FIELD EFFICACY OF NEWER INSECTICIDE MOLECULES AGAINST SPIDOPTERA LITURA FABRICIUS ON CABBAGE

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INTRODUCTION
The word “Cabbage” is derived from the French word “Coboche” meaning head and is supposed to be originated from Cyprus and around the Mediterranean coast. The larvae of Spodoptera litura (Fab.) (Lepidoptera: Noctuidae) has been reported to feed on 112 cultivated crops all over the world (Moussa et al., 1960). S. litura is a serious polyphagous pest of several cultivated crops and has attained global importance. Widespread development of resistance to chemical insecticides including the widely used pyrethroids has been reported in S. litura (Ahmad et al., 2007). In recent years the problem of resistance to chemical has worsened, resulting in 20-30% crop loss due to pests in India (Bhargava et al., 2008) and causing widespread hardship especially amongst poor farmers. Thus, it has worldwide distribution and cosmopolitan in food habit, feeding on the plants of economic importance. Besides this, the excessive use of only chemical insecticides has also been criticized for their deleterious effects like development of insecticide resistance in insects and pest resurgence. S. litura has been reported to show higher level of resistance against many of the insecticides used in the country, Hence it was necessitate to use the newer chemical insecticides or biopesticides against S. litura.

MATERIALS AND METHODS
A field experiment was carried out to evaluate the field efficacy of various insecticide es against S. litura on cabbage during the year 2013-14 at Agronomy Instructional Farm, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar in Randomized Block Design and replicated thrice with eleven treatments. The cabbage crop was raised by adopting standard recommended agronomical practices. The spray of respective chemical and non-chemical insecticides was applied as per the treatment. The first spray was applied on appearance of the larva of S. litura. The second spray was given at 10 days after first spray. The care was taken to have uniform coverage of the insecticides over crop canopy. Observations on number of larva were recorded from five randomly selected plants from each net plot before application of insecticides and 1, 3 and 7 days after spraying. The yield response of Golden acre variety to insecticides was recorded from net plot of each treatment separately and converted in to hectare basis. Statistical analysis of all the recorded data were subjected to analysis of variance in randomized block design with the procedure followed by Steel and Torrie (1980).

RESULTS AND DISCUSSION
First spray
The results on S. litura per plant before spraying are summarized in Table 1. The results showed that the difference in S. litura population per plant among different treatments before spray was non-significant, which indicated that S. litura population in cabbage crop was uniformly distributed in whole experimental plot.
Looking to the larval population per plant, one day after application, the lowest S. litura population was recorded in spinosad 45 SC @ 0.025 per cent (0.80/plant) and it was at
par with emamectin benzoate 5 SG @ 0.025 per cent (1.11/plant) and indoxacarb 14.5 SC @ 0.007 per cent (1.43/plant) and remained significantly superior over rest of the treatments. Rest of the treatments viz., profenophos 40% + cypermethrin 4% @ 0.017 per cent (1.57/plant), thiodicarb 75 WP @ 0.075 per cent (1.63/plant), rynaxypyr 20 SC @ 0.006 per cent (1.72/plant), neem oil @ 0.5 per cent (1.90/plant), Bacillus thuringiensis 5 × 10⁸ spores/mg @ 0.2 per cent (2.06/plant), SNPV @ 250 LE/ha (2.12/plant) and Beauveria bassiana 2 × 10⁸ cfu/gm @ 0.4 per cent (2.12/plant) did not show their efficacy and remained at par with untreated control (2.26/plant).

The results pertaining to S. litura population per plant, three days after application, the lowest larval population was recorded in spinosad 45 SC @ 0.025 per cent (0.60/plant) and it was at par with emamectin benzoate 5 SG @ 0.025 per cent (0.92/plant) and indoxacarb 14.5 SC @ 0.007 per cent (1.11/plant). Treatment with emamectin benzoate 5 SG @ 0.025 per cent remained at par with all other chemical insecticides viz., indoxacarb 14.5 SC @ 0.007 per cent, rynaxypyr 20 SC @ 0.006 per cent (1.32/plant), profenophos 40% + cypermethrin 4% @ 0.017 per cent (1.38/plant), thiodicarb 75 WP @ 0.075 per cent (1.43/plant) and biorational pesticide SNPV @ 250 LE/ha (1.52/plant). Looking to the efficacy of biorationals and biopesticides, treatment with SNPV @ 250 LE/ha, neem oil @ 0.5 per cent (1.63/plant), Bacillus thuringiensis 5 × 10⁸ spores/mg @ 0.2 per cent (1.72/plant) and Beauveria bassiana 2 × 10⁸ cfu/gm @ 0.4 per cent (1.78/plant) were ineffective against S. litura and they were at par with untreated control (2.26/plant).

After 7 days of first spray, spinosad 45 SC @ 0.025 per cent recorded the lowest S. litura population (0.27/plant) and it was at par with emamectin benzoate 5 SG @ 0.025 per cent (0.46/plant) and indoxacarb 14.5 SC @ 0.007 per cent (0.67/plant). However, the emamectin benzoate 5 SG @ 0.025 per cent remained at par with indoxacarb 14.5 SC @ 0.007 per cent, profenophos 40% + cypermethrin 4% @ 0.017 per cent (0.85/plant), rynaxypyr 20 SC @ 0.006 per cent (0.92/plant) and thiodicarb 75 WP @ 0.075 per cent (0.99/plant). Among the non chemical pesticides all the treatments viz., neem oil @ 0.5 per cent (1.16/plant), SNPV @ 250 LE/ha (1.24/plant) and Bacillus thuringiensis 5 × 10⁸ spores/mg @ 0.2 per cent (1.46/plant) except Beauveria bassiana 2 × 10⁸ cfu/gm @ 0.4 per cent (1.37/plant) were significantly superior over untreated control (2.32/plant).

The data (Table 1) recorded on first day after second spray indicated that all the treatments were significantly superior over untreated control (2.39/plant). Spinosad 45 SC @ 0.025 per cent proved as the best treatment, which recorded the minimum S. litura population of 0.60 larva per plant. However, indoxacarb 14.5 SC @ 0.007 per cent (0.78/plant), emamectin benzoate 5 SG @ 0.025 per cent (0.85/plant) and profenophos 40% + cypermethrin 4% @ 0.017 per cent (1.06/plant) also remained at par with spinosad 45 SC @ 0.025 per cent. Looking to the data on larval population per plant all the treatments remained at par in efficacy and significantly superior over untreated control except spinosad 45 SC @ 0.025 per cent and indoxacarb 14.5 SC @ 0.007 per cent. The larval population recorded per plant in various treatments was emamectin benzoate 5 SG @ 0.025 per cent (0.85/plant), rynaxypyr 20 SC @ 0.006 per cent and thiodicarb 75 WP @ 0.075 per cent (1.24/plant), SNPV @ 250 LE/ha (1.30/plant), neem oil @ 0.5 per cent (1.32/plant), Bacillus thuringiensis 5 × 10⁸ spores/mg @ 0.2 per cent (1.38/plant) and Beauveria bassiana 2 × 10⁸ cfu/gm @ 0.4 per cent (1.46/plant) and all these treatments remained at par with each other and significantly superior over untreated control.

The results pertaining to S. litura population per plant, three days after application all the treatments were significantly superior over untreated control (2.46/plant). The lowest S. litura population was recorded in spinosad 45 SC @ 0.025 per cent (0.33/plant) and it was at par with emamectin benzoate 5 SG @ 0.025 per cent (0.60/plant) and indoxacarb 14.5 SC @ 0.007 per cent (0.71/plant). The treatment with indoxacarb 14.5 SC remained at par with all other treatments in efficacy and recorded the larval population in ascending order as profenophos 40% + cypermethrin 4% @ 0.017 per cent (0.92/plant), rynaxypyr 20 SC @ 0.006 per cent (0.99/plant), thiodicarb 75 WP @ 0.075 per cent (1.06/plant), neem oil @ 0.5 per cent (1.19/plant), SNPV @ 250 LE/ha (1.22/plant), Bacillus thuringiensis 5 × 10⁸ spores/mg @ 0.2 per cent (1.27/plant) and Beauveria bassiana 2 × 10⁸ cfu/gm @ 0.4 per cent (1.32/plant) and performed significantly superior over untreated control.
After 7 days of spray, all the treatments were significantly superior over untreated control (2.53/plant). Among different treatments, spinosad 45 SC @ 0.025 per cent recorded the lowest *S. litura* population, which recorded only 0.19 larva per plant and it was at par with emamectin benzoate 5 SG @ 0.025 per cent (0.40/plant) and found significantly superior over rest of the treatments. However, emamectin benzoate 5 SG @ 0.025 per cent was at par with indoxacarb 14.5 SC @ 0.007 per cent (0.60/plant), profenophos 40% + cypermethrin 4% @ 0.017 per cent (0.71/plant), rynaxypyr 20 SC @ 0.006 per cent (0.73/plant) and thiodicarb 75 WP @ 0.075 per cent (0.80/plant) which registered as second effective group against *S. litura*. Among the treatments, botanical pesticide neem oil @ 0.5 per cent (0.92/plant) and biorationals viz., *Bacillus thuringiensis* 5 × 107 spores/mg @ 0.2 per cent (1.04/plant), *Beauveria bassiana* 2 × 108 cfu/gm and neem oil have also proved their superiority as against untreated control. Looking to the safety point of view, neem oil as well as biorational pesticides can be incorporated in IPM programmes against *S. litura*.

Prasad and Wadhwani (2011) reported that increase in yield of cauliflower was better with ROKET [147.8] against 93.2 for highest dose of 750 LE for SLNPV, the cost benefit ratio was 1:12.56, 1:15:24, and 1:22.77 with 750, 500 and 250 LE per hectare, respectively as compared to 1:42.21 with ROKET. The above results clearly indicated that the spinosad 45 SC @ 0.025 proved as the most effective treatment in controlling this pest under field conditions followed by emamectin benzoate 5 SG against *S. litura*. Similarly non chemical pesticides viz., *Bacillus thuringiensis* 5 × 107 spores/mg, SLNPV @ 250 LE/ha (1.19/plant) were also found effective and they remained at par with chemical treatments viz., rynaxypyr 20 SC @ 0.006 per cent and thiodicarb 75 WP @ 0.075 per cent. Thus, based on first and second spray the results clearly indicated that the spinosad 45 SC @ 0.025 was at par with emamectin benzoate 5 SG @ 0.40/plant and found significantly superior over rest of the treatments. However, emamectin benzoate 5 SG was at par with Indoxacarb 14.5 SC and rynaxypyr 20 SC (296.58 q/ha). Rest of the treatments viz., thiodicarb 75 WP (281.02 q/ha), profenophos40% + cypermethrin 4% (268.73 q/ha), neem oil (266.13 q/ha), SLNPV @ 250 LE (263.52 q/ha), *Bacillus thuringiensis* 5 × 107 spores/mg (250.82 q/ha) and *Beauveria bassiana* 2 × 108 cfu/gm (246.21 q/ha) remained at par with each other in yield. Neem oil performed better and remained significantly superior over untreated control. Whereas, all the biorational pesticides viz., SLNPV, *Bacillus thuringiensis* and *Beauveria bassiana* were failed to produce higher yield and remained at par with untreated control (216.70 q/ha).

Dharmendra et al. (2011) obtained the highest yield in spinosad (237.50 q/ha) followed by lufenuron (225.00 q/ha), rynaxypyr (205.00 q/ha) and abamectin (180.00 q/ha). The above reports are strongly in support to the present findings.

**REFERENCES**


