

INSECTICIDAL EVALUATION OF *Bridelia micrantha* AND *Dalbergia lactea* AQUEOUS EXTRACTS FOR THE CONTROL OF *Podagrica uniforma* (Jacoby) AND *Nisotra dilecta* (Jacoby) (COLEOPTERA: CHYSOMELIDAE) INFESTATION ON OKRA

Jacobs Mobolade Adesina^{1,2*)}, Kayode David Ileke³⁾, Rajashekar Yallappa²⁾
and Thomas Inomisan Ofuya^{4,5)}

- ¹⁾ Department of Crop, Soil and Pest Management Technology, Rufus Giwa Polytechnic, P.M.B. 1019, Owo, Ondo State, Nigeria
- ²⁾ Insect Chemical Ecology Laboratory, Institute of Bioresources and Sustainable Development, Takyelpat, Imphal – 795001, Manipur, India
- ³⁾ Department of Animal and Environmental Biology, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria
- ⁴⁾ Vice Chancellor's Office, Wellspring University, Benin City, Edo State, Nigeria
- ⁵⁾ Department of Crop, Soil and Pest Management, Federal University of Technology, P.M.B. 704, Akure, Ondo State, Nigeria
- ^{*)} Corresponding author E-mail: mobolade72@gmail.com

Received: March 14, 2016 /Accepted: May 3, 2016

ABSTRACT

Insect pest infestation is a major factor militating against okra production and farmers generally adopt synthetic insecticides for its management. A field trial was undertaken to evaluate the insecticidal potency of *Bridelia micrantha* and *Dalbergia lactea* for the management of *Podagrica uniforma* (Jacoby) and *Nisotra dilecta* (Jacoby) insect pest of okra (*Abelmoschus esculentus* L. Moench). The treatments consisted of aqueous leaf extracts of *Bridelia micrantha* and *Dalbergia lactea* and Cypermethrin as check; laid out in Randomized Complete Block Design and replicated three times. Data was collected on insect population before treatment application and 3 days after spraying of insecticides at 28, 35, 42, 56 days after planting (DAP). Yield parameters data collected were number of fruits and fruit weight. Results obtained showed that the plant extracts exhibited effectiveness in reducing the insect population and improved okra fruit yield compared to Cypermethrin. The order of effectiveness in decreasing sequence was found to be Cypermethrin > *D. lactea* > *B. micrantha*. *D. lactea* and *B. micrantha* crude extracts could be explored as promising insecticidal agents to provide valuable alternatives to chemical control of insect infestation on okra. Further study is recommended to determine the chemical constituents responsible for the plant insecticidal activity.

Keywords: *Bridelia micrantha*; *Dalbergia lactea*; insecticidal; insect population; synthetic insecticides

INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) is an important fruit vegetable grown throughout Nigeria for its soft immature edible green fruits or pods, which contain a glutinous, sticky substance that is used to thicken soups and stews or for making soup delicacy popularly called "okro soup" (Adeboye & Oputa, 1996; Ojo, Olunloyo, & Ibitoye, 2014).

Okro soup has a stretching characteristics which plays an important role to improve the palatability of many dishes and is generally used as nutritional supplements for vitamin A, B, C folic acid, calcium, magnesium, potassium, iron, iodine, proteins, Zinc, Phosphorus, β carotene, riboflavin (Cook et al., 2000; Glew et al., 1997; Gopalan et al., 2007; Huang, Wang, Eaves, Shikany, & Pace, 2007; Varmudy, 2011).

Despite the nutritional value of okra, the optimum yield (2-3 t ha⁻¹) in the tropical countries is low partly due to insect pest infestation. So many insect pests attack okra plants from sowing up to harvesting (Ahmed, Chaudhary, & Yusuf, 1998; Iqbal, Ali, Hassan, & Jamil, 2015; Rahman, Uddin, & Shahjahan, 2013; Sohail et al., 2015). The most prevalent and destructive insect pests are

Cite this as: Adesina, J. M., Ileke, K. D., Yallappa, R. & Ofuya, T. I. (2016). Insecticidal evaluation of *Bridelia micrantha* and *Dalbergia lactea* aqueous extracts for the control of *Podagrica uniforma* (Jacoby) and *Nisotra dilecta* (Jacoby) (Coleoptera: Chysomelidae) infestation on okra. *AGRIVITA Journal of Agricultural Science*, 38(3), 269-274. <http://doi.org/10.17503/agrivita.v38i3.845>

Accredited: SK No. 81/DIKTI/Kep/2011

Permalink/DOI: <http://dx.doi.org/10.17503/agrivita.v38i3.845>

Podagrica uniforma (Jacoby) and *Nisotra dilecta* (Jacoby) (Coleoptera: Chrysomelidae), which defoliated the plant; thereby reduces the photosynthetic activity of the leaves and resulting in poor plant growth and pod yield. The insects also responsible for transmission of okra mosaic virus (OMV), disease and results to yield reduction if not controlled.

The use of synthetic insecticide has been the major control strategy for insect pest of okra, particularly in the tropics and sub tropical nations. Recent advances in agricultural research are geared towards discovery and development of viable alternatives of natural origin which are less toxic besides being easily biodegradable in nature. The potential of using plant materials as deterrent against insect pest in crops, on the field and during post-harvest period, is a study that is currently gaining wider acceptability as a result of the numerous short comings associated with the use of synthetic insecticide. In view the nutritional and economic importance of okra and losses caused by insect pests to it, the present research aimed to evaluate the utilization of *Bridelia micrantha* and *Dalbergia lactea* aqueous extracts for the control of *P. uniforma* and *N. dilecta* infestation on okra.

MATERIALS AND METHODS

Experimental Location and Field Layout

The experiment was conducted on a total land area of 372 m² in a Randomized Complete Block Design (RCBD) replicated thrice during wet season 2015 in the Teaching and Research Farm Rufus Giwa Polytechnic Owo, Ondo State, Nigeria (7°11'43" N, 5°33'57" E). The plot was ploughed, harrowed and manually made into seed beds and divided into three blocks and each block was further divided into nine plots, with each plot measuring 6 m x 5 m (30 m²). A distance of 1 m was left as walkway between the blocks and the plots. The seeds of an early maturing okra variety and good draw qualify fruits "NH-47-H" was obtained from Ondo State Agricultural Development Program, Akure, Nigeria and were directly sown at two seeds per hole at a planting distance of 60 cm x 50 cm to a planting depth of not more than 0.5 cm; this was later thinned to one vigorous seedling per stand at 2 weeks after emergence. Prior to planting, seed viability test was conducted using floatation method few hours before planting (Adesina & Idoko, 2013); floated seeds were unviable and discarded. Weeding was done manually when necessary; but no fertilizer application was made.

Preparation and Application of Treatments

Fresh leaves of *Bridelia micrantha* and *Dalbergia lactea* were collected from Oka Akoko, Ondo State (7°27'0" N, 5°48'0" E) and authenticated at the Forestry and Wood Technology Department, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria. The leaves were washed in clean water to remove dirt and there-after their extracts were prepared by weighing 1.0 kg of the plant materials using an electric weighing balance (DHV 1000/ d model) and homogenized using a pestle and mortar and then allowed to seep overnight in 10 liters of water. The extracts were filtered through muslin cloth to obtain crude aqueous extracts. The treatments were applied at 21 days after sowing (DAS) by preparing 10% concentration of the extracts from the stock solution, using Spray well 16 L Knapsack sprayer model under fairly calm weather condition to avoid drifting to adjacent plots. Subsequent application of the treatments was carried out at weekly intervals till the plants reached the fruiting stage. Synthetic insecticide (Cypermethrin 25 EC) was applied at the rate of 0.25 kg active ingredient (ai) per ha to serve as check to compare the efficacy of the plant extracts.

Data Collection and Analysis

Sampling of the beetles was conducted by visual count and this commenced 3 weeks after planting (WAP) in the morning between 6 - 7 am when the insects are still inactive. Number of *P. uniforma* (Jaq.) and *N. dilecta* (Jaq.) was counted before each spray and also at 7 days post treatment application. Five plants were selected randomly and tagged within the inner rows of each plot and number of *P. uniforma* and *N. dilecta* was counted from 2 leaves on top, 2 leaves on bottom and 2 leaves at middle. The collected data was pooled and mean population was worked out separately.

Harvesting of fresh pods started at 8 WAP when the fruit/pod is still fresh. Fruit that broke easily when pressed at the tip of the finger were selected and harvested by twisting the fruit stalk and continued at 4 days intervals for a period of 5 weeks. Fresh pod yield was computed by totaling the yield of different pickings per plot and weighed using electronic digital balance. Data collected were transformed using the square root transformation method to ensure homogeneity of variance and normal distribution of the data. Data was later subjected to analysis of variance (ANOVA) using SPSS and significant treatment means were tested

by Duncan Multiple Range Test (DMRT) at 5% probability (Gomez & Gomez, 1984).

RESULTS AND DISCUSSION

RESULTS

Result presented in Table 1 shows the insect mean population before the application of the aqueous plant extracts and synthetic insecticide ranging from 1.41–1.47 insects per plant. The mean number of the insects showed there was no significant difference ($df = 2$, $F = 0.61$, $F = 0.57$) across the plots on the okra plants. Thereby, indicating similar infestation trend on the okra plants in the absence of treatments.

The effect of the treatments on the insect mean population on okra plants after different spraying regimes was presented in Table 2. At 28 days after planting (DAP) there was significant difference in the mean number of insects recorded on the okra plants treated with *B. micrantha*, *D. lactea* extracts and Cypermethrin. Application of Cypermethrin significantly reduced ($df = 2$, $F = 15.22$, $P = 5.64$) the insect population compared to the plots sprayed with the aqueous plant extracts. Plots sprayed with *D. lactea* extract significantly reduced the insect population as compared to *B. micrantha* extract application. At 35 DAP, days after second spraying (DAS), plots sprayed with synthetic insecticide still maintained significant ($df = 2$, $F = 22.05$, $P = 0.001$) reduction in insect population, while no significant ($P > 0.05$) difference was observed for insect population between the plant extracts applied, similar observation was recorded at 42 DAP after the third spraying ($df = 2$, $F = 12.12$, $P = 0.008$).

Table 1. Mean number of *P. uniforma* and *N. dilecta* counted on okra plants before treatment application at 21 DAP

Treatment	Mean \pm SE
<i>B. micrantha</i>	1.44 \pm 0.06a
<i>D. lactea</i>	1.41 \pm 0.05a
Cypermethrin	1.47 \pm 0.03a

Remarks: Means in each column bearing the same letters are not significant at the 5% level of probability ($P < 0.05$)

At 56 DAP, after the fifth spraying regime there was no significant difference ($df = 2$, $F = 6.20$, $P = 0.035$) between the plots treated with application of synthetic insecticide and *D. lactea* extract. However, causing a significantly lower insect population in the plots as compared to plots treated with *B. micrantha*.

The result in Table 3 shows the yield attributes of okra in response to the treatment applications for the control of *P. uniforma* and *N. dilecta*. As shown in table 3, there was significant difference between plots treated with the plant extracts and control (Cypermethrin) in terms of fruits number and fruit weight. Number of okra fruits harvested from plots treated with Cypermethrin recorded significantly highest mean number of fruits (2.20) than those treated with the plant extracts, there was no significant difference ($df = 2$, $F = 16.65$, $P = 0.004$) between the number of fruits in plots treated with the plant extracts. In terms of the fruit weight, there was significantly high weight of the fruits in the control plots compared to those treated with the extracts. Meanwhile, there was significant difference ($df = 2$, $F = 22.18$, $P = 0.002$) in the weight of okra fruits in the plots treated with *D. lactea* extract than plots treated with *B. micrantha*.

Table 2. Mean number of *P. uniforma* and *N. dilecta* counted on okra plants after different spraying regimes (treatment application)

Treatment	28 DAP	35 DAP	42 DAP	49 DAP	56DAP
<i>B. micrantha</i>	1.29 \pm 0.03a	1.19 \pm 0.04a	1.09 \pm 0.04a	0.86 \pm 0.08a	0.80 \pm 0.10a
<i>D. lactea</i>	1.15 \pm 0.04b	1.08 \pm 0.08a	0.81 \pm 0.05a	0.64 \pm 0.07b	0.62 \pm 0.12b
Cypermethrin	0.74 \pm 0.03c	0.71 \pm 0.07b	0.57 \pm 0.17b	0.50 \pm 0.00b	0.47 \pm 0.17b

Remarks: DMRT 5% was used to verify the differences between each treatments. Means in each column bearing the same letters are not significant at the 5% level of probability ($P < 0.05$)

Table 3. Mean yield parameters of okra fruits

Treatment	Number of fruits	Fruit weight (g)
	Mean±SE	Mean±SE
<i>B. micrantha</i>	0.93±0.13 ^b	7.33±0.33 ^c
<i>D. lactea</i>	1.33±0.06 ^b	10.00±0.58 ^b
Cypermethrine	2.20±0.23 ^a	13.33±0.88 ^a

Remarks: DMRT 5%, Means in each column bearing the same letters are not significant at the 5% level of probability ($P < 0.05$)

The low number of harvested fruits observed in this study was as a result of short spell of drought experience during the flowering stage of the plant.

DISCUSSION

Insect pests infestation pose major threat from sowing to harvest in okra cultivation, causing reduction plant height, number of effective branches and marketable fruit yield. A wide variety of synthetic insecticides are used to control Okra pests in many countries (McCaffery, 1998). Extensive use of insecticides leads to the problems of pest resistance, resurgence, pesticides residues, destruction of beneficial fauna and environmental pollution (Adilakshmi, Korat, & Vaishnav, 2008). In this regard, plant derived compounds have emerged as good candidates, not only as new effective tools in insect pest management but also as environmentally safer agents (Mohan, Haider, Andola, & Purohit, 2011).

The present study was conducted to assess the insecticidal properties of *B. micrantha* and *D. lactea* in suppressing *P. uniforma* and *N. dilecta* infestation and improve okra yield. Result shows that there was no significant difference in the insect infestation prior to application of treatments. The reason for this can be due to the fact infestation of the okra plant is just manifesting due to the presence of susceptible host and favorable environmental conditions.

Botanical insecticides were inferior to synthetic insecticides but partially effective in reducing the pest population and improved okra fruit yield after application. The present results are comparable to those of some earlier researchers who reported that plant extracts to have shown various degrees of toxicity against many insect pests (Aderolu, Omoloye, & Ojo, 2012; Adesina & Afolabi, 2014; Adesina & Idoko, 2013; Adewumi, Ofuya, & Folorunso, 2007; Anaso & Lale, 2001; Lee, Park, & Ahn, 2000; Shah *et al.*,

2013). High effectiveness of Cypermethrin compared to crude aqueous extracts could be attributed to un-degradability of the active ingredient formulation that possesses immediate knock down effects on the target insects (Oladimeji & Kannike, 2010; Alao, Adebayo, Olaniran, & Akanbi, 2011). The field observation showed that the crude extracts did not kill the observed insects but might likely have a repellent and/or barrier effect. The organic products might have created a hostile environment for insects and a physical barrier to infestation, hindered feeding activities of the insects. These effects might be attributed to characteristic offensive odor perceived during application. The improved yield observed from the study may be as result of the reduction in the defoliation of the okra leaves and in turn allow for normal photo-synthetic activity of the plant.

The *P. uniforma* and *N. dilecta* population varied significantly with the application of synthetic insecticide and *B. micrantha* and *D. lactea* crude extracts. Cypermethrin give the best result among the treatment. Out of the two crude plant extracts *D. lactea* crude extract suppressed the insect population at 28, 35, 42 and 49 DAP spraying regime and improved okra yield better than *B. micrantha*. The effectiveness of the crude plant extracts and synthetic insecticides was found in the following order Cypermethrin > *D. lactea* > *B. micrantha*.

CONCLUSION AND SUGGESTION

Conclusion

Crude extracts of *D. lactea* and *B. micrantha* act as promising insecticidal agents as it compares favorably with Cypermethrin and they could provide valuable alternatives to synthetic insecticides in the integrated management of *P. uniforma* and *N. dilecta* infestation on okra in the study area.

Suggestion

Resource-poor farmers are enjoined to adopt the utilization of *D. lactea* and *B. micrantha* to suppress *P. uniforma* and *N. dilecta* infestation and increase okra fruit yield. Further study is recommended to determine the extracts mode of actions and biochemical constituents responsible for the insecticidal activity of the plants.

ACKNOWLEDGMENT

The authors are grateful to Messrs. Bankole, O.A. and Adetule, A.R. Corp Members in the Department Crop, Soil and Pest Management Technology, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria for their technical support and the Director, Institute of Bioresources and Sustainable Development, Imphal, Manipur, India for his keen interest in this study. The first author acknowledges Mr. Balogun Blessing, Department of Agricultural Technology, Rufus Giwa Polytechnic, Owo, Ondo state, Nigeria for collecting *D. lacteal* and *B. micrantha* use in this study and The World Academy of Science (TWAS), Italy for financial support under fellowship for Research and Advanced Training.

REFERENCES

- Adeboye, O. C., & Oputa, C. O. (1996). Effects of galex on growth and fruit nutrient composition of okra (*Abelmoschus esculentus*). *Ife Journal of Agriculture*, 18(1&2), 1-9.
- Aderolu, I. A., Omoloye, A. A., & Ojo, J. A. (2012). Comparative evaluation of modified neem leaf, wood ash and neem leaf extracts for *Hymenia recurvalis* control on *Amaranthus* spp. in Ibadan Southwest Nigeria. *International Journal of Horticultural & Crop Science Research*, 2(1), 27–35. Retrieved from http://www.ripublication.com/ijhcsr/ijhcsrv2n1_5.pdf
- Adesina, J. M., & Afolabi, L. A. (2014). Comparative bio-efficacy of aqueous extracts of *Loncarpous cyanescens* and *Trema orientalis* against flea beetle (*Podagrica* spp.) (Coleoptera: Chrysomelidae) infestation and yield of okra. *International Journal of Horticulture*, 4(2), 4–9. <http://doi.org/10.5376/ijh.2014.04.0002>
- Adesina, J. M., & Idoko, J. E. (2013). Field evaluation of insecticidal activity of *Chenopodium ambrosiodes* and *Spondias mombin* crude extracts for the control of okra flea beetles *Podagrica uniforma* Jacq. (Coleoptera: Chrysomelidae). *Research Journal of Agricultural Science*, 4(1), 37–39. Retrieved from <http://rjas.org/Newlook/Issues.aspx?Issueld=13>
- Adewumi, M. A., Ofuya, T. I., & Folorunso, D. O. (2007). Effect of some aqueous medicinal plant extracts on *Podagrica* (Coleoptera: Chrysomelidae) infestation and yield of okra in a rain forest of Nigeria. In G. E. Onibi, S. O. Agele, V. A. J. Adekunle, & M. O. Olufayo (Eds.), Paper presented at *The 3rd Annual Conference of School of Agriculture and Agricultural Technology* (pp 48-51). Akure, Nigeria: Federal University of Technology.
- Adilakshmi, A., Korat, D. M., & Vaishnav, P. R. (2008). Bio-Efficacy of some botanical insecticides against pests of okra. *Karnataka Journal of Agricultural Science*, 21(2), 290–292. Retrieved from <http://14.139.155.167/test5/index.php/kjas/article/viewFile/1290/1282>
- Ahmed, B. I., Chaudhary, J. P., & Yusuf, S. R. (1998). Comparative efficacy of some insecticides for the control of *Podagrica* spp. (Coleoptera: Chrysomelidae) on okra (*Abelmoschus esculentus* (L.) Moench). In N. E. S. Lale, N. B. Molta, P. O. Donli, M. C. Dike, & M. Aminu-Kano (Eds.), *Entomology in the Nigerian Economy: Research focus in the 21st Century* (163-169). Maiduguri: Entomological Society of Nigeria.
- Alao, F. O., Adebayo, T. A., Olaniran, O. A., & Akanbi, W. B. (2011). Preliminary evaluation of the insecticidal potential of organic compost extracts against insect pests of Okra (*Abelmoschus esculentus* (L.) Moench). *Asian Journal of Plant Science and Research*, 1(3), 123–130. Retrieved from <http://pelagiaresearchlibrary.com/asian-journal-of-plant-science/vol1-iss3/AJPSR-2011-1-3-123-130.pdf>
- Anaso, C. E., & Lale, N. E. S. (2001). Evaluation of aqueous neem kernel extract for the control of major insect pests of okra (*Abelmoschus Esculentus* (L.) Moench) in Nigerian Sudan savanna. *Journal of Arid Agriculture*, 11, 63-72.
- Cook, J. A., Vanderjagt, D. J., Pastuszyn, A., Mounkaila, G., Glew, R. S., Millson, M. & Glew, R. H. (2000). Nutrient and chemical composition of 13 wild plant foods of niger. *Journal of Food Composition and Analysis*, 13(1), 83-92. <http://doi.org/10.1006/jfca.1999.0843>

- Glew, R. H., Vanderjagt, D. J., Lockett, C., Grivetti, L. E., Smith, G. C., Pastuszyn, A. & Millson, M. (1997). Amino acid, fatty acid, and mineral composition of 24 indigenous plants of Burkina Faso. *Journal of Food Composition and Analysis*, 10(3), 205-217. <http://doi.org/10.1006/jfca.1997.0539>
- Gomez, K. A. & Gomez, A. A. (1984). *Statistical procedures for agricultural research* (2nd ed.). New York: A Wiley Interscience Publications.
- Gopalan, C., Sastri, B. V. R., Balasubramanian, S. C., Rao, B. S. N., Deosthale, Y. G., & Pant, K. C. (2007). *Nutritive value of Indian foods*. Hyderabad: National Institute of Nutrition, Indian Council of Medical Research. Retrieved from http://www.eeb.cornell.edu/biogeo/nanc/Food_Feed/table_1_gopalan_et_al_1989.pdf
- Huang, Z., Wang, B., Eaves, D. H., Shikany, J. M., & Pace, R. D. (2007). Phenolic compound profile of selected vegetables frequently consumed by African Americans in the southeast United States. *Food Chemistry*, 103(4), 1395–1402. <http://doi.org/10.1016/j.foodchem.2006.10.077>
- Iqbal, J., Ali, H., Hassan, M. W., & Jamil, M. (2015). Evaluation of indigenous plant extracts against sucking insect pests of okra crop. *Pakistan Entomologist*, 37(1), 39–44. Retrieved from <http://www.pakentomol.com/Downloads/Issues/2015-1/08.pdf>
- Lee, S. G., Park, J. D. & Ahn, Y. J. (2000). Effectiveness of neem extracts and carvacrol against *Thecodiplosis japonensis* and *Matsucoccus thunbergianae* under field conditions. *Pest Management Science*, 56(8), 706-710. Retrieved from [http://onlinelibrary.wiley.com/doi/10.1002/1526-4998\(200008\)56:8%3C706::AID-PS176%3E3.0.CO;2-K/abstract](http://onlinelibrary.wiley.com/doi/10.1002/1526-4998(200008)56:8%3C706::AID-PS176%3E3.0.CO;2-K/abstract)
- McCaffery, A. R. (1998). Resistance to insecticides in Heliiothine Lepidoptera: A global view. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 353(1376), 1735-1750. <http://doi.org/10.1098/rstb.1998.0326>
- Mohan, M., Haider, S. Z., Andola, H. C. & Purohit, V. K. (2011). Essential oils as green pesticides: For sustainable agriculture. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, 2(4), 100-106. Retrieved from [http://www.rjpbcs.com/pdf/2011_2\(4\)/\[12\].pdf](http://www.rjpbcs.com/pdf/2011_2(4)/[12].pdf)
- Ojo, J. A., Olunloyo, A. A., & Ibitoye, O. (2014). Evaluation of botanical insecticides against flea beetles *Podagrica sjostedti* and *Podagrica uniforma* of okra. *International Journal of Advanced Research*, 2(4), 236–244. Retrieved from http://www.journalijar.com/uploads/457_IJAR-2447.pdf
- Oladimeji, A. & Kannike, M. A. (2010). Comparative studies on the efficacy of neem, basil leaf extracts and synthetic insecticide, lambda-cyhalothrin, against *Podagrica* spp. on okra. *African Journal of Microbiology Research*, 4(1), 033-037. Retrieved from <http://www.academicjournals.org/journal/AJMR/article-full-text-pdf/013356311381>
- Rahman, M. M., Uddin, M. M., & Shahjahan, M. (2013). Management of okra shoot and fruit borer, *Earias vittella* (fabricius) using chemical and botanical insecticides for different okra varieties. *International Research Journal of Applied Life Sciences*, 2(1), 1–9. <http://doi.org/10.6084/m9.figshare.156344.v1>
- Shah, J. A., Inayatullah, M., Sohail, K., Shah, S. F., Shah, S., Iqbal, T., & Usman, M. (2013). Efficacy of botanical extracts and a chemical pesticide against tomato fruit worm, *Helicoverpa armigera*. *Sarhad Journal of Agriculture*, 29(1), 1–4. Retrieved from [http://www.aup.edu.pk/sj_pdf/014_article_179-2012_\(EFFICACY_OF_BOTANICAL_EXTRACTS\).pdf](http://www.aup.edu.pk/sj_pdf/014_article_179-2012_(EFFICACY_OF_BOTANICAL_EXTRACTS).pdf)
- Sohail, K., Jan, S., Usman, A., Shah, S. F., Usman, M., Shah, M., ... Mehmood, A. (2015). Evaluation of some botanical and chemical insecticides against the insect pests of okra. *Journal of Entomology and Zoology Studies*, 3(2), 20–24. Retrieved from www.entomoljournal.com/vol3Issue2/pdf/3-2-31.1.pdf
- Varmudy, V. (2011). Need to boost okra exports, (February), 21-23. Retrieved from <http://www.efymag.com/admin/issuepdf/Okra-Feb11.pdf>