

## EVALUATION OF CROPPING SYSTEMS AS A STRATEGY FOR MANAGING SNAP BEAN FLOWER THIRPS IN KENYA

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### ABSTRACT

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Four cropping systems were compared in terms of their effectiveness to suppress flower thrips, *Frankliniella occidentalis* Pergande and *Megalurothrips sjostedti* Trybom infestation on Snap beans (*Phaseolus vulgaris* L.). Maize (*Zea mays* L.) was used either as a margin crop or an intercrop. In addition, a set of monocrop snap beans were treated with insecticide, Thiacloprid, and another set left untreated. The treatments were laid out in a Completely Randomised Design with four replicates at Mwea-Tebere, Central Kenya in two relay cropping periods, first planting in January 2006 followed by second planting in February 2006. Thrips were sampled from flowers and pods collected from ten randomly selected plants per plot. The results indicates that there was significant difference ( $P < 0.5$ ) among the four treatments. The lowest number of adult thrips and their larvae was recorded in plots treated with *Z. mays* as inter crop, while the highest was from untreated Snap beans. Thiacloprid treated plots had the lowest number of *M. sjostedti*, but *F. occidentalis* were slightly affected by this pesticide in both plantings. In general, the population of *F. occidentalis* was higher than that of *M. sjostedti* in both plantings. Snap beans under the intercrop showed the highest percentage of marketable pods whereas the untreated crop had the highest number of damaged pods which were unmarketable. Thrips natural enemies were high in the crop surrounded by the margin crop as well as the untreated crop but least in Thiacloprid treated plots.

**Keywords:** *Phaseolus vulgaris* L, *Frankliniella occidentalis*, *Megalurothrips sjostedti*,

### INTRODUCTION

Among arthropod pests of snap beans (*Phaseolus vulgaris* L.), western flower thrips (*Frankliniella occidentalis* Pergande) and legume flower thrips (*Megalurothrips sjostedti* Trybom) (Thysanoptera: Thripidae) are ranked as major pests in Kenya. They reportedly cause over 60% loss of marketable pods (Michalik *et al.*, 2006). Their feeding on the flowering parts causes abscission of flower buds, open flower peduncles and causes curling of pods, leading to loss of quality of Snap beans pods (Lewis, 1997). Snap beans farmers rely on pesticides such as Methiocarb, Thiacloprid, Deltamethrin, Spinosad, Chloropyrifos and Fipronil to control thrips damage (Nderitu *et al.*, 2001). The frequency of pesticides application in a crop cycle is known to range from four to 15 in a season (Nderitu *et al.*, 2001). Such high pesticide application frequency is particularly worrisome considering the short growing cycle of the snap beans. Furthermore, pod harvesting is done daily or every other day. As a result, farmers observe extremely short pre-harvest intervals. The introduction of maximum residual levels for export vegetables by European retailers, the main consumers of Kenyan snap beans has challenged the traditional pest control methods that encouraged use of pesticides. Many small holder farmers now face difficulties in complying with safe plant protection measures (Anon, 2006). In addition, most pesticides currently recommended for control of thrips are expensive to the smallholder grower. This calls for diversification of control options for flower thrips on snap beans to target minimization of pesticides usage. Several cultural practices have been used worldwide to manage legume flower thrips in cowpea, e.g., Nampala *et al.* (2002) in Nigeria. Kasina *et al.* (2006) noted intercropping snap beans with African marigold (*Tagetes erecta*) and Coriander (*Coriandrum sativum*), significantly reduced the population of flower thrips on snap beans. Unlike companion crops, intercrops and margin crops benefit farmers with extra income. Margin cropping enhances diversity of beneficial arthropods in the edges of the main crop, while intercrop attracts or repels pests from the crop, as well as encouraging build up of natural enemies (Kasina *et al.* (2006). This study was aimed at identifying a cropping system most suitable to suppress flower thrips population on snap beans while minimizing the use of pesticides.

### MATERIALS AND METHODS

The experiments were carried out at Mwea-Tebere, Central Kenya, a main snap bean growing area. Four cropping systems namely maize (*Zea mays*) grown with snap beans (*Phaseolus vulgaris*) as margin-crop, maize grown with snap beans as inter-crop, snap beans sole-crop (untreated), and snap beans treated with Thiacloprid were evaluated for their efficacy in the suppression of bean flower thrips field population. Treatments were laid out in a complete randomized design in plot size of 3x4 m replicated four times. In the inter-crop plots, two rows of snap beans alternated with one row of maize. Snap bean, var. Samantha was sown at intra row spacing of 10 cm and inter-row spacing of 60 cm. As margin crop, maize were planted 60 cm all round the snap beans, forming a protective border

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of the beans from the wild. Maize, var. Katumani, planted as margin- and inter- crop were sown one week prior to sowing beans to allow vegetative development for trapping thrips as they colonized the beans. All snap beans were planted concurrently. Thiocloprid treatment was applied at the rate of 480 g/l a.i. /ha (20 ml/20 water) twice per week in both plantings. All agronomic practices recommended for the research area were adhered to. In the first planting, maize seeds were sown on 31 January 2006 followed by snap bean seeds on 8 February 2006. Second planting was initiated two weeks later on 21 February 2006 and 30 February 2006, respectively.

Sampling of thrips began after formation of snap bean flowers by randomly selecting ten plants from inner six rows and a flower and a pod picked from each plant. Flowers were kept in 60% ethanol to preserve thrips for later identification, classification and counting. Each flower was placed in a petri dish, dissected and washed to make sure that no thrips was lost with the debris. Thrips were counted under dissecting microscope using a tally counter, and classified into *F. occidentalis* and *M. sjostedti* adults and larvae. Pods were harvested by picking immature ones that were ready for market and graded into marketable and unmarketable grades. Harvesting was done twice a week starting from 50 days after Snap beans emergence for four weeks. From ninety pods which were sampled from each plot, the number of pod showing thrips damage was scored using a scale of 1 to 4 whereby 1= 0-24% damage or slight damage, 2 =25-49% damage or moderate damage, 3= 50-74% or high damage and 4 =75-100% damage or severe damage.

Data analysis were done using Genstat Discovery edition (Anonymous, 2007). Thrips data was square root transformed and pod damage arcsine transformed from percentage scale to interval scale to fit assumption of analysis of variance (ANOVA). Where there was no significance difference in repeated experiments pooled data was carried out. For the treatments that showed significance *F*-statistic, mean were separated by standard error of difference of means.

## RESULTS

Two adult thrips species (*F. occidentalis* and *M. sjostedti*) were recorded on snap beans (Table 1). Their infestation on snap beans was significantly ( $P < 0.05$ ) higher in planting 2 compared with planting 1. All the thrips adults and their larvae had higher population in the second planting compared with the first planting ( $F_{(1,158)} = 62.51$ ,  $P < 0.05$ ;  $F_{(1,158)} = 40.50$ ,  $P < 0.001$ ;  $F_{(1,158)} = 59.05$   $P < 0.001$  *F. occidentalis*, *M. sjostedti* and larvae, respectively). Also recorded was *Orius* spp, a predator of thrips, which occurred in low numbers in both seasons though it was relatively more in planting 1 but not significant ( $P > 0.05$ ).

Table 1. Mean number of adult thrips, their larvae and *Orius* spp.

Treatment	<i>F. occidentalis</i>	<i>M. sjostedti</i>	Larvae	<i>Orius</i> spp.
Planting 1	8.77	1.96	8.17	0.463
Planting 2	17.20	8.21	20.80	0.275
Grand mean	12.99	5.09	14.49	0.369
$F_{(1,158)}$	62.51	40.50	59.05	2.72
P value	<.001	<.001	<.001	0.101
SED	0.1666	0.1944	0.218	0.0473

Treatments had significant ( $P < 0.05$ ) effects on the infestation of snap beans by the thrips and their larvae. Those snap beans intercropped with maize recorded the lowest number of adult *F. occidentalis* in both plantings (Table 2). However, for adult *M. sjostedti* and larvae, the lowest count was on the Thiocloprid-treated plots, which incidentally had the highest *F. occidentalis* count. Although there were significant differences on the number thrips adults and larvae individuals in the two plantings, these did not affect treatment effects on the pests (Table 2).

Table 2. Mean number of thrips adult, their larvae and *Orius* spp as influenced by different treatments and plantings

Treatment	<i>F. occidentalis</i>		<i>M. sjostedti</i>		Larvae		<i>Orius</i> Spp.	
	Season 1	Season 2	Season 1	Season 2	Season 1	Season 2	Season 1	Season 2
Maize margin crop	7.80	15.75	2.550	12.500	8.00	19.20	0.7500	0.0500
Thiocloprid insecticide	13.35	19.20	0.450	1.500	5.15	14.90	0.0500	0.2000
Maize intercrop	4.95	15.00	1.650	10.800	7.40	22.50	0.5000	0.5000
Beans monocrop	9.00	18.85	3.200	8.050	12.15	26.60	0.5500	0.3500
Grand mean	12.99		5.09		14.49		0.369	
$F_{(3,152)}$	5.55		10.39		4.01		3.19	
P value	0.001		<.001		0.009		0.025	
SED	0.2260		0.2477		0.302		0.1270	

Overall, the maize intercrop performed better than the other treatments in management of the thrips (Table 3). Nevertheless, Thiocloprid was more effective on *M. sjostedti* and larvae. The population of *Orius* species was low and incapable of reducing the pest population. However, their number was significantly different among the different treatments ( $F_{(3,156)} = 3.02$   $P = 0.032$ ). It is also in the snap beans intercropped with maize that recorded higher number of *Orius* spp.

Table 3. Mean number of thrips adult, their larvae and natural enemy on snap beans planted twice

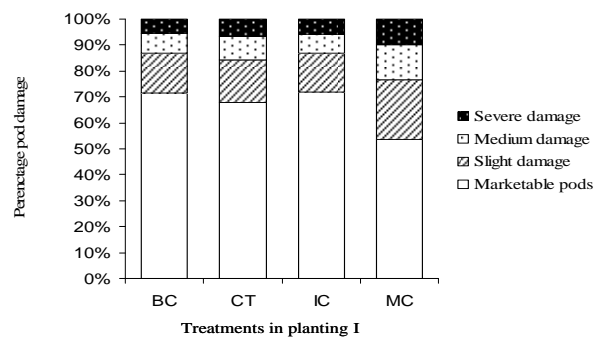
Treatment	<i>F. occidentalis</i>	<i>M. sjostedti</i>	Larvae	<i>Orius</i> spp
Maize margin crop	11.78	7.53	13.6	0.400
Thiacloprid insecticide	16.28	0.97	10.0	0.125
Maize intercrop	9.97	6.22	14.9	0.500
Beans monocrop	13.93	5.63	19.4	0.450
Grand mean	12.99	5.09	14.5	0.369
F <sub>(3,156)</sub>	3.88	7.60	2.92	3.02
P value	0.010	<.001	0.036	0.032
SED	0.2703	0.290	0.354	0.0661

Snap beans intercropped with *Zea mays* had the highest percentage of marketable pods whereas the sole crop had the highest number of pods under all the other categories of damage, implying that they were the least marketable (Figure 1). In the second planting, thiacloprid treated plots recorded higher marketable pods compared with the other treatments (Figure 2). Monocrop plots had the highest number of severely damaged pods.

**Discussion**

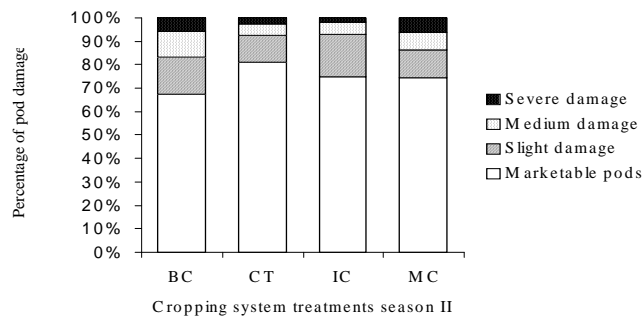
Thrips management in snap bean fields in Kenya has been challenging especially with the advent of *F. occidentalis*, which develops resistance to pesticides quickly. Studies done previously in Kenya have shown potential of manipulation of the cropping system to the disadvantage of the thrips (Kasina *et al.*, 2006). For example, Kasina *et al.* (Ibid.) suggested use of companion cropping with *Tagetes erecta* or *Corriandrum sativum* to manage the thrips on snap beans. Waiganjo *et al.* (2007) also recommended use of mulch and intercrop of traditional vegetables to manage thrips on snap beans. However, these technologies have not been uptake. This current study shows that maize intercrop can suppress effectively thrips population on the snap beans. This implies that the system can be promoted to farmers for management of this pest. Farmers are likely to adopt this technology compared with others because maize production is not new to them. Other than thrips infestation control, the maize intercropping system was shown to harbour *Orius* species, a main thrips predator. Likewise, maize has also been reported to suppress the population of *M. sjostedti* when used as an intercrop in cowpea and beans systems (Kyamanywa and Tukahairwa 1988, Emeasor and Ezueh, 1997, Kyamanywa *et al.*, 1998). Findings from this study also correlate to that from Uganda that showed population of *M. sjostedti* to be reduced when cowpea were intercropped with sorghum (Nampala *et al.*, (2002).

Manipulation of the microenvironment within the snap bean field could be attributed to the effectiveness of the intercrop, for example, resulting to reduced light penetration on the bean canopy. Gitonga *et al.* (2002) reported preference of *F. occidentalis* and *M. sjostedti* on open areas compared with shaded areas, hence are less in the intercropped Snap beans crop. Other studies suggest that by having different plants grown together, it interferes with the aroma of the main crop, which the pest is used to, hence the pest is least likely to locate its host.



(BC = *Zea mays* margin crop, CT = Thiacloprid, IC = *Zea mays* intercrop, MC = *Phaseolus vulgaris* sole crop)

Figure 1. Mean percentage of Snap beans pods recorded under different damage categories in the first planting



(BC = *Zea mays* Margin crop, CT = Thiacloprid, IC = *Zea mays* Intercrop, MC = *P. vulgaris* sole crop)

Figure 2. Mean percentage of Snap beans pods under different damage categories in the second planting

Findings from this study suggest that farmers are able to get an economic crop even without use of insecticides to manage thrips. This is especially so if they plan to use intercropping system of maize. Other than the benefit accruing from thrips infestation reduction, maize is an economic commodity that would add economic benefit to snap bean producers. Reduced pesticide use is good for environment and will thus contribute to land use management.

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