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Evaluate the Efficacy of Insecticides, Botanicals, Entomopathogenic Fungal and Biocontrol Agent against Infestation of Aphid, *Lipaphis erysimi* on Mustard

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ABSTRACT

Highest reduction of aphid population was observed in spray ofneem oil (32.5%) followed by Monocrotophos (36.5%), Beauveria bassiana (37.5%), Dimethoate (40.0%), Extract of Lantana camera (42.5%). The mustard production was found highest yield, Dimethoate (93g), followed by Monocrotophos (86g), Lantana camera (53g) and neem oil (53g), Beauveria bassiana (52.5g) as compared to the control one (50.5g).

Key words: *Mustard aphid, Insecticides and Bio agents.*

INTRODUCTION

At global level, India rank first in acreage with 30 per cent of area under rapeseed and mustard but ranks second in production after China. About 23 states of India are producing rapeseeds and mustard. Among them Rajasthan, Uttar Pradesh, Uttaranchal, Punjab, Haryana, Delhi, Bihar, Madhya Pradesh, Chhattisgarh, Jharkhand, Gujarat and West Bengal are major rapeseed and mustard growing states. After independence the area and production of oilseeds in general and rapeseed and mustard in particular have increased substantially.

Among various biotic factors like fungi, bacteria, viruses, nematodes, non-insect pest and insect pests, insect pests are one of the most important factors which are responsible to hamper and decrease the quality and productivity. It has been very rightly advocated that in agriculture the production technology is inextricably interwoven in the production technology and therefore, the production technology cannot succeed unless there is adequate progress in protection technology. A large number of insect-pests have been reported to be associated with various stages of crop growth of rapeseed and mustard. Among them mustard aphid, *Lipaphis erysimi* (Kalt.) is the most destructive one in India and other tropical and sub tropical parts of the world and is considered to be a major bottleneck in the successful cultivation of these very important edible oilseed crops.

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MATERIAL AND METHODS

Experimental site was situated in main campus of the university on the right side of Kanpur Road at a Distance of 12 km from Jhansi Railway Station. In addition to the lab work, micro-plot research work has been carried out behind the Institute of Agricultural Sciences, Bundelkhand University, Jhansi.

The use of insecticides, botanicals and entomopathogenic fungal biocontrol agent a randomized block design (RBD) was used to make a layout with six treatments including control along with two replications. In proposed layout, twelve microplots were prepared with individual size 2x2.5m^2 while 0.5m wide boarders were maintained among the treatments and replications. Prior to the seed sowing in prepared microplot, adequate and equal amount of well decomposed farm yard manure (FYM) were amended in each microplot followed proper mixing. At sowing, each microplot was maintained with sufficient amount of moisture by clean surface leveling. This design allowed us to optimize resources while still maintaining realistic plot sizes under typical conditions of commercial production during the winter season of 2015-2016. At seed sowing, chemical fertilizer *i.e*. Urea, Sulpher and DAP were also applied as accordance with recommended dose in each microplot. Seed sowing of mustard crop Cv. Sarthi SHS-5001 was done on 23 Nov. 2015 by spacing of seed to and row to row with 30x35cm.

RESULT AND DISSCUSON

The infestation of mustard aphid (*Lipaphis erysimi* Kalt.) and larval population on mustard crop treated with various insecticides. Aphids Population was recorded on the first, third and sixth day after the spraying of insecticides. On 1st spray, the minimum aphid population was recorded in the treatment of Neem Oil (40.5) followed by Monocrotophos (42.5), *Beauveria bassiana* (46.5), Dimethoate (47.5), Extract of *Lantana camera* (52.5) as compared to the adequate control (75) in table-1. Highest reduction of aphid population was observed in spray ofneem oil (32.5%) followed by Monocrotophos (36.5%), *Beauveria bassiana* (37.5%), Dimethoate (40.0%), Extract of *Lantana camera* (42.5%). Reduction in aphid population may be due the toxic effect of different molecules and active ingredient present in various management components used as spray in proposed investigation to suppress the aphid population during flowering of mustard crops. Botanicals, being a source of bunch of toxic compounds, are not only creating toxic environment against the insect pest but at the same time they are very safe, sustainable and biodegradable in nature as compared to the insecticides. In support of present findings, Arun and Lal[2] studied the effect of botanical leaves, neem leaf extract (*Azadirachta indica*), Congress grass leafextract (*Parthenium hysterophorus*) Lemmon grass leaf extract (*Cymbopogon citrates*), Bhang leaf extract (*Cymbopogon citrates*), Garlic leaf extract (*Allium sativum*), Punch phuli leaf extract (*Lantana camera*) and Marigold Leaf extract (*Tageteserecta*) on mustard aphid was assessed in field. The botanical extracts showed varying effect on aphidpopulation and neem leaf extract (T_1) inflicted consistently the maximum level of aphid mortality (77.33% and 71.76%) followed by Punch phuli leaf extract (74.35% and 70.96%) and Garlic leaf extract (73.19% and 62.17%) during seventh day after spray in both year 2009-2010 and 2010-2011. All the treatments of plant leaf extracts showed insecticidal activity, but Indian neem leaf extract followed by Punch phuli leaf extract and Garlic leaf extract reduced the aphid population to a great extent[7,8,4,2]. The combination of botanical insecticide was also been tried against aphid population by Gupta *et al.*[5], and observed that the efficacy of neem [*Azadirachta indica*] kernel extract in cow urine (NSKE; 30 ml/litre), neem oil (1.0%), dimethoate (0.045%), NSKE + dimethoate (0.03%), NSKE (3.0%) + dimethoate (0.03%), neem oil (1.0%) + dimethoate (0.03%), and neem kernel extract in cow butter milk (NCBM; 20 ml/litre) against *L. erysimi* on *Brassica juncea* (cv. Pusa Bold) under normal (31 October; D1) or

late (17 November; D2) sowing was evaluated in Tikamgarh, Madhya Pradesh, India, during the rabi of 2001-02 and 2002-03. *L. erysimi* infestation started on the last week of November under D1 and in the middle of December under D2. Clipping of aphid-infested twigs was conducted just after the onset of infestation and at 25 days after the initial clipping (DIC) for D1 and at 15 DIC for D2. Under D1, clipping significantly reduced the aphid population such that there was no need to apply another control measure. Under D2, clipping controlled the aphid incidence for approximately 25 days, reducing the amount of insecticides by at least one application. The grain yield was very high under D1 with 2 clippings (1855 kg/ha) compared to D2 (857 kg/ha). The former treatment gave a return of 13 972 rupees/ha. Under D2, all treatments significantly reduced the pest incidence up to 15 days of application and increased the grain yield over the control. NSKE (3.0%) + dimethoate (0.03%) recorded the highest grain yield (1532 kg/ha). The highest benefit cost ratio (30.1) was obtained with NCBM (2.0%).

On 2nd spray, extract of *Lantana camera* (30.0) was found most effective to combating the aphid population followed by Dimethoate (36.66), *Beauveria bassiana* (37.97), Monocrotophos (43.33), neem oil (46.00) as compared adequate control (90.5) as listed in Table-1. Maximum reduction of aphid population in 2nd spray was observed in Extract of *Lantana camera* (53.02%) treated microplot followed by Dimethoate (55.81%), *Beauveria bassiana* (58.54%), Monocrotophos (59.67%), neem oil (64.07%). In same line of action of present results, Agrawal *et al.*[1], also reported similar results by conducting with a field experiments were carried out in Kanpur, Uttar Pradesh, India, during rabi 2001-02 and 2002-03 to investigate the efficacy of some neem [*Azadirachta indica*]-based and chemical insecticides against mustard aphid (*L. erysimi*). The treatments comprised 1.0% neem oil, 5.0% neem seed kernel extract (NSKE), 0.07% endosulfan, 0.01% decamethrin [deltamethrin], 0.025% methyl-*O*-demeton [demeton-*O*-methyl], 0.03% dimethoate, 0.03% phosalone, 1 kg phorate+5.0% NSKE, 2.5% NSKE+0.035% endosulfan, 2.5% NSKE+0.015% dimethoate, 2.5% NSKE+0.015% phosalone, 2.5% NSKE+0.005% decamethrin and a control. The most effective insecticide was methyl-*O*-demeton at 0.025%, followed by dimethoate at 0.03% and phorate at 1 kg/ha+NSKE at 5.0%, which resulted in the minimum aphid infestation observed 15 days after spraying and the highest yield in both years. Neem oil at 1.0% was the least effective in controlling the aphid population and therefore, recorded the lowest mustard yield.

On 3rd spray, extract of neem oil (24.5) was found most effective to inhibiting the aphid population followed by Monocrotophos (27.54), *Beauveria bassiana* (30.5), Dimethoate (31.5), *Lantana camera* (34.5) as compared adequate control (101). Maximum reduction of aphid population in 2nd spray was observed neem oil (75.73%) treated microplot followed by Monocrotophos (72.76%), *Beauveria bassiana* (69.78%), Dimethoate (68.79%), Extract of *Lantana camera* (65.82%). Mortality of aphids were extended upto long spell of time as date of spraying extended towards fruit set and maturity. In present surveillance of aphid population, effect of toxic compounds suppressed the population of all stages of aphids particularly the botanical one. In support of present results and observations, Sharma[6] conducted experiment with mustard cv. Pusa Bold in Madhya Pradesh, India, during 1999-2000 and 2000-01 to investigate the efficacy of neem (*Azadirachta indica*) leaf extracts (NLE) and neem kernel extracts (NKE) in cow urine, neem oil, phosphamidon, dimethoate and their combinations were evaluated against the mustard aphid (*Lipaphis erysimi*) along with their impact on the activity of coccinellid beetles (biological control agents of mustard aphid. The treatments comprised NLE at 1% (5 l cow urine+1.250 kg neem leaves/ha), NLE at 2% (10 l cow urine+2.500 kg neem leaves/ha), NLE at 3% (15 l cow urine+3.750 kg neem leaves/ha), NKE at 1% (5 l cow urine+500 g neem kernels/ha), NKE at 2% (10 l cow urine+1 kg neem kernels/ha), NKE at 3% (15 l cow urine+1.500

kg neem kernels/ha), Neem oil at 1% (5 l neem oil/ha), phosphamidon (Phosphamidon 85 EC) at 0.04% (240 ml/ha) and untreated control. These treatments were framed on the basis of preliminary Conducted conducted at this station during 1998-99. During 2000-01, dimethoate at 0.045% was taken in place of phosphamidon at 0.04%. Three combination treatments were added: NLE (in cow urine) at 3%+dimethoate at 0.03%, NKE (in cow urine) at 3%+dimethoate at 0.03% and neem oil at 1%+dimethoate at 0.03%. The treatments significantly reduced the incidence of mustard aphid and increased the grain yield of mustard. Combination treatments of dimethoate at 0.03% either with NKE at 3% or NLE at 3% followed by dimethoate at 0.045% and phosphamidon at 0.04% were the most effective in reducing the aphid incidence. Mean grain yield was highest (1836 kg/ha) in phosphamidon at 0.04%, followed by neem oil at 1%+dimethoate at 0.03% (1541 kg/ha) and NKE at 3% (1508 kg/ha). Mean net profit was also highest in phosphamidon at 0.04% (Rs 9246/ha) and NKE at 3% (Rs 5938/ha). The incremental cost benefit ratio was highest in NKE at 2% (15.5%) and NKE at 3% (15.1). The results suggest that the incidence of mustard aphid can be safely and successfully managed by adopting 3 or 4 foliar sprays of NKE (in cow urine) at 3% either alone or in combination with reduced dose of dimethoate at 0.03%. As it is Arjun *et al*.[2], also furnished the data of conducted experiment on bio efficacy of mustard oil @ 2%, linseed oil @ 2%, neem oil @ 2%, sesame oil @ 2%, diesel @ 1%, kerosene @ 1%, mustard cake @ 2%, sesame cake @ 2%, neem seed kernel extract @ 5%, dimethoate 30 EC @ 300 g a.i/ha and water spray against mustard aphid, *Lipaphis erysimi* (Kalt.) revealed that significantly higher reduction was recorded without any phytotoxic effect. Water spray alone did not play any significant role in reduction of population. These treatments were also found safe to natural enemies of aphid and to honey bee. Most favourable cost benefit ratio was obtained with dimethoate 30 EC @ 300 g a.i/ha (1:39) followed by kerosene @ 1% (1:21), neem seed kernel extract @ 5% (1:19), diesel @ 1% (1:14), mustardcake @ 2% (1:13), sesame cake @ 2% (1:10), neem oil @ 2% (1:8), mustard oil @ 2% (1:7), water spray (1:6), linseed oil @ 2% (1:5), sesame oil @ 2% (1:3) and water spray (1:2). Present findings concluded that the combination of botanical and insecticide would be as assets for management of mustard aphids as accordance with the date of sowing and weather effect.

Table 1: Field efficacy of insecticidal treatments of neem oil, Monocrotophos, *Beauveriabassiana*, Dimethoate and *Lantana camera* on population of Aphids on mustard crop after 1st, 2nd and 3rd spray:

Treatment	Component	Dose@ g/L	Average Aphid population per top 10 cm of central shoot	Reduction of Aphid population after 1st spray	Average Aphid population per top 10 cm of central shoot	Reduction of Aphid population after 2nd spray	Average Aphid population per top 10 cm of central shoot	Reduction of Aphid population after 3rd spray
			7 DAS		14 DAS		21 DAS	
T-1	*Beauveria bassiana*		46.5	37.97 (38.03)	37.5	58.54 (49.92)	30.5	69.78 (56.66)
T-2	Monocrotophos	1.5	42.5	43.33 (41.17)	36.5	59.67 (50.57)	27.5	72.76 (58.54)
T-3	Neem Oil	15	40.5	46.00 (42.71)	32.5	64.07 (53.18)	24.5	75.73 (60.48)
T-4	Extract of *Lantana camera*	15	52.5	30.00 (33.21)	42.5	53.02 (46.74)	34.5	65.82 (54.23)
T-5	Dimethoate	1.5	47.5	36.66 (37.27)	40.0	55.81 (48.33)	31.5	68.79 (56.04)
T-6	Adequate Control		75		90.5		101	
C.D.@ 5%			3.19	2.37	3.19	1.58	3.70	1.00
Figures in parentheses are transformed angular values								
Mean of three replications								

The yield of mustard is one the major gray area where spraying of treatments would create major impact over the control one as results found in present observation. Among all the given treatments at different time intervals, the leading performer in producing highest yield was Dimethoate (93g), followed by Monocrotophos (86g), *Lantana camera* (53g) and neem oil (53g), *Beauveria bassiana* (52.5g) as compared to the control one (50.5g). It may be due to the high decline of aphid population by spraying of toxic compounds in form of treatments while gradual increment in mustard aphid population in untreated adequate control one due to the absence of toxin. High toxicity of treatments suppressing the aphids population as result very less effect/infestation were encountered on flower and pod set and ultimately the positive response appeared on yield as showed in Table-. In support of present result and their observation, Baral and Sethi[3]. also conducted experiment with five treatments for the management of aphid (*Uroleucon compositae* T.) on safflower cultivar Bhima during post rainy season of 2005-06 and 2006-07. The spray fluid @ 500 L ha^{-1} was used to each of the treatment. Every year, two sprays of all the treatments except seed treatment and absolute control were applied at an interval of 15 days commencing from 15-20 days after the first aphid occurance (>ETL). The seed treatment was given at the time of sowing. The fermented extract of dashparni was prepared on w/v basis by soaking the leaves of all ten plants in the clean water for the period of one month prior to the spraying. A daily shake was given for better soaking of the leaves. In the support of present findings, Baral and Sethi[3]. also observed that the effect of treatment of jivamrut, a mixture of 5 liter cow-urine, 1 kg jaggary, 1 kg crushed grains and 1 kg cow dung for each plot (4.00 x 4.50 m^2), was found the most effective in suppressing aphid infestation and producing good seed yield (1002 kg ha^{-1}) followed by seed treatment (684 kg ha^{-1}), goneem (578 kg ha^{-1}) and dashparni (540 kg ha^{-1}). The other two formulations *viz.*, jivamrut and cow-urine were relatively less effective for aphid control and producing seed yields as well.

Table 2: Field efficacy of insecticidal treatments of neem oil, Monocrotophos, *Beauveria bassiana*, Dimethoate and *Lantana camera* on germination (%), Plant Height (cm) and yield (g) on mustard crop after 1st, 2nd and 3rd spray:

			Germination (%)	**Plant Height**	**Seed weight (g)**
T-1	*Beauveriabassiana*		78.75 (62.79)	96 (10.26)	52.5 (7.58)
T-2	Monocrotophos	1.5	77.88 (62.11)	104.5 (10.67)	86 (9.76)
T-3	Neem Oil	15	77.88 (62.11)	100.5 (10.52)	53 (7.78)
T-4	Extract of *Lantana camera*	15	90.00 (71.57)	99 (10.44)	53 (7.76)
T-5	Dimethoate	1.5	77.50 (62.00)	124.5 (11.64)	93 (10.13)
T-6	Adequate Control		83.25 (65.84)	104 (10.69)	50.5 (7.73)
C.D.@ 5%			N.S.	N.S.	1.48
Figures in parentheses are transformed angular values					
Mean of three replications					

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