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Pesticidal effects of indigenous plant extracts against rape aphids and tomato red spider mites

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Abstract Aphids, *Brevicoryne brassicae* and Red spider mites, *Tetranychus evansi* are the most damaging pests of rape, *Brassica napus* and tomato, *Solanum lycopersicum,* respectively. Farmers respond by using synthetic pesticides which pose environmental challenges. Extracts of *Lippia javanica* leaf powder and *Solanum delagoense* ripe fruit pulp were evaluated for pesticidal effects under on-station conditions against rape aphids and tomato red spider mites as alternatives to conventional pesticides and in comparison to Neem, *Azadirachta indica* leaf powder. The extracts of *A. indica, L. javanica and S. delagoense* were mixed with water at 8, 12.5 and 25 % w/v respectively. Amitraz and dimethoate were applied on tomato and rape respectively at label rate. Extracts were kept for 24 h at room temperature and then sieved. A liquid soap surfactant was added at 0.1 % v/v, prior to spraying. Sprays were applied weekly once pest infestations had established within the crop. Pests were counted 24 h after spraying for six weeks. Plant extracts significantly reduced pest numbers ($P < 0.05$) in both experiments. Dimethoate reduced aphid by 96 % while amitraz reduced red spider mite by 72%. *L. javanica* and *S. delagoense* at 12.5 and 25 % reduced aphids by 63 % and 57.9 % and mites by 66.5 % and 55 %, respectively. Both extracts were more effective on aphids than mites while *L .javanica* was more effective than *S. delagoense* on both crop pests. *L. javanica* and *S. delagoense* had some pesticidal effects against the vegetable pests.

Key words: *Lippia javanica,* pesticidal effect, rape aphids, *Solanum delagoense,* tomato red spider mites

Introduction

Vegetable production such as rape and tomato significantly contributes to the livelihoods of most poor Zimbabwean farmers. However, the yields are severely limited by pests, including rape aphids, *Brevicoryne brassicae* and red spider mites, *Tetranychus evansi* . Use of natural pesticides is progressively becoming recognised as with one option to address yield losses due to pest attacks as well as addressing environmental degradations associated with the use of synthetic pesticides (Kopondo, 2004). Thus the need to provide alternatives to the use of conventional pesticides, that produce vegetables free of synthetic pesticide residues while maintaining high product yield and quality (Munyima *et al.*, 2004). The extracts have minimal toxicity to non-targeted organisms and degrade hastily in the environment (Munyima *et al.*, 2004). In this study, the pesticidal effects of *L. javanica* and *S. delagoense* applied as foliar sprays against rape aphids and tomato red spider mite populations were investigated.

Materials and Methods

Study site description. The experiments were carried out at the University of Zimbabwe's Department of Crop Science plots (17º46'51''S, 31º02'37''E; altitude 1516 m) from 5 March to 6 June 2008. The average annual rainfall is above 1000 mm and the mean annual temperature ranges from 15 to 30 ºC.

Plot management. Rape and tomato seedlings were spaced at 45 x 20 cm and 90 x 50 cm, respectively in plots spaced at 1 m apart. Basal compound fertilisers applied were S (7 % N: 20 % P_2O_5: 7 % K_2O: 8 %S) and D (7 % N: 14 % P_2O_5: 7 % K_2O: 8.5 % S**)** at a rate of 5 g for every tomato and rape seedling, respectively. The same amount of ammonium nitrate (34.5% N) was applied as top dressing three weeks after transplanting the rape and at marble fruit size for tomato plants (Agritex, 1998). The plants were irrigated using a hosepipe such that pests would not be washed off the leaves by water droplets if sprinkle irrigation was to be used. Natural pest infestations were used although mite populations had to be augmented with artificial infestation to boost their low initial population. Spraying started two weeks after pests were fully established within the crop.

Preparation of crude aqueous plant extracts. *A. indica* and *L. javanica* leaf powder and pulp of *S. delagoense* fresh fruits were mixed with water on w/v basis and left to stand for 24 h (Stoll, 2000). Liquid soap was added immediately after making the various plant mixtures at a rate of 0.1 % v/v. All the plant mixtures were strained with 710 and 250 μm sieves respectively after 24 h.

Treatments and experimental design. A randomised block design with five treatments replicated three times was used (Table 1). The plant extract application rates were adapted from Kuntashula *et al.* (2006) while the label rate was used in the case of synthetic pesticides.

Spraying, sampling procedures and intervals, and harvesting. The treatments were applied 24 h post-mixing the plant materials with water at rate of one litre on an area of 5 m^2 using a knapsack sprayer fitted with hollow cone spray nozzle. The synthetic pesticides were prepared at spraying time and all treatments were sprayed weekly for six consecutive weeks. Pests sampling was carried out on a weekly basis, 24 h after application of the treatments and before harvesting. Two plants were randomly selected in each plot. The two terminal fully developed tomato leaflets were plucked from bottom, middle and top positions of the plant. The mites were assessed by microscopically counting them in the laboratory. The entire rape plant was physically examined *in-situ* to assess the number of aphids per plant.

Table 1. Experiment treatments and their concentrations.

Crop	Treatment	Concentration
Rape	Water (untreated control)	-
	S. delagoense	25.0 % (w/v)
	L. javanica	12.5 % (w/v)
	A. indica	8.0 % (w/v)
	Dimethoate	0.1 % (v/v)
Tomato	Water (untreated control)	-
	S. delagoense	25.0 % (w/v)
	L. javanica	12.5 % (w/v)
	A. indica	8.0 % (w/v)
	Amitraz	0.3 % (v/v)

Data analysis. The weekly aphid and red spider mite counts were subjected to logarithmic transformation [$\log_{10}$ (pest count +1)] and analysed by General Treatment Structure in Genstat Discovery 2nd Edition (GenStat, 2005) and multiple comparisons of means were separated using the least significant difference (LSD) at 5 % level of significance.

Results

Effects on rape aphids. Aphid numbers for the various extract treatments were significantly lower compared to control ($P = 0.001$). *L. javanica* and *S. delagoense* at 12.5 and 25 % reduced aphids by 63 and 57.9 %, respectively. However, the mean aphid counts per plant increased with time (Fig. 1).

Effects on tomato red spider mites. The treatment efficacy differed significantly ($P < 0.05$) in mean red spider mite counts on tomato plants. *L. javanica* and *S. delagoense* reduced mites by 66.5 and 55 %, respectively. For all treatments, the mean mite counts per tomato plant increased with the sampling time (Fig. 2).

Discussion

The study demonstrated that both *L. javanica* and *S. delagoense* had pesticidal effects on aphids and red spider mites on rape and tomato respectively. The efficacy of both plant species extracts varied within the period of

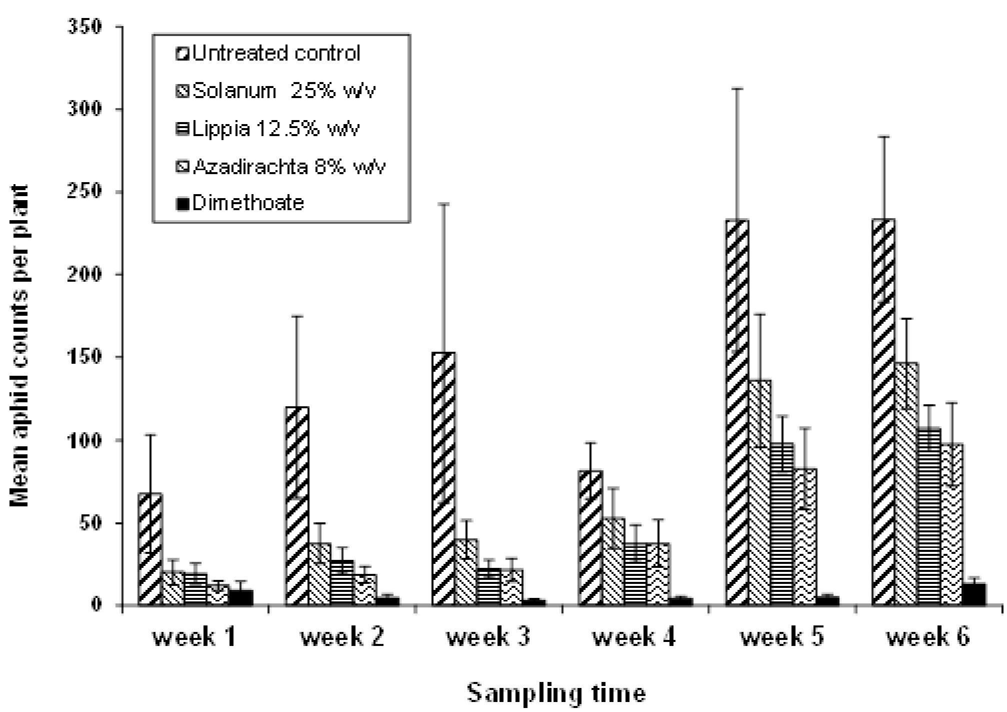

Figure 1. Effects of different pesticidal plant treatments on weekly mean (±SEM) aphid population recorded 24 h after spraying (n = 3).

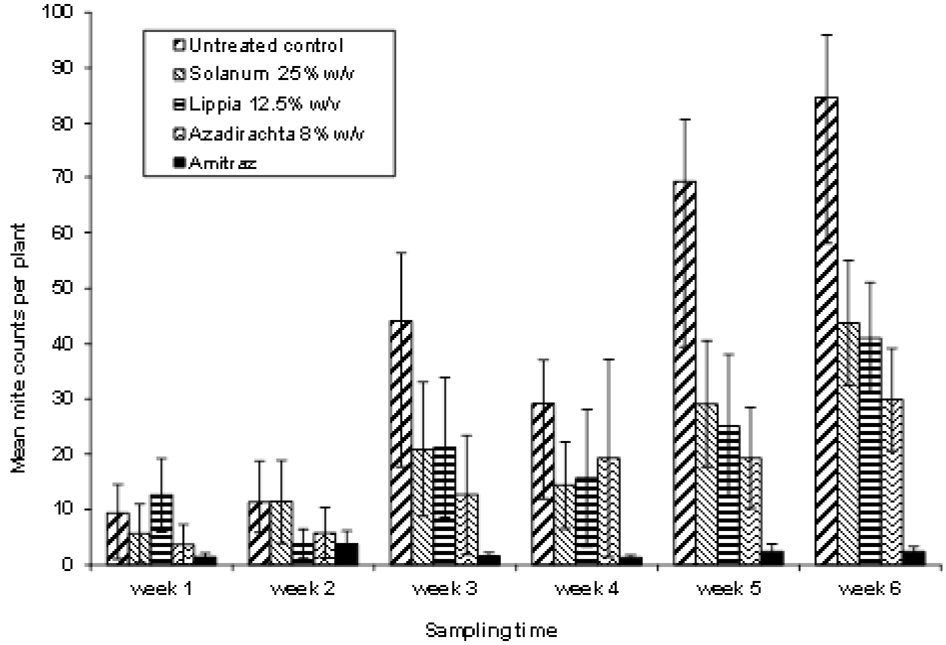

Figure 2. Effects of different pesticidal plant treatments on weekly mean (±SEM) red spider mite population recorded 24 h after spraying (n = 3).

treatment application probably due to chemical composition of the plant species used, spray droplet deposit site and distribution pattern as observed by Ngowi *et al*. (2007). However, some pest survival may have occurred owing to a build of resistance or due to the photodegradation of active components as suggested by Shonagh (1998). According to Chowdhury *et al.* (2003), the method of extracting the active ingredients also causes variations in concentration of the potent substance hence affect efficacy. In their study, they observed that red spider mite suppression rates were high with *S. delagoense* (43.1 to 55 %) and *L. javanica (*49.7 to 66.5 %) compared to *Chenopodium* essential oil extracts that had 23 % reduction rate on the same pest on Irish potato one-hour post application with 2 % v/v concentration oil extracts

Both *S. delagoense* and *L. javanica* were able to suppress aphids and mites below their economic threshold of 50 aphids per plant and five mites per leaf (Stoll, 2000). The reduced number of aphids and mites could be due to extracts' repellent, toxic and antifeedant effects since they contain essential oils and alkaloids constituents with pesticidal properties (Manenzhe *et al*., 2004).

Conclusion

L. javanica and *S. delagoense* water extracts showed potential to suppress vegetable pests when applied at 12.5 % and 25.6 % respectively. *L. javanica* was more efficacious than S. *delagoense* on rape aphids and tomato red spider mites. However, more studies are required to validate these results under typical farmer conditions.

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