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Field compatibility of microbial pesticide *SL NPV* with synthetic pesticide Roket, [Cypermethrin+Profenofos] against tobacco caterpillar *Spodoptera litura* [Fabricus]

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ABSTRACT

Synthetic chemicals are causing a serious threat of resistance and persistence in the environment. Cost effectivity is another aspect not to be ignored in developing and underdeveloped countries. Hence, introduction of an economically feasible and ecosafe pesticide is definitely a welcoming strategy in crop field by farmers.Microbials and herbals have been proving very safe and target oriented biopesticides provided they are formulated properly and farmers are convinced to use them in fields. The aim of present investigation was to check the compatibility and feasibility of microbial bio-pesticide, Spodoptera litura Nuclear Polyhedrosis Virus [Sl NPV] was assessed against Spodoptera litura [Fabricus] by comparing its efficacy with synthetic pesticide ROKET [Cypermethrin+Profenofos], using randomized block design [RBD] on cauliflower crop in South Rajasthan, India.. Assessment of the results was done on the basis of percent fruit infestations on number and weight basis and comparing the results with control check with no applications of chemicals at all. Economic feasibility were assessed on the basis of yield and cost benefit ratios. When three recommended doses of Sl NPV i.e. 750,500 and 250 LE[larval equivalents] per hectare were sprayed on cauliflower, minimum infestation of 8 kg florets out of 63.75 kg of florets were observed with percent infestation of only 12.43 [750 LE], 15.85 [500 LE] and 18.20 for [250 LE] as compared to 38.57 in control. When number of infested florets were observed in Sl NPV treated blocks, only 11 infested florets out of 120 florets in a block were observed with highest dose of 750 LE giving only 9.16 percent of infestations as compared to 37.58 in control. Comparative economics of Sl NPV with synthetic pesticides ROKET on the basis of yield and cost benefit ratio revealed, maximum yield over control with 750 LE i.e. 95.2 quintals followed by 79.93 and 67.05 quintals for 500 and 250 LE per hectare Although increase in yield was slightly better with ROKET[147.8]against 95.2for highest dose of 750LE 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 synthetic insecticide, although superior in yield but looking to their drawbacks, overall performance was better with bio-pesticide SL NPV, therefore successfully advocating the inclusion of bio-pesticides in Integrated Pest Management Program [IPM].

Keywords: Bio Pesticide, Cost Benefit Ratio, Randomized Block Design, Integrated Pest Management, ROKET, Larval equivalents [LE]

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INTRODUCTION

Indiscriminate and excessive use of toxic substances has almost collapsed the pest control system due to the resistance of pests to insecticides, resurgence of treated pests, rise of secondary pests and imbalance of ecosystem there by degradation of natural resources of land air and water. It has led to the search for an alternate method of pest control and IPM [Integrated Pest Management] has emerged as most successful alternative pest control strategy. Biological control method is an important component of IPM and microbial bio - pesticides. Microbial control through entomopathogens are gaining much advancement due to their eco safe nature and target specific action. [1]. Entomopathogenic viruses are one such special class of viral entomopathogen that present perfect biological solutions to curb insect pests simultaneously restoring environmental balance. [2]. Of the entire pest, Spodoptra litura [Fabricus], the tobacco caterpillar has been reported as major pests of cabbage from all important cabbage growing tracts of India. [3,4]. It is an ubiquitous, polyphagus Lepidopteron pest feeding almost on 112 cultivated crops all over the world [6]. Vegetable growers, by and large depend on chemical pesticides to counter the problem of insect pests. It accounts for 13-14 percent pesticides consumptions as against 2.6 percent of cropped area. [7]. Apart from damaging cole crops it also attacks most of the vegetable and tobacco crops causing heavy loss. .Further Southern part of Rajasthan in India is basically a tribal dominated area with less resources and small land holdings. Any loss in crop due to pests puts heavy toll on them. Cool seasons Crucifers particularly cabbage and cauliflowers are most important vegetable crops because of their economical and nutritional values [8,9]. Spodoptera litura attacks heavily on these two cole crops i.e. cabbage and cauliflower every year in this part of Rajasthan. Control of this pest with synthetic pesticide is the only option, however this fails to protect poor farmers and is becoming unacceptable for environmental costs reason. [10].

Hence, program of field evaluation of one microbial viral bio-pesticide SL NPV [Spodoptera litura Nuclear Polyhedrosis Virus was undertaken and compared with traditionally used synthetic pesticide ROKET [Cypermethrin+Prophenofos] to adjudge the potentialities of such biopesticides as an effective alternate to synthetic pesticides. The comparison was done on the basis of bioeffecacy as well as on the basis of economics so as to see the feasibility of the biopesticide for future use in pest management programmes by tribal farmers.

MATERIALS AND METHODS

Field experiments were carried out in cauliflower field by adopting Randomized Block design [RBD] [Figure 1A] in the month of July-November .Nurseries of cole crop , Brassica olearcia was prepared in July and they were planted in field according to our lay out design of RBD .Crops were harvested in the month of October and November.

In trial, there were nine treatments with one control with each treatment set. All treatments were repeated four times. The plot size was 60x80 square feet [18X24 meters] with an inter row spacing of 2 feet and interplant spacing of 10 inches. Three doses of Sl NPV i.e. 250

LE [T1], 500 LE [T2] and 750LE [T3], were selected for the treatments. 500 LE is the recommended dose for this crop. The first spray was given one month after transplantation. By this time pest infestation was seen in the field. The spraying of bio-pesticide was carried out during early in the morning or evening hours so as to avoid bright sunlight. Three sprayings were given during complete experimental tenure. [Figure 1]. Field of cauliflower were observed after each spraying. [Figure 2 and 3]

TRANSPLANTATION OF CAULIFLOWER SAPLINGS
(TAGS SHOWING RBD BLOCKS)
(FIG. 1)

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INFECTED BLOCK IN RBD WITHOUT SPRAY (CONTROL)

HEALYHY PLANTS OF CAULIFLOWER OBSERVED FOR PEST INCIDENCE AFTER IIIrd SPRAY OF BIO PESTICIDE

(FIG. 3)

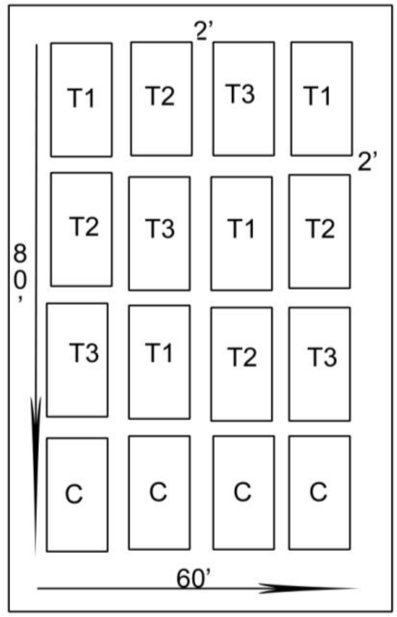

Figure: 1A: RDB Design

Statistical Analysis

Total yield was assessed onthe basis of number of florets and their weight in each sampling unit as compared to control where there was no spray of bio-pesticides.

Calculations were done by using following formulae:

$$\text{Percent Infestation [on weight basis]} = \frac{\text{Weight of infested fruits}}{\text{Total yield of fruits}} \times 100$$

$$\text{Percent Infestation [on number basis]} = \frac{\text{Number of infested fruits}}{\text{Total number of fruits}} \times 100$$

After getting the total yield, cost benefit ratio was calculated by comparing bio-pesticide with synthetic recommended pesticide [ROKET] by using following formula:

$$\text{Percent gain in yield over control} = \frac{\text{Yield in treated plot – yield in controlled plot}}{\text{Yield in treated plot}} \times 100$$

Further the net profit was calculated on the basis of yield gained from different treatments and cost incurred for the production, including cost of insecticide and their application cost etc.

RESULTS

Percent infestation on weight basis: [Table 1]

When three different recommended doses of Sl NPV i.e. 250,500 and 750 LE per hectare [Ti, T2 and T3] were sprayed on cauliflower crop, minimum infestation of fruits was obtained with 750 LE per hectare [T3] where only 8 kg of florets were infested out of total yield of 63.75 kg .Percent infestation was only 12.43 [T3] as compared to 15.85 [T2] and 18.20 [T1] at the dose level of 500 and 250 LE per hectare respectively. Percent yield was higher in all the Sl NPV treated plots as compared to control where 38.57 percent infestation was observed.

Percent Infestation on number basis: [Table-1]

Percent infestations on number basis were observed by counting number of infested florets obtained out of total number of florets. Out of three Sl NPV treated blocks i.e. T1, T2 and T3, minimum infestation was obtained in T3 [750 LE per hectare] with only 11 infected florets out of 120 florets giving only 9.16 percent infestation as compared to 37.58 percent in control. In T1 [250LE] and T2 [500 LE], percent infestations on number basis were almost at par having 14.16 and 11.45 percent infestation as compared to 37.58 in control

Comparative Economic of Sl NPV with chemical pesticide ROKET: [-Table 2]

Comparative economics was assessed on the basis of total yield per hectare, net profit and total incurred cost .The calculation was done on the basis of cost benefit ratio based on total yield obtained in different treatments together with an increase in yield over control. The sale price of cauliflower was Rs 500 per quintal.

Lowest dose of Sl NPV@250 LE per hectare gave maximum cost-benefit ratio [1:22.77] followed by 500LE [1:15.24] and 750LE [1; 12.56] respectively but the yield over control was maximum with highest dose of 750LE per hectare [95.2quintals] followed by 79.93 and 67.05 quintals with 500LE and 250LE -per hectare.

When the above results were compared with chemical pesticide ROKET [1litre per hectare], although average yield was higher [147.80 quintals] over bio pesticide treatment [95.2 quintals with 750LE per hectare], the cost benefit ratio did not vary much–. It was 1:42.21 with ROKET as compared to 1:22.77, 1:15.24 and 1:12.46 with 250,500 and 750 LE per hectare of SL NPV respectively.

Table-1: Bio-efficacy of bio-pesticide, Sl NPV against Spodoptera litura [Fabricus] infesting cauliflower Crop.

Treatment No.	Treatment	Dosage per hectare	Infestation of fruits on weight basis		Infestation of fruits on number basis	
			Average number	Percent infestation	Average number	Percent infestation
T_1	NPV	250LE	10.92≈11kg of 60 kg	18.20±1.0280	17 of 120	14.16±0.6818
T_2	NPV	500LE	9.83 ≈ 10 of 62kg.	15.85±0.8040	14 of 120	11.45±0.7990
T_3	NPV	750LE	7.92 ≈ 8 of 63.75 kg.	12.43±0.5150	11 of 120	9.16±0.6818
T_7	Control	--	20.75 of 53.75 kg	38.57±1.5179	45 of 120	37.58±1.5864
CD at5%				1.268		1.339
CD at 1%				1.728		1.825
Sem ±				0.431		0.455
CV				5.21		6.48

Table-2: Economics and cost benefit ratio of the bio-pesticide and synthetic insecticide on cauliflower

Sr. No	Treatment [Per hectare]	No. of Application	Average total yield [quintals per hectare]	Increased yield over control [quintals per hectare]	Approx. sales price Rs. / quintal	Value of increase yield [Rupees]	Approx. cost of insecticide + labor cost	Approx. net price ± in Rs. Per hectare	C.B. ratio
T_1	NPV @ 250 LE	3	204.66	67.05	500	33525	1410	32115	1:22.77
T_2	NPV @ 500 LE	3	217.54	79.93	500	39965	2460	37505	1:15.24
T_3	NPV @ 750 LE	3	232.81	95.2	500	47600	3510	44090	1:12.56
T_7	Control	--	137.61	--	--	--	--		
General insecticides used by farmers	ROCKET @ one liter	3	285.41	147.80	500	73900	1710	72190	1:42.21

First spray was made after one month of transplantation further second and third sprays were done at fifteen days of interval.

ROCKET: Profenofos 40+ Cypermethrin 4 percent EC [Effective Concentration]

DISCUSSION

The statistical analysis of SL NPV clearly showed that this viral bio pesticide was superior over control. At 500 and 750 LE per hectare the percent infestation was only 15.85 and 12.43 as compared to 38 .57 in control on weight basis [Moscordi, 1999]. Baculovirus, amongst other insect viruses are considered as safe and selective bio-insecticide restricted to invertebrates only. Our experiments further revealed that the percent infestations were also significantly reduced when number of florets was counted in bio-pesticide treated blocks as compared to control block. It was 14.16, 11.45 and 9.16 with an average of 17, 14 and 11 out of 120 cuds at 250.500 and 750 LE dose per hectare respectively. Poor productivity of Cruciferous crops is mainly due to the infestation of diamond back moth, Plutella xylostella [L] tobacco caterpillar Spodoptera litura [Fab], leaf webber, Crocidolomi binotalis [Zeller] and aphids .Although in an uninterrupted field there are many natural enemies available but due to increased pesticidal interference, their population has been reduced and it has become need of the hour to introduce some safer measures in the field. Microbial pesticides derived from Bacteria, Virus and Fungus are found very effective against these pests, [10].When Spodoptera exempta Nuclear Polyhedrosis Virus [SPexNPV] was evaluated to control Spodoptera exempta in the field of Tanzania as an alternate pest control method. Field trials demonstrated that both ground and aerial spray can cause pest population collapses at $1x10^{12}$polyhedra per hectare. It was concluded from studies that SPex NPV can have a potential role as a substitute for chemical insecticide in strategic pest control of army worm in the field [10]. Similarly when chemical, botanical and bio-pesticide were used at different concentrations against Spodoptera litura [Fab] on sugar beet, it was found that Trchograma chilonis a bio-pesticide at the dose level of 50000 per hectare and Azardirachtin at 3000 ppm gave 89.7 and 89.3 percent reduction in pest population there by proving the feasibility of bio pesticide and botanicals in field conditions [9].

Cost benefit ratio has more relevance in the introduction of bio-pesticides and judicious use of chemical pesticides. Although chemical pesticides give superior results in terms of yield and cost but microbials have also proved at par. If we see in our observations, SL NPV at the dose of 750 LE per hectare gave an average yield of 232.81 quintals per hectare as compared to 285.41 quintals per hectare with ROKET at the dose of one litre per hectare. And if we calculate cost benefit ratio for both bio and chemical pesticides it was 11:22.71,1:15.24 and 1:15.24 for 250,500and 750 LE per hectare respectively as compared to1:42.21 with one litre per hectare of ROKET. The difference is not much significant at all fronts. Looking into all the drawbacks of chemical pesticides, inclusion of bio-pesticides can be a welcoming step. Currently the industries interest in viral pesticide is increasing day by day because of buildup of insect resistance to pesticides, banning of many pesticides worldwide and overall demand of safer and less toxic chemicals .With the introduction of IPM programme, number of pesticidal applications in a crop field has fell down from average[11,12 &13] Use of insecticides against A. gemmatalis in Brazil has shifted to more selective chemicals like IGRS, NPV and Bt [14,15]. Ag NPV has shown high potential to control the pest [Moscardi, 1999]. The NPV of Gypsy Moth has been developed in United States Canada and many European countries. China uses NPV of Buzuras Suppresiaria to control this insect on tea and 80% control was achieved 1000 LE of GVS per hectare.NPV has been developed and used against Spodoptera litura in China, India and Taiwan and against Spodoptera exigua US and Egypt[16,17]

In a field application of fungal biopesticide Beauveria bassiana with chemical pesticide Pyridaben against citrus red mite Pononychrus citri, it was found that trial gave significant control and fungal chemical combinations always resulted in better control [18,19]. Similarly, when different isolates of Helicoverpa armigera Nuclear Polyhedrosis Virus [HaNPV] collected from different fields from different parts of India for their assessment in IPM of Helicoverpa armigera under field conditions, the observations revealed that Gulberga and Coimbatore isolates were most appropriate for designing IPM schedule against Helicoverpa armigera on various hosts crops[20].

Hence use of viral bio-pesticides can provide economic short term and long term control and are quiet effective at lower dosages under suitable environmental conditions, It can be very well established in the field if the ecological aspects of environment are considered in the light of hazard caused by synthetic insecticides. To conclude with, introduction of bio-pesticides is no doubt a welcoming step in the field of pest control.

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