Testing of Certain Chemical as well as Botanical Insecticides for their Safety to Lady Bird Beetle, *M. sexmaculatus* under Laboratory Condition

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Abstract: The toxicity of pesticides including nine chemical and four botanicals insecticides was studied against the predatory lady bird beetle, *M. sexmaculatus*under laboratory conditions.Cow urine 30.0 per cent and tobacco decoction 1.0 per cent were safest to the grubs and adults of *M. sexmaculatus*followed by uplenchwar formulation 1.0 per cent, neem oil 0.5 per cent and azadirachitin 0.01 per cent treatments, whereas, chemical insecticides *viz.*,phosphamidon 0.03 per cent, carbosulfan 0.025 per cent and quinalphos 0.05 per cent were found highly toxic against the predatory lady bird beetle, *M. sexmaculatus*.

keywords:*M. sexmaculatus, ladybird beetle, insecticides, toxicity, mortality*

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I. INTRODUCTION

Integrated pest management approach should be formulated instead of complete dependence on chemical pesticides, where in all the effective and feasible methods of pest control may be integrated to minimize the use of hazardous chemicals to manage aphid population below economic injury level.

It is therefore, imperative that other harmless methods of pest control should be used to minimize the ill effects of pesticides in the long run. Naturally, for this our attention reverts back to the use of cultural and biological methods of pest control. In view of above complexities, the maximum utilization of predators and parasites for managing the insect pests of major valuable crops is most desirable. Population of coccinellid and other predators keep the aphid population under check. They are great economic importance because a majority of them are predaceous both in their grub as well as in adult stages on aphid (Rawat and Modi, 1969). The ubiquity of pesticides use in crop production systems has posed a limitation for successful implementation of biological control. Thus, integration of biological and chemical control is the fundamental tenet on which integrated pest management is based. Approaches to this integration include reducing pesticide usage, use of selective pesticides and modifying natural enemies to reduce their susceptibility to pesticides (Talha*et al*., 2017).

II. MATERIALS AND METHODS

To evaluate the toxicity of insecticidal formulations against the grub of *M. sexmaculatus*, the laboratory trial was laid out in Completely Randomized Block Design with 14 insecticides in replicated thrice. A parallel control was also kept for comparison. The required concentration of various insecticides was prepared in one litre water. Topical application of insecticides was made on aphid infested twig of mustard kept inside the petridish. Immediately after the treatments, ten grubs of *M. sexmaculatus* were released in each treatment and kept for 1 hour. After 1 hour, these grubs were further transferred to another fresh petridishes containing the mustard aphids that served as food for the predators.

The adults of *M. sexmaculatus* were collected from unsprayed mustard field and exposed to different insecticides for toxicity study. The laboratory trial was laid out in Completely Randomized Block Design with 15 treatments in replicated thrice. Dry film method was used for testing toxicity of different insecticides. For preparing the insecticidal films, a petridish (10 cm diameter) was sprayed with one ml of each insecticide under Potter's spray tower at a pressure of 25 kg/cm^2. The treatments were replicated thrice and a control (water spray) was maintained for each replication. The insecticidal films thus formed were dried under the ceiling fan for about 15 minutes. Ten adults of *M. sexmaculatus* were released and allowed to remain in contact with the film for 45 minutes. Thenafter, the treated adults were transferred to fresh petridishes containing the mustard aphid that served as food for the predators.

The food was changed daily and proper care was taken to avoid the mortality due to starvation. Mortality due to the treatment of different insecticides under test was recorded at 12, 24, 36 and 48 hours after their release in the insecticidal treatment. The data on per cent mortality of adult was subjected to statistical analysis after arc sin transformation.

III. Result and discussion

Perusal of the data presented in Table 1 and fig. 1 indicated that 12 hours after the treatment, cow urine 30.0 per cent, tobacco decoction 1.0 per cent, uplenchwar formulation 1.0 per cent and neem oil 0.5 per cent found safer recording 2.45, 13.51, 16.86 and 23.66 per cent mortality, respectively as compared to chemical insecticides.

Methyl-O-demeton 0.025 per cent had 43.79 per cent grub mortality and was at par with azadirachitin 0.01 per cent. Among chemical insecticides, endosulfan 0.07 per cent, quinalphos 0.05 per cent and carbosulfan 0.025 per cent were found highly toxic to the grub of *M. sexmaculatus* (57.16 % mortality). However, its effect were significantly at par with monocrotophos 0.036 per cent (48.86 %), chlorpyriphos 0.05 per cent (53.82 %), fenvalerate 0.015 per cent (48.86 %), phosphamidon 0.03 per cent (48.86 %) and methyl parathion 0.05 per cent (48.86 %).

After 24 hours of treatments, cow urine 30.0 per cent registered the lowest mortality (2.45 %) followed by tobacco decoction 1.0 per cent(16.86 %), uplenchwar formulation 1.0 per cent (23.66 %), neem oil 0.5 per cent (30.48 %) and azadirachitin0.01 per cent (43.79 %). The highest grub mortality was exhibited by endosulfan 0.07 per cent, chlorpyriphos 0.05 per cent, quinalphos 0.05 per cent and carbosulfan 0.025 per cent (each of 67.22 per cent mortality) and was at par with monocrotophos 0.036 per cent (57.16 %), fenvalerate 0.015 per cent (57.16 %), methyl-O-demeton 0.025 per cent (57.16 %), phosphamidon 0.03 per cent (62.18 %) and methyl parathion 0.05 per cent (57.16 %).

It could be seen from the results obtained at 36 hours after the treatment that the lowest mortality was obtained in cow urine 30.0 per cent (2.45 %) followed by tobacco decoction 1.0 per cent treatment (20.49 %). Monocrotophos 0.036 per cent, methyl-O-demeton 0.025 per cent and methyl parathion 0.05 per cent had 67.22 per cent grub mortality followed by azadirachitin 0.01 per cent (48.86 %) and neem oil 0.5 per cent (33.73 %). Whereas, endosulfan 0.07 per cent and quinalphos 0.05 per cent were highly toxic to the grubs giving 77.28 per cent mortality and was at par with chlorpyriphos 0.05 per cent and carbosulfan 0.025 per cent (each of 73.95 per cent mortality), fenvalerate 0.015 per cent and phosphamidon 0.03 per cent (each of 70.48 % mortality).

After 48 hours of the treatments, the significantly lowest grub mortality was found in cow urine 30 per cent (5.81 %), which was comparable to control (0.50 %). Quinalphos 0.05 per cent treatment had maximum grub mortality (90.47 %) and was at par with endosulfan 0.07 per cent (87.46 %) and monocrotophos 0.036 per cent (84.13 %) as compared botanical insecticides.

Thus, on the basis of above results (Table 1 and Fig. 1), it can be concluded that botanical pesticides (*i.e.* neem oil 0.5 per cent, uplenchwar formulation 1.0 per cent, tobacco decoction 1.0 per cent) and cow urine 30.0 per cent were found safer to the predator grubs giving less than 50 per cent mortality as compared to chemical insecticides (*viz.*, quinalphos 0.05 per cent, endosulfan 0.07 per cent, monocrotophos 0.036 per cent, chlorpyriphos 0.05 per cent, carbosulfan 0.025 per cent, phosphamidon 0.03 per cent, fenvalerate 0.015 per cent, methyl-O-demeton 0.025 per cent and methyl parathion 0.05 per cent). These chemical insecticides were proved highly toxic to the predatory grubs. Similar observations were also reported by Patel (1985), Patel (1992), Zala (1995), Patel (1998), Prasad and Logiswaran (1998) and Talha*et al*., (2017). So, the present findings are more or less similar to the previous workers.

Results presented in Table 2 and fig. 2 revealed that after 12 hours of the treatment,cow urine 30 per cent, tobacco decoction 1.0 per cent, uplenchwar formulation 1.0 per cent, neem oil 0.5 per cent and azadirachitin 0.01 per cent were found safer to the adults of *M. sexmaculatus* causing less than 14 per cent mortality as compared to the chemical insecticides. Among chemical insecticides, quinalphos 0.05 per cent (67.22 %), chlorpyriphos 0.05 per cent (62.18 %) and phosphamidon 0.03 per cent (62.18 %) could gave maximum mortality to the adults of *M. sexmaculatus*. Though, these treatments were statistically equally to each other. Thus, it could be seen that comparatively minimum mortality was observed in botanical insecticides as compared to chemical insecticides.

After 24 hours of the treatment, cow urine 30 per cent, tobacco decoction 1.0 per cent, uplenchwar formulation 1.0 per cent, neem oil 0.5 per cent and azadirachitin 0.01 per cent treatments were found less toxic to the adults giving less than 17 per cent mortality, while chemical insecticides *viz.*, quinalphos 0.05 per cent, endosulfan 0.07 per cent, monocrotophos 0.036 per cent, chlorpyriphos 0.05 per cent, carbosulfan 0.025 per cent, phosphamidon 0.03 per cent, fenvalerate 0.015 per cent, methyl-O-demeton 0.025 per cent and methyl parathion 0.05 per cent were found toxic to the adults. However, adult mortality due to chlorpyriphos 0.05 per cent was (70.48 %) and was at par with quinalphos 0.05 per cent and phosphamidon 0.03 per cent. More or less similar trend was also observed when mortality was assessed at 36 hours the treatment.

After 48 hours of the treatment, the adult mortality was 5.81 per cent recorded in cow urine 30.0 per cent and it was inferior in toxicity as compared to remaining insecticides. Among botanicals products, the mortality was ranged from 23.66 (azadirachitin 0.01 per cent, neem oil 0.5 per cent and uplenchwar formulation 1.0 per cent) to 20.49 per cent (tobacco decoction 1.0 per cent). It was lowest than the chemical insecticides. In case of chemical insecticides, quinalphos 0.05 per cent and chlorpyriphos 0.05 per cent had maximum mortality *i.e.* 84.13 per cent and it was at par with phosphamidon 0.03 per cent (77.28 %). Then after, higher mortality was obtained in the treatment of carbosulfan 0.025 per cent (70.48 %) and methyl parathion 0.05 per cent (67.22 %) followed by endosulfan 0.07 per cent (57.16 %), fenvalerate 0.015 per cent (57.16 %),

monocrotophos 0.036 per cent (53.81 %) and methyl-O-demeton 0.025 per cent (53.81 %).

Looking to the results presented in Table 2 and fig. 2, it could be concluded that cow urine 30.0 per cent proved safer to the adults of *M. sexmaculatus* among all the treatments *i.e.* 5.81 per cent mortality. Among botanical insecticides, *viz.*,neem oil 0.5 per cent, uplenchwar formulation 1.0 per cent, tobacco decoction 1.0 per cent and azadirachitin 0.01 per cent were also found safer to the adults of *M. sexmaculatus*causing less than 25 per cent mortality. All these were significantly lower than all the chemical insecticides (*viz.*, quinalphos 0.05 per cent, endosulfan 0.07 per cent, monocrotophos 0.036 per cent, chlorpyriphos 0.05 per cent, carbosulfan 0.025 per cent, phosphamidon0.03 per cent, fenvalerate 0.015 per cent, methyl-O-demeton 0.025 per cent and methyl parathion 0.05 per cent).

Overall results from Table 1 and 2 (fig. 1 and 2) indicated that cow urine 30.0 per cent and tobacco decoction 1.0 per cent were safer to the *M. sexmaculatus*followed by uplenchwar formulation 1.0 per cent, neem oil 0.5 per cent and azadirachitin 0.01 per cent. Among chemical insecticides, methyl-O-demeton 0.025 per cent, methyl parathion 0.05 per cent, fenvalerate 0.015 per cent were also found less toxic to the *M. sexmaculatus*. From the results, it is concluded that the cow urine and botanicals were found safer to the grubs as well as adults of*M. sexmaculatus*, while chemical insecticides were proved highly toxic. Satpathy*et al*. (1968) suggested that thiometon, demeton-O-methyl and mevinphos and dimethoate exhibited low to moderate toxicity. According to Patel (1992), methyl-O-demeton and endosulfan were less toxic among synthetic insecticides next to the botanical insecticides (neemark, repelin and nicotine sulphate). Patel (1998) concluded that all neem based pesticides were less toxic to *M. sexmaculatus*. Thus, results obtained by the present investigations are confirmed with the results presented by the previous workers.

It can be summarised that botanical pesticides (*i.e.* neem oil 0.5 per cent, uplenchwar formulation 1.0 per cent, tobacco decoction 1.0 per cent) and cow urine 30.0 per cent were found safer to the grubs giving less than 50 per cent mortality as compared to chemical insecticides (*viz.*, quinalphos 0.05 per cent, endosulfan 0.07 per cent, monocrotophos 0.036 per cent, chlorpyriphos 0.05 per cent, carbosulfan 0.025 per cent, phosphamidon 0.03 per cent, fenvalerate 0.015 per cent, methyl-O-demeton 0.025 per cent and methyl parathion 0.05 per cent). These chemical insecticides were proved highly toxic to the predatory grubs as it caused more than 73 per cent mortality.

Cow urine 30.0 per cent proved safer to the adults of *M. sexmaculatus* among all the treatments *i.e.* 5.81 per cent mortality. Among botanical insecticides, *viz.*,neem oil 0.5 per cent, uplenchwar formulation 1.0 per cent, tobacco decoction 1.0 per cent and azadirachitin 0.01 per cent were also found safer to adults of *M. sexmaculatus*causing less than 25 per cent mortality.These was categorized under second group. All these were significantly lower than all the chemical insecticides (*viz.*, quinalphos 0.05 per cent, endosulfan 0.07 per cent, monocrotophos 0.036 per cent, chlorpyriphos 0.05 per cent, carbosulfan 0.025 per cent, phosphamidon 0.03 per cent, fenvalerate 0.015 per cent, methyl-O-demeton 0.025 per cent and methyl parathion 0.05 per cent).

Table 1: Testing of chemical and botanical insecticides for their safety to grub of *M.sexmaculatus*

Sr. No.	Treatment	Conc. (%)	Mortality (%)			
			12 hrs	24 hrs	36 hrs	48 hrs
1	Endosulfan 35 EC	0.07	49.12* (57.16)	55.07* (67.22)	61.54* (77.28)	69.27* (87.46)
2	Monocrotophos 36 WSC	0.036	43.35 (48.86)	49.12 (57.16)	55.07 (67.22)	66.52 (84.13)
3	Chlorpyriphos 20 EC	0.05	47.19 (53.82)	55.07 (67.22)	59.31 (73.95)	63.77 (80.46)
4	Fenvalerate 20 EC	0.015	43.35 (48.86)	49.12 (57.16)	57.08 (70.48)	59.31 (73.95)
5	Methyl-O-demeton 25 EC	0.025	41.43 (43.79)	49.12 (57.16)	55.07 (67.22)	59.31 (73.95)
6	Phosphamidon 85 EC	0.03	43.35 (48.86)	53.05 (62.18)	57.08 (70.48)	61.54 (77.28)
7	Quinalphos 25 EC	0.05	49.12 (57.16)	55.07 (67.22)	61.54 (77.28)	72.02 (90.47)

8	Methyl parathion 50 EC	0.05	43.35 (48.86)	49.12 (57.16)	55.07 (67.22)	61.54 (77.28)
9	Carbosulfan 25 EC	0.025	49.12 (57.16)	55.07 (67.22)	59.31 (73.95)	61.54 (77.28)
10	Azadirachitin 1 % EC	0.01	37.51 (37.08)	41.43 (43.79)	43.35 (48.86)	45.27 (50.46)
11	Cow urine	30.0	9.00 (2.45)	9.00 (2.45)	9.00 (2.45)	13.95 (5.81)
12	Uplenchwar formulation	1.0	24.24 (16.86)	31.31 (23.66)	33.51 (30.48)	35.51 (33.73)
13	Tobacco decoction 1%	1.0	21.57 (13.51)	24.24 (16.86)	26.91 (20.49)	29.11 (23.66)
14	Neem oil	0.5	31.31 (23.66)	33.51 (30.48)	35.51 (33.73)	37.51 (37.08)
15	Control (water spray)	-	4.05 (0.50)	4.05 (0.50)	4.05 (0.50)	4.05 (0.50)
S.Em. ±			2.32	2.24	2.07	2.27
C.D. at 5 %			6.70	6.47	5.98	6.56
C.V. %			11.13	9.49	7.98	8.02

* Figures indicates arc sin transformed values and those in parenthesis are retransformed values

Table 2: Testing of chemical and botanical insecticides for their safety to adult of *M.sexmaculatus*

Sr. No.	**Treatment**	**Conc. (%)**	**Mortality (%)**			
			12 hrs	**24 hrs**	**36 hrs**	**48 hrs**
1	Endosulfan 35 EC	0.07	35.51* (33.73)	37.51* (37.08)	43.35* (48.86)	49.12* (57.16)
2	Monocrotophos 36 WSC	0.036	31.31 (27.00)	41.43 (43.79)	43.35 (48.86)	47.19 (53.81)
3	Chlorpyriphos 20 EC	0.05	53.05 (62.18)	57.08 (70.48)	59.31 (73.95)	66.52 (84.13)
4	Fenvalerate 20 EC	0.015	33.51 (30.48)	37.51 (37.08)	47.19 (53.81)	49.12 (57.16)
5	Methyl-O-demeton 25 EC	0.025	35.51 (33.73)	37.51 (37.08)	47.19 (53.81)	47.19 (53.81)
6	Phosphamidon 85 EC	0.03	53.05 (62.18)	55.07 (67.22)	59.31 (73.95)	61.54 (77.28)
7	Quinalphos 25 EC	0.05	55.07 (67.22)	55.07 (67.22)	61.54 (77.28)	66.52 (84.13)
8	Methyl parathion 50 EC	0.05	35.51 (33.73)	41.43 (43.79)	53.05 (62.18)	55.07 (67.22)
9	Carbosulfan 25 EC	0.025	41.43 (43.68)	43.35 (48.86)	55.07 (67.22)	57.08 (70.48)
10	Azadirachitin 1 % EC	0.01	21.57 (13.41)	24.24 (16.86)	26.91 (20.49)	31.31 (23.66)
11	Cow urine	30.0	9.00 (2.45)	9.00 (2.45)	13.95 (5.81)	13.95 (5.81)
12	Uplenchwar formulation	1.0	18.90 (10.49)	24.24 (16.86)	29.11 (23.66)	31.31 (23.66)
13	Tobacco decoction 1%	1.0	13.95 (5.81)	21.57 (13.51)	24.24 (16.86)	26.91 (20.49)
14	Neem oil	0.5	18.90	24.24	29.11	29.11

			(10.49)	(16.86)	(23.66)	(23.66)
15	Control (water spray)	-	4.05 (0.50)	4.05 (0.50)	4.05 (0.50)	9.00 (2.45)
S.Em. ±			2.75	2.37	2.30	2.28
C.D. at 5 %			7.94	6.84	6.63	6.58
C.V. %			10.35	11.88	10.00	9.39

* Figures indicates arc sin transformed values and those in parenthesis are retransformed values

Fig-1: Testing of chemical and botanical insecticides for their safety to grub of *M. sexmaculatus*

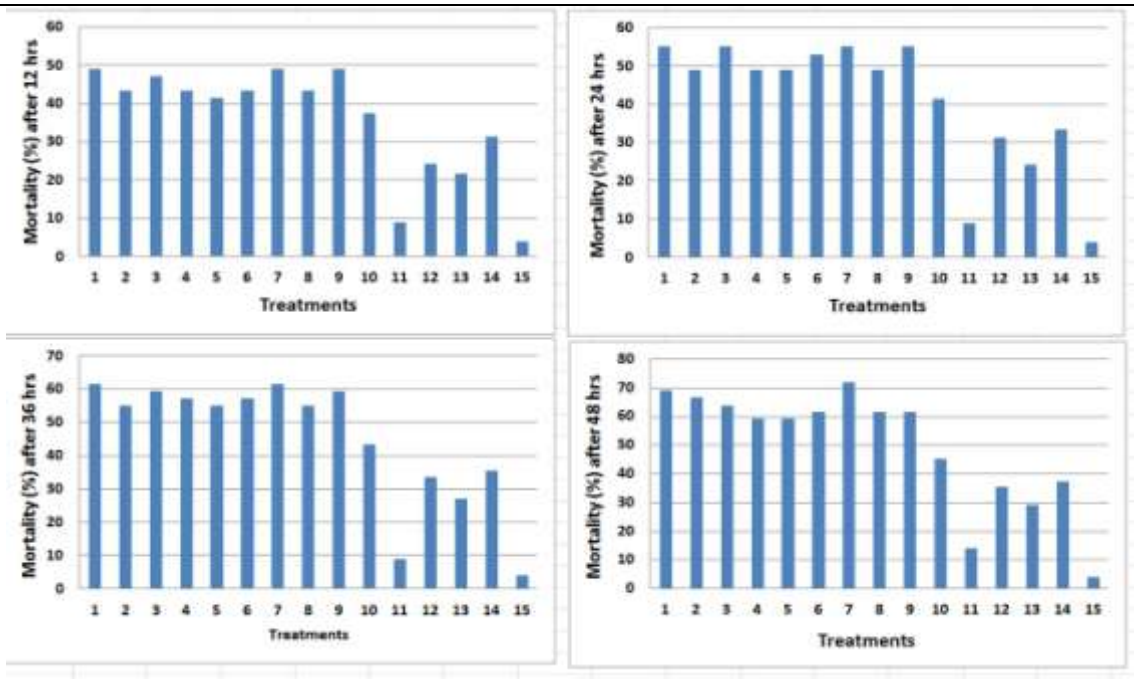
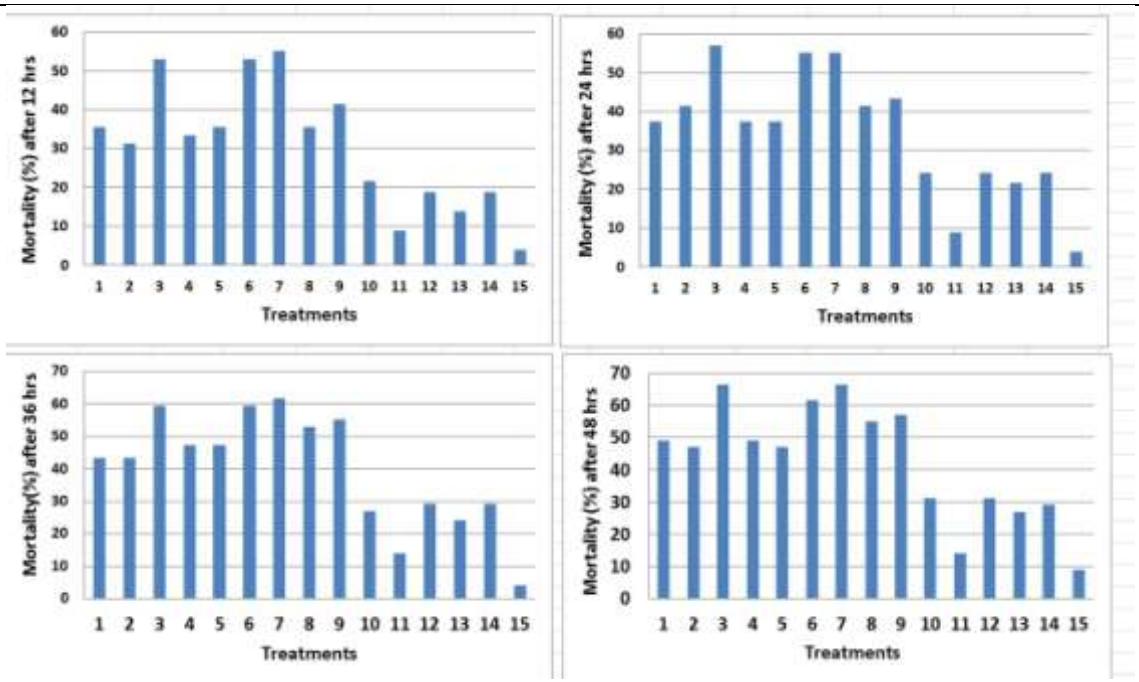


Fig. 2 :Testing of chemical and botanical insecticides for their safety to adult of *M. sexmaculatus*



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