Research Article

Comparative Efficacy of Botanical Pesticides against Sucking Insect Pests of Mustard Crop

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Abstract | The experiment was conducted at experimental field of Entomology Section, Agriculture Research Institute, Tandojam during the season 2018-19. Maximum reduction in thrips population (30.3%) was observed in plot sprayed with neem seed extract followed by plot sprayed with neem oil (24.47%), tobacco extract (22.00%) and akk plant extract (19.83). Neem seed extract showed higher efficacy (81.01%) against thrips population on mustard crop followed by neem oil (66.13%), tobacco extract (58.20%) and akk plant extract (53.12%). Maximum reduction in whitefly population (13.00%) was observed in plot sprayed with neem seed extract followed by plot sprayed with neem oil (10.33%), tobacco extract (9.50%) and akk plant extract (7.33%). Neem seed extract showed higher efficacy (88.67%) against whitefly population on mustard crop followed by neem oil (80.51%), tobacco extract (79.16%) and akk plant extract (64.69%). Maximum reduction in aphid population (14.33%) was observed in plot sprayed with neem seed extract followed by plot sprayed with neem oil (11.10%), tobacco extract (10.23%) and akk plant extract (9.60%). Neem seed extract showed higher efficacy (87.75%) against aphid population on mustard crop followed by neem oil (76.02%), tobacco extract (71.38%) and akk plant extract (68.57%). Maximum reduction in painted bug population (8.67%) was observed in plot sprayed with neem seed extract followed by plot sprayed with neem oil (8.00%), tobacco extract (7.66%) and akk plant extract (6.76%). Neem seed extract showed higher efficacy (83.93%) against painted bug population on mustard crop followed by neem oil (77.44%), tobacco extract (71.85%) and akk plant extract (67.60%). Maximum crop yield (22 kg/plot) were recorded when the neem seed extract was sprayed on mustard crop; followed by average crop yield of 20 and 18/plot when the mustard crop were sprayed with neem oil and tobacco extract, respectively. However, the lower crop yield (18 kg/plot) was noticed when the mustard crop were sprayed with akk plant extract. The control plots resulted in lowest crop yields of 10 kg/plot. It was concluded that neem seed extract ranked 1st in reduction of the thrips, whitefly, aphid and painted bug population followed by neem oil ranked 2nd, tobacco extract ranked 3rd and akk plant extract ranked 4th in reduction of pests population. Maximum efficacy against thrips, whitefly, aphid and painted bug population was counted in plot sprayed with neem seed extract followed by neem oil, tobacco extract and akk plant extract. Moreover, the pests population remained constant in un-treated (control) plot throughout the experiment.

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Introduction

Rapeseed (*Brassica* spp.) is grown primarily for its seed which yields about 40% oil and a high-protein animal feed. The scientists have sequenced the entire genome of rapeseed/canola (*Brassica napus*) and its constituent genomes present in *Brassica rapa* and *Brassica oleracea* in 2009 (Fekri *et al*., 2013). *Brassica napus* (canola) is covered with more bloom than other species. It is very late in maturity and remains green untill about the middle of April. Canola oil is the lowest in saturated fat, containing only 6% saturated fat and is high in mono-saturated fat. This has 50% less saturated fat than corn oil (Pradhan, 2012). Rapeseed oil generally contains a high level of erucic acid, which is mildly toxic to humans in large doses. Traditional and other uses have been for lamp oils, soap making, high-temperature and tenacious high-erucic acid lubricating oils, and plastics manufacturing. With the shift to rapeseed in the European Union, the low erucic acid content of rapeseed oil and its specific fatty acid composition make it highly appreciated edible oil. Apart from the agronomic factors, the decrease in production was also contributed by insect pest infestation. Among insect pests infesting oilseeds, sucking complex cause is a major factor constrains increased yields (Toscano e al., 2012).

According to 38 insect pests are known to be associated with rapeseed mustard crop in India. On the basis of their economic importance, the insect pests of mustard crop may be group into, key pest:aphid, *Lipaphis erysimi* (Kaltenbach), major pests: sawfly, *Athalia lugens proxima* (Klug); painte bug, *Bagrada cruciferarum* Kirkaldy and leafminer, *Chromatomyia horticola* Goureau, minor pests: Bihar hairy caterpillar, *Diacrisia abliqua* Walker; cabbage butterfly, *Pieris brassicae* Linnaeus; flea beetle, *Phyllotreta cruciferae* Goeze and green phid, *Myzus persicae* Seltzer, new pests:leafwebber, *Crocidolomia binotalis* Zeller; borer, *Hellula undalis* Fabricius and whitefly, *Bemisia tabaci* Gennadius. Among these, aphid, *L. erysimi* is the key pest in all the mustard growing regions of the country. The nymphs and adults of the aphid suck the cell sap from the minflorescence, terminal twig, siliqua (pod), leaves and branches. On evere infestation, plant gets poor pod formation, leaves get curled, shrivel and plants become completely dried. Rohilla *et al*. (2015) reported that *L. erysimi* is most destructive insect causing severe reduction in seed yield varying from 15.0 to 73.3%; while Verma (2013) found mustard aphid *Lipaphis erysimi* (Kalt.), Thrip *Thrip tabaci* and Whitefly *Bemesia tabaci* (Gennedius) as the major insect pests of mustard. Panda and Khush (2013) found that varieties with thicker pods suppressed insect pest infestation and showed resistance in diseases transmitted by insects; while Karmakar (2013) compared mustard cultivars B-9, NC-1, RW-351 and PGS-1004 for resistance to *Lipaphis erysimi* and found that lowest aphid population was recorded on PGS-1004 and this cultivar also showed higher yield than rest of the cultivars. Singh (2006) reported that Indian mustard showed relative resistance to *Lipaphis erysimi*; while Saljoqi (2006) reported that most of the hybrid mustard cultivars with thicker stems were resistant to *Lipaphis erysimi* and mustard sawfly. Sahito *et al*. (2010) indicated that the white fly *Bemisia tabaci*, (Genn). Mustard aphid *Lipaphis erysimi* (Kalt) and *Bagrada picta* (F) were major mustard insect pests and showed that higher (6.71+0.98/leaf) whitefly *Bemisia tabaci* population buildup was recorded on Indian mustard variety 'Yellow sarsoon' as compared to mustard variety 'Dark green leaves' (6.30 + 0.61), Indian mustard variety 'Brown sarsoon' (6.19 + 0.63), local mustard variety 'Raya Anmol' (5.40 + 0.55), local mustard variety 'Torya Early' (5.38+0.57) and Indian mustard variety 'Rai S-9' (3.79+0.50). Das *et al*. (2013) showed that relative humidity and rainfall had negative influence on pests and natural enemies during the study period. On the other hand, aphid produces a good amount of honey dew which facilitates the growth of the fungus that makes the leaves appeardirty black.

Among various biotic factors responsible for reducing the yield of rapeseed mustard, insect pests are the major one. Thirty eight insect pests are known to be associated with rapeseed mustard crop in India Bakhetia and Sekhon (1989). *Lipaphis erysimi* causes 35.4 to 96 % yield loss, 30.9 percent seed weight loss and 2.75 pecentoil loss (Bakhetia and Sekhon, 1989). In view of combating the notorious pest, the present investigation was under take to study the incidence and management of mustard aphid.

Materials and Methods

The experiment was conducted at Entomology section (A.R.I), Tando jam. The variety of Sindh Raya was sown with plot size 110 x 85 (9350 ft^2). The four botanical pesticides were tested to evaluate the performance against insect pests of mustard

crop in randomize complete block design with three replications.

Preparation of botanical extracts

Treatments= 5

T_1 = Neem powder (3-4 kg) T_2 = Akk (2-3 kg) T_3 = Tobbaco (2-3 kg) T_4 = Neem oil (900-1100 g) T_5 = Control (untreated)

The plant material was boiled in 10 litter of water per acre. A volume of (1354 gram neem seed after 1700 ml with add 5 liter water, 1500 gram Tobacco after 1600 ml with add 5 liter water, neem oil 250 ml and 1760 gram Akk leaves after 3600 ml with add 5 liter water), After boiling filtered through muslin cloth. after preparing stock solution the musturd crop was sprayed with a knapsack hand sprayer. The solution was added with required water calibrate earlier for spray the mustard crop. The prepare dose neem seed was 206 ml and neem oil 37 ml and Tobbaco was 131 ml and Akk was 261 ml for spray the musturd crop.

The observation was taken from 5 plant randomly selected and from each plant 5 leaves was observed. Two leaves from bottom, two leaves from middle and one leave from top portion of mustard plant. The pre treatment observation was taken before treatment and post treatment observation after spray 24 hours, 48 hours, 72 hours, 96 hours and one week. The significance of the botanical pesticide was evaluated using analysis at least significant difference.

Results and Discusion

Efficacy of various botanical pesticides against thrips (*Thrips tabaci*) population on mustard crop after spray

The results in regards to efficacy of various botanical pesticides against thrips population on mustard crop after spray is presented in Table 1. The data showed that before spray of various botanical pesticides the thrips population was recorded as 37.40, 37.33, 37.80 and 37.00 nymph/plant in various plots, respectively. After spray of 24 hours the thrips population was recorded as 31.15, 35.40, 31.33 and 31.00 nymph/plant in plots sprayed with neem seed extract, akk plant extract, tobacco extract and neem oil, respectively. The thrips population linearly declined after spray of 48, 72 and 96 hours of spray and reached at lowest level after 1 week of spray with average population of 7.10, 17.50, 15.00 and 13.33 nymph/plant in plots sprayed with neem seed extract, akk plant extract, tobacco extract and neem oil, respectively. In control plot the thrips population remains constant before and after 24 h, 48 h, 72 h, 96 h and 1 week. Maximum pest reduction (30.3%) was observed in plot sprayed with neem seed extract followed by plot sprayed with neem oil (24.47%), tobacco extract (22.00%) and akk plant extract (19.83). Neem seed extract showed higher efficacy (81.01%) against thrips population on mustard crop followed by neem oil (66.13%), tobacco extract (58.20%) and akk plant extract (53.12%). Statistical analysis of the obtained data revealed that there was significant ($p<0.05$) difference in thrips population on mustard crop between the botanical pesticides at various intervals.

Efficacy of various botanical pesticides against whitefly (Bemisia tabaci) population on mustard crop after spray

The results in regards to efficacy of various botanical pesticides against whitefly population on mustard crop after spray is presented in Table 2. The data showed that before spray of various botanical pesticides the whitefly population was recorded as 14.66, 11.33, 12.00 and 12.83 nymph /plant in various plots, respectively. After spray of 24 hours the whitefly population was recorded as 8.00, 10.00, 9.50 and 8.33 nymph/plant in plots sprayed with neem seed extract, akk plant extract, tobacco extract and neem oil, respectively. The whitefly population linearly declined after spray of 48, 72 and 96 hours of spray and reached at lowest level after 1 week of spray with average population of 1.66, 4.00, 3.12 and 2.50 nymph/plant in plots sprayed with neem seed extract, akk plant extract, tobacco extract and neem oil, respectively. In control plot the whitefly population remains constant before and after 24 h, 48 h, 72 h, 96 h and 1 week. Maximum pest reduction (13.00%) was observed in plot sprayed with neem seed extract followed by plot sprayed with neem oil (10.33%), tobacco extract (9.50%) and akk plant extract (7.33%). Neem seed extract showed higher efficacy (88.67%) against whitefly population on mustard crop followed by neem oil (80.51%), tobacco extract (79.16%) and akk plant extract (64.69%). Statistical analysis of the obtained data revealed that there was significant ($p<0.05$) difference in whitefly population on mustard crop between the botanical pesticides at various intervals.

Efficacy of various botanical pesticides against aphid (Lipaphis eryisimi) population on mustard crop after spray

The results in regards to efficacy of various botanical pesticides against aphid population on mustard crop

after spray is presented in Table 3. The data showed that before spray of various botanical pesticides the aphid population was recorded as 16.33, 14.33, 14.00, 14.60 nymph/plant in various plots, respectively. After spray of 24 hours the aphid population was recorded as 11.33, 12.50, 12.00 and 11.33 nymph/plant in plots sprayed with neem seed extract, akk plant extract, tobacco extract and neem oil, respectively. The aphid population linearly declined after spray of 48, 72 and 96 hours of spray and reached at lowest level after 1 week of spray with average population of 2.00, 4.40, 4.10 and 3.50 nymph/plant in plots sprayed with neem seed extract, akk plant extract, tobacco extract and neem oil, respectively. In control plot the aphid population remains constant before and after 24 h, 48 h, 72 h, 96 h and 1 week. Maximum pest reduction (14.33%) was observed in plot sprayed with neem seed extract followed by plot sprayed with neem oil (11.10%), tobacco extract (10.23%) and akk plant extract (9.60%). Neem seed extract showed higher efficacy (87.75%) against aphid population on mustard crop followed by neem oil (76.02%), tobacco extract (71.38%) and akk plant extract (68.57%). Statistical analysis of the obtained data revealed that there was significant ($p<0.05$) difference in aphid population on mustard crop between the botanical pesticides at various intervals.

Efficacy of various botanical pesticides against painted bug (Bagrada cruciferarum) population on mustard crop after spray

The results in regards to efficacy of various botanical pesticides against painted bug population on mustard crop after spray is presented in Table 4. The data showed that before spray of various botanical pesticides the painted bug population was recorded as 10.33, 10.00, 10.66, 10.33 nymph/plant in various plots, respectively. After spray of 24 hours the painted bug population was recorded as 6.66, 8.00, 7.80 and 7.60 nymph/plant in plots sprayed with neem seed extract, akk plant extract, tobacco extract and neem oil, respectively. The painted bug population linearly declined after spray of 48, 72 and 96 hours of spray and reached at lowest level after 1 week of spray with average population of 1.66, 3.24, 3.00 and 2.33 nymph/plant in plots sprayed with neem seed extract, akk plant extract, tobacco extract and neem oil, respectively. In control plot the painted bug population remains constant before and after 24 h, 48 h, 72 h, 96 h and 1 week. Maximum pest reduction (8.67%) was observed in plot sprayed with neem seed extract followed by plot sprayed with neem oil (8.00%), tobacco extract (7.66%) and akk plant extract (6.76%). Neem seed extract showed higher efficacy (83.93%) against painted bug population on mustard crop followed by neem oil (77.44%), tobacco extract (71.85%) and akk plant extract (67.60%). Statistical analysis of the obtained data revealed that there was significant ($p<0.05$) difference in painted bug population on mustard crop between the botanical pesticides at various intervals.

Mustard yield (kg/plot)

The data regarding crop yield plot^{-1} (Table 5) indicates that maximum crop yield (22±2.40 kg/plot) were recorded when the neem seed extract was sprayed on mustard crop; followed by average crop yield of 20±2.00 and 18±1.84 kg/plot when the mustard crop were sprayed with neem oil and tobacco extract, respectively. However, the lower crop yield (16±1.20 kg/plot) was noticed when the mustard crop were sprayed with akk plant extract. The control plots resulted in lowest crop yields of 10±1.10 kg/plot. This indicates that the neem seed and neem oil showed a remarkable performance resulting in a minor difference in crop yield, because botanical extracts also kept the insect pests below the economic injury level. Moreover, neem seed extract and neem oil is the cheap sources and cost effective to combat the mustard insect pests.

The findings of the present study showed that neem seed extract ranked 1st in reduction of the thrips, whitefly, aphid and painted bug population followed by neem oil ranked 2nd, tobacco extract ranked 3rd and akk plant extract ranked 4th in reduction of pests population. Maximum efficacy against thrips, whitefly, aphid and painted bug population was counted in plot sprayed with neem seed extract followed by neem oil, tobacco extract and akk plant extract. Whereas, the pests population remained constant in un-treated (control) plot throughout the experiment. The results of the present study are further confirmed by those of Kumar (2003) reported that neem extract gave maximum mortality against jassid and fruit borer compared with Achook and NSKE (3%). Haq (2006) also reported similar findings and stated that botanical pesticide (neem products) were highly effective for eradication and controlling sucking insect pests particularly whitefly, jassid, aphid and fruit borer under field conditions. On the otherhand, Hassan (2006) jassid population significantly control through

Table 1: *Efficacy of various botanical pesticides against thrips (Thrips tabaci) population on mustard crop.*

Botanical extracts	Pre obs.	24 h	48 h	72 h	96 h	1 week	Pest reduction / plant	Efficacy (%)
T_1=Neem seed	37.40±15.20a	31.15±12.50c	25.30±10.30d	20.10±8.30d	15.33±7.20d	7.10±2.10e	30.3	81.01
T_2=Akk plant	37.33±15.10a	35.40±14.40b	33.30±12.60b	29.20±10.30b	25.33±11.30b	17.50±5.80b	19.83	53.12
T_3=Tobbaco	37.80±15.40a	31.33±10.60c	29.33±11.20c	27.33±8.60c	22.13±8.90c	15.00±4.20c	22.00	58.20
T_4=Neem oil	37.00±15.05a	31.00±10.20c	29.00±11.03c	27.00±8.20c	20.00±7.60d	13.33±3.50d	24.47	66.13
T5=Control	40.00±20.30a	38.00±16.50a	42.00±22.30a	40.00±20.50a	43.00±23.50a	40.66±20.80a	-0.66	1.65
S.E.±	1.8257	1.5251	17.5010	20.9322	28.9322	33.8738	-	-
LSD 0.05	4.2102	4.3310	20.3102	24.4556	30.4556	36.3210	-	-

Table 2: *Efficacy of various botanical pesticides against whitefly (Bemisia tabaci) population on mustard crop.*

Botanical extracts	Pre obs.	24 h	48 h	72 h	96 h	1 week	Pest reduction / plant	Efficacy (%)
T_1=Neem seed	14.66±5.30	8.00±3.40e	5.20±2.80e	3.33±2.20e	2.10±1.30e	1.66±0.84e	13.00	88.67
T_2=Akk plant	11.33±4.20	10.00±3.90b	8.00±3.20b	6.20±2.40b	5.24±2.10b	4.00±1.60b	7.33	64.69
T_3=Tobbaco	12.00±4.80	9.50±4.10c	7.33±3.80c	5.50±3.20c	4.10±2.10c	3.12±1.60c	9.50	79.16
T_4=Neem oil	12.83±5.10	8.33±3.50d	6.66±2.80d	5.00±2.10d	4.00±1.80d	2.50±1.10d	10.33	80.51
T5=Control	15.40±6.30	12.40±5.20a	13.50±5.80a	13.00±5.30a	14.20±6.10a	15.30±6.40a	0.10	0.64
S.E.±	1.3499	1.2996	1.2996	1.2649	1.2996	1.4644	--	--
LSD 0.05	3.1129	2.9968	2.9968	2.9169	2.9968	3.3769	--	--

Table 3: *Efficacy of various botanical pesticides against aphid (Lipaphis eryisimi) population on mustard crop.*

Botanical extracts	Pre obs.	24 h	48 h	72 h	96 h	1 week	Pest reduction / plant	Efficacy (%)
T_1=Neem seed	16.33±8.60	11.33±5.30c	9.33±4.10c	7.33±3.50c	5.33±2.80c	2.00±1.10d	14.33	87.75
T_2=Akk plant	14.00±7.20	12.50±5.80b	10.40±5.10b	8.50±4.90b	6.33±3.20b	4.40±2.33b	9.60	68.57
T_3=Tobbaco	14.33±7.90	12.00±6.80b	10.00±5.20b	8.00±4.10b	5.10±3.20c	4.10±2.50b	10.23	71.38
T_4=Neem oil	14.60±8.10	11.33±7.60c	9.50±7.20c	7.40±5.30c	5.33±2.50c	3.50±2.10c	11.10	76.02
T5=Control	15.33±8.80	14.33±8.10a	12.33±7.60a	14.33±8.01a	15.33±8.50a	15.00±8.30a	0.33	2.15
S.E.±	1.5951	1.5951	1.6433	1.5094	1.5811	1.4644	--	
LSD 0.05	3.6784	3.6784	4.5244	3.6074	3.6461	3.3769	--	

Table 4: *Efficacy of various botanical pesticides against painted bug (Bagrada cruciferarum) population on mustard crop.*

Botanical extracts	Pre obs.	24 h	48 h	72 h	96 h	1 week	Pest reduction / plant	Efficacy (%)
T_1=Neem seed	10.33±5.10	6.66±4.16e	5.00±3.80e	3.00±3.10e	1.33±0.91e	1.66±0.50e	8.67	83.93
T_2=Akk plant	10.00±4.80	8.00±3.50b	7.33±2.90b	6.80±2.40b	5.66±2.10b	3.24±1.95b	6.76	67.60
T_3=Tobbaco	10.66±5.13	7.80±4.40c	6.66±4.10c	5.40±3.20c	4.20±2.80c	3.00±2.10c	7.66	71.85
T_4=Neem oil	10.33±5.05	7.60±4.10d	6.10±3.50d	4.33±3.10d	3.66±2.50d	2.33±1.80d	8.00	77.44
T5=Control	9.33±4.20	9.66±4.80a	9.00±4.40a	9.33±4.20a	9.66±4.80a	8.66±5.40a	0.67	7.18
S.E.±	1.2293	1.2480	1.1205	1.1595	1.1824	1.4644	--	
LSD 0.05	2.8347	2.8034	2.5839	2.6738	2.6098	3.3769	--	

the neem based products. Khattak (2006) stated that neem seed water extract 3% plus neem oil 2% spray against fruit borer and jassid significantly reduced the population. Dut (2007) reported that for controlling sucking insects pests of field crops botanical extracts such as dhatura and neem based products was

preferable for effective IPM strategies. Noonari and Yadav (2008) they recored 71.97% mortality when the field sprayed with neem oil after 24, 48, 72 hrs as well as one and two weeks, respectively. Noonari and Yadav (2008) reavled that formulation of azadirachtin-endosulfan and neem gave 0.65% per plant reduction in jassid population.

Table 5: *Crop yield (kg/plot).*

Botanical extracts	Yield (kg/plot)
T_1=Neem seed	22±2.40a
T_2=Akk plant	16±1.20d
T_3=Tobbaco	18±1.84c
T_4=Neem oil	20±2.00b
T5=Control	10±1.10e

Conclusions and Recommendations

From the above findings it was concluded that neem seed extract ranked 1st in reduction of the thrips, whitefly, aphid and painted bug population followed by neem oil ranked 2nd, tobacco extract ranked 3rd and akk plant extract ranked 4th in reduction of pests population. Maximum efficacy against thrips, whitefly, aphid and painted bug population was counted in plot sprayed with neem seed extract followed by neem oil, tobacco extract and akk plant extract. Whereas, the pests population remained constant in un-treated (control) plot throughout the experiment.

Novelty Statement

This is baseline study and information about the pesticides against sucking insect pests.

Author's Contribution

Arshad Ali Essani, Bhai Khan Solangi and Muhammad Ilyas Abro conceived the idea. Sultan Ahmed, Karim Bakhsh Sial and Muhammad Saleem wrote abstract. Ali Asghar Gola, Ghulam Ali and Moula Dad methodology, did SPSS analysis, conclusion. Mujeeb ur Rehman and Habibullah Kakar technical input at every step, overall management of the article, data collection, data entry in SPSS and analysis. Mitha Khan result and discussion, introduction, references.

Conflict of interest

The authors have declared no conflict of interest.

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