Evaluation of Safe Pesticides and Varieties for Management of Insect Pests in Snap beans in Kenya

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Introduction:

Snap beans (*Phaseolus vulgaris* L.) is an important vegetable in Kenya, grown for its immature pods that are sold mainly in external markets. The crop leads both in the amount exported and value of the exports compared with other vegetables.

Production is constrained by pests, diseases, water and fertility. Pests cause both direct losses through feeding and indirect losses such as the pytosanitary losses . For long, synthetic insecticides have been used to control these pests but success is varied, sometimes being ineffective due to resistance build up. In addition, the global trends in pesticide use has demanded adoption of environmentally friendly products. This study was carried out as part of evaluation to determine pesticides that can be incorporated in an IPM system for managing pests of snap beans in Kenya.

Key pest of Snap beans in Kenya are bean fly (*Ophyiomyia* spp), red spider mites (*Tetranychus evansi*), whiteflies (*Bemisia* Spp), aphids (*Aphis fabae*), leafminers (*Liriomyza* spp), western flower thrips (*Frankliniella occidentalis*), Bean flower thrips (*Megalurothrips sjostedti*) and African bollworm (*Helicoverpa armigera*). They occur at different times of the crop growth, requiring high pesticide use in a season (Nderitu et al., 2001). Seed dressing, though only highly practiced against soil pathogens, is known to reduce and delay pest infestation (Gebrekidan, 2003). The practice could also reduce foliar pesticide use which in turn helps to protect beneficial insects such as natural enemies and pollinators.

Materials and methods

The study was carried out at Mwea, a major Snap bean growing area in Kenya located at Kirinyaga County. The crop, Var Amy was grown under irrigation, which is the common practice there, and all agronomic practices were provided. The trial was done in three season from December 2009 to January 2011. Treatments included: Seed dressings with Imidacroprid products (Gaucho 350FS® and Monceren 390GFS®) and Thiamethoxam products (Apron Star® and Cruiser®). Other treatments included drenching with Imidacroprid product (Confidor®) and Thiamethoxam product (Actara®) at 3 days after emergence followed by foliar spray of the same product at 10 days after emergence. Plots with Var Amy where no seed treatment or spray application was performed were used as control. The trial was run on a RCBD replicated with three replicates and plots of 3 x 3m separated with 0.5m between plots and 1 m between blocks.

Data collected included individual number of pests occurring in situ. For Bean fly, 15 leaves were sampled weekly and punch marks counted under microscope. In addition, five plants were uprooted at week 3 and 5 to count maggots/ pupae. For thrips, 20 flowers were collected randomly, placed in a container with 70% ethyl-alcohol and taken to the lab for analysis. Yield data was collected through harvesting of pods 3 times a week, which were then graded as marketable & unmarketable.

Analysis of Variance was done to find out whether there was significant differences across the treatments in the infestation levels of the pests based on 95% level of confidence limits.

Results and Discussions

There were no significant differences in plant stand of snap beans even when grown under different pest management levels. However, significant differences was recorded in terms of bean fly infestation of beans at Mwea as influenced by the different pesticide treatments (Table 1). Foliar(incl. drenching) sprays-treated plots recorded the lowest infestation levels compared to plots where snap beans were seed dressed. Female punch marks on the snap bean leaves was not significantly different, showing that even oviposotion may not have been detered but only development of the maggots.

Table 1: Bean fly infestation levels on snap beans grown under different pesticide formulation treatments at Mwea, Kenya from December 2009 to January 2011

Treatment	No. of plants	Maggot/pupa	Punch marks
Confidor	103.7	0.22^{a}	388
Actara	96.7	0.44^{a}	388
Gaucho	106.9	5.57^{b}	427
Monceren	107.2	8.32^{b}	369
Cruiser	99.6	8.43^{b}	453
Apron Star	96.3	12.85^{c}	408
Control	91.8	13.23^{c}	380
P (5%)	0.256	<0.001	0.816
Lsd (95%)	14.21	3.473	117.6

Confidor treated snap beans

Un treated snap beans

Only thrips were found to infest snap beans at significantly (P<0.05) in different treatments (Table 2). There were no differences for whiteflies and redspider mites. Snap beans seed dressed with both products of imidacloprid showed significantly higher thrips infestation on leaves compared with foliar/drenching products.

Table 2: Mean number of whiteflies and thrips infesting snap beans from December 2009 to January 2011 at Mwea, Kenya

Treatments	Whitefly nymphs	Thrips on leaves	F. occidentalis	M. sjostedti	Thrips nymphs
Confidor	441	12.8^{a}	42.1^{b}	26.71^{b}	23.85^{b}
Actara	564	16.1^{a}	43.7^{b}	24.45^{b}	27.21^{c}
Gaucho	515	29.8^{b}	29.6$_{a}$	18.62^{a}	21.81^{b}
Monceren	554	26.9^{b}	31.9^{a}	16.69^{a}	21.15^{b}
Cruiser	443	28.5^{b}	30.3^{a}	18.40^{a}	15.71^{a}
Apron Star	626	14.1^{a}	28.4^{a}	16.14^{a}	15.82^{a}
Control	517	15.4^{a}	31.7^{a}	14.16^{a}	13.12^{a}
P (5%)	0.916	<0.001	<0.001	<0.001	<0.001
LSD (5%)	317.6	8.75	8.10	6.213	5.792

There was no significant differences in terms of the plant density by the end of season across the treatments (Table 3). However, the total possible harvestable yield and that is marketable was significantly different across the treatments. Snap beans under no pest management regime had the lowest yields while those sprayed had the highest yields.

Table 3: Snap bean yields as influenced by pesticide management regimes at Mwea, Kenya from 2009 to 2011.

Treatment	Number of plants	Marketable pods (g)	Total pod yield (g)
Confidor	103.7	522^{a}	573^{a}
Actara	96.7	220^{b}	247^{b}
Gaucho	106.9	149^{cb}	183^{c}
Monceren	107.2	206^{b}	243^{b}
Cruiser	99.6	192^{cb}	231^{b}
Apron Star	96.3	112^{c}	143^{c}
Control	91.8	101^{c}	118^{c}
P-value	0.256	<0.001	<0.001
LSD (95%)	14.21	90.2	93.4

The yield effects of the different pesticides on snap beans was varied (Figure 1a-c).

Similar to the total yields, confidor protected snap beans yielded significantly higher per plant compared with the rest. Apron star seed treated snap beans had no significantly different yields per plant compared with control.

There was no significant differences across the treatments based on the recovery of marketable pods in comparison of the total harvests (Figure 1b).

There was significant contribution of the pesticides to the yields of snap beans when comparing with control (Figure 1 c). For example, those treated with confidor increased yields 4 folds and apron star recorded the lowest yield increment.

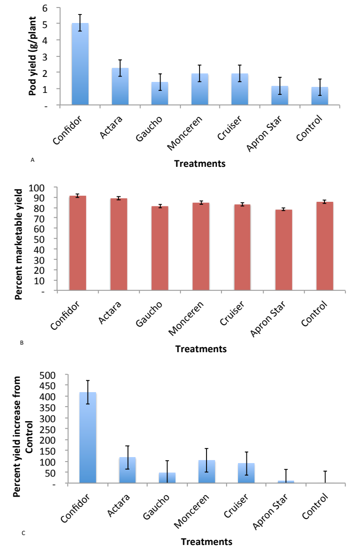

Figure 1: Detailed effects of the pesticides on snap bean yield at Mwea, Kenya from December 2009 to January 2011. A (yield per plant); B (percent marketable yield with the treatment); C (yield gain from control)

Considering the efficiency of the pesticides used on snap bean pests and resulting yield effects, cost benefit analyses show that though higher yields are achieved when confidor is used, the economic gains may be low (Table 4). The most cost effective product was Cruiser followed by Apron star and Monceren, all seed dressing products. Gaucho perfomed less compared with Confidor but better than Actara, another foliar products. The low economic performance of foliar products could be related to the frequency of use, resulting to higher product use and labor costs.

Table 4: Marginal rates of returns from snap beans grown in Mwea, Central Kenya under different pesticide formulation regimes

Treatment	Chemical			Marketable yield	Gross returns	Net returns	Marginal returns
	Amount/ha	KES/ha	Labor, KES/ha	kg/ha	KES/ha	KES/ha	
Cruiser	180ml	1,440	600	213	5,760	3,720	1.82
Apron Star	112.5g	690	600	124	3,360	2,070	1.60
Monceren	360ml	2,160	600	229	6,180	3,420	1.24
Confidor	435g	5,800	2,500	580	15,660	7,360	0.89
Gaucho	320g	2,432	600	166	4,470	1,438	0.47
Actara	400g	4,920	2,500	244	6,600	-820	-0.11
Control	0	0	0	112	3,030	3,030	-

Conclusions and Recommendations

1. Seed dressing is usually performed once and the products efficiency was lower compared with drenching followed with foliar applications
2. Confidor was the most effective product applied as drenching and foliar regime, in controlling pests of snap beans
3. Confidor protected snap beans had the highest yields.
4. Increased yield by four fold was recorded on confidor protected plots compared with all other regimes
5. Cost benefit analysis show that seed dressing products result to higher net returns compared with foliar applications. Cruiser recorded the highest gains compared with the rest while Actara did not record any gain but loss
6. Farmers are advised to consider economic gains while choosing any products as a pest control option.

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