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G Chhangani
Department of Entomology
Rajasthan College of Agriculture
Maharana Pratap University of Agriculture and Technology,
Udaipur, Rajasthan, India

MK Tali
Department of Entomology
Rajasthan College of Agriculture
Maharana Pratap University of Agriculture and Technology,
Udaipur, Rajasthan, India

B Singh
Department of Entomology
Rajasthan College of Agriculture
Maharana Pratap University of Agriculture and Technology,
Udaipur, Rajasthan, India

Correspondence
G Chhangani
Department of Entomology
Rajasthan College of Agriculture
Maharana Pratap University of Agriculture and Technology,
Udaipur, Rajasthan, India

Management of gram pod borer *Helicoverpa armigera* (Hubner) by bio-pesticides in farmscaping system

G Chhangani, MK Tali and B Singh

Abstract
The investigation on, "Gram pod borer *Helicoverpa armigera* (Hubner) management by bio-pesticides in farmscaping system" was conducted on Instructional Farm and Department of Entomology, Rajasthan College of Agriculture, Udaipur during *Rabi* 2018. Gram variety GNG-1581 was sown with different farms caped treatments to compare the impact of bordered plants viz., mustard, marigold and sunflower along with bio-pesticide protectants i.e. foliar applications of NSKE (5%) as prophylactic spray after one month of germination and Ha NPV @ 250 LE/ ha (when 1-2 larvae per m-row was observed). The marketable yield of gram among different farms caped treatment ranged from 1.26 to 1.89 kg/ plot. The maximum marketable yield of 1.89 kg/ plot was recorded in gram bordered with marigold with bio pesticide application The highest cost benefit ratio of 1:1.92, was recorded for gram bordered with marigold with biopesticide treatment; while, lowest cost benefit ratio of 1:1.33 was recorded for gram without farms caped treatment.

Keywords: Gram, gram pod borer, farmscaping, bio-pesticide, NSKE (5%), Ha NPV

1. Introduction
Chickpea (*Cicer arietinum* L.) is among the most widely consumed legumes in the world, particularly in tropical and subtropical areas. Chickpea is an important *Rabi* pulse crop of India and has been considered as 'King of Pulses' [1]; consumed as a major nutrient supplement for protein One of the more practical means of increasing chickpea production is to minimize losses caused by the biotic factors, which include insect-pests, diseases and weeds under field conditions. Among the many biotic factors responsible for low yields, damage due to insect pests is a major limiting factor [2].

In India the major insect pest of chickpea is the gram pod borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) which is polyphagous, multivoltine and cosmopolitan pest. It is known to feed on 182 species of plants belonging to 47 families in India [3] [4] and on more than 250 crop species [5] [6]. The gram pod borer, *H. armigera* (Hubner) is known to cause about 29 per cent yield losses in chickpea at national level. High polyphagy, mobility, reproduction rate and diapause are major factors contributing to its serious pest status [7]. NPV is being one of the important biopesticide, as it is ecofriendly, having less residual toxicity, compatible with many chemical pesticides, self-perpetuating nature.

Hence, NPV can be implemented as one of major component in IPM programme. But, there is a scope to develop quality control guidelines and methodologies, systematic registration policies, to identify effective stains and to develop UV (Ultraviolet) resistant strains. In addition, the guidelines and training for implementation of biocontrol agents should be made available. Over the past 25 years, the research approach on NPVs has evolved toward being more ecologically holistic with industry's concerns.

2. Materials and Methods
The seeds of chickpea variety GNG-1581 were sown on first week of October with spacing of 30 cm × 10 cm. Sunflower and mustard seeds were also sown with gram along the border as per treatment and marigold seedlings were transplanted one week after germination of gram seed. Mustard crop was grown in between sole and farmscaping treatments as a barrier crop and was harvested before flowering stage.

Table 1: Different farmscaping and bio-pesticide treatments

Treatment	Details
T_1	Gram without farmscaping (Untreated)
T_2	Gram without farmscaping (Treated)
T_3	Gram bordered with Mustard (Untreated)
T_4	Gram bordered with Mustard (Treated)
T_5	Gram bordered with Marigold (Untreated)
T_6	Gram bordered with Marigold (Treated)
T_7	Gram bordered with Sunflower (Untreated)
T_8	Gram bordered with Sunflower (Treated)

Foliar applications of NSKE (5%) as prophylactic spray after one month of germination and Ha NPV @ 250 LE/ ha (when 1-2 larvae per m-row was observed) were given in the treated plots.

3. Results and Discussion

3.1 Effect on pod borer larvae population

The lowest larval population (0.71larvae) was recorded in gram farms caped with marigold with bio pesticide application, which was at par with the larval population recorded from gram farms caped with sunflower (0.85 larvae) and gram farms caped with mustard (0.89 larvae) both given by bio pesticide protection (Table -2).

Farmscaping with bio pesticide application (one spray of NSKE and one spray of Ha NPV) had lower mean larval population as compared to farmscaping without bio pesticide application.

3.2 Effect on gram grain yield

From Table 2 it is evident that maximum marketable yield of 1.89 kg/ plot was recorded in gram bordered with marigold with bio pesticide application followed by gram bordered with marigold without bio pesticide application treatment. It was significantly higher than all other treatments. The lower yield was recorded from gram without any farms caped border.

The yield obtained in farmscaping with sunflower untreated was at par with gram without farmscaping treated; likewise, yield of gram in farmscaping with mustard untreated was at par with sunflower farmscaping with bio pesticide application.

Table 2: Influence of farms cape treatments on pod borer infestation and the grain yield, *Rabi* 2017-18

Treatment	Details	Mean Pod borer (№/ row)	Grain yield (kg/ plot)
T_1	Gram without farmscaping (Untreated)	2.97^{e}	1.26
T_2	Gram without farmscaping (Treated)	1.12^{b}	1.395
T_3	Gram bordered with Mustard (Untreated)	2.94^{d}	1.53
T_4	Gram bordered with Mustard (Treated)	0.89^{a}	1.665
T_5	Gram bordered with Marigold (Untreated)	2.71^{c}	1.8
T_6	Gram bordered with Marigold (Treated)	0.71^{a}	1.89
T_7	Gram bordered with Sunflower (Untreated)	2.95^{d}	1.44
T_8	Gram bordered with Sunflower (Treated)	0.85^{a}	1.485

*Various superscripts with different letter are statistically significant

3.3 B: C ratio

The farmscaping treatments were aimed to get higher economic return by increasing the natural enemies abundance and reducing the damage caused by the insect pest. Taking this into consideration the economics of each frams caped plot was worked out. The data presented in Table (3) during *Rabi* 2017-18 revealed that all the treatments were found to be profitable over sole gram. The maximum net profit of Rs. 55,200 and the highest cost benefit ratio of 1:1.92, was recorded for gram bordered with marigold treatment. The minimum net profit of Rs.32, 000 and lowest cost benefit ratio of 1:1.33 was recorded for gram without farms cape treatment.

Similary, highest cost benefit ratio in Chickpea intercropped with Coriander, Marigold, Mustard and Lentil. Among the all treatment highest cost benefit ratio was recorded in Chickpea + Coriander (1:2.93), followed by lowest Chickpea + Wheat (1:2.22). All treatments are significant. Farmscaping with bio-pesticide application gave an added advantage towards reducing the larval pod borer population [8]. It was found that Ha NPV is effective in larval reduction and keeping population of *Helicoverpa armigera* Hubner at its minimum levels and obtaining higher yields of pigeon pea [9]. Subsequently, leading to increased yield. This clearly indicates that farmscaping should be combined with suitable bio pesticide protection. However, due to non-availability of similar work on farmscaping along with bio-pesticides treatments much discussion is not possible.

Table 3: Economic and cost benefit ratio of different farms caped crops in gram during *Rabi* 2017-18

Treatments	No. of sprays	Average yield (q/ha)	Gross return (Rs.)	Increased yield over control (q/ha)	Value of increased yield over control (Rs./ha)	Management Cost (Rs./ha)	Net profit (Rs./ha)	B:C Ratio
T_1	0	14	56000	0	0	24000	32000	1:1.33
T_2	2	15.5	62000	1.5	6000	25800	36200	1:1.40
T_3	0	17	68000	3	12000	24800	43200	1:1.74
T_4	2	18.5	74000	4.5	18000	26600	47400	1:1.78
T_5	0	20	80000	6	24000	27500	52500	1:1.91
T_6	2	21	84000	7	28000	28800	55200	1:1.92
T_7	0	16	64000	2	8000	25500	38500	1:1.51
T_8	2	16.5	66000	2.5	10000	26100	39900	1:1.53

(1) Present price of NSKE 5%: Rs. 500/ lit
(2) Present price of Ha NPV (250 LE): Rs. 1300 per bottle
(3) Labour charge: 4 labour @ Rs. 250
(4) Market price of gram: Rs. 40/ kg

4. Conclusion

Farmscaping with bio-protectants should be used to increase the yield and obtaining higher returns. It also helps in attracting the associated natural enemies of pest which subsequently decreases the pest population.

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