Research Article

Comparison of Different Plant Extract Combinations Against Jassid (*Amrasca devastans*) and Whitefly (*Bemisia tabaci)* in Okra Crop

Azam Khurshid[1]*, Jawad Sarwar[1], Kamran Sohail[1], Hafiz Muhammad Faisal Ayub[2], Farooq Muhammad[1], Fida Muhammad Khan[3] and Adnan Ihsan[1]

[1]Department of Entomology, The University of Agriculture, Peshawar, Khyber Pakhtunkhwa, Pakistan; [2]Agricultural Research Station, Swabi, Khyber Pakhtunkhwa, Pakistan; [3]Institute of Development Studies, The University of Agriculture, Peshawar, Khyber Pakhtunkhwa, Pakistan.

Abstract | Present study was carried out to evaluate the efficacy of different plant extract combinations against Whitefly (*Bemisia tabaci*) and Jassid (*Amrasca devastans*) on okra crop at Kalu khan district Swabi, in 2022. Treatments included a synthetic insecticide, six plant extract combinations, and control. The results revealed that the minimum number of whitefly plant^{-1}, after 1st and 2nd spray application, was observed in plots treated with lambda-cyhalothrin (2.65 and 2.20) followed by (bakain leaf extract + neem seed extract) (3.67 and 2.74) and the maximum number of whitefly plant^{-1} were recorded in control (5.60 and 5.38). Similarly minimum number of jassid plant^{-1} after 1st and 2nd spray application was observed in plots treated with lambda-cyhalothrin (3.45 and 2.47), followed by bakain leaf extract + neem seed extract (4.13 and 3.16) and maximum number of jassid plant^{-1} was recorded in control (6.80 and 5.50). Lambda-cyhalothrin treated plots showed the highest marketable yield of 1359.3 kg/ha. Among plant extract combinations, the highest marketable yield of 1207.4 kg/ha was recorded in bakain leaf extract + neem seed extract, and the lowest marketable yield of 703.7 kg/ha was recorded in control plot. Lambda-cyhalothrin showed highest Cost-Benefit Ratio (1: 14.25), followed by plant extract combination bakain + neem seed extract (1: 10.49), and the lowest Cost-Benefit Ratio (1: 3.08) was recorded in eucalyptus leaf extract + neem seed extract. Therefore, It is concluded that bakain + neem seed extract should be incorporated in future IPM programs to manage the whitefly and jassid population effectively.

Received | May 25, 2023; **Accepted** | September 23, 2023; **Published** | September 30, 2023
***Correspondence** | Azam Khurshid, Department of Entomology, The University of Agriculture, Peshawar, Khyber Pakhtunkhwa, Pakistan; **Email:** azam.kalukhan@gmail.com
Citation | Khurshid, A., J. Sarwar, K. Sohail, H.M.F. Ayub, F. Muhammad, F.M. Khan and A. Ihsan. 2023. Comparison of different plant extract combinations against Jassid (*Amrasca devastans*) and whitefly (*Bemisia tabaci*) in okra crop. *Pakistan Journal of Weed Science Research,* 29(3): 149-155.
DOI | https://dx.doi.org/10.17582/journal.PJWSR/2023/29.3.149.155
Keywords | Bakain leaf extract, Neem seed extract, Okra crop, Plant extract efficacy

Introduction

Okra (*Abelmoschus esculentus* Moench) is a flowering plant in the Malveacea family is identified as Lady Finger or Bhindi in other countries (Amir *et al.*, 2018). Okra is grown across several countries, including Pakistan. In 2009, Pakistan produced 114.657 thousand tonnes of okra, an amount of 15.081

thousand ha (Anonymous, 2019). The overall amount of healthy pods produced per person is low for various reasons, including a lack of high-quality seed, insect diseases and pest infestation, weed competition, poor plant density, poor fertilization, and a shortage of area (Rahman *et al*., 2012). Almost 72 species of insects are recorded on okra crops. The significant insect pest going after okra incorporate whitefly, aphids, jassids, thrips, and fruit borer (Rakesh *et al*., 2006). Due to its own multivoltinism, host species range, high transience of behavior, high development rate, tolerance to extreme heat, ability to serve as a vector of numerous plant infectious diseases, and resistance to insect poisons, whitefly (*Bemisia tabaci,* G.) is among them the most destructive sucking major pest of okra (Kumar, 2017). Both the nymph and adult stages of the whitefly cause harm by sucking the cell sap of the leaves, which affects respiration (Atwal and Sing, 1990).

Jassid is also an important pest of okra; the life cycle includes egg, nymph, and adult. Greenish-yellow, curving eggs, which are never laid in the leaf lamina but rather in the midrib or a broad vein on one of the leaf's surfaces, a petiole or young stem, are oviposited (Vennila *et al*., 2007). Due to its destructive nature, Jassid introduces toxic substances into the plant, causing harm by reducing the photosynthetic surface (Bhatangar and Sharma, 1991). Plant extracts are preferred because they are cheap and easily available compared to synthetic insecticides. These are less poisonous to mammals, beneficial insects that include biocontrol agents and insect pollinators, and safer for our ecosystem (Iqbal *et al*., 2015). The present study is based on finding an environment-friendly plant extract combination that can minimize the population of whitefly and Jassid, increase the yield of okra crops, and evaluate the cost-benefit analysis to determine the most effective treatment.

Materials and Methods

The current study was conducted at a farmer's field in Kalu Khan, Swabi on comparison of different plant extract combinations against jassid and whitefly in okra crops. The experiment comprised of eight treatments, replicated three times in Randomized Complete Block Design (RCBD). Seedlings of hybrid "Nirali" of okra were purchased from a local market and transplanted in the field. Each treatment had four rows, and plot size was 3 x 3 m^2 with R-R and P-P distances kept at 60 and 30 cm, respectively. The treatments were T_1 (Bakain leaf extract + Datura leaf extract @ 5% each), T_2 (Bakain leaf extract + Eucalyptus leaf extract @ 5% each), T_3: Bakain leaf extract + Neem seed extract @ 5% each, T_4: Datura leaf extract + Eucalyptus leaf extract @ 5% each, T_5: Datura leaf extract + Neem seed extract @ 5% each, T_6: Eucalyptus leaf extract + Neem seed extract @ 5% each, T_7: Lambda Cyhalothrin @ 2.5% EC (Recommended dose) and T_8 (Control). The treatments were applied twice during the course of experiment. The desired plant parts after collection from the local area were washed and then oven dried for seven days. The dried material of the collected plant was grinded separately by a grinder (juicer), mixed with 5 liters of distilled water, and boiled for 2 hours. Muslin cloth was used for filtration during treatment application to remove the impurities.

Population of jassids and whiteflies

Whitefly and jassid population were noted by randomly selecting 5 plants. After selection, the plants were divided into three parts such as top, middle, and lower. Three leaves were randomly selected from each plant. Data was recorded one day before the treatment's application, and then after treatment application at different day intervals, i.e. (1, 2, 3, 7, and 14) days again data was recorded (Zeeshan *et al*., 2017).

Yield (Kg ha^{-1})

Yield $plot^{-1}$ was recorded after each picking, and total yield was calculated by adding the yield of all pickings. Data was converted to kg ha^{-1} yield by using the formula:

$$\text{Yield (kg ha}^{-1}) = \frac{\text{Yield plot}^{-1}(kg)}{\text{Plot size (m}^2)} \times 10000$$

Cost benefit ratio

Cost benefit ratio was calculated for each treatment to determine the treatment that provides us the maximum profit using the method of Usman *et al*. (2015).

Data analysis

Statistical analyses were carried out through Statistix version 8.1 to analyze the data. The means at 5 % significance level were separated by using the LSD test.

Table 1: *Mean number of whitefly plant^{-1} after 1st and 2nd application of plant extracts combinations and synthetic insecticide in okra crop in district Swabi.*

Treatments	Pre - Spray	1 DAS	2 DAS	3 DAS	7 DAS`	14 DAS	Mean
T_1: Bakain leaf extract + Datura leaf extract	5.2 b	4.77 bc	4.43 b	4.09 bc	3.31 b	3.58 b	4.23 bc
T_2: Bakain leaf extract + Eucalyptus leaf extract	5.18 b	4.76 bc	4.5 b	4.31 ab	3.28 b	3.61 b	4.27 bc
T_3: Bakain leaf extract + Neem seed extract	5.15 b	4.2 c	3.61 b	2.96 c	2.96 b	3.12 b	3.67 c
T_4: Datura leaf extract + Eucalyptus leaf extract	5.33 b	4.86 b	4.57 b	4.19 b	3.53 b	3.93 b	4.40 b
T_5: Datura leaf extract + Neem seed extract	5.41 ab	4.76 bc	3.51 b	3.18 bc	3.05 b	3.15 b	3.84 bc
T_6: Eucalyptus leaf extract + Neem seed extract	5.33 b	4.84 b	4.52 b	4.20 b	3.21 b	3.46 b	4.26 bc
T_7: Lambda Cyhalothrin	5.24 b	3.28 d	1.9 c	1.73 d	1.73 c	2.03 c	2.65 d
T_8: Control	6.00 a	5.77 a	5.81 a	5.51 a	5.30 a	5.25 a	5.60 a
LSD $_{(0.05)}$	0.62	0.60	1.17	1.19	0.61	0.92	0.73
2nd Spray							
T_1: Bakain leaf extract + Datura leaf extract	5.40 ab	5.02 a	4.30 c	3.92 c	3.16 c	4.16 c	4.32 cd
T_2: Bakain leaf extract + Eucalyptus leaf extract	5.03 abc	5.30 a	4.68 bc	3.69 c	3.72 b	4.65 b	4.51 bc
T_3: Bakain leaf extract + Neem seed extract	4.70 c	3.46 c	2.79 e	2.05 e	1.54 e	1.92 f	2.74 f
T_4: Datura leaf extract + Eucalyptus leaf extract	4.93 bc	5.51 a	4.80 b	4.62 b	3.69 b	4.92 b	4.74 b
T_5: Datura leaf extract + Neem seed extract	4.70 c	4.21 b	3.67 d	2.89 d	2.41 d	2.76 e	3.44 e
T_6: Eucalyptus leaf extract + Neem seed extract	4.55 c	5.21 a	4.43 bc	3.68 c	3.19 c	3.52 d	4.10 d
T_7: Lambda Cyhalothrin	5.53 a	2.68 d	1.86 f	1.13 f	0.79 f	1.22 g	2.20 g
T_8: Control	5.03 abc	5.60 a	5.46 a	5.39 a	5.38 a	5.43 a	5.38 a
LSD $_{(0.05)}$	0.55	1.48	0.46	0.66	0.43	0.35	0.29

Means value in columns with different letters are significantly different at p = 0.05 using LSD. DAS: days after spray.

Results and Discussion

Whitefly population plant^{-1}

Table 1 showed that all treatments except the control significantly affected the mean number of whitefly plant^{-1} after 1st and 2nd sprays. The population of whitefly plant^{-1} recorded after 1st and 2nd application of treatments revealed decline in the population with lambda-cyhalothrin as the most effective treatment with minimum mean number (2.65, 2.20) of whitefly plant^{-1} and among plant extract combinations minimum number of whitefly plant^{-1} (3.67, 2.74) were recorded for bakain leaf extract + neem seed extract treated plots and maximum number whitefly plant^{-1} (5.60, 5.38) were reported for control.

Jassid population plant^{-1}

Table 2 shows the mean number of jassids plant^{-1} after 1st and 2nd application of treatments. Data reveals that population of jassids plant^{-1} significantly affected by all the treatments except control. Mean number of jassids plant^{-1} after 1st and 2nd spray application revealed that minimum number (3.45, 2.47) of jassids plant^{-1} were recorded in plots treated with lambda-cyhalothrin among plant extract combinations minimum number (3.45, 2.47) of jassids plant^{-1} were observed in plots treated with bakain leaf extract + neem seed extracts and maximum number (6.80, 5.50) of jassids plant^{-1} were observed in control.

Yield (kg ha^{-1})

Results regarding the effect of synthetic insecticide and plant extract combinations on yield of okra crop is demonstrated in Table 3. Results showed that all plant extract combinations had a significant effect on the yield of okra crop. Maximum yield (1359.3 kg ha^{-1}) was recorded in plots treated with lambda-cyhalothrin, followed by bakain leaf extract + neem seed extract (1207.4 kg ha^{-1}), and minimum yield (703.7 kg ha^{-1}) was recorded for control.

Cost benefit ratio

All treatments were found profitable having a CBR value > 1. Maximum cost-benefit ratio was recorded for lambda-cyhalothrin (1: 14.25), followed by bakain leaf extract + neem seed extract (1: 10.49). Minimum cost-benefit ratio among treatments was recorded for eucalyptus leaf extract + neem seed extract (1: 3:08). Results show that bakain leaf extract + neem seed extract had maximum cost-benefit ratio compared to all tested plant extract combinations. Therefore, based on these findings, the application of bakain leaf extract + neem

Table 2: *Mean number of jassid plant^{-1} after 1st and 2nd application of plant extracts combinations and synthetic insecticide in okra crop in district Swabi.*

Treatments	Pre - Spray	1 DAS	2 DAS	3 DAS	7 DAS`	14 DAS	Mean
T_1: Bakain leaf extract + Datura leaf extract	7.56 a	5.93 ab	4.90 bc	4.49 b	4.22 bc	4.11 bc	5.20 b
T_2: Bakain leaf extract + Eucalyptus leaf extract	6.65 ab	5.86 ab	5.32 b	4.53 b	3.76 c	3.98 c	5.02 b
T_3: Bakain leaf extract + Neem seed extract	6.78 ab	5.2 bc	4.16 cd	3.15 c	2.60 d	2.89 d	4.13 c
T_4: Datura leaf extract + Eucalyptus leaf extract	6.50 ab	6.03 ab	5.53 ab	4.84 b	4.20 bc	4.51 bc	5.27 b
T_5: Datura leaf extract + Neem seed extract	6.85 ab	6.19 ab	5.81 ab	5.23 b	4.43 b	4.71 b	5.53 b
T_6: Eucalyptus leaf extract + Neem seed extract	6.64 ab	6.19 ab	5.77 ab	5.40 b	4.53 b	4.67 b	5.53 b
T_7: Lambda Cyhalothrin	6.43 b	4.30 c	3.26 d	2.50 c	1.90 e	2.30 d	3.45 d
T_8: Control	6.61 ab	6.57 a	6.59 a	6.71 a	6.91 a	7.45 a	6.80 a
LSD $_{(0.05)}$	1.06	1.14	1.15	0.91	0.60	0.67	0.62
2nd Spray							
T_1: Bakain leaf extract + Datura leaf extract	5.08 a	4.82 a	4.51 ab	4.17 b	3.43 b	3.6 c	4.27 b
T_2: Bakain leaf extract + Eucalyptus leaf extract	4.51 abc	4.16 ab	3.82 bc	3.44 c	3.07 b	3.26 d	3.71 c
T_3: Bakain leaf extract + Neem seed extract	4.20 bc	3.66 bc	3.29 cd	2.83 d	2.42 c	2.57 e	3.16 d
T_4: Datura leaf extract + Eucalyptus leaf extract	4.95 ab	4.63 a	4.15 b	3.83 bc	3.31 b	3.48 cd	4.06 bc
T_5: Datura leaf extract + Neem seed extract	4.86 abc	4.57 ab	4.28 b	3.93 bc	3.38 b	3.51 cd	4.09 bc
T_6: Eucalyptus leaf extract + Neem seed extract	4.53 abc	4.14 ab	3.85 bc	4.23 b	3.45 b	4.23 b	4.07 bc
T_7: Lambda Cyhalothrin	4.12 c	3.09 c	2.56 d	2.02 e	1.41 d	1.64 f	2.47 e
T_8: Control	5.08 a	4.96 a	5.25 a	5.29 a	6.00 a	6.44 a	5.50 a
LSD $_{(0.05)}$	0.79	0.91	0.81	0.48	0.48	0.29	0.54

Means value in columns with different letters are significantly different at p = 0.05 using LSD. DAS: days after spray.

Table 3: *Effect of different plant extract combinations on yield of okra crop in district Swabi.*

Treatments	Yield kg/ha
T_1: Bakain leaf extract + Datura leaf extract	933.3 de
T_2: Bakain leaf extract + Eucalyptus leaf extract	1070.4 c
T_3: Bakain leaf extract + Neem seed extract	1207.4 b
T_4: Datura leaf extract + Eucalyptus leaf extract	1022.2 cd
T_5: Datura leaf extract + Neem seed extract	855.6 e
T_6: Eucalyptus leaf extract + Neem seed extract	851.8 e
T_7: Lambda Cyhalothrin	1359.3 a
T_8: Control	703.7 f
LSD $_{(0.05)}$	132.76

seed extract should be encouraged in the Kalu Khan district Swabi area, as it is economically feasible and environmentally suitable. The findings of Table 4 are only confined to the area of Kalu Khan district Swabi because yield kg ha^{-1}, gross income and cost of control vary with time and place.

The current study evaluated the effect of some botanical combinations and synthetic insecticides against the sucking insect pests of okra. In this study, lambda-cyhalothrin was the most effective insecticide in minimizing the jassids and whiteflies population compared to all other treatments. These results agree with the findings of Sana *et al.* (2021), who found the lowest number of jassid leaf^{-1} in plots treated with lambda-cyhalothrin compared to other botanicals used in the study. Among the botanicals, bakain leaf extract + neem seed extract and bakain leaf extract in combination with eucalyptus leaf extract performed better in reducing the jassids and whiteflies population than the control. The results are also endorsed by Wawdhane *et al.* (2020), who applied neem seed extract against jassids and found a reduction in the population. Eucalyptus leaves extract also produced significant results against sucking pests compared to control, thereby causing a considerable reduction in the pest population. Iqbal *et al.* (2015) also studied that plant extracts possess significant potential in minimizing the Jassid, whitefly, and thrips population. Their finding revealed that neem extracts provided effective management in comparison to other tested treatments. Minimum population of jassid, whitefly and thrips was observed in neem and garlic treated plots. Lambda-cyhalothrin was noted as the most superior treatment in minimizing the jassids population. Mehmood *et al.* (2014) studied the performance

Table 4: *Cost-Benefit Ratio (CBR) of different treatments used against Jassid and whitefly at farmers field in district Swabi*

Treatments	Yield (kg/ ha)	Gross income (Rs.)	Cost of control	Return over control	Net income	CBR
T_1: Bakain leaf extract + Datura leaf extract	933.3	46665	2400	11480	9080	4.78
T_2: Bakain leaf extract + Eucalyptus leaf extract	1070.4	53520	2400	18335	15935	7.63
T_3: Bakain leaf extract + Neem seed extract	1207.4	60370	2400	25185	22785	10.49
T_4: Datura leaf extract + Eucalyptus leaf extract	1022.2	51110	2400	15925	13525	6.63
T_5: Datura leaf extract + Neem seed extract	855.6	42780	2400	7595	5195	3.16
T_6: Eucalyptus leaf extract + Neem seed extract	851.8	42590	2400	7405	5005	3.08
T_7: Lambda Cyhalothrin	1359.3	67965	2300	32780	30480	14.25
T_8: Control	703.7	35185	-	-	-	-

Average price of okra kg^{-1}= Rs. 50, Labour cost for collection of plants and preparation of stock solution = Rs. 3200 (800 per each plant), Spray charges = Rs. 1600 (800 per spray), Lambda-cyhalothrin per ha cost = Rs. 700.

of different bio-pesticides against whitefly population. They found neem powder as the most effective biopesticide in suppressing the whiteflies population compared to other treatments. Khan *et al.* (2013) tested different botanicals against whitefly and recorded that datura was the most effective plant extract in reducing the population density of whitefly. The findings of our study are also supported by Ashfaq *et al.* (2019). They used different botanicals, including bakain, at various concentrations and regarded that bakain greatly reduced the population density of whitefly, followed by neem seed extract and *D. sissoo*. The yield of okra was significantly higher in botanicals and lambda-cyhalothrin treated plots. Rehman *et al.* (2015) also observed maximum okra yield in plots treated with lambda-cyhalothrin than other treatments. The results are confirmed by Iqbal *et al.* (2015) and Sohail *et al.* (2015), who found that the application of neem seed extract had a positive impact on yield of okra crop compared to the control.

Conclusions and Recommendations

It was concluded from the results that lambda-cyhalothrin was found to be the most effective among all the treatments. Among plant extracts, Bakain leaf extract + neem seed extract significantly reduced the population of the targeted insect pests. Due to the effectiveness of bakain leaf extract + neem seed extracts in reducing the population of whitefly and Jassid and enhancing the yield of okra crop, it is recommended to incorporate this treatment in future IPM programs.

Author's Contribution

Azam Khurshid: Conceptualization, data curation, formal analysis
Jawad Sarwar: Conceptualization
Kamran Sohail: Software, validation
Hafiz Muhammad Faisal Ayub: Data curation, project administration
Farooq Muhammad: Data curation
Fida Muhammad Khan: Data curation, funding acquisition
Adnan Ihsan: Conceptualization, data curation

Conflict of interest
The authors have declared no conflict of interest.

References

Ali, J., A.U.R. Saljoqi, R.A. Shah and M. Salman. 2015. Comparison of two botanical extracts with Imidacloprid in suppressing cotton whitefly, *Bemisia tabaci* Gennadius (Hemiptera: Aleyrodidae). J. Entomol. Zool. Stud., 3(3): 215-217.

Amir, K., S. Hussain, M. Shuaib, F. Hussain, Z. Urooj, W.M. Khan, U. Zeb, K. Ali, M.A. Zeb and F. Hussain. 2018. Effect of gamma irradiation on OKRA (*Abelmoschus esculentus* L.). Acta Ecol. Sin., 38(5): 368-373. https://doi.org/10.1016/j.chnaes.2018.02.002

Anonymous, 2019. Agricultural statistics of Pakistan. Ministry of National Food Security and Research. Government of Pakistan (GoP), Islamabad. pp. 1-10.

Ashfaq, N., M.A. Bashir, M. Noreen, N. Jameel, A.

Ayoub and A. Latif. 2019. Insecticidal efficiency of native plant extracts against whitefly (*Bemisia tabaci*) on cotton crop. Pure Appl. Biol., 8(1): 727-732. https://doi.org/10.19045/bspab.2019.80014

Asi, M.R., M. Afzal, S.A. Anwar and M.H. Bashir. 2008. Comparative efficacy of insecticides against sucking insect pest of cotton. Pak. J. Life Soc. Sci., 6(2): 140-142.

Atwal, A.S. and E.B. Singh. 1990. Pest population and assessment of crop losses. Indian Agric. Res., 220 Inst. New. Delhi. Ind. J. Entomol., 69(3): 218.

Bhatangar, P. and P.D. Sharma. 1991. Comparative incidence of sucking insect peston different isogenic lines of cotton variety H777. J. Insect Sci., 4(2): 170-171.

Broek, R.V., G.D. Iacovino, A.L. Paradela and M.A. Galli. 2007. Alternative control of *Erysiphe cichoearun* on okra crop. Ecossistema, 27: 23-26.

Iqbal, J., H. Ali, M.W. Hassan and M. Jamil. 2015. Evaluation of indigenous plant extracts against sucking insect pests of okra crop. Pak. Entomol., 37(1): 39-44.

Iqbal, J., H. Mansoor, A. Muhammad, T. Shahbaz and A. Amjad. 2008. Screening of okra genotypes against jassid, *Amrasca biguttula biguttula* (Ishida) (Homoptera: Cicadellidae). Pak. J. Agric. Sci., 45(4): 448-451.

Jech, L.E. and S.H. Husman. 1998. Improved areawide whitefly management through industry and extension partnership. J. Environ. Sci., (China) (English ed.), pp. 1081-1083.

Khan, M.H., N. Ahmad, S.M.M. Rashdi, I. Rauf, M. Ismail and M.Tofique.2013. Management of sucking complex in Bt cotton through the application of different plant products. Pakhtunkhwa J. Life Sci., 1(01): 42-48.

Kumar, B.S., 2004. Okra, planting and propagation, problems and care. Web-india123.com:2.

Kumar, P. and A. Kumar. 2017. Efficacy of selected insecticides against sucking insect pests [*Amrasca biguttula* (Ishida) and *Bemisia tabaci* (Gennadius)] of okra [*Abelmoschus esculentus* (L.) Moench]. Int. J. Curr. Microbiol. App. Sci., 6(8): 3256-3259. https://doi.org/10.20546/ijcmas.2017.608.388

Mahmood, K., S. Eijaz, M.A. Khan, A. Alamgir, S.S. Shaukat, Z. Mehmood and A. Sajjad. 2014. Effects of biopesticides against jassid [*Amrasca devastans* (dist.)] and white fly [*Bemisia tabaci* (genn.)] on okra. Int. J. Biol. Biotech., 11(1): 161-165.

Memon, A.G., G.H. Abro and T.S. Syed. 2004. Varietal resistance of okra against *Earias* spp. J. Entomol., 1: 1-5. https://doi.org/10.3923/je.2004.1.5

Oyedunmade, E.E.A. and N.B. Izuogu. 2011. Efficacy of aqueous extract of lemon grass (*Andropogon citratus* L.) against Root-Knot Nematode Pests of Okra. (*Abelmoschus esculentus* (L.) Moench). *Agrosearch*, 11(1): 31-38. https://doi.org/10.4314/agrosh.v11i1.4

Rahman, K., K. Waseem, M. Kashif, M.S. Jilani, M. Kiran, Ghazanfarullah and M. Mamoon-Ur-Rashid. 2012. Performance of different okra (*Abelmoschus esculentus* L.) cultivars under the agro-climatic conditions of Dera Ismail khan. Pak. J. Sci., 64(4): 316-319.

Rakesh, M., P. Dhawan and B. Vinod. 2006. Evaluation of okra varieties against viral diseases. Population estimation on okra. Indian J. Ecol., 17: 58-60.

Rehman, H., M. Nadeem, M. Ayyaz and H.A. Begum. 2015. Comparative Efficacy of neem oil and lambda cyhalothrin against whitefly (*Bemisia tabaci*) and Jassid (*Amrasca devastans* Dist.) in Okra Field. Russ. Agric. Sci., 41(2-3): 138-145. https://doi.org/10.3103/S1068367415020238

Rote, N.B., B.K. Patel and N.P. Mehta. 1980. Impact of mechanical control measures in integrated pest management of cotton leaf worm [*Spodoptera litura* F.]. Andhra Agric. J., 27: 104- 106.

Sana. K., T. Iqbal, A. Usman, Karishma, F. Said, I.U. Khan, K. Shahjeer and G. Khan. 2021. Comparative efficacy of botanical and a synthetic insecticide against sucking insect pest of brinjal. Ann. R.S.C.B. 25(6): 19381-19389.

Sohail, K., S. Jan, A. Usman, S.F. Shah, M. Usman, M. Shah and A. Mehmood. 2015. Evaluation of some botanical and chemical insecticides against the insect pests of okra. J. Entomol. Zool. Stud., 3(2): 20-24.

Usman, A., I.A. Khan, M. Shah, F. Amin and J. Sarwar. 2015. Comparative efficacy of indigenous plant extracts and a synthetic insecticide for management of fruit worm (*Helicoverpa armigera* Hub.) and their effect on natural enemies. Pure Appl. Biol., 7(3): 1014-1020. https://doi.org/10.19045/

bspab.2018.700120

Vennila, S., V.K. Biradar, M. Sabesh and O.M. Bambawale. 2007. Know your cotton insect pest Jassids. J. Emerg. Tech. Innov. Res., 5(10): 2349-5162.

Wawdhane, P.A., V.N. Nandanwar, B. Mahankuda, A.S. Ingle and K.I. Chaple. 2020. Bio-efficacy of insecticides and bio pesticides against major sucking pests of Bt-cotton. J. Entomol. Zoo. Study, 8: 829-833.

Zeeshan, M.A., S. Ali, M. Atiq, N. Ahmed, M.U. Ghani, R. Binyamin and M. Rizwan. 2017. Assessment of whitefly mortality and decrease in yellow mosaic disease severity by using insecticides with different modes of action. Pak. Entomol., 39(1): 55-60.