001).Unfortunately, careless and unregulated use of these chemicals causes many problems, such as poisoning of food, soil, groundwater, lakes, rivers, oceans and air, harming beneficial insects and other living organisms. Recently, the continuous use of pesticides has led to an increase in the number of pests, which may also lead to the development of resistance to these chemical pesticides in pests (Naranjo, 2001). Therefore, there is an urgent need to explore alternative biological technologies such as botanical pesticides, especially new chemical bio-rational pesticides against ladybugs and other plant pests. A variety of defense mechanisms have been developed using botanical chemicals as natural rocks obtained from certified sources (Nisha *et al.*, 2012). In agricultural pest management, botanical polymers are suitable alternatives to a subset of conventional and biological pesticides. Significant work has been done on botanical chemicals obtained from various plant resources due to their specific classification, selectivity towards chemistries, and the inclusion of environmental protection and bio-conservation in the research.Light traps and sticky traps can be used as a part of integrated pest management by incorporating specific colors into crop management practices. By identifying the color preferences of crop pests, insect traps can be designed using these attractive colors, providing opportunities for pest control (Khuhro *et al.*, 2020). By reducing or eliminating the use of synthetic pesticides, it helps prevent the accumulation of pesticide residues in food and the environment. A quick and inexpensive way to estimate the relative abundance of pests is to use light and sticky colored traps. Both traps are commonly used to monitor populations of many pests. Light has the ability to reduce the longevity of pests and induce oxidative stress and antioxidant enzymes (Ali *et al.*, 2016; Ali *et al.*, 2017) and are safe for the natural environment (Khuhro *et al.*, 2020).

OBJECTIVES: Considering the significance of damage caused by sucking and chewing insects to cotton crops, several studies have been carried out to suppress the pest population with heavy reliance on the use of synthetic insecticides. However, the objective of this study is to combine and evaluate multiple approaches under integrated pest management (IPM) for pests associated with cotton Crop.

MATERIALS AND METHOD: **Study sites:** The study was carried out on cotton crop in the premises of experimental area of LUAWMS, Uthal. The cotton verity Cris-613 non BT was used in present experiment and it was sown in the month April 1st 2025.Three integrated pest management techniques were used in cotton crop field. The techniques such as sticky traps, light traps, organic and in organic pesticides were used to evaluate sucking and chewing insect pests of cotton crop. Complete Randomization Block Design (RCBD) was used with three replications. Water was used as a control group with compared both pesticides.

Sticky traps: Five different colours (yellow, green, blue, black, and red) of sticky traps were used. The sizes of the sticky traps were used 6× 27× 3 (width× length). The traps were attached to wooden sticks. Each colure three traps were installed in the field of cotton. Within each replicate block, one trap of each color was installed in a randomized arrangement, with traps spaced 1.5m apart. All sticky traps were made with rexine colour sheet that were installed 90 cm above the ground level with in cotton field. Different color of sticky traps was applied with white greese because of flying insects may get stuck in the traps. The grease was replaced on traps weekly and weekly data was observed by each colour of sticky traps through magnify glasses. The data were collected until crop harvested.

Light traps: Five different colours (red, blue, yellow, and green, white) of light traps were installed randomly cotton field to evaluate the effects of light traps against nocturnal insect's pest of cotton crop. Water was used in plastic installed traps for monitoring nocturnal insect pest. Weekly Data was recorded after installation of light traps until crop harvesting.

Botanical pesticides: Eucalyptus water extract, tobacco water extract and neem seed water extract 30% each and control.

Eucalyptus extract: Eucalyptus leaves were collecting from the surrounding of Uthal and dry it under the shade of Entomology laboratory. After dried leaves the leaves were ground with machine for making powder.

A 30% (w/v) stock solution was prepared by soaking 300g of eucalyptus powder in 1L of distilled water for 24 h. The mixture was then filtered through muslin cloth. The extract was used without further reduction by boiling and prepared it for use against insect pest of cotton crop. Hand sprayer was used for spray. Data were recorded in 24 and 48 hours after spray. Four plots were used with control groups. In each groups ten plants randomly selected for the treatments. Randomized Complete Block Design (RCBD) was used in the present experiment.

Tobacco water extract: Tobacco leave were purchased from the local market of Uthal, Lasbela. Leaves were ground with machine for making powder. A 30% (w/v) tobacco extract was prepared by soaking 300g of powder in 1L of distilled water left that were drained through muslin cloth and prepared it for use against insect pest of cotton crop. Hand sprayer was used for spray. Data were recorded in 24 and 48 h. after spray. Four plots were used with control groups. In each groups ten plants randomly was selected for the treatments. Randomized Complete Block Design (RCBD) was used in the present experiment.

Neem seed water extracts: Neem seed were collected from surrounding the University area and kept under shade of Entomology laboratory for drying. After drying, Neem seed were grind in machine for making powder. Neem seed powder 300 grams were used to prepare of 30% concentration of Neem seed water extract1-liter water was boiled with 5g detergent. After boiled water 300 grams Neem seed powder were included and left for 16 hours for preparation of 30% concentration of Neem seed water extract. After 16 hours' extract was drained through muslin cloth and prepared it to use against insect pests of cotton crop. Hand sprayer was used for spray. Data was recorded in 24 and 48 h. after spray. Four plots were used with control groups. In each groups tenplants was randomly selected for the treatments. Randomized Complete Block Design (RCBD) was used in present experiment. All botanical plant extracts methods was used according to (Magsi *et al.*, 2022).

Synthetic insecticides: Emmamectinbenzoate (1.9EC), Profenophos (50EC) and Bifenthrin (10EC). Three insecticides were used on cotton crop insect pest. All three synthetic pesticides (emmamectin, benzoate, profenofos and bifenthrin) were purchased by syngenta multinational pesticide company. Each treatment 1.50 cc doses of pesticides were used in 1000mL water according to pesticides manufacturing syngenta multinational pesticide company recommendations and compared with control group. Hand sprayer was used for spray. Data were recorded in 24 and 48 h. after spray. Each treatment was replicated thrice. In each group, ten plants were selected randomly for each treatment.

Statistical analysis: Collected data were analyzed using one way analysis of variance(ANOVA) where as Tukey test was used at P>0.05 probabilities.

RESULTS: Statistically significant (p < 0.05) increase was observed in the populations of jassid, whitefly, thrips, Grass hopper and leafhopper on yellow sticky traps, whereas significant decrease was observed in the populations of jassid whitefly, thrips, grass hopper and leafhopper on black and red sticky traps. While statistically significant (P > 0.05) difference was observed between black and red sticky traps on all pests (table 1).A statistically significantly (p<0.05) increase pest populations of Pink bollworm, American bollworm and spotted bollworm was observed on blue, white and yellow lights, while a significantly decrease pest populations of pink bollworm, american bollworm and spotted bollworm was noticed on red and green light colure. While statistically significantly difference was observed among all given light traps against three cotton bollworms (table-2).

A significant (P<0.05) reduction in the populations of whitefly, jassid, Thrips, and aphids was recorded with the application of inorganic pesticides such as bifenthrin, profenophos, and emamectin compared to all organic pesticides and the untreated control. Likewise, among the organic treatments, neem seed, tobacco, and eucalyptus extracts also demonstrated significant (P<0.05) differences in lowering the populations of these pests relative to the control. However, no statistically significant (P>0.05) variation was detected between Neem seed and tobacco extracts in managing the sucking insect pests of the cotton crop (table 3).

A significant (P<0.05) reduction in the populations of pink bollworm, spotted bollworm, american bollworm, and grasshopper was recorded with the use of inorganic pesticides including bifenthrin, profenophos, and emamectin compared to all organic treatments and the control group. Likewise, among the organic pesticides, neem seed, tobacco, and eucalyptus extracts also exhibited significant (P<0.05) reductions in these pest populations relative to the control. However, no significant differences (P>0.05) were observed among neem seed, tobacco, and eucalyptus extracts regarding their effects on all chewing insect pests of cotton (table 4).

Treatments	Jassid	Whitefly	Thrips	Grass hopper	Leaf hopper
Yellow sticky trap	35.80±1.20^{a}	75.13±2.75^{a}	68.90±1.23^{a}	39.30±2.18^{a}	33.33±1.08^{a}
Blue sticky trap	19.16±0.02^{b}	30.10±2.75^{b}	36.10±1.05^{b}	33.61±1.32^{b}	27.16±2.12^{b}
Green sticky trap	17.19±1.80^{b}	12.08±0.24^{c}	29.63±2.13^{c}	27.10±1.10^{b}	25.00±1.50^{b}
Black sticky trap	8.27±1.06^{c}	8.00±1.81^{d}	13.13±2.89^{d}	15.17±0.17^{c}	9.13±1.12^{c}
Red sticky trap	7.30±1.18^{c}	7.01±1.52^{d}	12.03±1.34^{d}	17.40±2.19^{c}	8.87±1.89^{c}

Table 1: Effect of various colours of sticky traps on the insect pest of cotton crop.
Values (mean ± SE) given in column letters are significantly different by tukey test (P < 0.05).

Treatments lights	Pink bollworm	American bollworm	Spotted bollworm
Green	11.27±3.10e	22.11±3.21d	24.55±1.66d
White	75.88±2.60b	66.67±1.66b	62.10±2.66b
Blue	87.55±3.27a	95.12±2.77a	66.77±1.98a
Red	15.18±1.18d	18.77±3.17e	17.99±2.60e
Yellow	66.16±2.70c	46.66±2.34c	33.99±2.78c

Tabble 2: Effect of different colours of light on nocturnal insect pest of cotton crop.
Values (Mean±S.E) given in the column letters are significantly different by tukey test (P<0.05).

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
Eucalyptus	26.8	7.7±0.9^{bc}	15.6	12.3±1.2bc	18.00	13.10±0.8^{b}	19.3	9.1±1.2^{b}
Tobacco	19.34	8.6±1.3^{b}	17.8	11.5±0.9bc	17.1	12.06±1.3^{b}	22.5	7.81±1.1^{bc}
Neemseed	23.91	9.10±1.0^{b}	19.4	13.1±1.2b	20.5	14.14±1.5^{b}	23.1	9.2±1.2^{b}
Emmamectin	18.80	2.2±0.8^{d}	15.4	3.3±0.8d	18.6	2.5±0.5c	18.5	1.14±1.0^{d}
Profenophos	24.7	3.1±0.2d	16.8	2.2±0.4d	19.1	2.52±0.9c	28.8	1.60±0.9d
Bifenthrin	35.4	1.6±0.2d	19.6	2.3±0.2d	25.5	1.08±0.7c	19.5	0.16±0.7^{d}
Control	26.6	25.1±1.0a	19.5	23.92±1.7a	20.5	23.58±1.6a	26.00	27.2±1.2^{a}

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

Treatments	Pink bollworm before treatment	Pink bollworm after treatment	Spotted bollworm before treatment	Spotted bollworm after treatment	American bollwormbefore treatment	American bollworm after treatment	Grass hopper before treatment	Grass hopper after treatment
Eucalyptus	5.5	3.3±0.2b	6.7	4.1±1.2b	5.5	3.9±0.7b	12.17	8.1±0.7b
Tobacco	6.7	2.4±1.3b	4.6	3.2±0.8b	6.5	2.0±1.9bc	19.66	7.0±2.1b
Neemseed	6.4	2.3±1.3b	4.6	4.0±0.3b	4.1	2.0±1.3c	18.33	8.1±0.9b
Emmamectin	4.7	0.33±1.6c	7.5	0.66±1.7c	3.9	0.16±2.1d	18.99	1.01±1.4c
Profenophos	6.4	1.2±1.0c	6.2	0.99±0.16c	4.2	0.19±2.2d	13.99	1.20±3.1c
Bifenthrin	5.5	1.01±0.3c	5.3	1.31±1.2c	5.8	1.11±2.4d	15.24	2.10±1.8c
Control	5.1	6.1±1.8a	8.1	7.66±0.6a	5.2	6.66±0.6a	18.60	21.6±2.3a

Table 4: Effect of different organic and inorganic pesticides on the chewing insect pests of cotton crop.
Values (Mean ± S.E) given in the column letters are significantly different by Tukey Test (P<0.05).

DISCUSSION: To control insect pest of cotton crops formers usually use synthetic and non-selective pesticides. Continuously uses of synthetic pesticides cause contamination in environmental and also harmful for human being and livestock's(ASLAM and NAQVI, 2000). According to (Lu *et al.*, 2012), yellow sticky traps serve as an effective strategy for managing pests in both greenhouse and field crops. These traps are widely employed for monitoring the population dynamics of various pest species. Over the past decades, research has primarily concentrated on optimizing their use for tracking pests such as whiteflies, leaf miners, jassids, thrips, and aphids (Qiu BaoLi and Ren ShunXiang, 2006). Consistent with previous findings, the present study also recorded the highest populations of jassids, whiteflies, thrips, leafhoppers, and grasshoppers on yellow sticky traps compared to other trap types (table 1). Magsi *et al.* (2022)also found these similar results regarding yellow sticky traps have catch maximum flying insect pest as compared to other sticky traps. Light traps are extensively utilized to study the seasonal dynamics and fluctuation patterns of insect pests in major field crops, vegetable plantations, and orchards. These traps have proven to be a highly effective tool for both monitoring and managing insect populations of both sexes, thereby contributing to a substantial reduction in pest pressure on crops (Singh and Bambawale, 2012). Furthermore, it was confirmed that most insects possess specialized photoreceptors that respond sensitively to ultraviolet, blue, and green wavelengths of light. In fact, many insect species have well-developed blue, green, and UV photoreceptors in their visual system, enabling them to detect and respond to these light spectra effectively (Briscoe and Chittka, 2001). In current research ahighest pest population of pink bollworm, Spotted bollworm and American bollworm moths were observed on blue, white and yellow light colures as compared with green and red colure lights (table 2). Similar results also were observed by Magsi *et al.* (2022) who reported that yellow and white light have negative impact on nocturnal insect pest. According to Ahmed *et al.* (2021)different light wavelengths exert a significant influence on several behavioral and physiological activities of insects, including orientation, locomotion, feeding, mating, oviposition, adult emergence, and overall developmental processes. Similarly, Semeao *et al.* (2011) reported that factors such as light intensity in combination with background color can markedly affect the number of adult insects attracted and captured. Despite advancements in integrated pest management, chemical pesticides have traditionally remained the primary choice of farmers for the rapid suppression of insect infestations. In the present investigation, three commonly used chemical pesticides emamectinbenzoate, profenofos, and bifenthrinwere applied to evaluate their efficacy against insect pests in cotton fields. The results revealed that all three chemical pesticides provided effective control, leading to a significant reduction in both chewing and sucking insect pest populations in cotton crops (tables 3&4). Hemadri *et al.* (2018)similarly reported that high-quality synthetic pesticides have consistently been regarded as the most effective chemical agents for managing both sucking and chewing insect pests. However, because of the severe toxic effects associated with synthetic pesticides on target and non-target organisms, as well as their contribution to environmental pollution, there is a pressing need to explore safer and more environmentally friendly pest management strategies. Numerous plant species are known to contain bioactive compounds such as alkaloids, phenolics, and terpenoids, all of which can play a significant role in suppressing insect pest populations (Banu *et al.*, 2010). Among these botanicals, extracts of Azadirachtaindica (Neem) have demonstrated a wide range of biological activities, including anti-feedant, insect-repellent, growth-regulating, and anti-ovipositional effects against various insect pests and mites . In fact, neem seed extracts and other plant-derived formulations have been repeatedly tested by several researchers under both in vivo and in vitro conditions for their effectiveness against a wide variety of arthropod species. The present study revealed that extracts from neem seeds, eucalyptus, and tobacco exhibit strong insecticidal properties against both sucking and chewing insect pests of cotton crops (table 3&4). Similar observations were reported by Mostafa *et al.* (2018), who documented that neem and tobacco plant extracts significantly reduced the populations of various insect pests in vegetable crops under field conditions.

CONCLUSION: In conclusion, Three Integrated Pest Managements (IMP) techniques were used for the management of cotton insect pest. Five different colures of sticky traps, five different colures of light traps, three organic and three synthetic pesticides applied for the sucking and chewing insect pest. We concluded that (yellow, blue and green) colours sticky traps, (blue, white and yellow)colours light traps was found most effective on sucking and chewing types insect pest of cotton crop, however three organic pesticides (eucalyptus, tobacco and neem seed) and synthetic inorganic pesticides (emmamectin, benzoate, profenofos and bifenthrin) have also proved significant effects on sucking and chewing insect pest. But Synthetic pesticides may be used as a last option because of their harmful effects on the environmental. All three IMP techniques Sticky traps, light traps and organic pesticides may be encouraged to reduce the pest population of cotton crop which could be ultimately useful for the ecosystem.

Declaration: We hereby certify that the current study has neither been published elsewhere, nor is it under consideration elsewhere, and will not be submitted elsewhere.

Certify from authors and co-authors: We certify that all co-authors have been informed and agree with the submission of this paper.

Ethics approval: Not needed for this study.

Consent for publications: Not applicable.

Conflict of interest: The authors declare that they do not have any personal relationships that can affect the work reported in this review.

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