Original Research Article

Laboratory evaluation of some mineral oils against *Myzus persicae*

Abstract

Bioassays were conducted to determine the impact of mineral oil on the mortality of *Myzus persicae* (Sulzer) (Hemiptera: Aphididae). Three concentrations of mineral oil i.e., 0.1, 0.5 and 1.0% v/v were used in the studies. The results revealed that the mean mortality of *M. persicae* varied from 15 to 75%. The results were stastically processed using one way analysis of variance (ANOVA) and Tukey post hoc test for multiple comparisons. This paper highlights the effectiveness of mineral oil in controlling *Myzus persicae*, by demonstrating its impact on aphid mortality and movement, offering valuable insights for pest management in potato fields.

Keywords: Mineral oil; aphids; *Myzus persicae*.

Introduction

Mineral oil, a petroleum-based substance, has been utilized as an insecticide in pest control [1]. Although it can kill some lepidopteran larvae [2], its primary target is small, soft-bodied arthropods like aphids, mites, and scales [3,4,5]. However, it is less effective than synthetic pesticides due to lower and slower insect mortality [6,7]. The mode of action of mineral oil has received comparatively less study attention in comparison to other pesticide classes.

Mineral oils interfere with the aphid's stylet ability to retain viruses [8]. Applying mineral oil to solanaceous crops resulted in a gradual decrease in PVY transmission [9]. Horticultural mineral oils interfere with the binding of virions within the stylets, reducing the viral competency of aphids for noncirculative viruses [10]. Mineral oils that have been properly emulsified can enter the intercellular spaces of the vascular plant's epidermal cells and, based on their molecular weight, the stomata [11]. Because of the cohesive and sticky qualities of the mineral oil, the aphid stylet quickly picks up a thin oil layer through intercellular probing [12]. According to studies oil may change the stylet's charge, which would prevent viral proteins from attaching to the stylet, adsorbing, or being extracted during feeding [13]. Aphid mortality was elevated by oil treatment but colorado potato beetle mortality was unaffected, adults that developed on oil-treated potato plants grew more slowly and were smaller. Furthermore, oil worked in concert with *Beauveria bassiana* an entomopathogenic fungus belonging to the *Hypocreales: Clavicipitaceae* family, killed Colorado potato beetle larvae more quickly when both products were sprayed on them than when *B. bassiana* was used alone. Oil also may induce plant defenses that help protect against PVY infection [14]. These findings suggest that mineral oil could be used more widely in potato IPM initiatives [15].

Recently, there has been a renewed focus on the usage of mineral oils due to the rising need for environmentally friendly pest management techniques. Mineral oil can form a physical barrier on plant surfaces, hindering aphid movement and feeding. Many insecticides have been removed due to negative impact on environment because they are highly hazardous to some beneficial insects. Despite some research, the effects of mineral oil on aphids (*Hemiptera: Aphididae)* remain unclear, partly due to the apparent contradictions in some of the published findings.The impact of mineral oil on aphids are detailed in this paper. Aphids named green peach aphid, *Myzus persicae* (Sulzer) (*Hemiptera: Aphididae*), were used in the tests. This species is among the most prevalent aphids that colonize potatoes.

Methodology

Average sized aphids were used for the experiment. The *Myzus persicae* colony was initiated from a single apterous parthenogenetic female. Aphids were reared on Chinese cabbage plants raised in a growth room maintained at 20 ± 1^{o}C under a photoperiod of L16:D8. Young adults were used for experiments. Chinese cabbage seeds have been sown in pots and placed in the glass house. After few days, plants were ready for the bioassay experiments. Three mineral oils named servo, orchol and agrospel with three concentration each were selected for the experiment. Three mineral oil concentrations (0.1% v/v, 0.5% v/v and 1% v/v were used for the spray. Vials were filled with agar solution and leaves were cut in a disc shape before placing them in experimental vials. Agar solution was prepared one night before setting the experiment. Leaves were treated with different concentrations of mineral oils. Leaves were air dried before placing them in agar filled vials. After that aphids were placed on the leaves to feed and vials were covered with muslin cloth before placed in incubator in 21^{O} C temperature. Thereafter, readings were recorded till 100% mortality rate or leaves got dry completely. The experiment was repeated several times. One-way anova was performed to analyse mineral oil effects on aphid mortality. After performing anova parametric tukey test was performed using software spss. Results are reported as mean ± standard error of the mean (SEM)

Results

1.Servo leaf treatment

Leaf discs were sprayed with servo oil concentrations and placed in incubator. Readings were recorded each hour for 5-6 days till the leaf disc got dried or aphids shown 100% mortality. Later on, normality tests were run for the values and one-way anova readings were recorded. From the table 1. it is observed that the mean and median for the treatment are almost equal and skewness for the constructs is nearer to zero, hence it confirms asymptotic normality of the data. This enables to apply parametric test on the collected sample data. Mineral oil application on leaf with different concentrations showed significant results. Mortality showing mean ± SE as 6.19±2.63, 15.9±3.51, 30.9±4.34 and 65.7±4.34 was observed for servo (df =3, mean square =4775.126 between groups and df=24, mean square =100.857) with significance <.001. After performing post hoc test for servo, it was found out in table 3 that control, 0.1v/v, 0.5%v/v and 1% v/v are showing significant results. After leaf treatment servo showed significant mortality with each concentration. Bar graph 1 showing six days average mortality for 0.1% v/v servo 15.9%. 0.5%v/v servo showed mortality in aphids to 30.9%. Average mean mortality for 1% servo was 65.7%. it didn't harm the potato leaves in any way. After leaf treatment servo showed significant mortality with each concentration. Bar graph 1 showing six days average mortality for 0.1% v/v servo 15.9%. 0.5%v/v servo showed mortality in aphids to 30.9%. Average mean mortality for 1% servo was 65.7%. it didn't harm the potato leaves in any way.

	Mean ± SE	Median	SD	Skewness	Kurtosis
Control		3.33		1.568	2.260
6.19±2.63		6.96			
0.1%	servo	14.2		-.001	-1.428
15.9±3.51		9.29			
0.5%	servo	33.3		-.235	-.816
30.9±4.34		11.5			
1.0%	servo	63.3		-.174	0.810

65.7±4.34	11.5

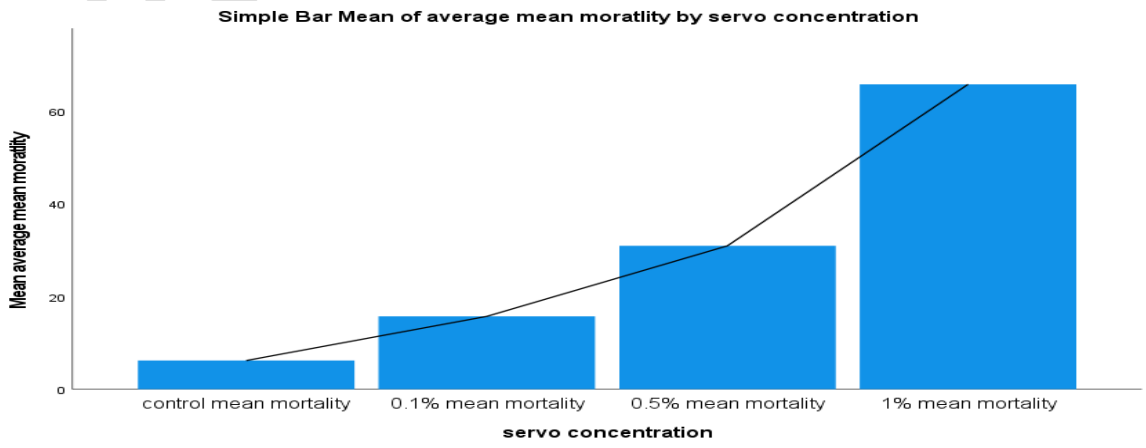
Table 1: Normality readings for servo leaf treatment.

Percentage Mortality					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14325.377	3	4775.126	47.345	<.001
Within Groups	2420.578	24	100.857		
Total	16745.955	27			

Table 2: One-way anova result for servo concentrations

Type of treatment (I)	Type of treatment (J)	Mean difference (I-J)	significance
Control	0.1% Servo	-9.55095	<.001
	0.5% Servo	-24.76667*	<.001
	1% Servo	-59.52857*	<.001
0.1% Servo Mortality	Control	9.55095	<.001
	0.5% Servo	-15.21571*	<.001
	1% Servo	-49.97762*	<.001
0.5% Servo Mortality	Control	24.76667*	<.001
	0.1% Servo	15.21571*	<.001
	1% Servo	-34.76190*	<.001
1% Servo Mortality	Control	59.52857*	<.001
	0.1% Servo	49.97762*	<.001
	0.5% Servo	34.76190*	<.001

Table 3: Tukey post hoc test values



Bar graph 1: mean mortality for servo

2. Orchol leaf treatment

Normality test showed that data was normally distributed and was ready for the performance for further tests. Control values showed (SD=8.32, skewness 1.23±0.752, kurtosis=0.97±1.481). further normality test for 0.1%v/v concentration showed (SD=11.9, skewness 0.24±0.752, kurtosis=-1.6±1.481). Then normality for 0.5%v/v concentration showed (SD=6.39, skewness -.214±0.752, kurtosis=-.814±1.481). lastly for 1% values were (SD=10.06, skewness -1.525±0.752, kurtosis=3.481±1.481). One-way anova result showed significant results. where sum of square between groups was14325.377, df=3, mean square= 14325.377, f=47.345 with significance value <.001. Anova showed percentage mortality between groups sum of square as 2420.578, df= 24, mean square= 100.857. Total sum of square was 2420.578 with df=27. After performing post hoc test for orchol, it was found in table 5 that control, 0.1v/v, 0.5%v/v and 1% v/v are showing significant results. Mean difference between different treatments was highly significant. Average mean in table 6 for control means mortality in six days was 6.17% with (SD=8.33, range=23.33, std error= 2.94). 0.1%v/v orchol treatment showed average mean for mean mortality as 23.07% (SD=11.98, range=31.33, standard error of the mean=4.23. mineral oil with 0.5% v/v treatment gave aphid average mean mortality 50.74% with (SD= 6.44, range=18, Standard error of the mean=2.28. lastly 1%v/v orchol concentration showed aphid mortality in potato plants to 71.79% with (SD=10.07, range=33.33, and standard error of the mean= 3.55. bar graph showing increase in aphid mortality after orchol treatment with 0.1%v/v, 0.5%v/v and 1%v/v for six days. Maximum mortality was reported in 1%v/v spray treatment in aphids. Potato leaves didn't show any kind of variations in their colour after spray.

Percentage Mortality					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14325.377	3	4775.126	47.345	<.001
Within Groups	2420.578	24	100.857		
Total	16745.955	27			

Table 4: one-way Anova result for servo concentrations

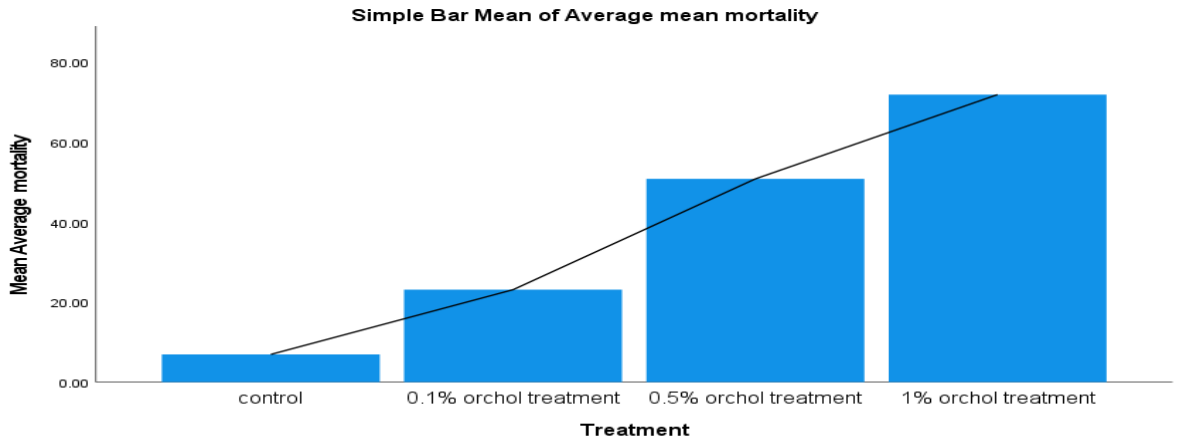
Type of treatment (I)	Type of treatment (J)	Mean difference (I-J)	significance
Control	0.1% orchol	-16.195*	<.001
	0.5% orchol	-43.742*	<.001
	1% orchol	-64.950*	<.001
0.1% Mortality	Control	16.195*	<.001
	0.5% orchol	-27.547*	<.001
	1% orchol	-48.755*	<.001
0.5% Mortality	Control	43.742*	<.001
	0.1% orchol	27.547*	<.001
	1% orchol	-21.207*	<.001
1% Mortality	Control	64.950*	<.001
	0.1% orchol	48.755*	<.001

0.5% orchol	21.207*	<.001

Table 5: Tukey post hoc test values for orchol

	control mean mortality	0.1% mean mortality	0.5% mean mortality	1% mean mortality
Mean	6.9167	23.0716	50.7471	71.7917
Std. Deviation	8.33190	11.97084	6.44835	10.06162
Range	23.33	31.33	18.00	33.33
Std. Error of Mean	2.94577	4.23233	2.27984	3.55732

Table 6: Mean values for the average mean mortality in aphid population



Bar graph 2: graph showing mean for the average mean mortality in aphids after orchol treatments in potato plants.

3. Agrospel leaf treatment

Potato leaves were sprayed with 0.1%v/v, 0.5%v/v and 1% v/v mineral oil with trade name agrospel. Then aphids were allowed to feed for six days. Readings were observed on every day and aphid mortality in treatments were compared with control. Before proceeding to one-way anova normality test was done for the mean mortality readings. Normality test for average mean mortality in aphids after agrospel treatment showed skewness for control as 1.68±0.75 and kurtosis to 2.81±1.48. Skewness and kurtosis for 0.1%v/v treatment is -1.35±0.75 and 1.22±1.48. Treatment with 0.5% agrospel for aphid mortality gave skewness and kurtosis values as -1.88±0.75 and 4.18±1.48. Anova results showed sum of square between groups to 21978.819, df=3, mean square=7326.273, f=124.011 with significance <.001. Sum of squares within groups is 1654.167 in table 7 with df=28 and mean square=59.077. Total sum of square is equal to 23632.986 with df=31 showing that our mean values are highly significant. Average mean in table 9 for control means mortality in six days was 5.00% with (SD=6.90, std error=2.43). 0.1%v/v agrospel treatment showed average mean for mean mortality as 20.4% (SD=8.62582, standard error of the mean=3.04969. mineral oil with 0.5% v/v treatment gave aphid average mean mortality 48.3% with (SD=8.35, Standard error of the mean=2.95. lastly 1%v/v agrospel concentration showed aphid mortality in potato plants to 73.3% with (SD=6.67, and standard error of the mean=2.35. Average mean in table 9 for control means mortality in six days was 5.00% with (SD=6.90, std error=2.43). 0.1%v/v agrospel treatment showed average mean for mean mortality as 20.4% (SD=8.62582, standard error of the mean=3.04969. mineral oil with 0.5% v/v treatment gave aphid average mean mortality 48.3% with (SD=8.35, Standard error of the mean=2.95. lastly 1%v/v agrospel concentration showed aphid mortality in potato plants to 73.3% with (SD=6.67, and standard error of the mean=2.35. Bar graph 3 showing increased trend in the mean of average mean mortality in aphids from lower to higher concentration of mineral oil spray used.

	Mean ± SE	SD	Skewness	kurtosis
Control	5.00±2.43	6.86	1.68±0.75	2.81±1.48
0.1% agrospel	20.4±3.04	8.25	-1.35±0.75	1.22±1.48
0.5% agrospel	48.3±2.95	8.35	-1.88±0.75	4.18±1.48
1.0% agrospel	73.3±2.35	6.66	-1.14±0.75	1.35±1.48

Table 7: Normality readings for servo leaf treatment

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	21978.819	3	7326.273	124.011	< 001