FIELD EVALUATION OF FIVE SYNTHETIC PYRETHROIDS AGAINST THE SPINY BOLLWORM, *EARIAS INSULANA* (BOISD.), FOCUSING ON THEIR NEGATIVE IMPACT ON BENEFICIAL ARTHROPODS (MINIA - EGYPT)

By

Abdelrahman M Younis
Sanaa A. Ibrahim
Minia University - Egypt.
Abdominia1947@yahoo.com
sibrahim51@yahoo.com

Abstract

Five synthetic pyrethroids were evaluated during 2012 cotton growing season against the spiny bollworm *Earias insulana* (Boisd.) using the recommended concentrations as suggested by the Egyptian Ministry of Agriculture. Those pesticides were commercially named Alfa-power (EC-10% alpha-cypermethrin), Nasrthrin (EC-25% cypermethrin), Fury (EW-10% zeta-cypermethrin), Kaput (EC-5% lambdcyhalothrin), and Mampada (EC-5% lambdcyhalothrin). Tested synthetic pyrethroids were compared with a carbamate insecticide commercially named Methocam (SP-90% methomyl). The spray program was started on July 19 when % infestation reached 3-5% and repeated twice at 15 days interval (on August, 2 and August, 16). Counts of spiny bollworm were conducted just before spray and at one week interval up to six weeks. Data revealed that the two formulations of lambdcyhalothrin were the most effective treatment resulted in more than 90% reduction in infestation and larval population. Cypermethrin, alpha-cypermethrin and zeta-cypermethrin came in the second order with an average of 83-85% reduction in infestation and 85-92% reduction in larval population. Methomyl was the least effective treatment resulted in 61.0% and 64.7% reduction in spiny bollworm infestation and larval density, respectively. Regarding the negative impacts on beneficial arthropods, Kaput and Methocam were the least harmful treatments. In the present study, Kaput is recommended to be used for controlling spiny bollworm in Egypt because of its excellent performance against this insect species with minimum side effect on beneficial arthropods.

Introduction

In Egypt, spiny and pink bollworms are the key pests of cotton **(Amin & Gergis, 2006)**. Alternative host plants play an important role in the carryover of *Earias* spp to cotton **(Saini & Singh, 2002 and Bhatti *et al.*, 2007)**. In Egypt, cotton cultivated area decreases annually; in the last five years, farmers do not prefer to cultivate cotton because of the high costs of both cotton pest control and cotton hand picking, accompanied with the low price of seed cotton yield that does not cover the costs of cotton production **(Aziz, 2011)**. Cotton cultivated area was 121,000 hectare during 2009/2010, compared to 132,000 hectare in 2008/2009 growing season with a decline about 11,000 Hectare **(Aziz, 2011).** In another survey by **Abdul Aziz, (2012),** the cultivated area with cotton in 2009/2010 cotton growing season was 390,000 feddan (feddan = 0.42 hectare) compared to 750,000 feddan in 2002.

Damage to cotton crop by insect pests throughout the world results in a significant yield loss each year **(Al-Ameer *et al*, 2010)**. In Egypt, spiny bollworm (SBW), *Earias insulana* (Boisd.) is considered one of the most destructive pests of cotton bolls; cotton is preferred, but is not the only host for this insect species. Egypt spends about 15-20 million dollars to combat cotton bollworms (CBW) on an area of about 800,000 acres every year.

(Temerak, 2003). In Minia Governorate, spiny bollworm is more abundant than pink bollworm, possibly because: 1) spiny bollworm is a polyphagous pest, but the host plants for pink bollworm are very limited; 2) cotton cultivated area was reduced, as a result pink bollworm lost the most favorable host plant and 3) burning process of the collected plants after harvest kills the diapausing larvae in cotton seeds and prevents the next year infestation.

Protect the green bolls from spiny bollworm damage is impossible without chemical control, most of its larvae live inside the green bolls and the pesticides used must be carefully selected to affect egg and adult stages with minimum side effect on beneficial arthropods. Synthetic pyrethroids are the most suitable pesticides to control this insect species because the lipophilic effects of these chemicals make it effective against adult and egg stages. The objective of this study is to evaluate the performance of five synthetic pyrethroids against spiny bollworm in comparison with a carbamate insecticide. The effect of tested chemicals on predators was also considered.

Materials and Methods

An area of about 1.5 feddan (feddan = 0.42 hectare) was cultivated with cotton *Gossypium barbadens* (Giza 90 variety) on April, 12 of 2012 cotton growing season at Minia University Farm, Egypt. Cotton plants received the conventional agricultural practices (tillage, irrigation, hoeing and fertilization etc) as common in Egypt. Also, cotton plants in this experiment did not previously received any pesticide treatments. Starting from July, samples of green bolls were weekly collected from the 4 corners and the center of the cotton cultivated area (100green bolls/each site) to determine the level of infestation. When infestation reached ~3-5%, the experiment was divided to 24 plots of 175m^2 each (6 treatments by 4 replicates), in addition to a separate plot was served as control treatment. Five synthetic pyrethroids and a carbamate insecticide **(Table, 1)** were evaluated for their effect on cotton bollworm and also for their negative impacts on beneficial arthropods.

Table (1): Tested pesticides

<table>
<tr><th>Trade name</th><th>Common name</th><th>Formulation and %AI</th><th>Rate of application [Formulated material/feddan (feddan = (0.42 hectare)]</th></tr>
<tr><td>Alfa-power</td><td>Alpha-cypermethrin</td><td>EC-10%</td><td>250ml</td></tr>
<tr><td>Nasrthrin</td><td>Cypermethrin</td><td>EC-25%</td><td>250ml</td></tr>
<tr><td>Fury</td><td>Zeta-cypermethrin</td><td>EW-10%</td><td>200ml</td></tr>
<tr><td>Kaput</td><td>Lambdcyhalothrin</td><td>EC-5%</td><td rowspan="2">375ml</td></tr>
<tr><td>Mampada</td><td>Lambdcyhalothrin</td><td>EC-5%</td></tr>
<tr><td>Methocam</td><td>Methomyl</td><td>SP-90%</td><td>300gm</td></tr>
</table>

Four plots were used for each insecticide treatment; the 24 plots of 175m^2 each, were distributed in completely randomized blocks design as shown below. Separate area of about 0.3 feddan was left untreated and served as control treatment. The use of separate area for control treatment was to prevent the overlapping of chemicals during the spray.

The evaluation of tested insecticides was based on three successive sprays of 15 day intervals (July, 19; August, 2 and August, 16). Samples of 100 green bolls aged 14-21 day old were collected from each plot just before the first spray (July, 19) and at weekly intervals after the three successive sprays (July, 26; August, 2; August, 9; August, 16; August, 23 and August 30). Green bolls in each sample were inspected and dissected to record number of infested bolls and number of larvae. Mean percentages of spiny bollworm infestation and larval population density were calculated from the data of the two successive weeks after each spray. Also, general average of %infestation after the three successive sprays was also calculated. At each time interval mentioned above (July, 19; July, 26; August, 2; August, 9; August, 16; August, 23 and August 30), number of predators was counted on 25 plants, randomly chosen from each plot. Percentages of reduction in spiny bollworm infestation, larval population and predator populations were calculated using the equation suggested by **Telton and Henderson (1955)**. Then data were subjected to Duncan Multiple comparison Test at 5% level of probability. Pink bollworm, *Pectinophora gossypiella* did not appear until the end of August, moreover, larval population of this species was very low during September and October (<1%). This is why this insect species did not include in the current study?

<u>The experimental design</u>

<table>
<tr><th colspan="7">Plant Pathology Farm (West)</th></tr>
<tr><td rowspan="8">Irrigation source (South)</td><td>Kaput</td><td>Mampada</td><td>Methocam</td><td>Alpha-power</td><td rowspan="7">Control</td><td rowspan="7">Other experiment (North)</td></tr>
<tr><td>Fury</td><td>Methocam</td><td>Nasrthrin</td><td>Kaput</td></tr>
<tr><td>Methocam</td><td>Nasrthrin</td><td>Fury</td><td>Mampada</td></tr>
<tr><td>Mampada</td><td>Alpha-power</td><td>Kaput</td><td>Nasrthrin</td></tr>
<tr><td>Nasrthrin</td><td>Fury</td><td>Mampada</td><td>Methocam</td></tr>
<tr><td>Alpha-power</td><td>Kaput</td><td>Alpha-power</td><td>Fury</td></tr>
<tr><td colspan="4">Other experiment</td></tr>
<tr><td colspan="6">Road (East)</td></tr>
</table>

<u>Results and Discussion</u>

Percentages of reduction in spiny bollworm infestation after each spray and the general average of reduction after the three successive sprays are graphed in **Fig. (1).** At the end of the first spray, the two formulations of lambdcyhalothrin, Kaput and Mampada, exhibited the greatest efficiency in reducing the spiny bollworm infestation (84.1 and 87.7%, respectively). The difference between the two treatments was not significant, probably because both have the same active ingredient at the same concentration (EC-5%) and used at the same rate (375ml/feddan). Other three pyrethroids [Alpha-power (alpha-cypermethrin), Nasrthrin (cypermethrin) and Fury (zeta-cypermethrin)] are statistically similar. (69.3% to 76.5% reduction in infestation). The carbamate insecticide, Methocam (Methomyl) considered the least effective treatment (55.2%). After the second spray, tested pyrethroids are statistically similar in reducing the spiny bollworm infestation (86% to 97%). However, Methocam was significantly less effective (64.2%). Data of the third spray confirmed the insignificant differences between tested pyrethroids with $\geq$ 90% efficiency in reducing the insect infestation and confirming the unsatisfactory results of Methocam

(63.7%). General averages of the three successive sprays keep the first order for Kaput and Mampada, however pushed the other three pyrethroids to the second order and still Methocam inferior with the least efficiency in controlling this insect species **(Table 2 and Fig.1).**

In **Fig (2)**, the comparisons between tested pesticides were based on the reduction in the population density of spiny bollworm larvae. After the first spray, similar trend of pesticides efficiency against the spiny bollworm when the calculations based on %infestation or %larval content [**Fig. (1)** versus **Fig. (2)**]. similarly, the two formulations of lambdcyhalothrin are the most efficient treatments with the greatest reduction in spiny bollworm population (>90%). Other three pyrethroids were in the second order and the carbamate insecticide was the least effective treatment. After the second spray, Kaput, Mampada and Fury were statistically similar, giving the best control and still Alpha-power and Nasrthrin in the second order. Data graphed in **Figure (2)** confirmed that Methocam was not effective in controlling this insect species. After the third spray, tested pyrethroids offered statistically similar efficiency in controlling spiny bollworm, but the carbamate insecticide, Methocam still inferior. General average **(Fig. 2 and Table 2)** after the three successive sprays revealed that Kaput, Mampada and Fury offered the highest efficiency (> 90%) followed by the other two pyrethroids (85-87% reduction). Methocam offered unsatisfactory results (64.7%reduction). The great efficiency of synthetic pyrethroids compared to other conventional pesticides was confirmed in previous study by **Khanzada (2002)**, who reported excellent performance of two formulations of Baythroid against *E.insulana*. Also our data reconfirmed by the finding of **Younis *et al* (2007)** who mentioned that lambdcyhalothrin exhibited great reduction in bollworm infestation compared to other tested insecticides. In another study, alpha-cypermethrin was less effective than deltamethrin against the spiny bollworm, *Earias insulana* **(Scott-Dupree *et al*, 2008)**. In more recent study by **Ibrahim and Younis (2012)**, two formulations of lambada-cyhalothrin and zeta-cypermethrin were tested against bollworms and all were effective without significant difference between them in this respect; they gave more than 80% reduction in bollworm larval content**.** Also, another study conducted by **Zidan *et al* (2012),** revealed that tested pyrethroids (cypermethrin and lambdcyhalothrin) were effective in controlling the field populations of the spiny bollworm.

In our study, this is the first time to cultivate Giza 90 variety in the University farm at Minia Governorate. Cotton variety, Giza 80 was always cultivated in previous seasons. Seed cotton yield with Giza 90 was significantly less than that from Giza 80 in previous year (data not shown). It is hard to know if the reason related to the unexpected high temperature that was dominant on July and August of 2012 cotton growing season or related to the variety unsuitability to the weather in our region (Minia). However, **Aziz (2011)** reported that Giza 90 variety comes in the third rank, it cultivated in 10% (12,000 hectare) of the total cultivated area with cotton in Egypt. In disagreement with the present study, the previous study **(Aziz, 2011)** confirmed that this variety is cultivated in Upper Egypt as it is tolerance to temperature stress, short duration, high productivity and ginning outturn.

Population of predators was reduced in insecticide treatments by 20-29% **(Table 2)**. The greatest harmful treatments are Alpha-power, Nasrthrin, Fury and Mampada with percentages of reduction in predator population averaged 28.65, 26.78, 28.03 and 29.07%, respectively. The least harmful treatment was Methocam (19.89%) and Kaput (23.96%). Predators surveyed in the untreated check belong to the true spiders and three insect orders: Coleoptera [*Coccinella septempunctata, Coccinella undecimpunctata, Cydonia spp., Hippodamia tredecimpunctata*, *Scymnus spp. (Coccinellidae)* and *Paederus alfierii* (Staphylinidae)], Hemiptera [*Orius* spp. (Anthocoridae)] and Neuroptera [*Chrysoperla carnea* (Chrysopidae)]. In agreement with our results, **El-Sayed (2005)** mentioned that the total population of insect predators was, generally, higher in pesticide free cotton field compared with sprayed one. **Also, Younis *et al* 2007** found that some of synthetic pyrethroids (lambdcyhalothrin, esfenvalerate and deltamethrin) treatments were associated with great reduction in the population of predators. **Younis and Ibrahim (2010)** confirmed the harmful effect of synthetic pyrethroids. In addition, **Zidan *et al* (2012)** found that cypermethrin, and lambdcyhalothrin were more toxic against predators than methomyl which induced a moderate effect.

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References cited

Abdul Aziz M. (2012). Cotton: the magic wand. **The Egyptian Gazette. pp: 2.**

Al-Ameer, M. A.; M. E. Abd El-Salam; W. M. B. Yehia and I. A. I. Saad (2010). Evaluation of some cotton genotypes for ability to infestation tolerance to bollworms for improving of some important economic characters. **J. Agric. Res. Kafer El-Shiekh Univ., 36 (2): 147-162.**

Amin, A. A. and M. F. Gergis (2006). Integrated management strategies for control of cotton key pests in middle Egypt. **Agron. Res., 4: 121-128.**

Aziz, M. A. (2011). Arab Republic of Egypt, statement of the Egyptian delegation. **The 69th Plenary Meeting International Cotton Advisory committee 20-25 September 2010 Lubbock, Texas, USA, pp: 18.**

Bhatti, J. A.; M. A. Khan; M. A. Murtaza; M. Z. Majeed and F. F. Jamil (2007). Response of American bollworm (*Helicoverpa armigera* HUB.) to weather factors in cotton under unsprayed conditions. **J. Agric. Res., 45 (3): 209-214.**

El-Sayed, A. A. A. (2005). Ecological studies on the pink bollworm, *Pectinophora gossypiella* (Saunders) and its natural enemies. **Ph. D. Thesis, Plant Protection Department, Faculty of Agriculture, Moshtohor, Benha University, pp: 229**.

Ibrahim, S. A. and A. M. Younis (2012). Field and semi-field trials for evaluating the efficiency of certain pesticides against some cotton pests (Minia University - Egypt). **In Proceedings of Beltwide Cotton Conferences (Cotton insect Research and control Conference), Orlando, FL., USA: 1190-1203.**

Khanzada, A. G. (2002). Pyrethroids against spiny bollworm. **Pakistan Journal of Agricultural Research**, **17 (2): 199-200.**

Saini, R. K. and R. Singh (2002). Host plant preference for oviposition by the spiny bollworm, *Earias insulana* Boisd. (Lepidoptera: Noctuidae). **Journal of Applied Entomology, 123 (4): 241–246**.

Scott-Dupree, C. D.; C. Ron Harris; M. L. Dugas and S. Pirani (2008). Situation of pyrethroids resistance in spiny bollworm, *Earias insulana,* (Boisd.) and carbaryl joint toxic effect. **Resistant Pest Management Newsletter, 17 (2): 38-42.**

Temerak, S.A. (2003). Differential susceptibility of pink and spiny bollworms to the ova-larvicidal activity of spinosad, a natural metabolite of the actinomycete *Saccharopolyspora spinosa* with special reference to solve the field failure of thiodiocarb in the current resistance rotation spraying program in Egypt. **Resistant Pest Management Newsletter, 13 (1): 427-446.**

Tilton, E. W. and D. F Henderson (1955). Tests with acaricides against the brown wheat mite. **J. Econ. Entomol., 48: 157-161.**

Younis, A. M.; S. H. H. Hamouda; S. A. Ibrahim and Z. A. M. Zeitoun (2007). Field evaluation of certain pesticides against the cotton bollworms with special reference to their negative impact on beneficial arthropods (2006 cotton season, Minia region, Egypt). **African Crop Science Conference Proceeding, 8: 993-1002.**

Younis, A. M. and S. A. Ibrahim (2010). Population fluctuations of spiny bollworm, *Earias insulana* (Boisduval); pink bollworm, *Pectinophora gossypiella* (Saunders) and their associated predators. **In Proceedings of**

Beltwide Cotton Conferences (Cotton insect Research and control Conference), New Orelans, LA., USA: 966-977.

Zidan, N. A.; J. B. El-Nagar; A. S. Aref and M. E. El-Dewy (2012). Field evaluation of different pesticides against cotton bollworms and sucking insects and their side effects. **Journal of American Science, 8 (2): 128-136.**

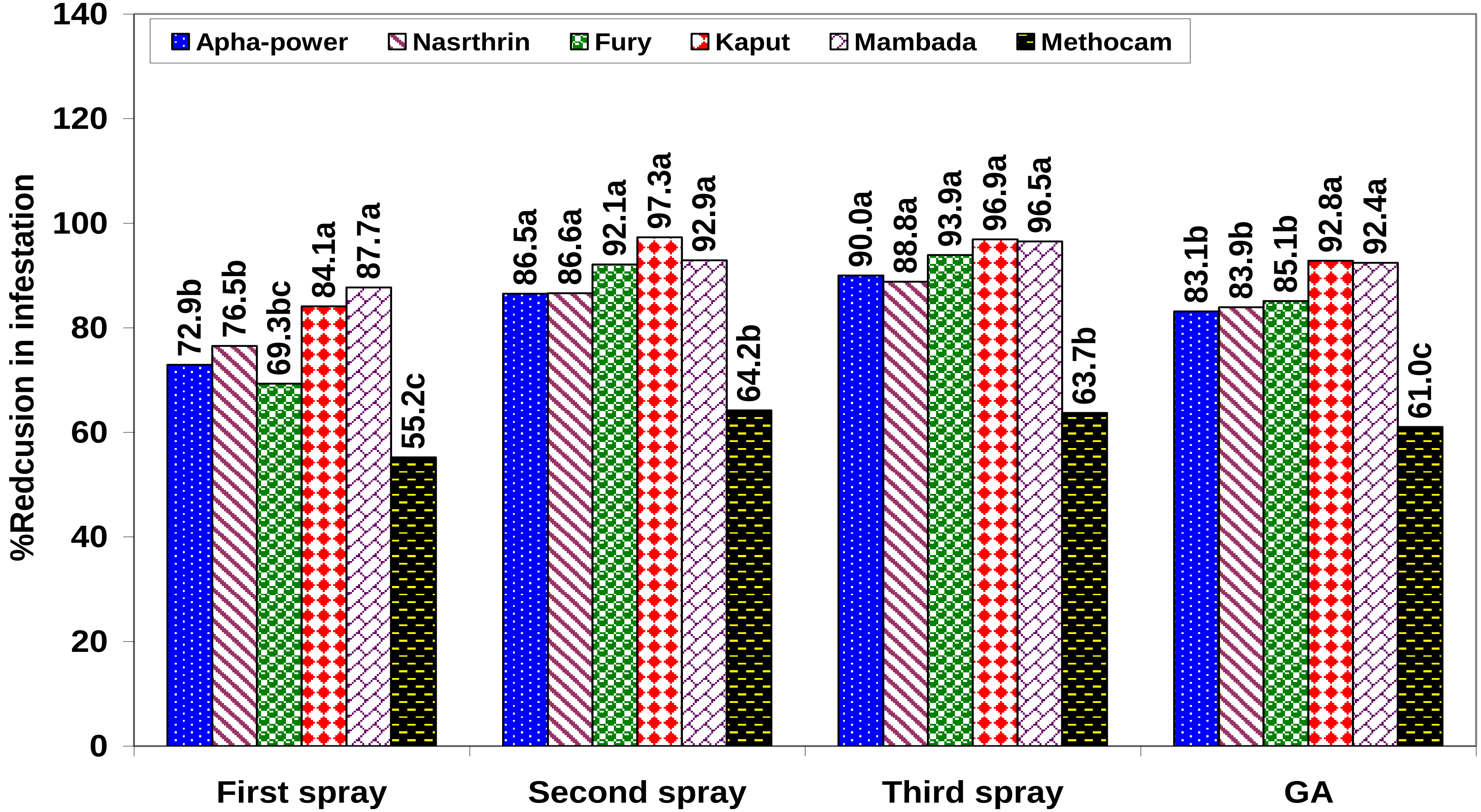

Fig (1): Mean percentages of reduction in spiny bollworm infestation. For each group, means followed by the same letters are not significantly different (Duncan Multiple comparison Test with the least significant range at 5% level of probability).

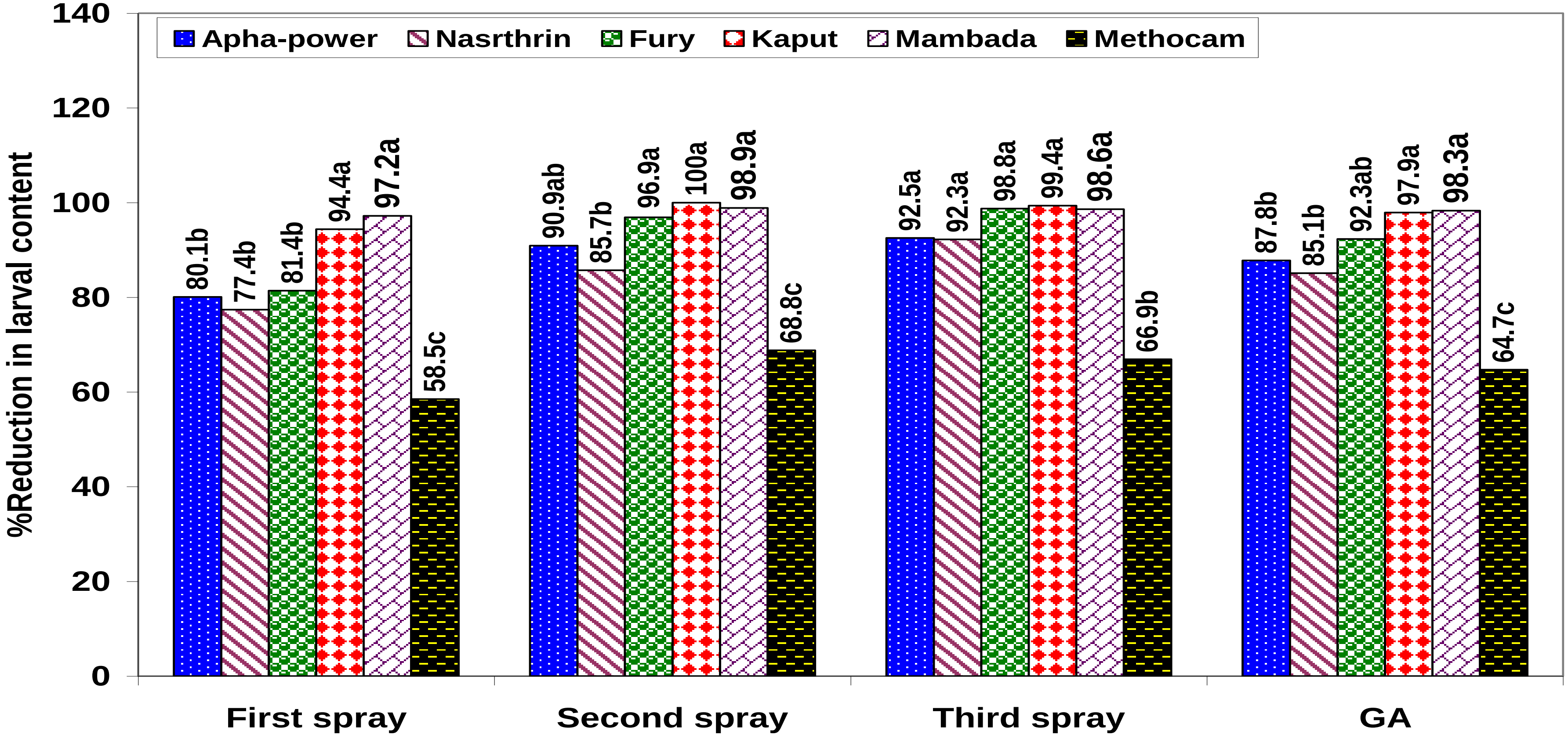

Fig (2): Mean percentages of reduction in the population density of spiny bollworm larvae counted in 100 green bolls/replicate. For each group, means followed by the same letters are not significantly different (Duncan Multiple comparison Test with the least significant range at 5% level of probability).

Table (2): Mean percentages of reduction in spiny bollworm infestation, larval content and number of predators (Mean ± SD).

Trade names	%Reduction in bollworm infestation	%Reduction in bollworm larval population	%Reduction in predator population
Alfa-power	83.1 ± 2.22b	87.8 ± 4.93b	28.65 ± 4.26a
Nasrthrin	83.9 ± 3.24b	85.1 ± 6.52b	26.78 ± 5.32ab
Fury	85.1 ± 5.56b	92.3 ± 3.76b	28.03 ± 6.11a
Kaput	92.8 ± 2.51a	97.9 ± 1.79a	23.96 ± 6.79bc
Mampada	92.4 ± 4.52a	98.3 ± 3.47a	29.07 ± 7.79a
Methocam	61.0 ± 6.37c	64.7 ± 7.37c	19.89 ± 2.03c

For each column, means followed by the same letters are not significantly different (Duncan Multiple comparison Test, with the least significant range at 5% level of probability).