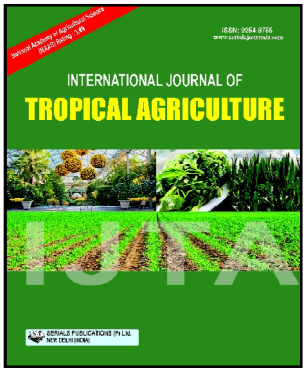

INTERNATIONAL JOURNAL OF TROPICAL AGRICULTURE

ISSN : 0254-8755

available at http: www.serialsjournals.com

Volume 36 • Number 2 • 2018

LC_{50} and Relative toxicity of insecticides against cowpea aphid, *Aphis craccivora* (Koch)

S. S. Ahmed[1], A. Devee [2]and S. Kalita[3]

Assam Agricultural University, Jorhat 785 013

Abstract: The LC_{50} and relative toxicity of insecticides *viz* malathion 94 SC(Technical grade),spiromesifen 240 SC (Oberon) and dimethoate 40EC(Agro) were evaluated against cowpea aphid (*Aphis craccivora*).LC_{50} values of different insecticidal treatment against adult *A. craccivora*, the lowest was 0.00046 % (malathion 94 SC) at 48 hours of treatment followed by 0.00106 % at 24 hours of treatment.Similarly, in case of spiromesifen 240 SC at 48 hours of treatment the lowest LC_{50} was found at 0.063% followed by 0.073 % at 24 hours of treatment. When dimethoate was considered as unity the order of toxicity malathion>dimethoate>spiromesifen.

Key words: *Aphis craccivora*, dimethoate, malathion and spiromesifen.

Pulses are an integral part of many diets across the globe and they have great potential to improve human health, conserve soils, protect the environment and contribute to global food security. India is the largest producer (25% of global production), consumer (27% of world consumption) and importer (14%) of pulses in the world. Though pulses are grown in both kharif and rabi seasons, rabi pulses contribute more than 60 per cent of the total production.The area under pulses has been increased from 19 million ha in 1950-51 to 25 million ha in 2013-14, indicating an increase of 31 per cent whereas the production of pulses during the same period has been increased from 8.41 million tons to 19.27 million tons Anonymous[1].

Among them, Cowpea [*Vigna ungiculata*(L.) Walp.] is a nutritionally important legume crop commercially cultivated in India. It is also used as pulse crop, fodder, vegetable as well as green manure crop. It was probably originated in Africa and widely grown in the drier regions of the tropics covering parts of Asia, Oceania, the Middle East, Southern

Europe, Africa, Southern USA and Central and South America, Singh, *et al.*[2]".It is also known as "vegetable meat" due to high protein content in the grain which contains 26.61 per cent protein, 56.24 per cent carbohydrates and 3.99 per cent lipids, Owolabi *et al.* [3]".

The cowpea crop thrives best under warm condition and well-drained loam or slightly heavy soil. Being a warm weather crop it can withstand considerable degree of drought and has a promise as an alternate pulse crop in dry land farming. Optimum temperature required for germination is 12-15 degree centigrade and for rest period 27-35 degree centigrade. As, pulses are mostly cultivated under rainfed conditions and do not require intensive irrigation facility ,they are mostly grown in areas left after satisfying the demand for cereals/cash crops. It also has the useful ability to fix atmospheric nitrogen through its root nodules.

As a short duration and high yielding crop, which is nutritionally superior and capable of producing high amount of food per unit area and time, cowpea has a great potential in modern agriculture for successful cultivation in *kharif* and summer in northern India and throughout the year in peninsular India. It provides much needed dietary fibres, essential minerals and vitamins .Being a major pulse crop in India, cowpea is cultivated in about 25.26 lakh hectare area with an annual production of 16.47 million tonnes during the year 2015-16, Anonymous[4].

The major constraint for low yield of pulse crops is the damage caused by various biotic and abiotic factors which include the use of unimproved varieties, poor soil conditions, inadequate management practices, poor cultural practices and heavy biotic stresses, particularly from insects, diseases and parasitic weeds which often attack in the field and weevils that destroy seeds in storage. In India, cowpea is attacked by near about 21 insect pests right from the seedling to pod bearing stage out of which, a handful are of major importance *viz.,*. aphid, *Aphis craccivora* Koch; jassid, *Empoasca fabae* (Harris)*;* thrips, *Megaleuro thrips distalis* Karny; army worm, *Mythimna separata* (Walker); semilooper *Thysanoplusia orichalcea* (Fab.); Leafminer, *Phytomyza horticola* (Meigen) and pod borer, *Helicoverpa armigera* (Hubner) which causes great loss to growers. Out of different insect pests, cowpea aphid (*A.craccivora*) has been recognised as one of the important, major and economic pest of cowpea, El-Ghareeb *et al.* [5]" which is solely responsible to cause 20-40 percent yield loss, Reddy, *et al.* [6]" and possess major threat to cowpea growers throughout the country. They cause direct damage by sucking sap cell sap from leaves, petioles, tender stems, inflorescence and pods which results in stunting, crinkling and curling of leaves, delayed flowering, shriveling of pods and ultimately reduction in yield and indirect damage by transmission of aphid borne mosaic virus, phytotoxicity as a result of saliva toxins, Atiri *et al.*[7]". They also secrete honey dew which retards photosynthesis and thereby leading to the development of black sooty mold and leaf shedding, Kotadia and Bhalani [8]" which also attract saprophytic fungi covering the leaf surface and accelerating the ageing of leaves, Schepers [9]". *A. craccivora* is also known to transmit a virus known as "Rosette".

It is very important to manage the population of aphid in cowpea. In the recent year, several newer insecticides viz. malathion 94 SC, spiromesifen 240 SC and dimethoate 40EC have been developed which are effective against sucking pests like aphid, whiteflies, thrips and plant hoppers. Information regarding the toxic effect of these insecticides against *A. craccivora* Koch is scanty particularly in Assam. Keeping in view, the present study has been undertaken to investigate the efficacy of these insecticides against cowpea aphid, *A.craccivora* Koch which will help to optimize crop yield and quality of cowpea and also will be helpful to the farmers for managing the population of aphids efficiently in cowpea.

MATERIALS AND METHODS

A.craccivora were collected from the experimental plots on cowpea located at ICAR Farm, Assam Agricultural University, Jorhat and maintain the laboratory culture on potted cowpea plants under insectary at 26 ± 2 ^{0}C and 70±5% RH and natural light period. The seedlings were grown following standard agronomic practices and no any chemical were applied. For the experiment 4th instar aphids were collected from the laboratory culture and malathion 94SC (Technical grade), spiromesifen 240 SC(Oberon) and dimethoate 40EC(Agro) were evaluated at Department of Entomology, Assam Agricultural University, Jorhat-13, by dry film bioassay technique of Gupta and Rawlins (1966). Required concentrations were prepared by using acetone as solvent.A control with application of acetone alone was kept as control for comparison. Twenty 4th instar aphids were placed in each insecticide treated test tubes and replicated three times. The number of aphids as well as coccinellid beetle responding to different treatments were recorded at different time interval *viz.*24 and 48 hours after treatment (HAT). Mortality data were expressed into percentage after Abbot's correction (Abbot,1925) and further subjected to Probit Analysis to find out the LC_{50} values (SPSS Compute Programme, ver. 14.0).

Table 1

LC_{50} value of different insecticides against 4th instar *A.craccivora* at 24 hour

Insecticides	*Regression equation*	*Heterogeneity**	*LC50 (%)*	*Fiducial limit*	*Relative toxicity*	*Order of toxicity*
Malathion 94 SC	Y= 3.22+1.10X	177.37	0.00106	0.00020 0.00324	54.71	I
Spiromesifen 240 SC	Y=1.853+1.63X	29.88	.073	0.063 0.083	0.79	III
Dimethoate 40 SC	Y= 0.421+0.460X	21.65	.058	0.043 0.198	1.00	II

In none of these cases the data were found to be significantly heterogeneous at P = 0.05

Y = Probit kill, X = log dose

Mortality based on 3 replications each with 20 individuals

Table 2

LC_{50} value of different insecticides against 4th instar *A.craccivora* at 48 hour.

Insecticides	*Regression equation*	*Heterogeneity**	*LC50 (%)*	*Fiducial limit*	*Relative toxicity*	*Order of toxicity*
Malation 94 SC	Y= 3.92+1.23X	101.78	0.0046	0.00080 0.00128	9.13	I
Spiromesifen 240 SC	Y=1.97+1.63X	53.17	0.063	0.050 0.075	0.66	III
Dimethoate 40 SC	Y= 0.73+0.52X	14.35	0.042	0.022 0.065	1.00	II

In none of these cases the data were found to be significantly heterogeneous at P = 0.05

Y = Probit kill, X = log dose

Mortality based on 3 replications each with 20 individuals

RESULTS AND DISCUSSION

Devee [10]" reported that the LC50 values of imidacloprid, bifenthrin, lambda-cyhalothrin, dimethoate and deltamethnrin against *Coccinella septempunctata* were found to be 1.44, 0.47, 1.20, 0.77 and 0.74% after 24 h, respectively. The order of toxicity on the basis of LC50 values was bifenthrin > deltamethrin > dimethoate > lambda-cyhalothrin >imidacloprid. Taking deltamethrin as unity, the order of relative toxicity were bifenthrin (1.57) > dimethoate (0.97) > lambda-cyhalothrin (0.61) >imdacloprid (0.51) after 24 hour. The order of toxicity with respect to LC50 value was as imidacloprid > bifenthrin > deltamethrin when these chemicals were evaluated against *Lipaphis erysimi,* Devee and Baruah, [11]". The comparison with toxicity of deltamethrin indicated that imidacloprid and bifenthrin were 11.71, 8.93 and 1.31, 1.10 times more toxic than deltamethrin 24 and 48 hr after treatment. Imidacloprid was the most effective insecticide against nymph and adult stages of red cotton bug at very low concentration; the LC50 of imidacloprid against red cotton bug was 0.000031, Gupta and Lal, [12]" The order of toxicity observed in the present study was in conformity with that of Singh and Singh, [13]" who reported the order as lambdacyhalothrin> cypermethrin > bifenthrin >decamethrin>fenvalerate> fluvalinate > malathion >endosulfan, against grey weevil (*Myllocerous undecimpustulatus maculosus*),where bifenthrin was 1.15 times more toxic to deltamethrin. Similar comparison of toxicity between bifenthrin and deltamethrin were also reported against 3rd instar larvae of *Spodoptera litura,*Kodandaram and Dhingra, [14]".

The LC_{50} value of Malathion 94 SC were evaluated against 4 th instar *A.craccivora* at 24 and 48 hours of treatment. It was observed that the lowest LC_{50} value was found in case of Malathion 94 SC followed by Dimethoate 40 SC and Spiromesifen 240 SC after 24 hours of treatment. Similarly, after 48 hours of treatment the lowest LC_{50} value was found in Malathion 94 SC followed by Dimethoate 40 SC and Spiromesifen 240 SC. When dimethoate was taken as unity the relative toxicity is found in case of Malathion 94 SC (54.71) and Spiromesifen 240 SC (0.79) after 24 hours of treatment and 9.13 in case of Malathion 94 SC and 0.66 in spiromesifen at 48 hours of treatment.The order of toxicity were found to be Malathion< Dimethoate < Spiromesifen

In present investigation, it can be concluded that spiromesifen was the less toxic one in comparison to malathion, this might be due to the more acaricidal action of spiromesifen.

ACKNOWLEDGEMENT

With immense pleasure, the author takes the privilege to acknowledge her deepest sense of gratitude and indebtedness to Dr. A.A.L.H.Baruah, retired Professor Department of Entomology, Faculty of Agriculture, Assam Agricultural University, Jorhat for sustained help by providing the chemicals.

REFERENCES

Anonymous (2015). Indian pulses sector. NABARD rural pulse, Department of economic analysis and research, Mumbai, India.

Anonymous (2016). Agriculture Statistics (2016).Crop wise advanceestimates of area, production and yield of various crop during 2015-16. Department of Agriculture, Government of Rajasthan, 2016.

Atiri,G.I.; Enobakhare, D.A. and Thottapilly, G.(1986). The importance of colonizing and non-colonizing aphid vectors in the spread of cowpea aphid-borne mosaic virus in cowpea. *Crop Protection* **5**:406-410.

Devee, A. and Baruah,A.A.L.H. (2012). Bio-efficacy of imidacloprid and bifenthrin against mustard aphid (*Lipaphis erysimi*) on *Brassica rapa* subsp *oleifera*. *Indian Journal of Agricultural Sciences* **82** (10): 845–51.

Devee, A.; Tungkhang, S.; Baruah, A. A. L. H. and Bhattacharyya, B. (2011). Efficacy of certain insecticides against Lipaphis erysimi (Kalt.) and their relative toxicity against predatory coccinellid Beetle. *Pesticide Research Journal* Vol. **23**(2): 140-145.

El-Ghareeb, M., Nasser, M.A.K., El-Sayed, A.M.K. and Mohamed, G.A. (2002). Possible mechanisms of insecticide resistance in cowpea aphid, *Aphis craccivora* Koch - The role of general esterase and oxidase enzymes in insecticide resistance of cowpea. *First Conference Central Agriculural Pesticide Laboratory* **2:** 635-649.

Kodandaram M H and Dhingra S. (2003). Comparative toxicity of ester and non-ester pyrethroids against *Spodoptera litura* (Fab.). *Pesticide Research Journal* **15** (1): 23.

Kotadia,V.S. and Bhalani, P.A. (1992). Residual toxicity of some insecticides against *Aphis craccivora* Koch on cowpea crop.*GAU. Res. J*. **17**(2) : 161-164.

Lal O P. (1996). Integrated pest management for sustainable crop production. (*In*) *Agrochemicals and Sustainable Agriculture,* pp1. 29–44. Roy N K (Ed.). APC Publication Pvt Ltd, New Delhi.

Owolabi, A.O.; Ndidi, U.S.; James, B.D. and Amune, F.A. (2012). Proximate, antinutrient and mineral composition of five varieties of cowpea, *Vigna unguiculata*, commonly consumed in Samaru community, Zaria-Nigeria. *Asian J. Food Sci. Technol.* **4**(2):70-72.

Reddy, D.S., M.P. Latha, L.R. Chowdary and L.R. Kumar (2014). Efficacy of chemical and botanical against cowpea aphid (*Aphis craccivora* (Koch)]. Bioinfolet. **11**: 853-854.

Schepers, A. (1988). Aphids- their biology, natural enemies and control. World crop pests, 2C. Amsterdam: Elsevier, pp 89-121.

Singh, B.B., Ehlers, J.D., Sharma, B. and Freire Filho, F.R., (2002). Recent progress in cowpea breeding. Challenges and Opportunities for Sustainable Cowpea Production. Proceedings of the World Conference III.4-8th September 2000. C.A. Fatokun, S.A., Tarawali, B.B., Singh, P.M., Kormawa and M.Tamo. Eds. International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. pp. 22-40.

Singh D S and Singh J P. (1997). Relative toxicity of pyrethroid and non pyrethroid insecticides to the adults of grey weevil, *Myllocerus undecimpustulatus maculosus*. *Indian Journal of Entomology* **59** (4): 354–8.