



Irving K. Barber School of Arts and Sciences
3333 University Way
Kelowna, BC Canada V1V 1V7

2010-03-08

Soheil S. Mahmoud
Assistant Professor
Phone: (250) 807-8752
Email: smahmoud@exchange.ubc.ca

Sarah Clark
Certified Organic Association of BC

Dear Ms Clark:

I am please to provide this report, confirming that my project “Developing Lavender Essential Oils Produced in BC as Natural Insect Repellents for Use in Organic Farming” has been completed. We have now met all objectives of the study. We obtained two samples of lavender oil from two different BC businesses. Sample #1 was the oil of Grosso lavender, and was obtained from FPI Inc (Vancouver, BC). Sample #2 was the oil of Supper Lavender, provided by Okanagan Lavender Herb Farm, Kelowna BC.

We evaluated the repellent activity of these essential oils against Spider Mites, and Aphids on bean leaves and green pepper seedlings. The experiments were conducted as a paid service by Ecorational Technologies Inc., who also provided facilities and expertise as in-kind support.

Our results indicated that when diluted in a suitable carrier, 0.2 to 0.5% lavender oils can provide efficient control of Aphids. However, lavender oils tested were not effective against spider mites. For full details please see the final report by Ecorational Technologies Inc. Enclosed please also find a copy of the financial statement. We are considering publishing our results in the Growers Journal, and other related outlets. Please let me know if you require additional information.

Sincerely,

A handwritten signature in black ink that reads 'S. Mahmoud' with a stylized flourish at the end.

Soheil Mahmoud



Efficacy of Lavender Oil Formulations against Spider Mites and Aphids

Andy Maganga BSc(Agric.) MPM

Introduction

Plants utilize their essential oils as a natural defense mechanism against pathogens, insects and mites. While the insecticidal action of lavender oil has been demonstrated in various published studies (e.g. Refaat M et al 2002), variation in efficacy often occurs between different varieties/strains of lavender. Our own previous unpublished studies on the repellence of lavender oils from different varieties against house flies, *Musca domestica* L., have confirmed this phenomenon. Hence, in developing lavender-based repellents and insecticides, it is essential to confirm the efficacy of individual varieties against registered reduced-risk pest control products. The most commonly used reduced-risk insecticide against aphids and to some extent spider mites is insecticidal soap, Potassium salts of Stearic Acid. One limitation of using insecticidal soap is its phytotoxicity and adverse effects on beneficial insects and predatory mites useful in biological control programs (Bostanian N.J and Akalach M. 2006). French Lavender oil *Lavendula Officianalis* Chaix at 0.25% has been found to be least toxic to the beneficial mite *Amblyseius swirskii* Athias-Henriot (Amer S A A & F. M. Momen, 2002). In addition to insecticidal action, lavender is reported to possess repellent action against Green Peach Aphids *Myzus persicae* (Hori M., 1998).

This study was aimed at comparing the efficacy of 0.5% - 2% liquid formulations of lavender oil samples from different lavender varieties produced at UBC Okanagan with that of a commonly-used organic pest control product.

Material and Methods

Comparisons of two samples of essential oils (Sample 1 and Sample 3) from Dr. Soheil Mahmoud were undertaken using field grown green peppers and bean plants in the lower Fraser Valley region of BC. Initially the planned treatments included 0.5%, 1.5 and 2%

lavender oil formulations, a negative control and a positive control. However, after preliminary phytotoxicity studies on Pepper plants, all the proposed concentrations were found to cause plant injury. Hence, lavender oil concentrations used for efficacy comparisons were lowered to 0.1%, 0.125%, 0.2% and 0.5%. All treatments were done either early in the morning or late afternoons on cloudy but not rainy days to reduce plant injury. In all cases, test plants were spray to the point of run-off.

Phytotoxicity Trial Procedures

All preliminary phytotoxicity studies were conducted using Sample 1 and involved spraying the different concentration of lavender oil and control solutions on test plants and rating plant injury as either having No Observable Injury (NOI) or Observable Plant Injury (OPI). Photographs 1 and 2 depict examples of Pepper leaves that fell under each category respectively. Initial assessments involved testing declining concentrations of a carrier (a commercial fruit wash approved by Health Canada for use in food processing) ranging from 5 – 100%. Once the concentration of carrier producing NOI was reached, lavender oils were added to this carrier concentration at increasing rates. These lavender-carrier concentrations were then sprayed on Bell pepper plants to ensure NOI before testing against spider mites and aphids on test plants.

Procedure Used to Assess Efficacy against Aphids

Concentrations of the two samples of lavender oil ranging from 0.1% to 0.5% in 5% carrier solution were sprayed on tips of test plants heavily affected by aphids. While a 10% concentration of carrier alone had NOI on Bell Pepper plants, the 5% concentration was used to reduce the risk of plant injury if the formulation was to be used on more sensitive plants. Upon spraying of aphid-infested tips, the number of dead and live aphids on the top 7.5 cm of the treated tip was determined for each treatment, which was replicated four times. Counts were made 24 hours and 48 hours after treatment as longer periods after treatment did not seem to affect the results. If a treatment was not effective after 48 hours, it did not become effective after one week. Where any of the treatments was effective 48 hours after spraying, re-infestation was never observed to occur after one

week. Dead aphids turned reddish brown after 24 hours (Photograph 3) and black after 48 hours (Photograph 4).

Procedure Used to Assess Efficacy of Test Materials Against Two Spotted Spider Mites (Acari:Tetranychidae)

Preliminary studies with spider mites were undertaken using 1 cm² and 4 cm² bean leaf discs (Photograph 5). The discs were cut out of spider mite infected leaves of bean plants, appropriately treated and then placed on Petri-dishes covered with moistened paper towel and placed in a tray containing water. This enabled the plant tissue to remain turgid for at least 48 hours, increasing the survival rate of untreated spider mites on the leaf discs for the duration of the trial. Infested bean leaves can easily be identified by their mottled appearance (Photograph 6). Counts of mites were obtained under a dissecting microscope. These bioassays were useful in eliminating lower concentrations (0.1% and 0.125%) as ineffective. The remaining concentration (0.2% and 0.5%) were then tested against mites affecting field-grown bean plants. These tests involved counting spider mites on single leaves of the test plants before and after treatment with the two concentrations of oil, insecticidal soap at label recommended rate and the carrier used to dilute lavender oil.

Results

The results of Phytotoxicity assessments are summarized on Table 1 below. Lavender oil concentrations ranging from 0.1% to 0.5% in carrier concentrations less than 10% in water (v : v) did not produce observable phytotoxic effects on Bell Pepper plants. Table 2 below summarized the results of tests conducted against aphids. For both samples (1 and 3), concentrations of 0.2% and 0.5% lavender oil in 5% Carrier concentration provided satisfactory control of aphids after 24 hours (greater than 85% mortality). The 0.5% concentration provided mortality levels (99% and 100% for Sample 1 and 2 respectively) considered sufficient for a control claim with Canadian regulators. The 0.2% concentration will qualify for a suppression claim. Observations made 48 hours after treatment suggest that higher levels of aphid mortality can be achieved with lower concentration.

Spider mite tests did not produce reliable results apart from indicating that the three lower concentrations (0.1 to 0.2% of lavender oil in 5% carrier) and the carrier alone were not effective against two spotted spider mites. Mites were found on treated leaves 24-hours and 48 hours after treatment. The 0.5% lavender in 5% carrier and insecticidal soap produced highly variable results with some leaves having no spider mites and some having as many as 8 out of an initial count of 9 mites still present on the leaves after 24 hours.

Table 1 *phytotoxicity of 0.1% to 0.5% Lavender Oil concentrations in various concentrations of a carrier used to dilute the oil.*

Treatment		Rating
Test Material	Concentration	
Carrier Alone	Undiluted	OPI
	75% in Water	OPI
	50% in Water	OPI
	25% in Water	OPI
	10% in Water	NOI
	5% in Water	NOI
Insecticidal Soap	Label Rate	NOI
Lavender/Carrier	25% Carrier in Water with 0.1% Lavender	NOI
	25% Carrier in Water with 0.125% Lavender	OPI
	25% Carrier in Water with 0.2% Lavender	OPI
	25% Carrier in Water with 0.5% Lavender	OPI
Lavender/Carrier	10% Carrier in Water with 0.1% Lavender	NOI
	10% Carrier in Water with 0.125% Lavender	NOI
	10% Carrier in Water with 0.2% Lavender	NOI
	10% Carrier in Water with 0.5% Lavender	NOI
Lavender/Carrier	5% Carrier in Water with 0.1% Lavender	NOI
	5% Carrier in Water with 0.125% Lavender	NOI

	5% Carrier in Water with 0.2% Lavender	NOI
	5% Carrier in Water with 0.5% Lavender	NOI

Table 2 Numbers of Dead aphids on 7.5 cm of treated plant tips out of the total number of dead and live aphid on tip 24 Hours after treatment with various concentration of two samples of lavender oil, Sample 1 (S1) and Sample 2 (S2).

Treatment Description	Replicate				Means (% Mortality)
	1	2	3	4	
Insecticidal Soap at Label Rate	43/45	30/31	40/40	29/31	35.5/36.75 (97%)
5% Carrier in Water	22/39	34/52	12/45	23/39	22.75/43.75 (52%)
5% Carrier in Water with 0.1% S1	34/52	23/37	35/48	29/38	30.25/43.75 (69%)
5% Carrier in Water with 0.125% S1	29/35	42/55	38/47	32/33	35.25/42.5 (83%)
5% Carrier in Water with 0.2% S1	23/31	39/43	29/32	42/48	33.25/38.5 (86%)
5% Carrier in Water with 0.5% S1	36/38	48/48	45/45	46/46	43.75/44.25 (99%)
5% Carrier in Water with 0.1% S2	32/49	25/38	32/46	35/43	31/44 (70%)
5% Carrier in Water with 0.125% S2	31/39	38/50	41/49	37/39	36.75/44.25 (83%)
5% Carrier in Water with 0.2% S2	26/34	40/45	33/37	39/44	34.5/40 (86%)
5% Carrier in Water with 0.5% S2	27/27	51/51	27/27	32/32	34.25/34.25 (100%)

Conclusion

The results of these trials suggest that lavender oil diluted with a suitable carrier can provide high mortality of aphids without phytotoxicity on Bell Peppers and Bean plants. The optimum lavender concentration was 0.5% lavender oil in 5% surfactant carrier solution in water. The carrier can be substituted for any other surfactant (e.g. dish soap) with low phytotoxicity. In this study, the carrier was phytotoxic at concentration of around 25% in water, hence may not be suitable for more sensitive plants. Organic grower faced with aphid problems can prepare their own lavender oil formulations in surfactants using oils derived from an appropriate lavender variety (strain). However, before such formulation become acceptable for organic farming, they may need to be tested for toxicity to beneficial insects, mites, nematodes and microorganism. In this trial, differences between the two samples were not significant.

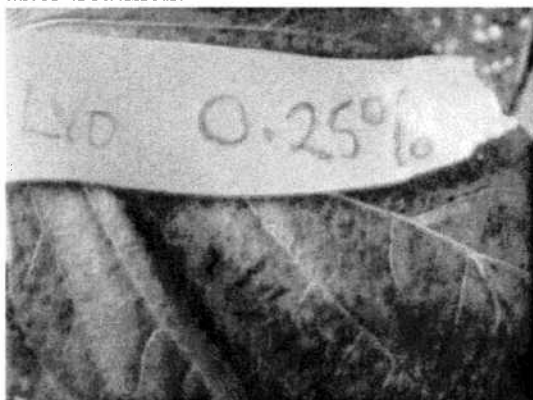
References

- 1) Amer S. A. A; F.M. Momen, 2002 Effect of some essential oils on the predacious mite *Amyloseius swirskii* A. (Acari: Phytoseiidae). *Acta Phthopathologica et Entomologica Hungarica* 37 (1-3) pp 281 – 286.
- 2) Bostanian, Noubar J; Akalach, Mohammed. 2006 The effect of indoxacarb and five other insecticides on *Phytoseiulus persimilis* (Acari: Phytoseiidae), *Amblyseius fallacis* (Acari:Phytoseiidae) and nymphs of *Orius indidiosus* (Hemiptera:Anthocoridae). *Pest Management Science* 62(4) pp.334-339.
- 3) Hori M. 1998 Repellency of Rosemary oil against *Myzus persicae* in a laboratory and in a greenhouse. *Journal of Chemical Ecology* 24(9) pp. 1425 - 1432
- 5) Refaat M.; F. M. Momen; S. A. A. Amer 2002 Acaricidal activity of Sweet Basil and French Lavender essential oils against two species of mites of the Family Tetranychidae (Acari:Tetranychidae).

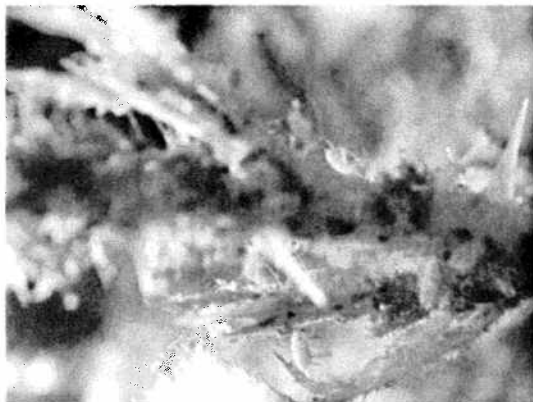
Photograph 1, an example of a leaf exhibiting No Observable Injury (NOI) 48 hours after treatment with 0.5% lavender oil in 5% carrier solution.



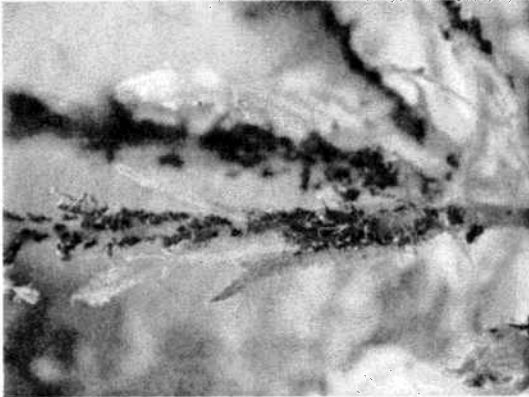
Photograph 2, an example of a leaf exhibiting Observable Plant Injury (OPI) 48 hours after treatment



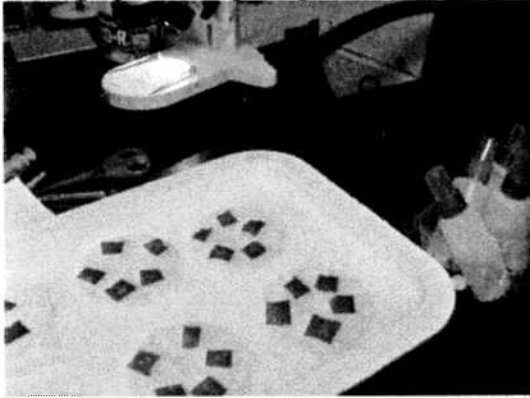
Photograph 3, red coloration of dead aphids after 24 hour used to distinguish them from live ones



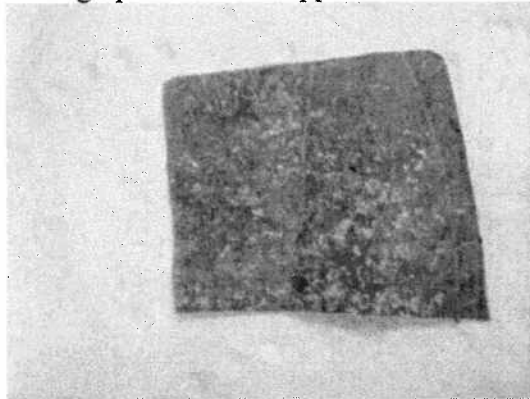
Photograph 4, black coloration of dead aphids used to assess mortality of different treatments after 48 hours



Photograph 5, setup for preliminary bioassays with spider mites on bean leaf disc.



Photograph 6, mottled appearance of bean leaves infested with two-spotted spider mites



THE UNIVERSITY OF BRITISH COLUMBIA



OKANAGAN

Financial Services
Admin 002
3333 University Way
Kelowna, B.C., Canada V1V 1V7
Tel: 250.807.8616
Fax: 250.807-9354

Granting Agency
Certified Organic Associations of BC
202-3002 32nd Avenue
Vernon, BC V1T 2L7
Attn: Sarah Clark, Administrator

Date: February 10, 2010

Project/Grant # 62R45268

Agency Account # N/A

Account Title: Developing Lavender Essential Oils Produced in BC as Natural
Insect Repellents for Use in Organic Farming

UBC Researcher: Dr. Soheil Mahmoud

Statement of Revenue and Expenditures

For the Period of June 1, 2009 to December 31, 2009

Revenue Received in 09/10: \$ 2,500.00

Expenditures:

Travel	289.78
Consulting Fees / Research Contract	3,710.22
Overhead	1,000.00

Total Expenditures \$ 5,000.00

Balance as of December 11, 2009 \$(2,500.00)

Soheil Mahmoud
Principal Investigator

Feb 23, 10

Date

Jeannette Chevette
Research & Trust Accounting

March 2 '10

Date

Note: Please direct all queries regarding this financial statement to Jeannette Chevette
Phone (250) 807-8616 Fax (250) 807-9354 Email: j.chevette@ubc.ca