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Evaluation of companion crops for thrips (Thysanoptera: Thripidae) management on French bean *Phaseolus vulgaris* (Fabaceae)

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Abstract. Six companion crops, i.e. *Tagetes erecta*, *Daucus carota* L., *Coriandrum sativum* L., *Brassica oleraceae* L. var. *acephala, Capsicum annuum* L. and *Zea mays* L., were evaluated for their efficacy in suppressing field populations of *Frankliniella occidentalis* (Pergande) and *Megalurothrips sjostedti* Trybom on French bean *Phaseolus vulgaris* L. Each companion crop was interplanted with French beans in a 3×10 m plot and replicated three times in a completely randomized block design. The thrips populations on French bean flowers in experimental plots were compared with those on beans treated with two insecticides: L-cyhalothrin (Karate 1.75% EC) and methiocarb (Mesurol 500 SC) or untreated (control). *Coriandrum sativum, Z. mays* and *T. erecta* are recommended as companion crops for intercropping with French beans to reduce populations of thrips and hence minimize the use of chemical insecticides on this crop.

Key words: companion crops, intercropping, *Frankliniella occidentalis*, *Megalurothrips sjostedti*, *Phaseolus vulgaris*

Résumé. Six plantes associées, i.e. *Tagetes erecta, Daucus carota* L., *Coriandrum sativum* L., *Brassica oleraceae* L. var. *acephala, Capsicum annuum* L. et *Zea mays* L., ont été évaluées pour leur capacité à contrôler les populations naturelles de *Frankliniella occidentalis* (Pergande) et *Megalurothrips sjostedti* Trybom sur le haricots vert *Phaseolus vugaris* L. Chaque plante a été plantée en alternance avec des haricots verts dans des parcelles de 3×10 m, á raison de trois répétitions par plante dans un bloc complétement aléatoire. Les populations de trips présentes sur les fleurs de haricots verts dans les différentes parcelles expérimentales ont été comparées á celles de haricots verts traités avec deux insecticides L-cyhalothrin (Karate 1,75% EC) et methiocarb (Mesurol 500 SC) et, un témoin. Les résultats montrent que *C. Sativum, Z. mays* et *T. erecta* sont les meilleures plantes associées pour réduire l'utilisation des insecticides.

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Mots clés: cultures associées, *Frankliniella occidentalis*, *Megalurothrips sjostedti*, *Phaseolus vulgaris*

Introduction

Among the arthropod pests of French beans, flower thrips *Frankliniella occidentalis* (Pergande) and *Megalurothrips sjostedti* (Trybom) (Thysanoptera: Thripidae) are ranked as major pests and have been known to cause over 60% yield loss of the marketable fresh pods (Nderitu *et al.*, 2001). Nderitu *et al*. (1997, 2001) reported high use of λ-cyhalothrin by farmers for controlling thrips in Central Kenya. Methiocarb is documented elsewhere to be effective for thrips control (Herron *et al.*, 1996), but it is more expensive than λ-cyhalothrin. There is a need therefore, to diversify control options for the flower thrips on French beans and stop relying only on chemical insecticides. Several cultural practices have been found to be effective in minimizing legume flower thrips in cowpea (Kyamanywa and Ampofo, 1988; Ampong-Nyarko *et al*., 1994). Companion and intercrops can be used by the farmers purely to benefit the main crop, e.g. for pest reduction or nitrogen fixation, without being used for yield gains. The companion crops could act through manipulation of the environment around the main crop such that natural enemies of the pest build up in large numbers. In addition, they attract or repel the pests from the main crop (Root, 1973; Vandermeer, 1989).

This study was carried out to evaluate six companion crops for interplanting with French beans to manage flower thrips and to identify crops that could be interplanted with French beans to minimize the flower thrips infestation and to reduce crop damage and use of insecticide sprays.

Materials and methods

The study was carried out at Mwea-Tebere, Central Kenya, which is a major French bean growing area. Six companion crops (African marigold *Tagetes erecta*, carrot *Daucus carota*, coriander *Coriandrum sativum*, kale *Brassica oleraceae* var. *acephala,* chilli *Capsicum annuum* and maize *Zea mays*), two insecticides (λ-cyhalothrin (Karate 1.75% EC) and methiocarb (Mesurol 500 SC)) and unsprayed French bean monocrop (as a control), were evaluated for their efficacy in suppressing bean flower thrips. The experiment was laid in a randomized complete block design with plot size of 3×10 m, replicated three times. Two rows of French beans were alternated with one row of the companion crop, at an intra-row spacing of 10 cm and inter-row spacing of 50 cm. The companion crops were planted 1 week prior to French bean crop as the French bean matures early compared to the other crops. The experiment was performed on 28 January, 14 February and 8 July 2002. Diammonium phosphate was applied during sowing at the rate of 494 kg/ha, while calcium ammonium nitrate was top dressed at the second and fourth weeks after French bean emergence at the rate of 494 kg/ha. Plots were kept weed-free while furrow irrigation was provided to supplement the rains when necessary. Insecticide treatments were applied with a knapsack sprayer at the rate of 1 kg a.i./ha (50 ml/20 l water) and 200 g a.i./ha (40 ml/20 l water) for λ-cyhalothrin and methiocarb, respectively at 20, 27 and 34 days after crop emergence.

Sampling of thrips on French bean flowers and companion crops was made by picking 20 flowers per plot, after 50% of the crop had flowered, at 4-day intervals until the crop senesced. Companion crop flowers were sampled later as they emerged after French bean flowers. The flowers were immersed in bottles containing 70% ethyl alcohol. In the laboratory, the flowers were emptied into Petri dishes with square grids engraved on the bottom (to facilitate counting). They were dissected and washed thoroughly with 70% alcohol, removing the flower debris to make sure no thrips were discarded. Thirty leaves of all companion crops were sampled for thrips presence at 4-day intervals until the French bean crop senesced. Thrips were counted under a dissecting microscope and categorized as adults of *F. occidentalis*, *M. sjostedti* and larvae (not separated into different species).

French beans were harvested by picking up immature pods (ready for the market) and were graded into marketable and unmarketable grades. Harvesting was done at 3-day intervals from 45 days after crop emergence. Fifty pods were sampled in each plot, separated into damage categories as follows: 1 (25%)—no damage to slight damage; 2 (26–50%)—moderate damage; 3 (51–75%)—high damage; and 4 (76–100%)—severe damage. Analysis of variance (ANOVA) was performed on the data and where the treatments showed significant *F*-test, the means were separated by SED.

Results

Thrips infestations varied across treatments (Fig. 1). High thrips numbers were recorded on French beans treated with λ-cyhalothrin and interplanted with *B. oleraceae* var. *acephala* and *C. annuum*, which were not significantly different from the French

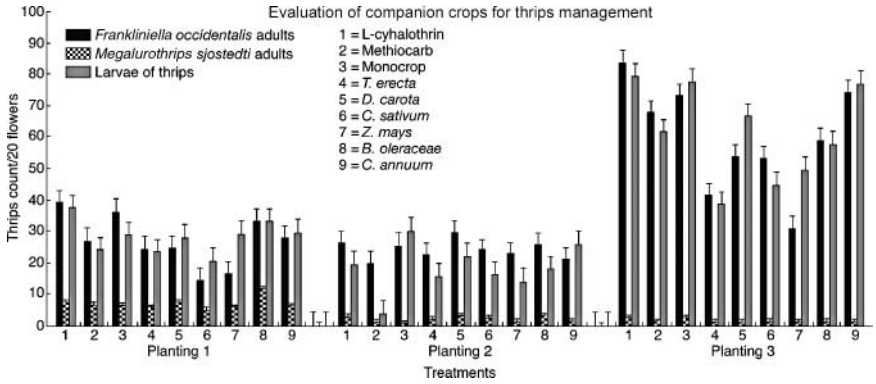

Fig. 1. Mean number of flower thrips on French bean flowers for three plantings at Mwea-Tebere, Central Kenya

bean monocrop (Fig. 1). French beans interplanted with *D. carota* and those treated with methiocarb had moderate thrips counts, while French beans interplanted with *Z. mays, C. sativum* and *T. erecta* had relatively low thrips counts.

Generally, French beans interplanted with *Z. mays, T. erecta* and *C. sativum* had the least number of thrips in all the three plantings (Fig. 2). French beans treated with methiocarb had fewer thrips than those treated with λ-cyhalothrin. Four companion crops *Z. mays, T. erecta, C. sativum* and *D. carota* reduced thrips damage to French beans (Table 1). Methiocarb effectively controlled flower thrips on French beans. French beans interplanted with *C. sativum*, *Z. mays* and *T. erecta* had a relatively higher percentage of the marketable fresh pods (Fig. 3).

The numbers of pods damaged were not significantly different ($P > 0.05$) among the treatments (Table 2). Among the companion crops, only *C. sativum* had noticeably more thrips on its leaves. *T. erecta* had high numbers of thrips in its flowers as opposed to its leaves. The companion crops *Z. mays, D. carota* and *B. oleraceae* var. *acephala* had very few thrips on the leaves (Fig. 4).

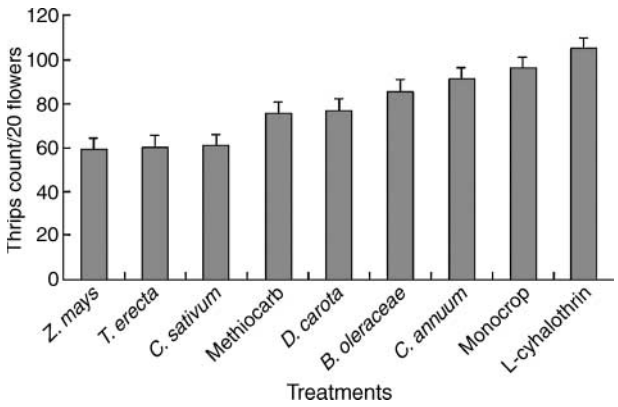

Fig. 2. Mean number of flower thrips (totals of *Frankliniella occidentalis, Megalurothrips sjostedti* and their larvae) on French bean flowers for three plantings at Mwea-Tebere, Central Kenya

Discussion

French bean plots treated with λ-cyhalothrin had more thrips than the French beans treated with methiocarb, interplanted with companion crops and untreated French bean monocrop. λ-Cyhalothrin reduced *M. sjostedti* populations on the French beans, but had no effect on *F. occidentalis*. Kyamanywa and Kuo (1996) and Anyango *et al.* (1989) also reported the effectiveness of this insecticide against *M. sjostedti*. Methiocarb was more effective compared with λ-cyhalothrin in controlling *M. sjostedti* and *F. occidentalis*. Methiocarb has been reported to be effective for controlling *F. occidentalis* on several crops (Herron *et al.*, 1996). Three companion crops, *T. erecta, Z. mays* and *C. sativum* effectively minimized *M. sjostedti* and *F. occidentalis* populations on French beans. They can be incorporated in a management programme for flower thrips to reduce production costs. *Zea mays* has been reported to suppress *M. sjostedti* populations when intercropped with cowpeas and beans (Kyamanywa *et al.*, 1993; Kyamanywa and Kuo, 1996; Emeasor and Ezueh, 1997). Studies have indicated that *F. occidentalis* populations are suppressed by intercropping with several crops, e.g. sweet corn and thus could be used for thrips management (Capinera *et al.*, 1985). *Coriandrum sativum* minimizes *Thrips tabaci Lindeman* populations on onion (Devalash and Sugha, 1997). Its role in reducing *F. occidentalis* and *M. sjostedti* populations could offer an affordable and easy means of thrips management. Produce from both crops interplanted with the French bean crop could be sold at the local market and thus earn farmers additional income, if these crops are intercropped with French beans. *Coriandium sativum* is a spice and its local demand is increasing. *Tagetes* sp. is known to be a trap crop for plant-parasitic nematodes (Rodriguez-Kabana and Canullo, 1992).

Table 1. Mean number of flower thrips per 20 French bean flowers at different treatment contrasts

Treatment	*Frankliniella occidentalis* (a)	*Megalurothrips sjostedti* (b)	Larvae of a and b (= c)	Total thrips (a + b + c)
All treatments	2.7	0.7	2.8	6.2
Insecticides	3.3	0.7	3.1	7.1
L-Cyhalothrin	3.9	0.8	3.7	8.43
Methiocarb	2.7*	0.7	2.4	5.8
Monocrop	3.6	0.6	2.9	7.2
Companion crops	2.4	0.7	2.7	5.8
T. erecta	2.4*	0.5	2.3	5.3*
D. carota	2.5*	0.7	2.8	6.0
C. sativum	1.4*	0.5	2.1	4.0*
Z. mays	1.7*	0.6	2.9	5.1*
B. oleraceae var. *acephala*	3.3	1.2	3.3	7.8
C. annuum	2.9	0.7	3.0	6.5
SED	0.4	0.2	0.7	0.9

*Significant *F*-test was done at 95% level of significance.

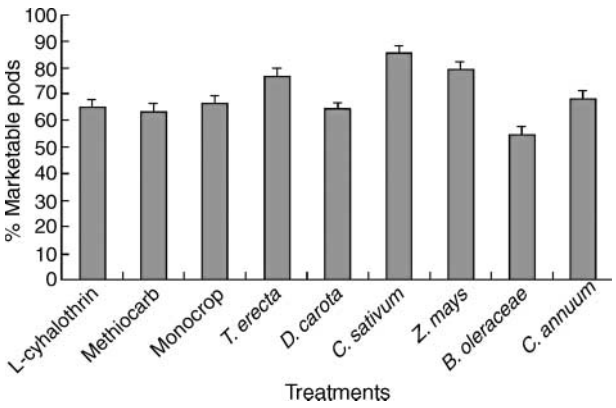

Fig. 3. Mean percentage marketable French bean pods from different treatments, at Mwea-Tebere, Central Kenya

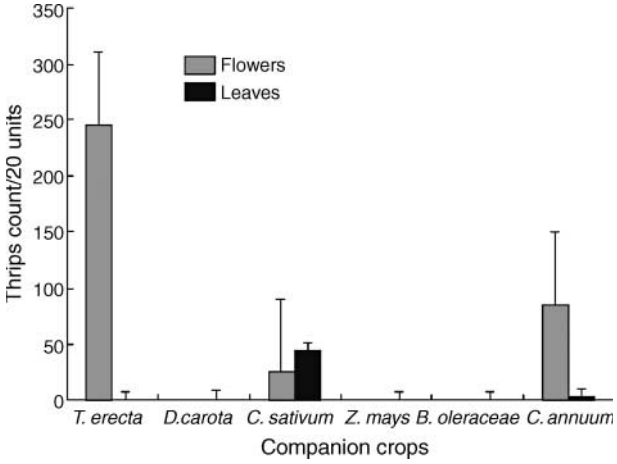

Fig. 4. Mean number of flower thrips (totals of *Frankliniella occidentalis, Megalurothrips sjostedti* and their larvae) on leaves and flowers of companion crops, at Mwea-Tebere, Central Kenya

Table 2. Mean number of pods in each damage category per damage score in 50 pods per plot, at Mwea-Tebere, Central Kenya

Treatment	Damage score			
	1	2	3	4
λ-Cyhalothrin	12.8	12.7	11.6	13.1
Methiocarb	13.1	12.7	11.0	13.2
Mono-crop	14.6	12.0	12.8	10.7
T. erecta	11.2	11.9	11.1	15.6
D. carota	13.4	12.6	11.8	12.6
C. sativum	11.8	11.3	11.8	15.1
Z. mays	13.2	11.6	10.9	14.3
B. oleraceae var. *acephala*	11.6	8.4	11.2	18.8
C. annuum	12.7	12.1	12.1	13.1
P-value	0.7	0.07	0.9	0.1
SED	1.8	1.3	1.4	2.5
LSD	3.6	2.6	2.8	4.9

Since French beans are also affected by plant-parasitic nematodes, *Tagetes erecta* can therefore reduce the damage by both thrips and nematodes. *Tagetes erecta* attracts the thrips because it has brightly coloured flowers. Therefore, *T. erecta* can be used for thrips management and may be sown 1 week before, at the same time, or 1 week after the French bean crop to make sure this plant is in a vegetative phase throughout the French bean flowering period. The farmers should prune the flowers as soon as they form. Marketable pods are the ultimate goal; and the French beans interplanted with *Z. mays, C. sativum* and *T. erecta* had a higher percentage of marketable fresh pods.

Intercropping is widely practised by small-scale farmers as a risk aversion mechanism. Farmers may

not be aware of the other advantages of the system unless they are informed of them. A combination of companion crops and insecticides could offer the best option to farmers who wish their crops free of insect damage (Mensah, 1997). This recommendation might limit the number of sprays from 10–15 to 2–3 sprays (Nderitu *et al.*, 1997).

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