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Management of Thrips (Thysanoptera: Thripidae) Infestation on French Beans (*Phaseolus vulgaris* L.) in Kenya by Combination of Insecticides and Varietal Resistance

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Abstract: A field study was conducted in 2002 to evaluate the combined effectiveness of insecticides and varietal resistance in the control of thrips infestation and damage at Kabete, Central Kenya. Four test varieties (Amy, Monel, Samantha and Impala) of French beans (*Phaseolus vulgaris* L.) and four insecticides (Lambda-cyhalothrin (Karate 1.75 EC), Petroleum spray oil (DC Tron 500 ML), Spinosad (Tracer 480 SC) and Fipronil (Regent 50 SC)) were used. The experiment was set in a split plot design, with variety forming the main plot and insecticide the subplot. Results show both varieties and insecticides influenced thrips infestation independently. For example, Tracer 480 SC and Regent 50 SC sprayed plots had the lowest thrips numbers across all varieties. Individual thrips species infestation differed across the treatments. For example, the mean number of *Frankliniella occidentalis* (Pergande) in Karate 1.75 EC sprayed plots was higher and significant compared to plots sprayed with Tracer 480 SC and Regent 50 SC but mean number of *Megalurothrips sjostedti* Trybom was not significantly different in all plots except those sprayed with DC Tron 500 ML and the control (unsprayed) plots. The research concludes by discussing the implications and applicability of the findings in French bean IPM systems in Kenya.

Key words: *Frankliniella occidentalis*, insecticides, IPM, *Megalurothrips sjostedti*, *Phaseolus vulgaris*

INTRODUCTION

French bean (*Phaseolus vulgaris* L.) is the most important export vegetable in Kenya and it accounts for over 60% of all exported vegetables. The crop ranks second after cut flowers in terms of volume and value among export crops (MOA, 2006). The small scale farmers usually take the main share of French bean production, in terms of volume. These farmers rely primarily on chemical insecticides for pest control. For example, Nderitu *et al.* (2001) reported applications of up to 15 sprays per season that farmers said they mainly targeted thrips infestations. However, high spray applications have been shown to result to pesticide residue problem on harvested beans (Lohr, 1996). Successful use of insecticides for thrips control requires attention to the issues of insecticide choice, coverage, phytotoxicity, residues and resistance. The introduction of maximum residue limits by the importing countries of Kenyan French beans has posed a challenge in the export industry given the high

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number of smallholder growers involved (Okello, 2005). A further limitation to the effective control of thrips with chemical insecticides is the development of resistance (Jensen, 2000; Sonya and Grant, 2007). This is in addition complicated by preference of cheaper and non effective insecticides by farmers. Continuous production of French beans all year round also ensures thrips have conducive breeding environment. The introduction of *Frankliniella occidentalis* (Pergande) to Kenya in early 1990s has challenged the existing pest management programs in the country, due to its resistance to most of the insecticides that have been relied on by farmers for long. The long existing thrips species, *Megalurothrips sjostedti* Trybom and *Frankliniella schultzei* (Trybom) were easily controllable by use of insecticides but the situation has since changed following the arrival of the new thrips pest, *F. occidentalis*. This study was therefore conducted to determine effectiveness of different varieties and insecticides combinations for thrips management on French beans. Knowledge from this study will contribute to the development of an integrated thrips management on French beans in Kenya.

MATERIALS AND METHODS

The study was carried out at Kabete Campus Field Station farm, University of Nairobi in Kenya. Land was ploughed and harrowed to fine tilth using a disc harrow but marking of blocks and digging of furrows was done manually. The experiment was laid in a split plot design. The variety formed the main plot while insecticide formed the subplot. Five plots measuring 3×4 m per plot and a 2 m alley between main plots was maintained. Seeds were sown in furrows at 30 cm inter-row and 15 cm intra-row spacing from first week of June 2002. Overhead sprinkler irrigation was applied to supplement rainfall during the dry period. Four commercial varieties were selected from an earlier experiment based on their differential susceptibility to thrips; the most susceptible (Monel), the least susceptible (Impala) and two moderately susceptible (Amy and Samantha). The seeds of these varieties were treated with Imidacloprid (Gaucho 350 FS) before sowing to prevent bean fly (*Ophyiomia* sp.) and other soil-borne pest infestation during the early seedling development. Four insecticides were selected from the local market based on registration for use on French beans in Kenya, earlier efficacy trials and what farmers were currently using. These included Karate 1.75 EC (Lambda-cyhalothrin, a pyrethroid), Tracer 480 SC (Spinosad, biological), Regent 50 SC (Fipronil, a phenyl pyrazol) and DC Tron 500 ML (Petroleum spray oil). In addition, control plots for each variety were maintained where no insecticide was applied. Two plantings were done at an interval of two weeks, which is a common practice by French bean farmers. Diammonium Phosphate (DAP) fertilizer was applied at a rate of 494 kg ha^{-1} and mixed well with the soil before placing the seeds during sowing. At the first trifoliate leaf stage, top dressing was done at the same rate using Calcium Ammonium Nitrate (CAN) and a second application done just before flowering. Weeding was done two weeks after crop emergence followed by a second weeding three weeks later. Insecticides were sprayed using recommended rates (Regent at 50 g L^{-1}, Karate at 0.75 mL L^{-1}, Tracer at 0.25 mL L^{-1} and DC Tron at 2 mL L^{-1}) at the onset of flowering using a hand operated knapsack sprayer. A clear polythene sheet was used between the plots during application of insecticide sprays to avoid drifting. Sampling of thrips infestation was done just before spraying, then one day, three days, seven days and fourteen days after spraying to monitor the influence of the insecticide on the thrips infestation over the crop flowering period. In total, 5 samplings were done in each planting period. Ten open flowers were randomly picked from each plot at every sampling. The samples were put in 70% alcohol in separate bottles in the field and taken to the laboratory for thrips counting. The bottles were shaken and flowers dissected for thrips counting under a dissecting microscope using a tally counter. Each of the adult thrips species was recorded separately for each treatment but larvae were not separated to their different adult species. The data collected was subjected to Analysis of Variance (ANOVA) using GENSTAT statistical package version 6.1. Test of significance at $p<0.05$ was performed using F-test and means separated by use of standard error of difference of means.

RESULTS

Two main thrips species and their larvae were found infesting the French bean varieties; the *F. occidentalis* and *M. sjostedti*. The number of *F. occidentalis* individuals was high on unsprayed plots of monel and lowest in the unsprayed plots of Samantha (Table 1). DC-Tron sprayed plots had the highest *F. occidentalis* infestation among the insecticide treated plots. This was closely followed by those plots sprayed with Karate. Only Tracer and Regent showed significant effects in reducing numbers of *F. occidentalis*.

Table 2 shows that unsprayed plots of Monel recorded the highest number of *M. sjostedti* while Samantha had the lowest, which is similar to the influence of the insecticides to *F. occidentalis* as seen in Table 1. All plots treated with Regent, Tracer and Karate exhibited lower numbers of *M. sjostedti* compared to DC-Tron and the unsprayed plots. The mean number of *M. sjostedti* was however not significantly different for all the plots sprayed with Regent, Tracer and Karate.

The infestation of larvae (Table 3) on French beans was just like the adult thrips as it was higher in the unsprayed Monel plots while Samantha had the least. Sprays of Tracer, Regent and Karate effectively reduced the larval number in all the varieties. However, application of DC-Tron in all the varieties did not significantly reduce the larval infestation compared to the unsprayed plots.

Table 1: Mean No. of *F. occidentalis* infesting French bean flowers as influenced by a combination of insecticides and varieties in 2002 at Kabete, Kenya

	Insecticides				
Varieties	No spray	DC Tron	Karate	Tracer	Regent
Monel	22.970	16.470	13.640	9.170	9.970
Amy	15.000	18.440	10.270	4.500	8.340
Impala	14.240	16.770	8.130	5.770	8.540
Samantha	11.870	14.240	9.770	5.240	5.800
Mean	16.020	16.480	10.450	6.170	8.160
SED	2.411	0.863	1.157	1.033	0.867

p-value for *F. occidentalis*, *Insecticide-factor interaction is 0.000 while *F. occidentalis*, *Varieties-factor interaction is 0.443

Table 2: Mean No. of *M. sjostedti* infesting French bean flowers as influenced by a combination of insecticides and varieties in 2002 at Kabete, Kenya

	Insecticides				
Varieties	No spray	DC Tron	Karate	Tracer	Regent
Monel	19.000	16.17	7.230	5.940	5.840
Amy	12.000	11.40	4.670	4.540	2.670
Impala	10.700	7.87	3.900	3.670	3.140
Samantha	9.430	8.70	2.840	2.640	1.500
Mean	12.780	11.04	4.660	4.200	3.290
SED	2.138	1.87	0.935	0.699	0.918

p-value for *M. sjostedti*, *Insecticide-factor interaction is 0.001 while *M. sjostedti*, *Varieties-factor interaction is 0.527

Table 3: Mean No. of larvae on French bean flowers as influenced by a combination of insecticides and varieties in 2002 at Kabete, Kenya

	Insecticides				
Varieties	No spray	DC Tron	Karate	Tracer	Regent
Monel	5.670	4.17	2.740	1.830	2.370
Amy	3.970	4.67	2.140	1.270	1.870
Impala	2.930	2.70	1.900	1.900	1.800
Samantha	2.740	4.40	1.730	1.330	1.800
Mean	3.830	3.99	2.130	1.580	1.960
SED	0.671	0.44	0.221	0.164	0.138

p-value for larvae, *Insecticide-factor interaction is 0.001 while larvae, *Varieties-factor interaction is 0.230

Table 4: Mean No. of total thrips infesting French bean flowers as influenced by a combination of insecticides and varieties in 2002 at Kabete, Kenya

	Insecticides				
Varieties	No spray	DC Tron	Karate	Tracer	Regent
Monel	47.64	36.800	23.600	16.930	17.170
Amy	30.97	36.400	17.070	10.300	12.870
Impala	29.37	27.330	13.940	11.340	13.470
Samantha	24.03	27.330	14.330	9.130	9.100
Mean	33.00	31.970	17.240	13.150	11.930
SED	5.10	2.677	2.233	1.652	1.728

p-value for larvae, *Insecticide-factor interaction is 0.000 while larvae, *Varieties-factor interaction is 0.375

Table 5: The mean No. of total thrips (*F. occidentalis*, *M. sjostedti* and their larvae) infesting French bean flowers during the flowering period in 2002 at Kabete, Kenya

	Sampling				
Insecticide application	1	2	3	4	5
No spray	17.63	16.46	33.71	40.42	56.79
Dc Tron	19.50	15.33	30.92	38.67	55.42
Karate	19.75	7.59	8.71	18.67	31.46
Tracer	13.54	3.71	6.88	15.46	20.04
Regent	17.21	5.63	10.38	13.09	20.71

In overall, higher number of the total thrips (the 2 adult species plus larvae) individuals was supported by unsprayed plots of Monel while the least was supported by unsprayed plots of Samantha (Table 4). In terms of pesticide sprays, plots treated with Tracer and Regent had the lowest number of thrips than those sprayed with the other insecticides with exception of Impala variety when sprayed with Karate.

Generally, Tracer and Regent sprayed plots recorded the lowest total thrips number throughout the sampling period compared to other treatments (Table 5). The trend of thrips population decreased after the first day of spray application and then increase there after. Mean number of the total thrips in the unsprayed plots and DC Tron sprayed plots were observed to increase throughout the sampling period. A general observation revealed that the effect of the insecticides was higher against *M. sjostedti* than *F. occidentalis* across all the varieties.

DISCUSSION

The mean number of *M. sjostedti* and *F. occidentalis* was significantly lower in the Regent 50 SC and Tracer 480 SC treated plots than in the other treatments across all varieties. Thus both Tracer 480 SC and Regent 50 SC reduced thrips population effectively irrespective of the variety involved. The effectiveness of Regent 50 SC in the control of thrips especially *F. occidentalis*, was also reported by Gauzo *et al.* (2000). Lohr (1996) also reported the effectiveness of Regent 50 SC in reduction of *F. occidentalis* infestations in French beans grown in Kenya. This product could be recommended for use in French bean given that it is broad spectrum and may also be useful in controlling other insect pests of French beans. The effectiveness of this insecticide fourteen days after application implies that it can be applied early in the crop growth to avoid residue problems. Tracer 480 SC, belongs to a naturalyte class of insect control products, being a secondary metabolite from aerobic fermentation of *Saccharopolyspora spinosa* on nutrient media. It has short re-entry interval and requires minimal protection standards and therefore could be most appropriate for use late in the season given that it has also short pre-harvest interval and pose less danger to the environment and has no residue problems. Karate 1.75 EC had a limited control of *F. occidentalis* but effectively controlled *M. sjostedti* in all the varieties. Amatobi (1994) found Karate 1.75 EC to be effective against *M. sjostedti* in cowpeas in Nigeria. Similar findings were also reported by Kibata and Anyango (1996) while working on French beans in Kenya. Ineffectiveness of Karate 1.75 EC to control infestations of *F. occidentalis* on French beans was also reported by Kasina *et al.* (2006) although it is not known whether the pest might have developed resistance due to the frequent use of the insecticide by farmers (Nderitu *et al.*, 1997). Current studies show that *F. occidentalis* are becoming the most serious thrips pest of French beans (Kasina *et al.*, 2006) and this study offers insight to its management. For example, although variety choice may be depended on market preference, farmers should emphasize cultivation of cultivars that show resistance to thrips and effectiveness in population reductions should be given priority while selecting an insecticide, among other properties. Use of Karate 1.75 EC, in IPM programs may be unsuitable due to the non target harmful effects associated with pyrethroids to natural enemies present and the risk of pesticide resistance (Kibata and Anyango, 1996). Likewise, DC Tron 500 ML was found to be ineffective against thrips and may not be recommended for use in control or IPM of thrips. Finally, this study shows both insecticides and varietal management can be used in an IPM system for thrips on French bean crops. With this kind of combinations, it is possible for a farmer to drastically reduce insecticide use against thrips in a season. This would reduce the variable costs of production and hence increase the net income of the farmer.

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