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Field Evaluation of Bio and Synthetic Pesticides Against Jassid (*Amrasca Devastans* Dist.) on Okra

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Abstract: Bio and synthetic pesticides were evaluated against jassid (*Amrasca devastans* Dist.) on okra during 2014 and 2015 at Murredke, Punjab.The treatments included neem oil, extracts of neem, tobacco, akk, tooh/tumma, datura, garlic, eucalyptus and ginger; while synthetic pesticides include Tracer 45SC, Runner 240 SC, Radiant 120 SC, Coragen 20 SC and Belt 480 SC. All the bio and synthetic pesticides were effective and showed highest efficacy 7 days after spray (DAS) as jassid population started increasing 14 DAS during both the years. During 2014, among bio and synthetic pesticides, tobacco extract and Runner produced maximum jassid mortality of 64.33and 87.30% after 1st spray, while 63.89 and 90.86% mortality 7 DAS, respectively. During 2015, neem extract among biopesticides and Runner 240 SC among synthetic pesticides resulted in highest insect mortality of 65.37 and 92.84% after 7 days of 1st spray, while 67.33 and 88.67% mortality after 7 days of 2nd spray, respectively.

Keywords: Jassid, Okra, Biopesticides, Synthetic Pesticides, Efficacy

1. INTRODUCTION

Like other field crops, okra (*Abelmoschus esculentus* Monech,) is also infested by numerous insect pests including sucking insect pests and bollworms (Vaughn, 2000). Insect pests are the biotic factors that cause devastation in relation to crop yield and production quality (Mahal *et al.*, 1994). The insects that are most damaging for okra crop include thrips, *Thrips tabaci* (Bhatti *et al*., 1996; Tipping *et al.*, 2002; Lee and Wilson, 2004), jassid, *Amrasca biguttula biguttula* (Ahmed *et al.*, 2009); whitefly, *Bemisia tabaci* (Ullah *et al*., 2010), aphid, *Aphis gossypii* (Shivanna *et al.*, 2011); termite, *Microtermes obesi* (Mahmood *et al.*, 2014), cutworm, *Agrotis ipsilon* (Ursani *et al.*, 2014). leaf-roller, *Sylepta derogate*; mite (Atwal *et al.*, 1990; Mani and Ramanathan, 2005), *Tetranychus macfarlanei* (Gosalwad and Kawathekar, 2009; and Khan *et al.* ,2011; Ramesh and Chandrasekharan, 2010) and bollworms (*Earias spp.*, *Pectinophora gossypiella Helicoverpa armigera*) (Metha and Saxena, 1998; Silva *et al.*, 1974; Bianchini and Corbetta, 1976; Adediran *et al*., 1976; Suman *et al*., 1984; Govindachari, 1992; Saini and Singh, 1999; Lohar, 2001; Tipping *et al*., 2002; Ahmed *et al.*, 2009; Dhaka and Pareek, 2007; Gafar *et al.*, 2012).

Although, there is a variety of methods used for insect pest management, but spraying synthetic pesticides with new chemistry is yet the most effective technique to combat crop insect pests. However, spray of synthetic pesticides is only suggested when the insect population is at ETL (Mohyuddin *et al*., 1997; Ullah *et al.*, 2010); as the chemical pesticides contribute to the environmental pollution; while toxic residues have also been detected in vegetable and fruit samples collected from the markets (Shivanna *et al.*, 2011). The biopesticides are based on environmental friendly botanical substances could partially substitute and minimize reliance on synthetic pesticides to control insect pests. The plant extracts have feeding and repellency, oviposition deterrence, growth disruption, reduced fitness and sterility (Schmutterer, 1990).

The continuous use of toxic chemicals as pesticides is also developing pesticides resistance in targeted insect pests (Ahmad *et al.*, 2010). Zobayer and Hasan (2013) tested efficacy of extracts based on neem, garlic, ginger, eucalyptus and papaya and found that neem, garlic and ginger based biopesticides were outstanding in suppressing the insect pest infestation. Mahmood *et al.*, (2014) reported reduced *B. tabaci* population upto 92.62% when the crop sprayed with tobacco extract, followed by Neem powder (91.50%), Heeng, Asafoetida (50.93%) and detergent 1.85 (53.16%) and *A. devastans* upto 99.57, 98.18, 59.89 and 59.64%, respectively. There were marked ($P<0.05$) differences in the efficacy of botanical pesticides and *Azadirachta indica*, *Nicotiana tabacum* and Asafoetida were found safe for toxic residues and cost effective compared to synthetic pesticides. Ursani *et al.* (2014) reported higher efficacies of Confidor, neem, tobacco, tooh, akk and Dhatura extracts were 97.95, 96.08, 95.63, 86.17, 81.19 and 70.94 percent, respectively. This study was mainly aimed at evaluating bio and synthetic pesticides against jassid (*Amrasca devastans* Dist.) on okra (*Abelmoschus esculentus* L.) under field conditions.

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2. MATERIALS AND METHODS

Okra is a crop cultivated almost in all parts of Pakistan and its sowing in upper Punjab starts from March. A private agriculture farm situated in Mureedke was selected for experimentation to evaluate the efficacy of different bio and synthetic pesticides against jassid on okra during two consecutive years (2014 and 2015). The experiment was laid out in a three replicated Randomized Complete Block Design in a sub-plot size of 3m x 3m ($9m^2$). In all 45 plots were prepared to develop 15 treatments with three replicates.

Sowing of okra: The prepared experimental soil was subjected to soaking dose; the plots were properly worked with recommended field implements to achieve a good seedbed. The plots were prepared and treatments were separated by strips and feeding channels; while the sowing of okra was done by keeping 60cm row spacing and 30cm plant spacing.

Treatments (Bio and synthetic pesticides): The treatments include: Neem extract (5.0%), Neem Oil (2.50 %),Tobacco extract (3.5%), Akk (3.5%), Tooh/Tumma (3.0%), Datura (3.5%), Garlic extract (3.5%), Eucalyptus (5.0%), Ginger extract (3.5%), Tracer 45% SC (100ml/acre), Runner 240 SC (240g/acre), Radiant 120 SC (120ml/acre), Coragen 20 SC (50ml/acre), Belt 480 SC (100ml/acre) and Control (untreated).

The experiment crop was weeded manually and recommended irrigation schedule was followed. On appearance of insect pests, the botanical and synthetic pesticides were applied in all the plots with the exception of control. The jassid population 24 hours before spraying pesticides was recorded; while the post treatment observations on jassid population were recorded after 24 hrs, 72hrs, one week and two weeks of spray.

The recommended doses of insecticides, using 100 liter of water was sprayed against jassid. The jasid population was observed on the basis of five leaves from each selected plant; two from bottom, two from middle and one from the top of the plant to count average per plant jassid population on treated plants and control to compare the efficacy of different insecticides against jassid. Overall two sprays were carried out.

Neem oil: The neem oil was obtained with the courtesy of Lower Sindh Rural Development Organization (LSRDA), Ratanabad, Mirpukhas and as per the label 400 ml neem oil is mixed in 80 liter water for spraying one acre. The cropped area in this experiment was $405m^2$ and the quantity of neem oil and water was managed accordingly.

Neem extract: The dried neem seeds were obtained and after grinding these the neem powder was prepared. One kilogram obtained neem powder was mixed in 20 liter boiling water along with 100g of detergent. Detergent or washing powder was mixed for absorption of neem powder properly by the plant leaves sprayed.

Garlic/ginger/tooh extract: For preparation of garlic/ginger/tooh extracts, 50 g portion of each was taken separately and grinded by grinding machine and kept in distilled water for 24 hours. After obtaining the extract, the liquid was boiled in 5 liters water and filtered through muslin cloth and sprayed at the rate given in treatments.

Tobacco extract: The leaves of tobacco were put in the water for overnight. In the next day morning, the water was filtered and sprayed on experimental okra crop.

Datura, Akk and Eucalyptus extracts: For preparation of Datura, Akk and Eucalyptus extracts, 5 kg each of Datura, Akk, Eucalyptus leaves were processed to achieve the extracts. After obtaining the leaves of these plant species, they were boiled separately in 5 liters water and filtered. After extract preparation, the experimental okra plots were sprayed with knapsack manual sprayer.

The experimental okra crop was sprayed with bio and synthetic pesticides in the morning time by knapsack sprayer. The sprayer was thoroughly washed when the solution of any one of the pesticide was completed to avoid residual effects. The jassid infestation was recorded as per the planned schedule.

The collected data were tabulated and statistically analysed for ANOVA to examine the significance of treatment effect and LSD test was employed to compare the treatment means.

3. RESULTS AND DISCUSSION

Year 2014

Regardless the nature of the pesticides, the trend of effectiveness was similar and bio or synthetic pesticides equally lost their efficacies before 14 days of spray and jassid population showed slight on increase when recorded after 14 days of spray as compared to the population recorded on 7 days of spray. Synthetic pesticides showed significantly better performance against jassid on okra as compared to biopesticides. Categorically, Runner killed more about 87 percent jassid; and Tracer, Radiant, Coragen and Belt showed similarity ($P>0.05$) for their efficacy against jassid population with 70% jassid mortality. However, neem oil, neem extract and tobacco extract killed more than 60% jassid population; while tooh/tumma, akk, ginger and garlic extracts showed similarity suppressing more than 55% jassid population after 7 days of spray. Although, synthetic pesticides were more effective in killing the insect pests of okra, but neem oil, neem extract and tobacco extracts also showed appreciable

jassid control and their application is suggestible because of non-toxic natural substances with appreciable positive effect on crop foliage and fruiting **(Table 1).** There was a superb performance of synthetic pesticides, particularly the Runner 240 SC showed outstanding efficacy and almost vanished the jassid infestation after 7 days of spray. However, apparent crop growth and fruit development was relatively better in plots sprayed with biopesticides which suggested that spray of plant extracts found beneficial in improving the crop growth and development of healthier fruits. Among biopesticides tobacco extract, neem oil and neem extracts showed superiority over rest of the botanical extracts; while Runner 240 SC showed superiority over rest of the synthetic pesticides **(Table 2).**

Table 1: 1st spray jassid mortality (%) by synthetic and biopesticides during 2014

Treatments	Insect mortality percentage (days after spray)			
	24-hrs	3-days	7-days	14-days
1. Neem extract (5.0%)	20.00^{B}	46.48^{B}	62.16^{C}	60.77^{C}
2. Neem Oil (2.50 %)	22.69^{A}	48.20^{B}	63.22^{C}	61.75^{C}
3. Tobacco extract (3.5%)	22.80^{A}	49.05^{B}	64.33^{C}	63.26^{C}
4. Akk extract (3.5%)	15.82^{C}	38.14^{C}	56.08^{D}	55.64^{D}
5. Tooh/tumma extract (3.0%)	15.41^{C}	37.40^{C}	56.18^{D}	55.74^{D}
6. Datura extract (3.5%)	5.00^{E}	25.90^{E}	41.46^{E}	37.36^{F}
7. Garlic extract (3.5%)	15.00^{C}	39.54^{C}	58.88^{C}	55.18^{D}
8. Eucalyptus extract (5.0%)	8.00^{D}	31.92^{D}	48.26^{D}	44.64^{D}
9. Ginger extract (3.5%)	18.34^{B}	39.57^{C}	58.91^{C}	55.21^{D}
10. Tracer 45% SC (100ml/acre)	22.00^{A}	48.52^{B}	75.29^{B}	73.07^{B}
11. Runner 240 SC (240g/acre)	19.00^{B}	54.64^{A}	87.30^{A}	85.90^{A}
12. Radiant 120 SC (120ml/acre)	22.00^{A}	47.74^{B}	74.92^{B}	72.66^{B}
13. Coragen 20 SC (50ml/acre)	20.00^{B}	44.80^{B}	72.40^{B}	71.85^{B}
14. Belt 480 SC (100ml/acre)	18.00^{B}	43.42^{B}	71.71^{B}	71.14^{B}
15. Control (untreated)	2.56^{F}	0.78^{F}	2.39^{E}	2.04^{G}
S.E.±	*1.1871*	*2.8459*	*4.5625*	*3.5801*
LSD 0.05	*2.4317*	*5.7327*	*8.1522*	*6.1883*
P-Value	*0.0039*	*0.0001*	*0.0001*	*0.0000*

Table 2: 2nd spray jassid mortality (%) by synthetic and biopesticides during 2014

Treatments	Insect mortality percentage (days after spray)			
	24-hrs	3-days	7-days	14-days
1. Neem extract (5.0%)	18.00^{D}	45.14^{D}	61.22^{C}	59.79^{D}
2. Neem Oil (2.50 %)	27.28^{B}	46.11^{D}	61.74^{C}	60.20^{D}
3. Tobacco extract (3.5%)	24.00^{C}	48.42^{D}	63.89^{C}	62.81^{D}
4. Akk extract (3.5%)	18.44^{D}	25.78^{G}	47.31^{E}	43.62^{G}
5. Tooh/tumma extract (3.0%)	17.20^{D}	38.73^{E}	57.11^{C}	56.68^{E}
6. Datura extract (3.5%)	6.50^{F}	16.40^{H}	33.96^{F}	29.33^{H}
7. Garlic extract (3.5%)	10.00^{E}	35.98^{E}	56.47^{D}	52.55^{F}
8. Eucalyptus extract (5.0%)	10.00^{E}	33.40^{F}	49.38^{D}	45.84^{G}
9. Ginger extract (3.5%)	17.00^{D}	39.80^{E}	59.06^{C}	55.38^{E}
10. Tracer 45% SC (100ml/acre)	30.00^{B}	59.45^{B}	80.54^{B}	78.78^{B}
11. Runner 240 SC (240g/acre)	32.00^{A}	67.35^{A}	90.86^{A}	89.85^{A}
12. Radiant 120 SC (120ml/acre)	36.00^{A}	62.13^{A}	81.82^{B}	80.18^{B}
13. Coragen 20 SC (50ml/acre)	32.00^{A}	51.29^{C}	75.64^{B}	75.16^{C}
14. Belt 480 SC (100ml/acre)	22.00^{C}	53.98^{C}	76.99^{B}	76.53^{C}
15. Control (untreated)	-0.20^{G}	0.38^{I}	-2.60^{G}	-5.53^{I}
S.E.±	*1.0286*	*1.6567*	*1.2959*	*1.0579*
LSD 0.05	*4.1552*	*5.3937*	*7.6545*	*4.1671*
P-Value	*0.0029*	*0.0000*	*0.0000*	*0.0000*

Year 2015

The data showed that Runner 240 SC sustained its superiority in jassid mortality (92.84%); followed by Tracer 45 SC (84.06%); while similar efficacy of 81.89 and 81.53% was recorded in plots sprayed with by Radiant 120 SC and Belt 480 SC, respectively after 7 days of spray. However, Coragen 20 SC remained least among synthetic pesticides in jassid mortality (75.54%) after 7 days of spray, but Coragen was the only pesticides that showed increase in efficacy upto 14 days of spray with 76.12% jassid mortality. On the basis of second year efficacy of biopesticides, it was confirmed that biopesticides are effective to keep the jassid population below the threshold level. However, the high jassid mortality by the synthetic pesticides is also associates numerous environmental risks and resistance development of insect pests to these lethal chemicals; while on the other hand biopesticides based on natural plant substances are riskless for the environment and support plant foliage to sustain growth under scorching sunshine and contributes to development of healthier fruits **(Table 3).**

In 2nd spray, the neem extract produced maximum insect mortality (67.33%) among the biopesticides; and almost equal jassid mortality was resulted by tobacco extract (66.50%); while similarity in insect mortality was observed in plots sprayed with neem oil (64.06%), garlic extract (63.28%) and ginger extract (62.77%). Runner 240 SC among the synthetic pesticides as usual

remained most effective in controlling jassid population with 88.67% mortality, followed by Tracer 45 SC (78.13%); Radiant 120 SC (77.80%), Coragen 20 SC (75.50%) and Belt 480 SC (74.80%) after 7 days of spray. The second year second spray data confirmed the jassid control potential of biopesticides and particularly the neem oil and extracts of neem, tobacco, garlic and ginger showed appreciable jassid control on okra. There were encouraging results from biopesticides application on killing of jassid in okra fields and particularly the neem and tobacco based biopesticides performed appreciably to control jassid. Moreover, the insect mortality in plots sprayed with garlic and ginger extracts was also well recognized **(Table 4).**

Table 3: 1st spray jassid mortality (%) by synthetic and biopesticides during 2015

Treatments	Insect mortality percentage (days after spray)			
	24-hrs	3-days	7-days	14-days
1. Neem extract (5.0%)	23.00^{C}	51.02^{C}	65.37^{E}	64.09^{D}
2. Neem Oil (2.50 %)	28.00^{B}	49.39^{D}	64.07^{E}	62.63^{D}
3. Tobacco extract (3.5%)	24.00^{C}	48.87^{D}	64.21^{E}	63.14^{D}
4. Akk extract (3.5%)	18.00^{D}	27.50^{F}	48.53^{H}	44.92^{H}
5. Tooh/tumma extract (3.0%)	19.00^{D}	42.27^{E}	59.59^{F}	59.19^{E}
6. Datura extract (3.5%)	10.00^{E}	24.72^{F}	40.53^{I}	36.37^{I}
7. Garlic extract (3.5%)	15.00^{D}	41.06^{E}	59.92^{F}	56.31^{F}
8. Eucalyptus extract (5.0%)	15.00^{D}	39.13^{E}	53.74^{G}	50.50^{G}
9. Ginger extract (3.5%)	17.00^{D}	47.77^{D}	63.48^{E}	60.29^{E}
10. Tracer 45% SC (100ml/acre)	30.00^{B}	62.04^{B}	84.06^{B}	82.62^{B}
11. Runner 240 SC (240g/acre)	32.00^{A}	70.18^{A}	92.84^{A}	92.06^{A}
12. Radiant 120 SC (120ml/acre)	36.00^{A}	64.49^{B}	81.89^{C}	81.09^{B}
13. Coragen 20 SC (50ml/acre)	32.00^{A}	53.85^{C}	75.54^{D}	76.12^{C}
14. Belt 480 SC (100ml/acre)	22.00^{C}	59.85^{B}	81.53^{C}	80.96^{B}
15. Control (untreated)	0.75^{F}	1.48^{G}	2.19^{J}	2.87^{J}
S.E.±	*2.0286*	*1.6567*	*1.2959*	*1.0579*
LSD 0.05	*4.1552*	*3.3937*	*2.6545*	*2.1671*
P-Value	*0.0029*	*0.0000*	*0.0000*	*0.0000*

Table 4: 2nd spray jassid mortality (%) by synthetic and biopesticides during 2015

Treatments	Insect mortality percentage (days after spray)			
	24-hrs	3-days	7-days	14-days
1. Neem extract (5.0%)	30.00^{A}	53.99^{B}	67.33^{D}	66.03^{C}
2. Neem Oil (2.50 %)	23.37^{C}	48.66^{C}	64.06^{E}	62.98^{C}
3. Tobacco extract (3.5%)	30.00^{A}	52.61^{B}	66.50^{D}	65.27^{C}
4. Akk extract (3.5%)	23.00^{C}	44.56^{D}	60.64^{F}	60.24^{D}
5. Tooh/tumma extract (3.0%)	24.00^{B}	42.24^{D}	59.57^{F}	59.16^{D}
6. Datura extract (3.5%)	15.00^{D}	32.85^{F}	46.95^{H}	43.24^{F}
7. Garlic extract (3.5%)	25.00^{C}	46.00^{D}	63.28^{E}	59.98^{D}
8. Eucalyptus extract (5.0%)	18.00^{D}	38.50^{E}	53.26^{G}	49.99^{E}
9. Ginger extract (3.5%)	27.00^{B}	45.25^{D}	62.77^{E}	59.42^{D}
10. Tracer 45% SC (100ml/acre)	32.00^{A}	54.44^{B}	78.13^{B}	76.16^{B}
11. Runner 240 SC (240g/acre)	29.00^{A}	59.53^{A}	88.67^{A}	87.42^{A}
12. Radiant 120 SC (120ml/acre)	32.00^{A}	53.76^{B}	77.80^{B}	75.81^{B}
13. Coragen 20 SC (50ml/acre)	30.00^{A}	51.00^{B}	75.50^{B}	75.01^{B}
14. Belt 480 SC (100ml/acre)	28.00^{B}	49.60^{C}	74.80^{C}	74.30^{B}
15. Control (untreated)	2.00^{E}	1.00^{G}	-0.74^{I}	-1.00^{G}
S.E.±	1.7015	1.4469	1.0529	2.8059
LSD 0.05	3.4855	2.9638	2.1568	4.6508
P-Value	0.0005	0.0000	0.0000	0.0000

4. DISCUSSION

The pesticide resistance is an issue challenging the stakeholders to develop new chemistry pesticides for effective management of the insect pests. The okra is one of the vegetables that are frequently picked from the field; and probably picked daily; hence highly toxic chemicals might leave the chances of residual effects in consumable pods (Ahmad *et al.*, 2010). Under these situations, use of biopesticides using different organic sources could be the appropriate solution to minimize the reliance on chemical pesticides. This also compensates the yield deficit in organic farming over the conventionally produced vegetables. The world agricultural scientists are working hard to develop organic means of crop production and crop protection to minimize the use of synthetic pesticides. In the present investigation, the efficacy of bio and synthetic pesticides against jassid population on okra was evaluated for two consecutive years. The research embodied in this publication suggested that neem and tobacco based biopesticides were adequately effective to

combat jassid infestation on okra, followed by garlic and ginger extracts. In case of chemical control, the tested insecticides were effective to combat the jassid infestation; but the spray of Runner 240 SC vanished the pest population. Zobayer and Hasan (2013) tested efficacy of extracts based on neem, garlic, ginger, eucalyptus and papaya and found that neem, garlic and ginger based biopesticides were outstanding in suppressing the insect pest infestation. Mahmood *et al.*, (2014) reported reduced *B. tabaci* population upto 92.62% when the crop sprayed with tobacco extract, followed by Neem powder (91.50%), Heeng, Asafoetida (50.93%) and detergent 1.85 (53.16%) and *A. devastans* upto 99.57, 98.18, 59.89 and 59.64 percent, respectively. There were marked ($P<0.05$) differences in the efficacy of botanical pesticides and *Azadirachta indica*, *Nicotiana tabacum* and Asafoetida were found safe for toxic residues and cost effective compared to synthetic pesticides. Ursani *et al.* (2014) reported higher efficacies of Confidor, neem, tobacco, tooh, akk and Dhatura extracts were 97.95, 96.08, 95.63, 86.17, 81.19 and 70.94 percent, respectively. Agro (2016) obtained higher efficacy against sucking insect pests of okra when the synthetic pesticides were applied in combination/mixing with neem oil. Nzanza and Mashela (2012) recommended frequent spray of neem based biopesticides to control insect pests of okra; because in any case the application of synthetic pesticiedes on okra is not acceptable due to their residual effects. Adalbert *et al.* (2013) have also reported high effectiveness of neem oil against jassid population on okra. However, Bardin *et al.* (2008) have suggested conjunctive application of neem oil and synthetic pesticide to combat okra insect pests.

5. CONCLUSIONS

It was concluded that neem and tobacco based biopesticides were controlled the jassid population effectively on okra, followed by garlic and ginger extracts. Runner 240 SC showed highest efficacy against jassid among synthetic pesticides, followed by Tracer, Radiant and Belt.

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