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COMPARATIVE EFFICACY OF FIVE MEDICINAL PLANT EXTRACTS AGAINST *ROSA INDICA* INSECT PESTS AND ELABORATION OF HAZARDOUS EFFECTS ON POLLINATORS AND PREDATORS

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ABSTRACT

Field evaluation of the application of botanical extracts from five medicinal plants viz., *Azadirachta indica*, *Melia azadirach*, *Eucalyptus cineraceae*, *Momordica charantia*, *Calatropis cineraceae* was conducted against the pest complex of *Rosa indica*, and pollinators and predators associated with it. Plant extracts exhibited variable responses to *Thrips tabaci* (L.), *Helicoverpa armigera* (Hub.), Syrphid flies, *Apis florea* (F.) and *Maladera castanea* (A.) population. Results unveiled that *A. indica* seed extract caused 77% mortality in *T. tabaci* population after 72 hours of the application. *A. indica* seed extract and *M. charantia* extract killed 84.00 and 82.00 percent *H. armigera* population after 72 hours. *M. azadirach* leaf extract and A. *indica* leaf extract proved safer to Syrphid flies. *M. azadirach* and *E. cineraceae* leaf extract proved less effective to *A. florea*. Order of efficacy of botanical extracts of plants used in the experiment against *M. castanea* was *C. cineraceae* > *A. indica* seed kernel extract> *M. azadirach*>E. *cineraceae*> *A. indica* leaf extract> *M. charantia* fruit extract after 72 hours of the treatment. Biopesticides are future of agriculture pest management. Studies suggest that these botanical extracts should be manipulated in field to control pest population.

Keywords: *Azadirachta indica,* botanical extracts, *Calatropis cineraceae, Eucalyptus cineraceae*, insects, *Melia azadirach*, *Momordica charantia*, Rose.

INTRODUCTION

Rose (*Rosa indica*; Rosaceae) are cultivated for ornamental, decorative, aesthetic pleasure, volatile scanted compounds production, health ailments (gulcand), cosmetics, tea and other commercial purposes (Khan and Rehman, 2005) . Pakistan total export of cut flowers is 35 million rupees among which, roses have major share. Pakistan can earn billions of dollars through export of ornamental roses and its products if cultivation of roses is promoted in the country (Government of Pakistan, 2007). However many factors scourge high qualitative and quantitative production of roses on large commercial scale (Kumar and Bhatt, 1999). Among these factors, one is attack of insects and pests. Many insects are associated with rose crop, among which pests such as American bollworm, thrips, jassids, aphids, mites play a vital role in reducing qualitative and quantitative production of roses (Drees *et al*., 2000; Layton 2008). Some beneficial fauna are also associated with rose crop. Among which coccinellids, honey bees and various other pollinators play a vital role (Akhtar and Khaliq, 2003; Mukhopadhyay *et al*., 2007).

Application of insecticides is common practice to control pests in South East Asia and throughout the world. However its regular use has fraught future of these chemicals due to environmental pollution, resistance, elimination of natural enemies, pollinators and residues abundance of commodities. Sucking and chewing pests associated with rose crops have long been known to develop resistance to pyrethroids, organophosphates, carbamates and new chemistry insecticides (Lopez *et al*., 2008; Vanisree *et al*., 2011). Biopesticides are gaining importance in the present and future

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scope of the scientist's approach. . Use of biopesticides and botanicals is new control strategy to deter, inhibit growth and restrict oviposition rate of major economically important pests (Shukla and Shukla, 2012; Ahmad *et al*., 2002). However a few of them have been found safe for beneficial fauna i.e., pollinators and predators (Smith and Krischik, 2000; Khater, 2012). Botanicals are also cheaper to make and then use for pest control, which not only suppress pests but also decreases per acre farmer's cost of production.

Botanical insecticides have long been touted as an attractive alternative to synthetic chemical insecticides for pest management because botanicals reputedly pose little threat to environment health (Parkash *et al*., 2008). However in spite of all this dilemma medicinal plants available in Asia can be used as potent alternatives to synthetic commercial insecticides (Batugal *et al*., 2004; Isman, 2006). Wild trees of neem (*A. indica*), sufaida (*E. cineraceae*), bakain (*M. azadirach*), wild herbs (Ak) and medicinal wildly cultivated 'karela' (*C. cineraceae*) are available throughout the subcontinent (Kumar and Bhatt, 1999). If farmers are aware of their effects then millions of dollars spent on import of synthetic insecticides can be saved. Hence country's economy can be stabilized.

For this purpose five botanical leaf extracts and one seed extract of five medicinal plants viz., *Azadirachta indica*, (Meliaceae), *Melia azadirach* (Meliaceae), *Eucalyptus cineraceae* (Myrtaceae), *Momordica charantia* (Cucarbitaceae), *Calatropis cineraceae* (Apocrynaceae) were compared for their efficacy against chewing, sucking pests and hazardous effects of these botanical extracts were also evaluated against pollinators and predators complex under field conditions.

MATERIALS AND METHODS

The experiment was conducted in Horticultural Research Substation (HRSS) Multan, Punjab Pakistan during the year 2011. The experiment comprised of seven treatments and three replicates. The experimental plot size was 33 x 17.5 ft^2 in Randomized complete block design. Desi Ghulab variety of rose *Rosa indica (Rosaceae)* was sown. Preparation of solution was done by the method described below.

Azadirachta indica seed (Neem) kernel extract

Fresh seeds of *A. indica* were collected from wild *A. indica* trees in August to September. Seeds were then dried in Sunshine in glasshouse for one week. One kilogram dried seeds were then ground in a pestle and mortar. The ground powder was mixed in 5L tap water and allowed to decompose for 72 hours at room temperature (After 72 hours it was sieved through muslin cloth and total 5 L water extract was obtained which was 20% solution.

A*zadirachta indica* (Neem), M*elia azadirach* (Bakain) and *Eucalyptus cineraceae* (Sufaida) leaf extract

Fresh leaves of *A. indica*, *M. azadirach*, *E. cineraceae,* one kilogram each were plucked from wild trees in Agricultural Farms in Multan, then surface dried in sunshade in glass houses. Dried leaves were ground in a pestle and mortar. The powder so obtained was dissolved in 5 L water. The mixture was allowed to decompose for 72 hours at room temperature. Then sieved through muslin cloth (Centre for Indian Knowledge Systems, 2011).

Calatropis cineraceae leaf (AK) leaf extract

One kilogram, fresh leaves of *C. cineraceae* were ground in a Pestle and mortar, dissolved in 5 L water, sieved through muslin cloth (Centre for Indian Knowledge Systems, 2011).

Memordica charantia (KFE) fruit extract

One kilogram fresh fruits of *Memordica charantia* were taken from the field. These fruits were then ground in a pestle and mortar. Extract was dissolved in 5 L water. Then it was sieved through the muslin cloth and applied in the field (Centre for Indian Knowledge Systems, 2011).

Collection of data and statistical analysis

Data were taken 24 hours before spray from all plots including control. When the population was above ETL (Economic Thresh hold level) then spray was done. As we know that no ETL still has been established for rose pests. So ETL established for these pests on cotton crop was followed i,e Thrips 8-10/leaf; *Helicoverpa armigera* 3-5 eggs/25 plants. The data were collected from five plants from each flower. S. *dorsalis* were counted through the use of a hand lens after striking the flower on black paper cards. Adults and nymphs both were recorded. American bollworm populations were recorded from flowers and plant by eye observations. Both eggs and larvae were counted. Syrphid fly, Honey bee, *Coccinellid* population only adults or including larvae was also recorded from the flowers of 5 plants from each treatment including control. Population was recorded 24, 48, 72 and seven days after the botanical extract application. Percent mortality was determined through the formulae.

$$\text{Percent mortality} = \frac{\text{Population in Control- Population in Treated Plots}}{\text{Population in Control}} \times 100$$

Data was statistically analyzed through MSTAT-C program (Anon., 1989). Means separated through the Duncan Multiple Range test method at 5% level of significance. Following control standards were followed. “Good control” means statistically significant reduction in pest number I,e 75% mortality compared to untreated. “Fair control” significant reductions up to 50-74%. “Poor control” means results with less than 50% mortality. For benefecials following standard was followed. 50-75% mortality means “Highly hazardous”, 25-50% mortality means “Hazardous” and 1-25% mortality means “Safe”.

RESULTS

Table 1 depicts efficacy of botanical extracts against *Thrips tabaci* (L.) which is a common specie found in South East Asia. Results unveiled that *M. azadirach* had good control (54.4-71.9%) in 24, 48 and 72 hours interval. However efficacy of the *M. azadirach* leaf extract was then reduced to

38.4 and 8.3 % in 7 and 15 days interval respectively. After 72 hours *A*. *indica* seed kernel extract provided significantly effective control 77% followed by *M*. *azadirach* leaf extract (71.9%) *E. cineraceae* leaf extract (70.4%), *A*. *indica* leaf extract (58.5%), *C. cineraceae* leaf extract (54.3%) and *M. charantia* fruit extract (63.4%). All botanicals showed effectiveness to control thrips population till 72 hours interval and then declined. Only *M*. *charantia* extract and *C*. *cineraceae* leaf extract showed persistency up to 36% and 33% till 15 days interval respectively.

Table 2 points comparative efficacy of botanical extracts against *Helicoverpa armigera* (Hubner.). Results revealed that A. *indica* seed kernel extract and *M*. *charantia* leaf extract proved significantly highly toxic to *H*. *armigera* till 72 hours interval inflicting 84 and 82 % (as mentioned in the table) percent mortality. *C*. *cineraceae* leaf extract provided fair control (74.4%) till 48 hours but then proved less effective after 72 hours. Order of efficacy was *A*. *indica* kernel extract *M. charantia* fruit extract *E*. *cinerceae* leaf extract *A*. *indica* leaf extract *C*. *cineraceae* leaf extract *M*. *azadirach* leaf extract.

Table 3 elaborate hazardous effects of botanical extracts against Syrphid flies. *M*. *charantia* leaf extract proved highly toxic to syrphid flies after 24 hours interval. However *M. azadirach* leaf extract and *A. indica* leaf extract proved safer to Syrphid flies causing mortality 0.0%. Again *C*. *cineracea* leaf extract, *M*. *charantia* fruit extract, *E*. *cineraceae* and *A*. *indica* seed kernel extract exhibited persistency to 72 hours days and 7 days inflicting (16.6%, 8.0%), (33.3 and 15.4%); (27.66% ; 4.10%) and (16.7 and 8.1 %) mortality respectively. No botanical with exception to *M*. *charantia* provided mortality after 15 days.

Table 4 exhibits hazardous effects of botanical extracts against honey bees. Table 4 unveiled that nearly all botanical extracts were hazardous and had toxic effects on Honey bee (*Apis florea* F.) However, *M*. *azadirach* leaf extract safe to *A*. *florea* causing 16.66% mortality after 48 hours. *A*. *indica* seed kernel Extract proved highly hazardous to *A*. *florea* after 48 hours interval. *A*. *indica* seed kernel extract inflicted 52.33% mortality after 48 hours.

Table 5 shows efficacy of botanical extract against *Maladera castanea* **(**Arrow). All extracts proved highly toxic to *M*. *castanea* after 48 hours interval but then declined in 72 hours. Comparative efficacy of botanicals revealed that *C*. *cineraceae* extract and *A*. *indica* seed Kernel Extract are highly hazardous. *M. castanea* population in 72 hours interval inflicting 63% and 60.0 percent mortality. Order of toxicity of applied botanical extracts against *M*. *castanea* after 72 hours interval was *C*. *cineraceae* leaf extract *A*. *indica* seed Kernel Extract *M*. *azadirach* leaf extract *E*. *cineraceae* leaf extract *A*. *indica* leaf extract *M*. *charantia* fruit extract.

Table 6 shows effect of extracts on population of *C. septempunctata.* After 72 hours no harmful effect on *Coccinellid* fauna was observed in all treated plots. However

Table 1

Comparative efficacy of botanical extracts against rose thrips (*Scirtothrips dorsalis* Hood).

Treatments	24 hrs	48 hrs	72 hrs	7 days	15 days
M. charantia fruit extract	23.58±7.44ab	61.66±3.73ab	63.420±2.21a	45.63±4.09b	35.96±2.02a
C. cineraceae leaf extract	23.77±9.53ab	43.56±15.09bc	54.33±10.20a	34.90±2.20c	32.89±1.74b
E. cineraceae leaf extract	27.22±6.12ab	80.74±2.14a	70.44±8.16a	55.57±2.93a	22.53±1.46c
M. azadirach leaf extract	54.38±16.87a	68.97±8.02ab	71.93±13.37a	38.36±1.52a	8.32±15.40d
A. indica leaf extract	41.32±34.80ab	43.38±26.58bc	58.48±42.95a	47.32±18.63a	0.14±4.20e
A. indica seed kernel extract	3.50±5.53b	16.68±6.77c	77.33±26.28a	46.86±13.68a	0.00±0.00e
LSD	42.723	30.657	44.693	31.210	2.24

Table 2

Comparative efficacy of botanical extracts against *Helicoverpa armigera* (Hubner).

Treatments	24 hrs	48 hrs	72 hrs	7 days	15 days
M. charantia fruit extract	45.33±14.38a	73.21±5.10a	82.00±1.17a	81.74±14.53a	0.00±0.00
C. cineraceae leaf extract	53.33±15.40a	74.40±15.09a	49.66±7.76a	0.25±0.089c	0.00±0.00
E. cineraceae leaf extract	13.33±7.74a	47.02±2.14a	78.66±2.77a	15.71±14.02a	0.00±0.00
M. azadirach leaf extract	16.66±9.62a	69.64±8.02a	44.00±13.92a	0.63±0.15c	0.00±0.00
A. indica leaf extract	31.11±9.04a	56.54±26.58a	58.66±26.14a	0.50±42.53c	0.00±0.00
A. indica seed kernel extract	53.33±36.85a	61.85±6.77a	84.00±27.43a	0.29±0.17c	0.00±0.00
LSD	50.05	30.694	50.007	1.89	0.000

Table 3

Comparative efficacy of botanical extracts against syrphid fly (*Scyrphus rectus*).

Treatments	24 hrs	48 hrs	72 hrs	7 days	15 days
M. charantia fruit extract	83.33±9.71a	28.57±5.10a	33.33±9.50b	15.43±2.76a	4.10±0.96a
C. cineraceae leaf extract	25.00±14.41a	28.70±3.87a	16.66±3.77ab	7.93±1.49b	0.00±0.00
E. cineraceae leaf extract	41.66±12.99a	19.04±8.35a	27.66±8.36a	0.48±2.30c	0.00±0.81b
M. azadirach leaf extract	41.33±12.42a	33.33±2.19a	0.00±14.69b	0.00±1.78c	0.00±0.00
A. indica leaf extract	42.66±13.46a	23.80±18.81a	0.00±0.21a	0.00±0.33b	0.00±1.63b
A. indica seed kernel extract	24.11±13.28a	23.80±20.51a	16.66±18.48ab	8.14±1.90b	0.00±0.00
LSD	48.988	15.780	41.347	1.72	0.705

after 48 hours *A. indica* seed extract and *E. cineracea*, was safe (0.0%. However, *M. charantia*, *A. indica* leaf extract were hazardous to coccinellids till 48 hours.

DISCUSSION

Present work on the comparative efficacy of botanical extracts against insect pests, pollinators and predator fauna revealed that botanical extracts can be a relatively safer alternative to synthetic insecticides. Present studies depict that *A. indica* seed extract provided good control after 72 hrs interval. While *M. azadirach* leaf extract, *E. cineraceae* leaf extract, *M. charantia* extract, *C. cineraceae* leaf extract provided fair control. Results of present studies were similar to Dadmal *et al.* (1999), who conducted a field experiment, to test the efficacy of NSKE (5%) and 1500 ppm *azadirachtin* (1%) along with insecticides against thrips on roses and reported that all treatments significantly reduced thrips populations but between the two botanicals, azadirachtin achieved 69.8 per cent reduction after 72 hours after treatment. Again in 2006, Satyanarayan evaluated six different botanicals for their efficacy against rose thrips under laboratory condition and reported that neem seed kernel extract, aqueous extract of *V. negundo*, karanja oil (all at 2%) were found toxic to adult thrips causing 82.60, 73.72 and 77.18 percent mortality, respectively at 48 hours after treatment. The difference in percent mortality to present studies might be due to high concentration of NSKE used in the present studies.

Present work also provided evidence that after 72 hours *A. indica* seed kernel extract and M. *charantia* extract provided good control against *H. armigera* population. *A. indica* leaf extract provided fair control while *C. cineraceae* leaf extract and *M. azadirach* leaf extract provide poor control against *H. armigera* population. *H. armigera* (Hub) is notorious and serious pest of Pakistan agriculture since 1980. Its high attack on cash crop is reduced due to introduction of Bt cotton invasion. However pest attacks in April and May on various other crops and passes its generation. Among various hosts of this pest "Rose" is prominent host in the month of March-April.

Recent work on effects of botanical extracts against Syrphid fly, a wellknown predator of Aphids and thrips on roses conclude that *M. charantia* fruit leaf extract and *E. cineraceae* leaf extract were hazardous to Syrphid fly after 72 hours interval, whilst *A. indica* leaf and *M. azadirach* leaf extract were safe after 72 hours interval. Results of present studies were in contradiction to Likhil, 2006 who elaborated that Nimbicidin a product of neem exaggerated mortality after 10 days and did not cause reduction in population after 24 hours interval. However present work was supported by Srijankul, 2002, who emphasized on toxic effects of five botanical extracts including *A. indica* and *E. cineraceae* on Syrphid fly larvae.

Table 4
Comparative efficacy of botanical extracts against honeybee (*Apis florea.* F.).

Treatments	24 hrs	48 hrs	72 hrs	7 days	15 days
M. charantia fruit extract	44.31±0.08a	41.66±17.43a	33.33±19.24a	0.00±0.00	0.00±0.00
C. cineraceae leaf extract	33.33±19.24a	33.33±19.21a	16.66±9.62 a	0.00±0.00	0.00±0.00
E. cineraceae leaf extract	22.00±12.62a	27.77±8.49a	27.66±15.97a	0.00±0.00	0.00±0.00
M. azadirach leaf extract	33.33±19.27a	16.66±9.70a	0.00±0.00	0.00±0.00	0.00±0.00
A. indica leaf extract	33.33±19.32a	52.00±16.83a	0.00±0.00	0.00±0.00	0.00±0.00
A. indica seed kernel extract	33.33±19.51a	52.33±16.90a	16.66±9.62a	0.00±0.00	0.00±0.00
LSD	42.441	59.204	43.411	0.00	0.000

Table 5
Comparative efficacy of botanical extracts against garden beetle (*Maladera castanea* Arrow).

Treatments	24 hrs	48 hrs	72 hrs	7 days	15 days
M. charantia fruit extract	23.33±8.44a	55.55±16.88a	29.33±4.55a	0.00±0.00	0.00±0.00
C. cineraceae leaf extract	33.33±19.34a	58.33±17.48a	63.66±6.83a	0.00±0.00	0.00±0.00
E. cineraceae leaf extract	45.33±13.09a	62.50±18.17a	40.16±2.40a	0.00±0.00	0.00±0.00
M. azadirach leaf extract	56.66±17.09a	69.22±1.72a	42.66±13.17a	0.00±0.00	0.00±0.00
A. indica leaf extract	53.33±36.81a	54.16±17.01a	33.33±52.57a	0.00±0.00	0.00±0.00
A. indica seed kernel extract	33.33±19.45a	45.83±17.05a	60.00±18.52a	0.00±0.00	0.00±0.00
LSD	63.567	71.541	71.412	0.00	0.00

Table 6
Effect of botanical extracts on population of seven spotted beetle (*Coccinella septempunctata* L.).

Treatment	24 hrs	48 hrs	72 hrs	7 days	15 days
M. charantia fruit extract	13.33±7.66a	33.33±19.19a	0.00±0.00	0.00±0.00	0.00±0.00
C. cineraceae leaf extract	0.00±0.04a	11.11 ±6.28a	0.00±0.00	0.00±0.00	0.00±0.00
E. cineraceae leaf extract	13.33±7.67a	0.00±0.13a	0.00±0.00	0.00±0.00	0.00±0.00
M. azadirach leaf extract	0.00±0.039a	22.22±12.74a	0.00±0.00	0.00±0.00	0.00±0.00
A. indica leaf extract	0.00±0.07a	44.44±36.28a	0.00±0.00	0.00±0.00	0.00±0.00
A. indica seed kernel extract	11.11 ±6.49a	0.00±0.13a	0.00±0.00	0.00±0.00	0.00±0.00
LSD	21.883	53.860	0.00	0.00	0.00

Present findings also conclude decisively that the botanical extracts were hazardous to honey bees after 24 hours interval. However, after 48 and 72 hours interval less mortality has been observed. Studies on comparative hazardous effects of botanical extracts against honey bees revealed that *A*. *indica* seed kernel extract caused reduced mortality however it caused significant reduction in thrips and *Heliothis* population after 72 hours interval. *E*. *cineraceae* leaf extract and *C*. *cineraceae* leaf extract showed no persistency in toxicity to honey bees even after 7 days interval. Present work results were similar to Banken and Stark, 1997 who elaborated negative effects of botanical extracts to foraging honeybee species during application. Lowery and Isman (1994) also concluded that *A*. *indica* products must be incrusted in IPM programme being less toxic to benefecials.

Recent work also elaborated that *A*. *indica* seed kernel extract and *C*. *cineraceae* leaf extract were hazardous to Asian garden beetles. While all others did not exhibit toxic effects on Asian garden beetles till 72 hours while no persistency was reflected after 7 and 15 days exposure. Our results on *Coccinellid*s were similar to Swaminathan 2010 who reported side effects of botanicals on *Coccinella septempunctata* population. All the botanical extracts have proved hazardous up till 72 hours but all of them were safe after 7 days.

CONCLUSION

A. *indica* seed Kernel extract proved hazardous to pests of rose and safer to beneficial and non-target insect fauna after 7 days of the application. However other plant extracts also have potency to kill the pest pests in ecosystem. We conclude that work must be done to explore the biochemical properties of these extracts against target pests. So that, the active ingredients of these extracts might be explored and utilized in IPM.

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