Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2015; 3(4): 303-306

Received: 05-06-2015
Accepted: 07-07-2015

Imtiaz Ali Khan
Department of Entomology, The University of Agriculture, Peshawar, Pakistan.

Komal Habib
Department of Entomology, The University of Agriculture, Peshawar, Pakistan.

Rasheed Akbar
Department of Entomology, The University of Agriculture, Peshawar, Pakistan.

Ashraf Khan
Department of Entomology, The University of Agriculture, Peshawar, Pakistan.

Muhammad Saeed
Department of Agricultural Sciences, University of Haripur, Haripur, Pakistan.

Abid Farid
Department of Agricultural Sciences, University of Haripur, Haripur, Pakistan.

Ijaz Ali
Institute of Biotechnology and Genetic Engineering, The University of Agriculture, Peshawar, Pakistan.

Mukhtar Alam
Faculty of Agriculture, University of Swabi, Pakistan.

Correspondence:
Imtiaz Ali Khan
Department of Entomology, The University of Agriculture, Peshawar, Pakistan.

Proximate chemical composition of brinjal, *Solanum melongena* L. (Solanales: Solanaceae), genotypes and its Correlation with the insect pests in Peshawar

Imtiaz Ali Khan, Komal Habib, Rasheed Akbar, Ashraf Khan, Muhammad Saeed, Abid Farid, Ijaz Ali, Mukhtar Alam

Abstract
Aphis gossypii Glover (Homoptera, Aphididae), *Amrasca biguttula biguttula* (Ishida) (Hemiptera, Cicadellidae) and *Leucinodes orbonalis* Guenee (Lepidoptera, Pyralidae) are serious pests of *S. melongena* in Pakistan. Using host plant resistance can be safe and cheap alternative to insecticidal control of insect pests of *S. melongena*. The experiment was conducted at the New Developmental Farm (NDF), The University of Agriculture, Peshawar (UAP) in 2014. Three Brinjal genotypes Shamli, Pearl Long and Black Beauty were used in the study. The results of proximate chemical composition of leaves and fruits revealed that moisture content was higher (93%) in Black Beauty, ash (6.4%) in Pearl Long, crude protein (1.51%), crude fat (0.31%), total sugars (4.22%) and fiber (1.33%) in Shamli. Moisture and protein were significant and positively correlated with the population of *A. gossypii*, *A. biguttula biguttula* and *L. orbonalis* except in Black Beauty. The ash and fat were significantly negatively correlated with the pests density whereas fiber and total sugar showed non-significant effect. These results of proximate chemical composition will provide baseline for using host plant resistance in insect pests control of brinjal in Peshawar.

Keywords: Insect pests, Correlation, Host plant resistance, Proximate chemical composition, *S. melongena.*

1. Introduction

Solanum melongena, also called egg plant or aubergine (French name), is extensively grown in almost all parts of the world [1]. In Pakistan, it occupies 9,044 ha area and its production is 88,1,48 tons. Yield of brinjal in Pakistan has been reported to be 97,466 kg/ ha [2].

Some of the important insect pests of brinjal in Pakistan are brinjal fruit borer, *Leucinodes orbonalis* Guenee (Lepidoptera, Pyralidae), brinjal stem borer, *Euzophera perticella* Ragonot (Lepidoptera, Pyralidae), leaf roller, *Eublemma olivacea* (Walker) (Lepidoptera, Noctuidae), beetle, *Epilachna vigintioctopunctata* Fabr. (Coleoptera, Coccinellidae), aphid, *Aphis gossypii* (Homoptera, Aphididae), Whitefly, *Bemisia tabici* (Genn.) (Hemiptera, Alerodydidae), thrips, *Thrips palmi* Karny (Thysanoptera, Thripidae) [3] and cotton jassid (CJ), *Amrasca biguttula biguttula* (Ishida) (Hemiptera, Cicadellidae) [4, 5].

Adults and nymphs of *A. biguttula biguttula* feed on the underside of the leaves by sucking plant sap, which results in yellowing and curling of leaves. They also inject toxic material into the leaves, which causes necrosis. The blades of severely infested leaves show burn symptom and such leaves may ultimately drop down [6]. Damage caused by the jassid to brinjal could be up to 54 percent [7].

Host plant resistance is a preventive control measure, which is compatible with integrated pest management (IPM) strategy. Growing resistant varieties, such as ISD006, BL114 and BL095 has been recommended as a control method for the jassid on brinjal by [8]. Screening of brinjal varieties have been done by a number of researchers. Brinjal varieties KB9, Pusa Purple Long, KP10 and BB1 were tolerant to CJ [9]. In another study, a large number of varieties were reported to be resistant against the jassids [10]. In a study on resistance of brinjal to jassid 19 brinjal accessions were tested, where all exhibited high level of resistance to it [11]. Varieties A 300 (Mistasa), Abar, Parat, EG 2003, Mara and Acc 612 were found resistant to jassid in a four year resistance study in Philippines [12].

Leocinodes orbonalis has remained a major pest of brinjal since two decades. Fruit infestation

by this pest ranges from 20.70 to 88.70% in various parts of India [13]. Twenty varieties of brinjal were tested for resistance to *L. orbonalis*, but none was found resistant to it [14]. The lower fruit infestation may be found due to the presence of smaller fruit diameter and weight and more seed presence in the fruit. The presence of thin stem, more branches, lower third leaf length and width, more spines, rough leaf surface area, heavily lignified thick cuticle, broad and thick hypodermis, closely packed vascular bundle and small pith area may be responsible for lower infestation and vice versa in case of higher infestation [15].

Keeping in view the importance of brinjal crop and the losses caused by various insect pests to it, the present research project aimed to determine proximate chemical composition of brinjal genotypes and its correlation with the insect pests in Peshawar.

2. Materials and Methods

2.1 Field layout

Seedlings of three brinjal genotypes, namely Shamli hybrid, Pearl Long (long brinjal) and Black Beauty (round brinjal) were purchased from the local market of Gurh Mandi in Peshawar and transplanted in March, 2014 in the NDF, UAP. The experiment continued till the end of September, 2014. The experiment was laid out in Randomized Complete Block Design. Plant to plant and row to row distance was kept at 30 cm and 65 cm, respectively. There were five rows of ten plants each per treatment and each treatment replicated three times. The size of each treatment was 26 m^2. The crop was given standard agronomic practices throughout the growing season. Fertilization was done through broadcast method after three weeks of transplantation. Weeds were removed when necessary.

2.2 Insect Sampling

Aphids and jassids (adults + nymphs) sampling was started two weeks after transplanting. Data was recorded weekly and from 07 to 11 am. Three randomly selected leaves, from top, middle and bottom of each of ten randomly selected plants per treatment were selected every time for data recording. The leaves were separately placed into 500 ml plastic bottles containing 70% ethyl alcohol. The samples were transported to the laboratory where the leaves were washed to dislodge the insect pests and its associated natural enemies. Provisional identification of the insect pests was done from high resolution photos of living specimens. Identifications were confirmed by a Stereo microscope at 40 magnifications of the preserved specimens with the help of available literature [16, 17, 18].

Assessment of fruit damage by *L. orbonalis* was recorded after fruits were collected from all the treatments. The fruits of each treatment were put in tagged ethylene bags and transported to the Entomology Laboratory. The fruits were examined for insect damage. The number of holes per fruit was counted. Percent fruit infestation by number was determined. The number of fruits per treatment was counted and weighed through an electronic balance. The weight of fruit was converted to kg/ha.

Application of a synthetic insecticide Advantage 20% EC (Carbosulfuran) was done twice when the pest status reached to economic threshold level. Data on mortality of insects pests was recorded 24h before and then 24h, 48h, 72h and at weekly intervals after each spraying.

2.3 Proximate Chemical Analysis

Proximate chemical composition of brinjal leaves and fruits were conducted. Standard methods for determining % moisture, % ash, crude protein, crude fiber, total reducing sugars and crude fat per 100 grams of brinjal leaves and fruits were followed [19].

2.4 Statistical analysis

The data recorded for each parameter was analyzed statically by using Statistix 8.1 Software and means were separated by using Fisher Protected Least Significance Difference Test at 5% level of significance [20].

3. Results and Discussion

3.1 Proximate chemical composition of leaves and fruits of the brinjal genotypes

The results revealed that proximate chemical composition varied among the brinjal genotypes (Table 1). Moisture content was higher of 89.47% for Black Beauty and lower of 86.15% for Pearl Long. Ash content was higher in Pearl Long (11.84%) and lower in Shamli (9.36%). Crude protein was higher in Shamli (1.53%) and lower in Pearl Long (1.37%). Crude fat was higher in Shamli (0.42%) and lower in Pearl Long (0.29%). Total Sugars were higher in Shamli (1.53%) and lower in Black Beauty (1.38%). Fiber content was higher in Shamli (3.37%) and lower Pearl Long (2.84%).

The results of proximate chemical composition of fruits also varied among the three brinjal genotypes (Table 1). Moisture content was higher in Black Beauty (93%) and lower in Pearl Long (92.10%). Ash content was higher in Pearl Long (6.4%) and lower in Black Beauty (5.4%). Crude protein was higher in Shamli (1.51%) and lower in Black Beauty (1.30%). Crude fat was higher in Shamli (0.31%) and lower in Black Beauty (0.28%). Total sugars were higher in Shamli (4.22%) and lower in Black Beauty (3.96%). Fiber content was higher in Shamli (1.33%) and lower in Pearl Long and Black Beauty each with 1.31%.

Table 1: Proximate chemical composition of leaves and fruits of the three brinjal genotypes during 2014.

Content	Brinjal Genotype					
	Shamli		Pearl Long		Black Beauty	
	Leaf	Fruit	Leaf	Fruit	Leaf	Fruit
Moisture (%)	87.31	92.70	86.15	92.10	89.47	93.00
Ash (%)	9.36	6.30	11.84	6.40	10.02	5.40
Crude Protein (g/100gms)	1.53	1.51	1.37	1.42	1.42	1.30
Crude Fat (g/100gms)	0.42	0.31	0.29	0.29	0.34	0.28
Total sugars (g/100gms)	1.57	4.22	1.42	3.99	1.38	3.96
Fiber (g/100gms)	3.37	1.33	2.84	1.31	3.17	1.31

Eggplant possesses the highest nutritive value, providing energy of 24 Cal, which gets easily deteriorated by the attack of certain 12 pests. Proximate principles in 100 gm fruit were found as follows: moisture (96%), protein (1.4 g), fat (0.3 g) carbohydrates (4 g), and fiber (1.3 g) [18]. The essential minerals per 100 g of fruit contained calcium (18 mg), phosphorus (47 mg), iron (0.38 mg), magnesium (15 µg), sodium (3 mg), chromium (0.07 mg), sulphur (44 mg). Vitamin per 100 gm of fruit were carotene (74 mg), riboflavin (0.11 mg), thiamin (0.03 mg), niacin (0.9 mg), folic acid (5 mg), total folic acid (34 mg), vitamin C (1.2 mg) and Chlorine (52 mg). Essential amino acids (mg/g) in fruit were nitrogen (0.22), arginine (210), histamine (130), lysine (330), tryptophan (60), phenylanine (250), tyrosine (240), methionine (70), cysteine (30), threonine (230), lucien (270) and valine (320). Apart from huge domestic consumption in various forms, dry shoots of brinjal are source of fuel in rural areas. White brinjal is used in many ayurvedic medicines [21].

3.2 Correlation between insect pests density and biochemical factors of brinjal genotypes

The results regarding the correlation between biochemical factors and population of *A. gossypii, A. bigutulla bigutulla and L. orbonalis* are given in Table 2. The results revealed that the maximum moisture content and protein were significant and positively correlated with the population of *A. gossypii, A. bigutulla bigutulla and L. orbonalis* except in Black Beauty. The ash content and fat were significant negatively correlated with their density whereas fiber content and total sugar showed non-significant effect.

Table 2: Correlation matrix of insect pests density and biochemical factors of three brinjal genotypes during 2014.

		Moisture	Ash	Crude Protein	Crude Fat	Crude Fibre	Total Sugars
Variety	**Insect Pest**	**Leaf/Fruit**	**Leaf/Fruit**	**Leaf/ Fruit**	**Leaf/Fruit**	**Leaf/Fruit**	**Leaf/Fruit**
Shamli	Aphids	1.01*, 0.34	0.88,-0.32	0.58,0.67	-0.51,0.64	0.54,0.52	0.53,0.41
	Jassids	0.30*,-0.80	-0.23,-0.97*	0.30,0.71	-0.95,-0.66	-0.67,-0.66	0.99,-0.75
	Fruit borer	0.30,0.52	0.72,-0.52	0.99*,-0.25	-0.68,0.29	0.28,0.29	0.68,0.14
Pearl Long	Aphids	0.52,-0.48	-0.71,-0.22	1.02*,-0.52	0.32, 0.51	-0.51,0.78	0.52,0.52
	Jassids	0.89*,0.83	-0.72-0.99	0.78,-0.84	0.84,-0.83	0.88,-0.57	-0.84,0.88
	Fruit borer	1.01*,0.52	-0.51,0.86	0.59,0.98	0.97,0.99	-0.94,0.74	0.94,-0.70
Black	Aphids	0.51,0.66	0.98, 0.67	-0.64,0.51	-0.52,-0.51	0.52,-0.51	0.51,-0.97
Beauty	Jassids	0.74,-0.84	-0.42,-0.84	-0.84,0.92	0.73,0.92	0.73,0.92	0.92,0.32
Fruit borer		-0.47,0.97	0.91,0.61	-0.36,-0.44	0.52,-0.45	0.52,-0.44	0.42,-0.98

*= Significant at 5%

Chemical contents of the plant attract deter the insects in some way or the other. Ash content exerts influence on the infestation of the pest. Higher ash content reduces the pest attack. It plays a deterrent role for the pests. Host plant soluble nitrogen level can influence aphid's reproduction. A common response of aphids to stress may be due to accumulation of triacylglycerols (Fatty acids) and has been observed in other species of aphids including spotted alfalfa aphids, *Therioaphis maculate* [20]. Biochemical factors of crop were correlated and it was found that moisture contents, nitrogen, protein, lipids, reducing sugars, calcium, magnesium, and zinc were positively and significantly related with thrips population, whereas total minerals were negatively significantly related. All the chemicals were significantly enhanced in the resistant varieties [22].

Higher phenol contents increased resistance to fruit borer. Ash content of the fruits was found to be negatively correlated (r = -0.83) with fruit borer infestation [23, 24, 25, 26]. Similarly, flavonols (r = -0.83) and starch (r = -0.88) exerted a significant negative correlation with per cent fruit borer infestation indicating that these constituents might have influenced the biology and establishment of fruit borer by playing an important role in the antibiosis mechanism. In the present study, dietary fiber content was highest (3.63 g/100 g) in resistant check, Pusa Shyamala followed by IC280954 (3.53 g/100 g) and IC099723 (3.39 g/100 g) in contrast to the susceptible accession IC090093, which contained 1.77 g dietary fibre per 100 g. FFSB infestation had significant negative correlation with dietary fibre (r = -0.92).

This finding was consistent with the findings of some earlier researchers [23, 25] who found that fiber had significantly negative correlation with per cent fruit infestation by fruit borer. The total sugars content present in 23 accessions was significantly different with one another. The highest sugars content (1.76 g/100 g FW) was recorded in highly susceptible accession (72%), while lowest (0.75 g/100 g FW) was recorded in resistant accession IC280954 (7.89%). EFSB infestation had significant positive correlation with total soluble sugars (r = 0.65). Since sugar is considered one of the vital nutrients in plants, the difference in the relative amount of sugars between different genotypes with differential susceptibilities to fruit borer indicate that these compound might act as phago-stimulants to EFSB feeding on eggplant. The present result are in agreement with the findings of some earlier researchers [24, 28] who reported that total sugars were positively correlated with fruit infestation. Higher concentration of sugars in eggplant fruits may act as feeding stimulant in the susceptible varieties. On correlating the protein content in fruits with borer infestation, a significant positive correlation was observed (r = 0.48) [27, 29]. A strong positive correlation was observed between the moisture content and EFSB infestation (r = 0.97). Similar correlation was reported where increased palatability of the food material with more moisture content in case of susceptible varieties was observed [27].

Allelochemicals or secondary plant substances could possibly be responsible for ovipositional preference of the adults. Green fruit color and seediness were associated with resistance to *L. orbonalis*, while purple fruit color was associated with susceptibility to this insect. Expression of resistance to *L. orbonalis* was also associated with low amounts of sugars and high amounts of phenols. It is evident from the present study that the resistance is not conferred by any single character alone. The combination of biophysical and biochemical traits can be used as an effective and reliable selection criteria to select resistance plants. Nevertheless, it is suggested that the eggplant genotypes with green fruit color and seediness with low amount of sugars, and high amounts of phenols may be used in hybridization program to develop cultivars with resistance to *L. orbonalis*. The accessions identified as resistant can be utilized in the breeding programme for development of resistant cultivars.

4. Conclusion and Recommendation

All the three brinjal genotypes confer some kind of resistance to its insect pests. On the basis of the present results Shamli brinjal genotype is recommended to the farmers in Peshawar.

5. References

1. Shanmugavelu KG. Production Technology of Vegetable. Oxford & IBH Pub. Co. Pvt. Ltd. Calcutta, 1989, 15.
2. Srinivasan R. Insect and Mite Pests on Eggplant: A Field Guide for Identification and Management. AVRDC – The World Vegetable Center, Shanhua, Taiwan. AVRDC Publication 2009; 09-729:64.
3. FAO FAOSTAT. Eggplant statistics, 2010. Statistical Division, Food and Agriculture Organization of the United Nations, 2012.
4. Nagia DK, Malik F, Kumar S, Saleem MD, Sani ML, Kumar A. Studies on control of cotton jassid and leaf

blight on brinjal crop. Plant Protection Bulletin Faridabad 1993; 45:16-18.
5. Mahmood T, Hussain SI, Khokhar KM, Hidayatullah, Jeelani G. Varietal resistance in eggplant to cotton jassid (*Amrasca bigutulla bigutulla*). Asian Journal of Plant Science. 2002; 1:107-108.
6. Rahman MM, Rahman MM. Study on the development of resistance in brinjal shoot and fruit borer against different insecticides. World Journal of Zoology. 2009; 4(2):137-143.
7. Rawat RR, Sahu HR. Estimation of losses in growth and yield of okra due to *Empoasca devastans* Dist and *Earias* spp. Indian Journal of Entomology. 1973; 35:252-254.
8. Alam SN, Rashid MA, Rouf FMA, Jhala RC, Patel JR, Satpathy S *et al.* Development of an Integrated Pest Management Strategy for Eggplant Shoot and fruit borer in South Asia. Technical Bulletin. AVRDC, the World Vegetable Centre 2003; 28:56.
9. Gaiwad BP, Darekar KS, Chavan VP. Varietal reaction of eggplant against jassid. Journal of Maharashtra Agriculture University. 1991; 16:354-356.
10. Elanchezhyan K, Basharan AKM, Rajavel DS. Field screening of brinjal varieties on major pests and their natural enemies. Journal of Biopesticides. 2008; 1:113-120.
11. Suiza RC. Host-plant resistance in eggplant germplasm to cotton leafhopper, *Amrasca biguttula biguttula* (Ishida). Thesis, Philippines Univ. Laos Banos, College Laguna, 1997, 138.
12. Lit MC. Combined resistance of eggplant, *Solanum melongena* L., to leafhopper, *Amrasca bigutulla bigutella* (Ishida) and eggplant borer, *Leucinodes orbonalis* Guenee. Terminal Report, Inst. Plant Breeding, Philippines Univ. Laos Banos, College Laguna, 2009, 191.
13. Haseeb M, Sharma DK, Qamar M. Estimation of the losses caused by shoot and fruit borer, *Leucinodes orbonalis* Guen. (Lepidoptera: Pyralidae) in eggplant. Trends Bioscience 2009; 2(1):68-69.
14. Ahmad H, Rahman MH, Haque MA, Ahmed KS. Screening of brinjal varieties/lines resistance to brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. Journal of Agroforestry and Environment. 2008; 2(2):131-133.
15. Hossain MM, Shahjahan M, Prodhan AKMS. Study of anatomical characters in relation to resistance against brinjal shoot and fruit borer. Pakistan Journal of Biological Sciences. 2002; 5(6):672-678.
16. Balckman RL, Eastop VF. Aphids on the world's herbaceous plant and shrubs. Vol. 1 and 2. J. Willey and Sons, Chichester, UK, 2006.
17. Mahal MS, Lal H, Singh R. Standardization of a technique for screening of okra germlasm for resistance against cotton jassid, *Amrasca biguttula* (Ishida). II. Ovipositional preference of adults. J Insect Sci. 1993; 6(2):223-225.
18. Dadmal SM, Nemade SB, Akhare MD. Field screening of brinjal cultivar for resistance to *Leucinodes orbonalis* Guen. Pest Management in Horticultural Ecosystems 2004; 10(2):145-150.
19. AOAC. Approved Methods of AOAC, American Association of Agricultural Chemists: St. Paul, Minnesota, 2004.
20. Steel RGD, Torrie JH. Principals and procedures of statistics: A biological approach. 2nd Ed. McGraw Hill Book Co. New York, 1980, 481.
21. Chen NC, Li HM. Asian Cultivation and breeding of eggplant. Vegetable Research and Development Center, 1990, 26.
22. Gopalan C, Sastri SBV, Balasubramanian S. Nutritive value of Indian foods, National Institute of Nutrition (NIN), ICMR, India, 2007.
23. Dixon AFG, McKay S. Aggregation in the sycamore aphid Drepanosiphum platanoides (Schr.) (Hemiptera: Aphididae) and its relevance to the regulation of population growth. Journal of Animal Ecology. 1970; 39:439-454.
24. Saleem MA, Mustafa K, Hussain R. Comparative efficacy of some insecticides against some sucking insect pests of CIM-443, Cotton Pakistan Entomologist 2001; 23(1/2):91-92.
25. Chandrashekhar CH, Malik VS, Singh R. Morphological and biochemical factors of resistance in eggplant against *Leucinodes orbonalis* (Lepidoptera: Pyralididae). Entomology Journal. 2009; 31:337-45.
26. Elanchezhyan K, Basharan AKM, Rajavel DS. Field screening of brinjal varieties on major pests and their natural enemies. Journal of Biopesticide. 2008; 1:113-120.
27. Warade SD, Shinde KG, Kadam JH. Association of characters in relation to shoot and fruit borer infestation in brinjal (*Solanum melongena* L.). Asian Journal of Horticulture. 2008; 3:304-6.
28. Elanchezhyan K, Baskaran RKM, Rajavel DS. Biochemical basis of resistance in brinjal genotypes to shoot and fruit borer, *Leucinodes orbonalis* Journal of Entomology Research. 2009; 33:101-4.
29. Jat KL, Pakeer BL. Biophysical and biochemical factors of resistance in brinjal against *Leucinodes orbonalis.* Indian Journal of Entomology. 2003; 65(2):252-258.