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Certificate

This is to certify the work recorded in this thesis entitled "**Bio-efficacy of Insecticides, Acaricides and Bio-insecticides on Brinjal insect-pest**". Submitted by Gagan Deep (Reg. number- 11719010) in partial fulfilment of the requirements for the award of Degree of Master of Science (Agriculture) in Agriculture Entomology of Lovely Professional University, Phagwara, Punjab is the faithful and bonafide research work carried out under my personal supervision and guidance.

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Bio-efficacy of Insecticides, Acaricides and Bio-insecticides on Brinjal insect-pest

Introduction

Brinjal *Solanum melongena* L. belongs to the family Solanaceae having its origin in the Indian sub-continent and currently used throughout the world as vegetables. It is a most important vegetable in the Indian Subcontinent. Color shades different in same cultivar and different cultivar due to anthocyanin and chlorophyll concentration in fruit peel. Fruit is available in different colors. Brinjal is a important vegetable grown due to its nutritive value, consisting of minerals like calcium, iron, phosphorous, and vitamins like A, B and C. unripe fruits are used mostly as vegetable and also used as raw material in making pickle (Singh *et al*. 1963) and as an excellent remedy for those suffering from liver complaints. Brinjal also reported as Ayurvedic medicine for curing the diabetes. In addition it is used as a good appetizer, good aphrodisiac, cardiotonic, laxative and reliever of inflammation.

As per the report of I kisan agriinformatics & service Brinjal is grown extensively in India, Bangladesh, Pakistan, China and other parts of the world. India ranks second in the world and its contribution is 27.1 per cent. In India, it is mainly grown in Bihar, Orissa, West Bengal, U.P. and other parts. Brinjal is being cultivated round the year during *kharif, rabi* and summer season. The area under brinjal cultivation is estimated as 0.68 million ha with the total production of 12706 thousand MT (Laichattiwar *et al*. 2017). At present, the brinjal is of much importance in the warm areas of the far east with extensive cultivation in the Indian subcontinent and China.

As the report of Horticulture statistic division, Department of Agriculture, cooperation and farmers welfare In 2016 India exported 288,910 (000kg) of Brinjal and earn $703,319 value. Major export of Brinjal to Bangladesh $155,114, Singapore $95,823, United Arab Emirates $74,681. (As per the report of zauba). In 2014 - 15 India produced 12,413.7 (1000 Tonne), from the area of 677.1 (000 ha.). West Bangal got 1st rank in production 2985.4 (000 tonne), from the area of 161.9 (000 ha.). Odisha got 2nd rank in production 2103.3 (000 tonne), from the area of 122.7 (000 ha). Gujarat got 3rd rank in production 1477 (000 tonne), from the area of 76.0 (000 ha). Madhya pradesh got 4th rank in production 1154 (000 tonne), from the area of 46.1 (000 ha). Bihar got 5th rank in production 1141.6 (000 tonne), from the area of 57.6 (000 ha)

Eggplant production is severely constrained by several insect and mite pests. The major pests include eggplant fruit and shoot borer, leafhopper, whitefly, thrips, aphid, spotted beetles, leaf roller, stem borer, blister beetle, and red spider mite. The yield loss due to the major pests is to the extent of 70-92 per cent (Chakraborti and Kanti 2011). Growers rely heavily on chemical pesticides to protect their eggplant crop. Pesticide misuse has adverse effects on the environment and human health and also increases the cost of production. The share of the cost of pesticide to total material input cost was 55% for eggplant in the Philippines (Orden *et al.*, 1994). Many farmers refrain from growing eggplant due to the cost of pesticides (Gapud and Canapi 1994).

The losses caused by various pests to Brinjal crop can be avoided by adopting proper pest control tactics. Controlling of insect pests through Bio insecticide is one of best method that has no harmful affect on environment and human health. Insecticide and Acaricide application is one of the management options that can substantially reduce yield losses associated with insect pest

infestations. But indiscriminate use of high dose of pesticide have harmful effect on environment and human health, also increase the cost of production. Repeated application of same pesticide cause resistant in insect – pests of crop. To overcome the problems related to resistant in insect pest and decreasing the cost of production proper pesticide and dose have to apply. Sufficient work has been done on testing the bio-efficacy of conventional insecticides and acaricides against pests of Brinjal. There is a paucity of information about the efficacy of newer insecticides and acaricides against pests of Brinjal. It is therefore imperative to resort the knowledge on above aspects, the present investigations will be undertaken with following objectives:

Objectives :-

1. Evaluation of relative bio-efficacy of certain newer insecticides against insect - pests infesting Brinjal.
2. Evaluation of relative bio-efficacy of certain newer acaricides against mites infesting Brinjal.
3. Evaluation of relative bio-efficacy of certain bio-insecticides against Brinjal insect pest.

Review of literature :-

1. **Evaluation of relative bio-efficacy of certain newer insecticides against insect - pests infesting Brinjal.**

Bioefficacy of spinosad, emamectin benzoate, cypermethrin and neem extract insecticides studied against brinjal insect pest by Kalawate Aparna and Dethe M. D. (2012). Spinosad found most effective in controlling BSFB then whiteflies, aphid and jassid.

As per the report of Patel Satyendra (2013), among different insecticides applied to manage insect pest of brinjal. Emmamectin Benzoate treated plot is found less infested followed by pyriproxifen and fenpropethrin.

From the different nine insecticides evaluated to control brinjal sucking pest jassid and whitefly Shaikh A.A. et al. (2014), found thiamethoxam, diafenthiuron and thiacloprid most effective in controlling pest.

Sajjan A. A. and Rafee C. M. (2015) investigated the efficacy of newer insecticides against brinjal shoot and fruit borer. Flubendiamide 480 SC @ 0.1 ml, cyantranilprole 10 OD @ 0.3 ml/l and spinosad 45 SC @ 0.1 ml/l of water found most effective to reduce brinjal shoot and fruit borer infestation.

According to Sajjad Anwar *et al.* (2015) evaluated efficacy of different insecticides against brinjal fruit borer showed that emamectin benzoate most effective against brinjal fruit borer infestation followed by cypermethrin.

Mainali *et al*. (2015) tested the bio efficacy of newer insecticides against *L. orbonalis*. and found that the fruit infestation percent on number and weight basis was significantly lowest in Chlorantraniliprole and Spinosad treated plots.

Singh *et al.* (2016) evaluated various insecticides against brinjal shoot and fruit borer (*L. orbonalis*). Emamectin benzoate 5 SG @ 12.5g a.i./ha treated plots found lowest infested and gave higher fruit yield followed by Flubendiamide 480 SC and Novaluron 10 EC.

Roy Gobinda *et al.* (2016) tested the efficacy of four insecticides, *viz*., carbosulfan 25 EC, emamectin benzoate 5% SG, lamda-cyhalothrin 5% EC, and fenpropathrin 30% EC at different doses, showed carbosulfan 25 EC, most effective against *L. orbonalis* in brinjal crop.

Kumar Awaneesh *et al.* (2017) investigated the Efficacy of different newer insecticides against *Bemisia tabaci.* Thiamethoxam 25WG @ 100g/ha found most effective insecticide in reducing the population of whitefly followed by imidacloprid 17.8 SL @ 100 ml/ha. Dimethoate 30 EC @ 500 ml/ha was recorded less effective to reduce the white fly population.

Niranjana *et al.* (2017) evaluated efficacy of ten insecticides against L. orbonalis on brinjal. Chlorantraniliprole 18.5% SC found highly effective in controlling L. orbonalis infestation followed by spinosad and flubendiamide.

2. Evaluation of relative bio-efficacy of certain newer acaricides against mites infesting Brinjal

Kumar *et al.* (2009) evaluated the efficacy of some newer acaricide and insecticide molecules for management of two spotted spider mite, *T. urticae* in brinjal ecosystem. Dicofol @ 4ml/l found highly effective in reduction of mite population closely followed by fenpyroximate 5 EC @ 0.8 ml/l.

Sharma S. R. A. (2010) investigated the relative toxicity of acaricides against *Tetranychus* spp. on Brinjal mite. Among all acaricides dicofol was the most effective acaricide (LC50=206.177 ppm) followed by spiromesifen (LC501061.64

ppm), propargite (LC50=2061.64 ppm), milbemectin (LC50 =2652.87 ppm) and diafenthiuron (LC50=3306.34 ppm).

Dutta N. K. *et al.* (2012) investigated the efficacy of four new acaricides against red spider mite, *Tetranychus urticae* Koch in brinjal. Among the tested acaricides, Abamectin 1.8 EC provided the highest (83.4%) reduction of mite population.

Karmakar K. and Patra S. (2013) showed that the bio-efficacy of new acaricide molecule, etoxazole 10% SC (w/w) against red spider mite, *Tetranychus urticae* koch in brinjal, and found that Etoxazole 10%SC (w/w) @ 40 g *a.i.*/ ha, etoxazole 10%SC (w/w) @ 55 g *a.i.*/ ha and etoxazole 10%SC (w/w) @ 80 g.*a.i.*/ha were very effective in controlling eggs and immature stages of red spider mites in brinjal.

Investigations on toxicity and field efficacy of selected acaricides against *T.urticae* were carried out by Kavya, M. K. on Brinjal crop (2014). Among the acaricides evaluated against *T. urticae* fenazaquin @125g, fenpyroximate @30g, propargite @570g and spiromesifen @100g ai/ha found lowering mite population up to two weeks after application.

Reddy *et al.* (2014) evaluated different newer acaricides to control two spotted spider mites infesting cucumber under laboratory and green house condition. Abamactin and fenazaquin found highly effective in controlling two spotted spider mites.

Kavya *et al*. (2015) studied the bioefficacy **of** newer acaricides against *Tetranychus urticae* on Brinjal plants. Propargite and spiromesifen found more effective in controlling mite population with in three days application.

Patel N.B. and Patel C.C. (2017) evaluated the efficacy of different nine acaricides against brinjal mite, fenazaquin 0.01%, diafenthiuron 0.05%, spiromesifen 0.02%, dicofol 0.05%, ethion 0.05%, chlorfenapyr 0.01%, propargite0.06%, fenpyroximate 0.005% as well as wettable sulphur 0.16% compared with control. Fenazaquin 0.01% and spiromesifen 0.02% found most effective in controlling mite population.

3. Evaluation of relative bio-efficacy of certain bio-insecticides against Brinjal insect pest

Belair *et.al.* (2003) reported that the susceptibility of insect's larvae to EPN increased with the development in larvae. They recorded 95.8% mortality in cabbageworm from *S. feltiae*. After 12 hours of exposure 76% and 78% mortality was achieved by *S. carpocapse* and *S. feltiae*. But they also stated that the foliar spray of *S. carpocapse* did not provide good results for control of cabbageworm under field conditions.

Steinernema carpocapsae entomopathogenic nematode cause significant reduction in brinjal fruit borer damage when applied 1-1.5 and 2 billion /ha at 10 days interval (Ganga Visalakshy *et.al.*2009).

Saimandir J. and Gopal M. (2011) conducted the field experiment for the evaluation of two *Bacillus thuriegensis* (Bt) based formulations namely Biolep and PUSA Bt and two azadirachtin formulations namely Neem Seed Kernal Extract (NSKE) and Nimbo Bas for the management of the Eggplant shoot and fruit borer (ESFB). NSKE found effective against ESFB, however NimboBas found to be non-effective against ESFB.

Xun yan *et al.* (2013) tested the efficacy used *Steinernema carpocapsae* and *Heterorhabditis indica* entomopathogenic nematode to check their efficacy against

Phyllotreta striolata pest of crucifer vegetables. Both nematode species decreased population of soil dwelling stage that reduce adult population and increased yield through preventing shot hole damage on leaves.

As per the report of Islam MD. A. (2013) evaluated the performance of some plant extracts for the management of brinjal shoot and fruit borer, (*L. orbonalis* Guenee) evaluated. Results revealed that the use of neem leaf extract @ 50 g L-1 water would be highly effective to reduce the shoot and fruit infestation as well as to get higher yield of brinjal.

Gowrish (2014) studied the biorational management of major pests in Brinjal. Azadirachtin 1% was found to be most effective in controlling *E. vigintioctopunctata* adults as well as grubs. The *Bt* formulation was found to be highly effective for early instar larvae of *A. olivacea*. The azadirachtin 1% was found to be highly effective against *S. docilis* as compared to other treatments.

Gozel *et al.* (2015) tested the efficacy of the four species of EPN on the tomato leaf minor which are *Steinernema affine, S. carpocapse, S. feltiae* and *Heterorhabditis bacteriophora,* from which the most effective was *S. feltiae* with 90.7% and 94.3% and the least effective was *S. affine* with 39.3% and 43.7% mortality respectively during 2012-13.

Nagesh *et.al*. (2016) showed that the response surface Modelling (RSM) predicted that 58.05-62.54 IJs/cm2 of different *Heterorhabitis* and *Steinernema* entomopathogenic nematode strains were required for affecting 97.10-99.67% grub mortality at 90-97hours of exposure. They also stated that EPN were positively correlated with sandy soils and negatively correlated with clay soils and EPN performed better in content of sand, alluvial, mountain soil, red laterite compared to black cotton soil.

As per the report of Ali *et al.* (2016) the effect of bio-pesticides against sucking insect pests of brinjal crop evaluated. They found Chemical control (confidor/Diamond) showed its superiority in effect to combat sucking insect pests studied in brinjal, followed by Neem extract, Tobacco extract, Eucalyptus extract and untreated control remained the least.

3.0 Proposed program of work and methodology:

1. Evaluation of Relative bio-efficacy of certain newer insecticides against insect pests infesting Brinjal

Evaluate the relative bio-efficacy of some insecticides/acaricides/biopesticide against insect pests infesting brinjal, a field experiment is carried out at Agriculture farm, of Lovely professional university, Jalandhar. Details of the field experiment are given here under.

Details of the experiment:

Experimental design	: Randomised Block Design (RBD)
No. of replications	: Three
Treatment details	: Given below
Crop and Variety	: Brinjal and Navkiran F1 hybrid
Method of sowing	: Transplanting
Spacing	: 60 X 60 cm
Fertilizers	: 100:50:30 (NPK kg/ha)
Plot size	: Gross: 3.0 X 3.0 m
	Net: 1.8 X 4.8 m

Experimental period : Kharif and Rabi season.

Treatments:

Sr. No	Treatments	a.i. g or ml/ha	formulation (g or ml/ha)	Dose g or ml / 1 lit.
1	Emamectin benzonate 5%SG	10	200	0.4
2	Spinosad	250	1000	2.0
3	Thiacloprid 21%SC	180	750	1.5
4	Fipronil 5%SC	50	1000	2.0
5	Diafenthiuron 50%WP	300	600	1.2
6	Thiamethoxam 25% WG	50	200	4.0
7	Control (water spray)	-	-	-

2. Evaluation of Relative bio-efficacy of certain newer acaricides against insect pests infesting Brinjal

Sr. No	**Treatments**	**a.i. g or ml/ha**	**CIB g or ml/ha**	**Dose g or ml / 1 lit.**
1	Spiromesifen 22.9% SC	72	300	0.6
2	Spiromesifen 22.9% SC	96	400	0.8
3	Spiromesifen 22.9% SC	120	600	1.0
4	Abamectin 1.8% EC	11.25	625	1.25
5	Abamectin 1.8% EC	13.5	750	1.5
6	Abamectin 1.8% EC	15.75	875	1.75
7	Control (water spray)	-	-	-

3. Evaluation of relative bio-efficacy of certain bioinsecticides against Brinjal insect pest

1. *Heterorhabtid spp.*entomopathogenic nematode @2000 IJ3/l water
2. *Heterorhabtid spp.*entomopathogenic nematode @4000 IJ3/l water
3. *Steinnernema spp.*entomopathogenic nematode @2000 IJ3/l water
4. *Steinnernema spp.*entomopathogenic nematode @4000 IJ3/l water
5. *Cannabis sativa* leaf extract @ 10 ml /l water.
6. Neem based insecticide (Azadirachtin 1%) @ 3 ml/l of water
7. Control water spray

Method of recording observations:

In order to record the incidence of various insect pests, five plants will be randomly selected from net plot area of each plot and tagged. Observations on population of major insect pests will be recorded by counting the number of nymphs/larva as well as adults in case of thrips and aphids and only adults in case of whitefly from three leaves (top, middle and bottom) of tagged plants. In case of mite, the observations will be recorded from 2 cm^2 area from three leaves (top, middle and bottom) of tagged plants. In case of shoot and fruit borer observation will taken base on no. of fruit/shoot affected. Such observations will be recorded a day before the spray as well as 3, 5 and 7 days after each spray. The data obtained will be converted to average population per leaf (for thrips, whitefly and aphids) or per cm^2 (for mite) and subjected to statistical analysis after suitable transformation, if necessary.

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