



INTRODUCTION

Plants have natural defences against herbivory. These defences can be artificially induced by application of chemicals such as **salicylic acid (SA)** and **methyl jasmonate (MeJa)**. Previous studies have shown that application of MeJa to Brassica plants induces the production of indolyl glucosinolates that protect against generalist pests, and that application of SA induces the alkenyl glucosinolates, which break-down upon plant damage to produce volatile isothiocyanates, chemicals that are attractive to Brassica specialist pests. The different effects of plant defence-inducing chemicals can potentially be exploited in 'push-pull' strategies that aim to deter pests from crops and divert them to attractive trap crops where they can be more easily controlled.

We tested the following hypotheses:

1. Application of MeJa will make oilseed rape (*Brassica napus*) crops less susceptible to pests, particularly generalists, such as the aphid *Myzus persicae* ('Push')
2. Application of SA will make turnip rape (*Brassica rapa*) trap crops more effective by making these plants more attractive to pests, particularly Brassica specialists such as the pollen beetle (*Meligethes aeneus*) and the aphids *Brevicoryne brassicae* and *Lipaphis erysimi* ('Pull')



Pollen beetle on anthers



Brevicoryne brassicae



Myzus persicae

MATERIALS AND METHODS

Aphid Bioassay – Petri dish choice test

Five, oilseed rape or turnip rape leaf discs from plants treated with (1) control, (2) 0.1 mM, (3) 1 mM, (4) 10 mM, and (5) 100 mM solutions of MeJa or SA, respectively, were placed in a randomized circular array in a Petri dish 48 h after treatment. One alate (winged) aphid was placed in the centre of the dish and its position recorded after 1 h. Three aphid species were tested: *Myzus persicae* (generalist) and *Brevicoryne brassicae* and *Lipaphis erysimi* (Brassica specialists), each test was replicated 50 times.

Pollen beetle Bioassay – Polytunnel semifield arena

Five, oilseed rape or turnip rape plants treated with MeJa or SA (as above) were placed across the span of a polytunnel arena 48 h after treatment. Pollen beetles (500) were released downwind from the plants and the numbers colonizing each plant were recorded 4 h after release. Each experiment was replicated 5 times in a Latin-square design

Field Experiments

Plots of oilseed rape (OSR) treated or not treated with MeJa and either with or without a turnip rape trap crop border (TR), which was treated or not treated with SA were sampled for pollen beetle infestation throughout the growing season. An insecticide treatment was also included for comparison.



Oilseed rape plot with turnip rape trap crop

RESULTS AND DISCUSSION

The numbers of aphids (Table 1) and beetles (Figure 1) were generally higher on the turnip rape plants treated with SA and lower on oilseed rape plants treated with MeJa than control plants. These trends were consistent with our hypotheses, but in both cases, differences were not statistically significant.

On 15 June, the growth stage most susceptible to pollen beetle damage, the insecticide treated plots were significantly less infested than all other plots, but the other treatments did not differ from each other (Figure 2).

Comparing beetle populations between the borders and centre main crop (Table 2) showed that populations were lower in the oilseed rape crop centre than the plot borders, especially when there was a turnip rape trap crop. This suggests that pollen beetles prefer turnip rape over oilseed rape. Populations in the crop centre were generally smaller in the presence of turnip rape trap crop than in its absence suggesting that turnip rape can protect oilseed rape from pollen beetle infestation.

Crop	Treatments	Mean No. of aphids per leaf		
		<i>M. persicae</i>	<i>B. brassicae</i>	<i>L. erysimi</i>
Turnip rape	Control	0.6 ± 0.4	0.8 ± 0.2	1.8 ± 0.6
	0.1 mM SA	0.8 ± 0.4	2.2 ± 0.7	0.8 ± 0.5
	1 mM SA	1.0 ± 0.6	1.6 ± 0.5	1.4 ± 0.5
	10 mM SA	2.4 ± 0.5	1.8 ± 0.9	1.8 ± 0.7
	100 mM SA	1.0 ± 0.5	2.0 ± 0.0	1.8 ± 0.6
Oilseed rape	Control	1.4 ± 0.6	1.4 ± 0.6	1.4 ± 0.9
	0.1 mM MeJa	1.2 ± 0.6	1.2 ± 0.5	2.2 ± 0.7
	1 mM MeJa	1.4 ± 0.4	1.2 ± 0.6	0.8 ± 0.6
	10 mM MeJa	1.4 ± 0.4	0.8 ± 0.6	1.2 ± 0.3
	100 mM MeJa	0.4 ± 0.2	0.6 ± 0.4	0.8 ± 0.2

Table 1. Mean no. of pollen beetles per plant from trap crop (border) and oilseed rape main crop (centre)

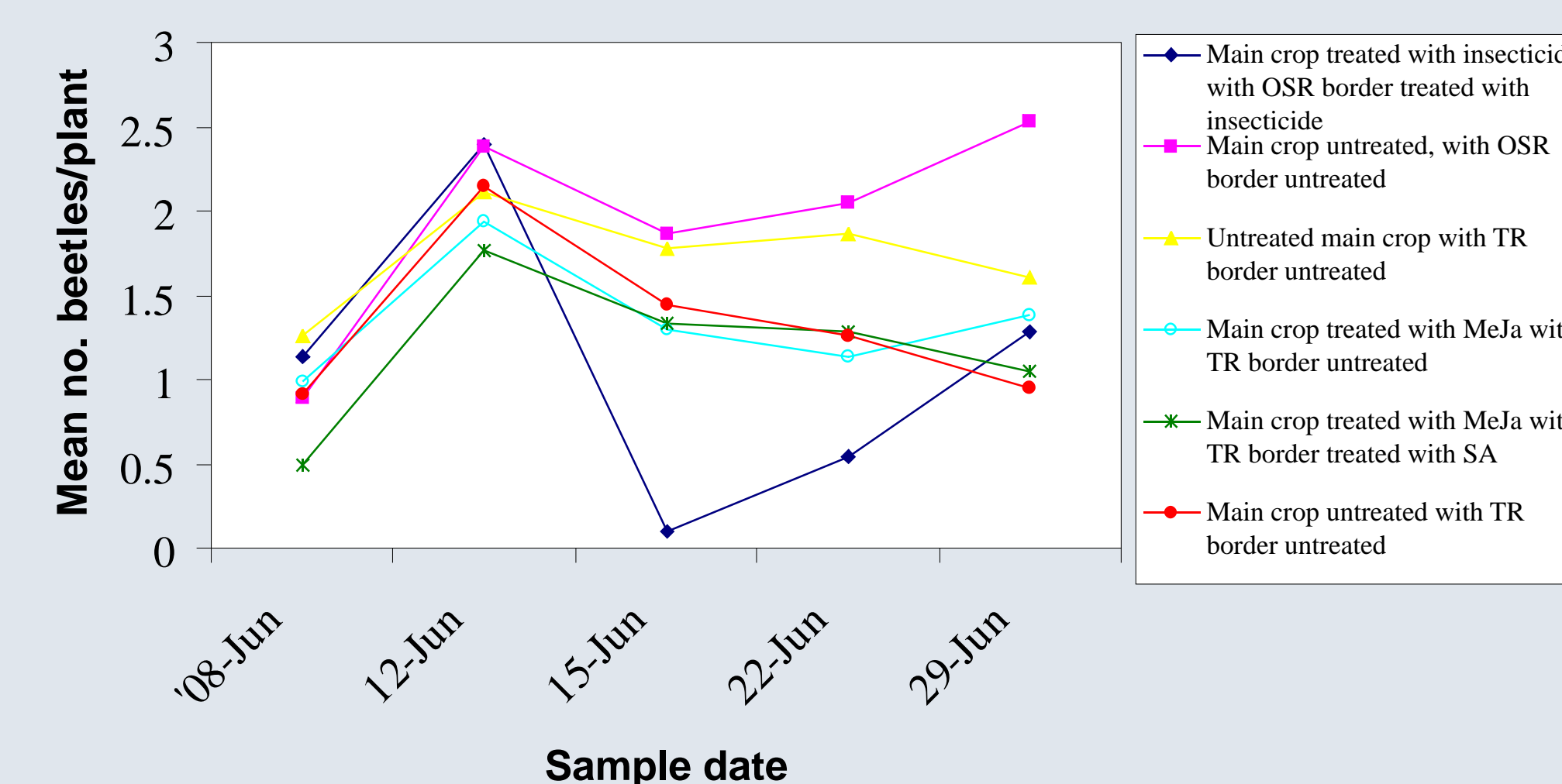


Figure 2. Mean number of pollen beetles in the oilseed rape main crop in response to presence or absence of a turnip rape trap crop and treatment with MeJa and/or SA

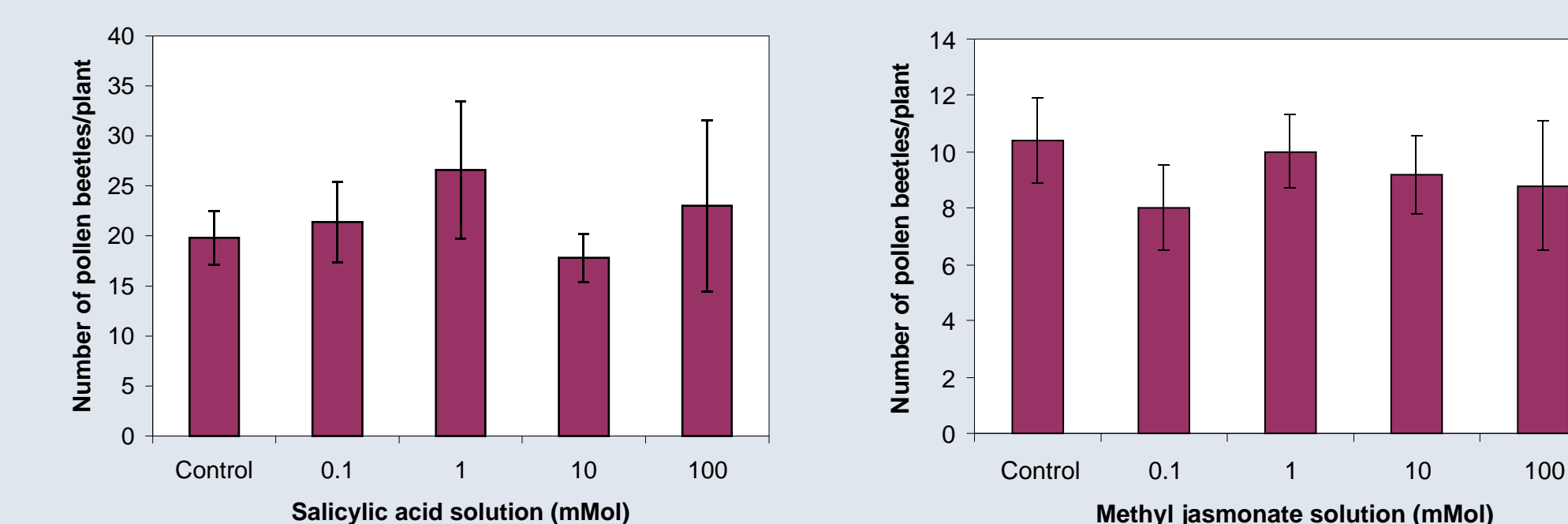


Figure 1. Effect of SA treatment of turnip rape or MeJa treatment of oilseed rape on number of pollen beetles colonizing plants in A polytunnel bioassay (both $P > 0.05$).

Treatments	Border	Centre	t-value	P-value
Main crop treated with insecticide; OSR border treated with insecticide	1.63	1.17	2.42	0.094
Main crop untreated; OSR border untreated	2.52	2.08	1.05	0.371
Main crop untreated; TR border untreated	3.21	1.70	6.03	0.009
Main crop treated with MeJa; TR border untreated	2.56	1.35	2.18	0.117
Main crop treated with MeJa; TR border treated with SA	2.19	1.18	6.15	0.009
Main crop untreated; TR border treated with SA	2.36	1.35	1.95	0.147

Table 2. No. of aphids colonizing turnip rape or oilseed leaf disks after one hour of exposure to leaves treated with SA or MeJa.

CONCLUSION

The suitability and success of turnip rape as a trap crop for pollen beetles in oilseed rape was confirmed in this study. However, there is little evidence that plant induction by salicylic acid (SA) and methyl jasmonate (MeJa) can be used in a push-pull strategy to make the trap crop more attractive and the main crop less attractive to pests, respectively.