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Bio-efficacy of newer insecticides and neem derivatives against major insect pests of soybean

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Abstract

A field experiment was laid out in Randomized Block Design with twelve treatments replicated thrice to study the bio efficacy of newer insecticides and neem derivatives against major pests of soybean at Instructional Farm, Rajasthan College of Agriculture, Udaipur (Rajasthan) during kharif season of year 2014 and 2015. The treatments consisted as Chlorantraniliprole 18.5 SC, Emamectin benzoate 5 SG, Flubendiamide 39.35 SC, Novaluron 10 EC, Spinosad 45 SC, Triazophos 40 EC, Neem leaf extract 10%, Neem cake extract 10%, NSKE 5%, Azadirachtin 10000 ppm, NSKE 5% + *B. bassiana* and Control. It was revealed that spraying of Triazophos 40 E.C@1.6ml/lit recorded significantly maximum reduction of jassids and white fly population at 3,7 and 14 days respectively followed by emamectin benzoate 5 SG at first as well as second spraying during both the years. In case of semilooper and Tobacco caterpillar spraying of Spinosad 45 SC @ 0.4ml/lit recorded significantly maximum reduction of population followed by chlorantraniliprole 18.5 EC at 3, 7 and 14 days respectively during both the years at first and second spraying.

Keywords: Bio-efficacy, neem derivatives, soybean, newer insecticides

Introduction

Soybean [*Glycine max* (L.) Merrill] being an important legume crop has innumerable possibilities to combat nutritional deficiencies in human being due to its high protein content about 42 per cent as well as sustaining soil fertility. It also supports various agro industries; therefore, it is also known as the "Golden Bean" of the 20th century. Sprouted soybean contains vitamin C, vitamin A, vitamin E (a natural antioxidant) and its by product soya milk contains 20 fold higher iron as compared to cow milk(1.3mg/100 ml). Soybean meal is used as protein supplement in diet, cattle and poultry feed. The minimum inputs requirement and less management led to the rapid expansion in area and production of soybean crop.

Therefore, India now ranks 4th in terms of area under soybean cultivation and 5th in terms of its production after USA, Brazil, Argentina and China. In India, the total production of soybean during 2014-15 was 103.73 lakh MT from an area of 109.10 lakh hectares with productivity of 951 kg ha⁻¹.

The low productivity of soybean both at national and state level is attributed to abiotic and biotic stresses like drought, weeds, insect pests and diseases. Among these, insect pests often pose a serious threat to soybean production by increasing cost of cultivation and impairing quality of the produce in many ways (Singh *et al.*, 2000) [1]. The luxuriant crop growth, soft and succulent foliage attract many insects and provides unlimited source of food, space and shelter. Grain yield and quality of soybean is adversely affected by major pests such as tobacco caterpillar, green semilooper, jassids and whitefly. The increasing population of these insect pest complexes may cause severe yield loss up to 50 per cent. It was also reported that about 15-20 per cent of the total soybean production is lost directly or indirectly due to attack of insect pests every year (Biswas, 2013) [2]. There is an urgent need to find out eco-friendly, effective and economically viable techniques by using some newer insecticides, botanicals and use of neem derivatives or neem product for control of these pests below economic threshold level. Therefore, a study on bio-efficacy of newer insecticides and neem derivatives against major insect pests of soybean was undertaken.

Materials and Methods

A field experiment was laid out in Randomized Block Design with twelve treatments replicated thrice. The soybean variety JS-335 was sown on 2nd July, 2014 and 3rd July 2015 respectively with a row to row and plant to plant spacing of 45 cm and 5 cm. Treatments consisted as T1- Chlorantraniliprole 18.5 SC 0.0037 per cent, T2 - Emamectin benzoate 5 SG 0.0018, T3- Flubendiamide 39.35 SC 0.0079, T4- Novaluron 10 EC 0.020, T5- Spinosad 45 SC

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0.018, T6 - Triazophos 40 EC 0.064, T7-Neem leaf extract 10% 10, T8- Neem cake extract 10% 10, T9- NSKE 5%, T10- Azadirachtin 10000 ppm 0.002, T11- NSKE 5% + *B. bassiana* and T12-Control. The first sprays of various treatments were given at the ETL level of pests and subsequent second was 15 days after first spray. Observation were recorded on incidence of major insect pests on one day before and three, seven and fourteen days after spraying (DAS) of each spraying. The population of semilooper and tobacco caterpillar was recorded on trifoliolate of five randomly selected and tagged plants in each replication. Similarly the population of white fly and jassids were recorded from five randomly selected plants. Three leaves were selected from the upper, middle and lower portion and population of nymphs and adults was visually counted in each replication. The per cent reduction in population of major insect pest was computed using the statistical method described by Henderson and Tilton (1955)^[4].

Results and Discussion

Bio-efficacy of newer insecticides and neem derivatives against Jassids population

During kharif-2014 and 2015 at first spraying as shown in Table 1 & 2 it was observed that spraying of Triazophos 40 E.C@1.6ml/lit recorded significantly maximum reduction of jassids with mean reduction of 90.63, 87.26 and 82.64 and 91.00, 86.05 and 81.75 per cent was at 3, 7 and 14 days respectively followed by emamectin benzoate 5 SG. During both the years at second spraying the highest mean reduction in population of jassid was recorded in Triazophos 40 E.C@1.6ml/lit i.e. 86.68, 84.20 and 81.08 and 85.56, 83.50 and 80.70 per cent at 3, 7 and 14 days after spray respectively during both the years followed by emamectin benzoate 5 SG. The results corroborates the findings of Joshi and Patel, 2010). Gupta (2008)^[3].

Table 1: Bio efficacy of newer insecticides & neem derivatives against jassids during *kharif* 2014

Treatments	Dosage (ml or g/ha)	PTP *	Mean reduction (%) in population after 1 st spray			PTP *	Mean reduction (%) in population after 2 nd spray		
			3 DAS	7 DAS	14DAS		3 DAS	7DAS	14 DAS
Chlorantraniliprole 18.5 EC	0.2ml/l	14.08	72.05 (58.09)	70.50 (57.18)	68.46 (55.84)	15.66	69.36 (59.39)	66.98 (54.97)	63.25 (52.70)
Emamectin benzoate 5 SG	0.35 g/l	14.66	85.63 (67.77)	82.68 (65.72)	78.30 (62.24)	15.00	82.61 (65.40)	80.07 (63.54)	77.60 (61.81)
Flubendiamide 39.35 SC	0.2ml/l	14.33	66.72 (54.79)	62.90 (52.50)	58.62 (49.97)	14.66	63.33 (52.77)	59.68 (50.59)	54.50 (47.58)
Novaluron 10 EC	2.0ml/l	15.00	63.30 (52.71)	61.2 (51.48)	59.29 (50.36)	15.66	60.08 (50.82)	57.64 (49.41)	55.02 (47.88)
Spinosad 45 SC	0.4ml/l	14.66	78.92 (62.72)	73.32 (58.92)	69.50 (56.52)	16.00	75.15 (60.10)	71.50 (57.82)	67.53 (55.33)
Triazophos 40 EC	1.6ml/l	14.08	90.63 (72.27)	87.26 (69.29)	82.64 (65.61)	14.00	86.68 (68.68)	84.20 (66.71)	81.08 (64.31)
Neem leaf extract 10 %	10%	14.33	50.07 (45.04)	47.65 (43.65)	44.51 (41.85)	15.00	48.20 (43.97)	46.12 (42.77)	43.00 (40.97)
Neem cake extract 10 %	10%	14.66	47.25 (43.42)	45.02 (42.14)	42.36 (40.60)	15.66	45.67 (42.52)	43.51 (41.27)	41.07 (39.85)
NSKE 5%	5%	14.66	50.51 (45.29)	48.69 (44.25)	45.21 (42.25)	14.00	47.18 (43.38)	44.45 (41.81)	41.36 (40.02)
Azadirachtin 10000 ppm	2ml/l	15.00	43.86 (41.47)	41.05 (39.84)	40.99 (39.81)	15.33	41.65 (40.19)	38.67 (38.44)	35.42 (36.52)
NSKE 5% + <i>B. bassiana</i>	2ml/l	15.33	62.20 (52.06)	58.87 (50.11)	54.38 (47.51)	16.00	59.98 (50.76)	54.53 (47.60)	51.10 (45.63)
Control		14.00	-	-	-	13.33	-	-	-
SEm±		0.48	1.55	1.88	1.61	0.59	1.32	2.22	1.94
CD (p=0.05)		NS	4.56	5.52	4.72	NS	3.88	6.50	5.69

Table 2: Bio efficacy of newer insecticides & neem derivatives against jassids during *kharif* 2015

Treatments	Dosage (ml or g/ha)	PTP *	Mean reduction (%) in population after 1 st spray			PTP *	Mean reduction (%) in population after 2 nd spray		
			3 DAS	7 DAS	14 DAS		3 DAS	7 DAS	14 DAS
Chlorantraniliprole 18.5 EC	0.2ml/l	13.66	71.96 (58.04)	70.66 (57.29)	67.56 (55.28)	14.33	70.50 (57.11)	67.00 (54.98)	64.52 (53.47)
Emamectin benzoate 5 SG	0.35 g/l	13.66	84.90 (67.17)	83.05 (65.80)	79.00 (62.73)	14.00	83.21 (65.87)	81.05 (64.26)	76.84 (61.29)
Flubendiamide 39.35 SC	0.2ml/l	13.33	65.72 (54.18)	63.00 (52.56)	59.65 (50.57)	13.66	64.42 (53.42)	60.00 (50.77)	55.25 (48.02)
Novaluron 10 EC	2.0ml/l	14.00	63.50 (52.83)	60.90 (51.30)	60.00 (50.78)	14.66	61.05 (51.39)	59.20 (50.32)	56.80 (48.91)
Spinosad 45 SC	0.4ml/l	13.66	77.99 (62.07)	74.05 (59.39)	68.72 (56.03)	15.00	74.89 (59.93)	70.69 (57.30)	69.50 (56.56)
Triazophos 40 EC	1.6ml/l	13.00	91.00 (72.64)	86.05 (68.24)	81.75 (64.92)	14.66	85.56 (67.74)	83.50 (66.16)	80.70 (64.03)
Neem leaf extract 10 %	10%	13.33	51.25 (45.72)	46.99 (43.27)	45.52 (42.43)	14.00	48.50 (44.14)	45.08 (42.17)	43.20 (41.09)
Neem cake extract 10 %	10%	13.66	49.30	46.00	43.80	14.66	46.01	44.50	41.50

			(44.60)	(42.71)	(41.43)		(42.71)	(41.84)	(40.10)
NSKE 5%	5%	13.66	50.01 (45.01)	49.10 (44.48)	46.00 (42.71)	13.66	47.55 (43.59)	43.50 (41.26)	42.50 (40.68)
Azadirachtin 10000 ppm	2ml/l	14.00	44.41 (41.79)	41.98 (40.38)	41.50 (40.11)	14.33	42.00 (40.40)	39.65 (37.65)	37.20 (37.58)
NSKE 5% +B. bassiana	2ml/l	14.33	61.91 (51.89)	59.24 (50.33)	55.20 (47.99)	15.00	60.08 (50.82)	55.55 (48.19)	52.00 (46.15)
Control		13.00	-	-	-	13.48	-	-	-
SEm±		0.45	1.56	1.88	1.61	0.52	1.33	2.40	1.97
CD (p=0.05)		NS	4.58	5.52	4.72	NS	3.91	7.03	5.77

*Pre-treatment population **Figures in parenthesis are retransformed per cent values DAS-Days after spray NS=Non-significant

Bio-efficacy of newer insecticides and neem derivatives against White fly population

At first spraying as shown in Table 3 & 4 Triazophos 40 E.C@1.6ml/lit recorded significantly maximum reduction of white fly with mean reduction of 92.90,88.02 and 83.45 and 92.50,81.25 and 76.25 per cent was at 3,7 and 14 days respectively during both the years. It was followed by emamectin benzoate 5 SG. At second spraying the highest

mean reduction in population of white fly was recorded in Triazophos 40 E.C@1.6ml/lit i.e. 93.00, 87.98 and 81.41 and 92.75, 86.50 and 82.00 per cent at 3, 7 and 14 days after spray respectively during both the years. It was followed by emamectin benzoate 5 SG. The present findings are in conformity with Gupta (2008) [3], Shirale and Bidgire (2009) [10] and Vinaykumar *et al.* (2013) [12].

Table 3: Bio efficacy of newer insecticides & neem derivatives against whitefly during *kharif* 2014

Treatments	Dosage (ml or g/ha)	PTP *	Mean reduction (%) in population after 1 st spray			PTP *	Mean reduction (%) in population after 2 nd spray		
			3 DAS	7 DAS	14 DAS		3 DAS	7 DAS	14 DAS
Chlorantraniliprole 18.5 EC	0.2ml/l	17.28	82.75 (65.49)	79.88 (63.57)	74.50 (59.68)	15.47	83.00 (65.66)	80.88 (64.25)	76.52 (61.11)
Emamectin benzoate 5 SG	0.35 g/l	17.70	88.71 (70.440)	83.40 (66.08)	80.05 (63.48)	16.34	89.12 (70.83)	84.25 (66.71)	81.30 (64.47)
Flubendiamide 39.35 SC	0.2ml/l	17.49	78.67 (62.56)	75.92 (60.70)	72.04 (58.09)	16.72	79.05 (62.96)	74.50 (59.70)	72.38 (58.33)
Novaluron 10 EC	2.0ml/l	17.92	65.40 (53.97)	62.75 (52.40)	59.70 (50.60)	16.53	66.00 (54.33)	63.20 (52.68)	60.05 (50.80)
Spinosad 45 SC	0.4ml/l	17.70	84.40 (66.84)	80.30 (63.69)	78.34 (62.38)	16.34	84.75 (67.03)	81.12 (64.49)	78.25 (62.41)
Triazophos 40 EC	1.6ml/l	17.28	92.90 (74.70)	88.02 (69.98)	83.45 (66.26)	15.96	93.00 (74.96)	87.98 (69.94)	81.41 (64.35)
Neem leaf extract 10 %	10%	17.49	48.75 (44.28)	45.50 (42.42)	41.00 (39.81)	15.77	49.50 (44.71)	46.50 (42.99)	44.18 (41.65)
Neem cake extract 10 %	10%	17.70	45.68 (42.52)	42.33 (40.59)	41.24 (39.94)	16.53	47.00 (43.28)	44.10 (41.61)	41.16 (39.90)
NSKE 5%	5%	17.28	59.35 (50.40)	55.50 (48.16)	51.70 (45.97)	15.96	61.00 (51.36)	56.72 (48.86)	51.75 (46.00)
Azadirachtin 10000 ppm	2ml/l	18.13	55.34 (48.07)	51.65 (45.95)	49.33 (44.62)	16.34	60.25 (50.92)	56.00 (48.46)	52.50 (46.43)
NSKE 5% +B. bassiana	2ml/l	17.28	72.20 (58.18)	68.24 (55.70)	64.15 (53.23)	15.77	73.12 (78.79)	69.35 (56.41)	65.00 (53.78)
Control		17.92	-	-	-	16.34	-	-	-
SEm±		0.58	1.68	2.07	1.68	0.44	1.58	2.56	2.21
CD (p=0.05)		NS	4.94	6.08	4.91	NS	4.61	7.50	6.48

Table 4: Bioefficacy of newer insecticides & neem derivatives against whitefly during *kharif* 2015

Treatments	Dosage (ml or g/ha)	PTP *	Mean reduction (%) in population after 1 st spray			PTP *	Mean reduction (%) in population after 2 nd spray		
			3 DAS	7 DAS	14 DAS		3 DAS	7 DAS	14 DAS
Chlorantraniliprole 18.5 EC	0.2ml/l	16.64	82.50 (65.30)	78.75 (62.75)	75.20 (60.14)	16.81	83.50 (66.05)	81.00 (64.33)	77.01 (61.45)
Emamectin benzoate 5 SG	0.35 g/l	17.06	87.26 (69.15)	84.20 (66.71)	81.00 (64.17)	17.98	88.75 (70.53)	83.75 (66.31)	80.97 (64.22)
Flubendiamide 39.35 SC	0.2ml/l	16.85	79.00 (62.80)	75.11 (60.15)	71.50 (57.75)	18.26	80.05 (63.69)	75.05 (60.06)	72.50 (58.41)
Novaluron 10 EC	2.0ml/l	17.28	66.10 (54.39)	64.50 (53.44)	60.05 (50.81)	18.20	66.45 (54.61)	62.99 (52.56)	60.25 (50.52)
Spinosad 45 SC	0.4ml/l	17.06	85.05 (67.37)	81.25 (64.38)	76.25 (60.93)	17.98	83.90 (66.36)	80.28 (63.86)	77.65 (61.98)
Triazophos 40 EC	1.6ml/l	16.64	92.50 (74.25)	88.20 (70.14)	84.22 (66.88)	17.55	92.75 (74.66)	86.50 (63.63)	82.00 (65.00)
Neem leaf extract 10 %	10%	16.85	49.50	46.35	42.87	17.33	50.05	48.10	43.50

			(44.71)	(42.91)	(40.90)		(45.03)	(63.91)	(41.26)
Neem cake extract 10 %	10%	17.06	47.00 (43.28)	43.75 (41.41)	41.33 (40.00)	18.20	49.05 (44.46)	45.00 (42.13)	42.25 (40.54)
NSKE 5%	5%	16.64	60.37 (50.99)	58.25 (49.75)	52.28 (46.31)	17.55	60.50 (51.07)	57.20 (49.14)	53.08 (46.77)
Azadirachtin 10000 ppm	2ml/l	17.49	57.06 (49.06)	52.75 (46.58)	50.05 (45.03)	17.98	59.20 (50.30)	55.08 (47.93)	53.75 (47.15)
NSKE 5% +B. bassiana	2ml/l	16.64	71.55 (57.77)	69.20 (56.30)	65.69 (54.15)	17.33	72.68 (58.50)	70.00 (56.82)	64.25 (53.32)
Control		17.28	-	-	-	17.98	-	-	-
SEm±		0.56	1.70	2.07	1.68	0.50	1.58	2.55	2.21
CD (p=0.05)		NS	4.99	6.08	4.92	NS	4.64	7.48	6.48

- Pre-treatment population **Figures in parenthesis are retransformed per cent values DAS-Days after spray NS=Non-significant

Bio-efficacy of newer insecticides and neem derivatives against Semilooper population

As shown in Table 5 & 6 at first spraying the Spinosad 45 SC @ 0.4ml/lit recorded significantly maximum reduction of semilooper with mean reduction of 92.50,94.25 and 93.22 and 89.00,91.25 and 90.50 per cent was at 3,7 and 14 days respectively during both the years which was followed by chlorantraniliprole 18.5 EC. At Second spraying the highest

mean reduction in population of semilooper was recorded in Spinosad 45 SC @ 0.4ml/lit i.e 92.00,94.20 and 93.25 and 89.75,91.00 and 90.18 per cent at 3,7 and 14 days after spray respectively during both the years. It was followed by chlorantraniliprole 18.5 EC. Similar results were reported by Balaji *et al.* (2012) [1] More *et al.* (2014) [7]. Patil *et al.* (2014) [9] Khandwe *et al.* (2011) [6]

Table 5: Bio efficacy of newer insecticides & neem derivatives against semiloopers during *kharif* 2014

Treatments	Dosage (ml or g/ha)	PTP *	Mean reduction (%) in population after 1 st spray			PTP *	Mean reduction (%) in population after 2 nd spray		
			3 DAS	7 DAS	14 DAS		3 DAS	7 DAS	14 DAS
Chlorantraniliprole 18.5 EC	0.2ml/l	14.66	87.25 (69.14)	89.00 (71.45)	88.75 (70.44)	13.71	88.30 (70.03)	90.36 (72.69)	89.00 (71.09)
Emamectin benzoate 5 SG	0.35 g/l	15.33	84.21 (66.62)	88.12 {70.07}	86.25 (68.25)	14.33	85.20 (67.45)	89.12 (70.94)	87.00 (69.07)
Flubendiamide 39.35 SC	0.2ml/l	14.66	79.75 (63.33)	83.00 (65.84)	81.63 (64.67)	13.66	80.00 (63.65)	84.20 (66.66)	82.50 (65.38)
Novaluron 10 EC	2.0ml/l	15.66	65.25 (53.88)	69.50 (56.50)	67.34 (55.17)	14.66	65.50 (54.03)	70.00 (56.85)	68.25 (55.71)
Spinosad 45 SC	0.4ml/l	15.66	92.50 (74.61)	94.25 (76.57)	93.22 (76.19)	14.50	92.00 (73.63)	94.20 (77.05)	93.25 (75.22)
Triazophos 40 EC	1.6ml/l	14.70	75.00 (60.01)	80.00 (63.52)	77.09 (61.53)	13.66	77.02 (61.38)	79.50 (63.16)	78.50 (62.44)
Neem leaf extract 10 %	10%	15.00	48.00 (43.85)	52.08 (46.19)	50.54 (45.31)	14.00	49.50 (44.71)	53.00 (46.72)	51.52 (45.87)
Neem cake extract 10 %	10%	15.33	50.72 (45.41)	54.25 (47.44)	52.50 (46.44)	14.33	52.00 (46.15)	55.27 (48.03)	53.86 (47.22)
NSKE 5%	5%	16.00	60.05 (50.81)	64.50 (53.44)	62.10 (52.00)	16.00	61.25 (51.51)	65.12 (53.81)	62.71 (52.40)
Azadirachtin 10000 ppm	2ml/l	16.33	53.85 (47.21)	57.78 (49.48)	56.00 (48.45)	14.66	55.00 (47.87)	58.18 (49.73)	57.37 (49.24)
NSKE 5% +B. bassiana	2ml/l	15.00 (3.94)	70.58 (57.16)	73.20 (58.83)	72.75 (58.55)	14.33 (3.85)	72.25 (58.23)	74.00 (59.39)	73.00 (58.81)
Control		14.25	-	-	-	13.00	-	-	-
SEm±		0.51	1.72	2.24	1.84	0.41	1.56	2.59	2.29
CD (p=0.05)		NS	5.03	6.58	5.41	NS	4.57	7.59	6.06

Table 6: Bio efficacy of newer insecticides & neem derivatives against semiloopers during *kharif* 2015

Treatments	Dosage (ml or g/ha)	PTP *	Mean reduction (%) in population after 1 st spray			PTP *	Mean reduction (%) in population after 2 nd spray		
			3 DAS	7 DAS	14 DAS		3 DAS	7 DAS	14 DAS
Chlorantraniliprole 18.5 EC	0.2ml/l	13.33	85.50 (67.66)	88.00 (70.42)	87.05 (68.94)	13.45	87.00 (68.89)	90.00 (72.28)	89.22 (71.30)
Emamectin benzoate 5 SG	0.35 g/l	14.05	82.30 (65.15)	84.50 (60.95)	83.27 (65.87)	14.33	84.34 (66.75)	86.00 (68.15)	85.12 (67.46)
Flubendiamide 39.35 SC	0.2ml/l	13.66	77.00 (61.40)	79.25 (63.03)	78.50 (62.41)	13.66	79.05 (62.96)	81.00 (64.21)	80.08 (63.57)
Novaluron 10 EC	2.0ml/l	14.33	61.75 (51.80)	64.33 (53.34)	62.25 (52.11)	14.28	63.25 (52.69)	65.88 (54.30)	64.12 (53.21)
Spinosad 45 SC	0.4ml/l	14.66	89.00 (70.85)	91.25 (72.99)	90.50 (72.68)	14.66	89.75 (71.36)	91.00 (73.73)	90.18 (73.45)
Triazophos 40 EC	1.6ml/l	13.66	75.00	78.00	76.05	13.54	77.50	79.00	78.50

			(60.01)	(62.09)	(60.81)		(61.71)	(62.80)	(62.44)
Neem leaf extract 10 %	10%	14.00	48.00 (43.85)	50.25 (45.14)	49.01 (44.43)	14.33	50.00 (45.00)	52.50 (46.44)	51.25 (45.72)
Neem cake extract 10 %	10%	14.52	49.08 (44.47)	51.50 (45.86)	50.15 (45.09)	15.00	51.50 (45.86)	54.23 (47.43)	52.57 (46.48)
NSKE 5%	5%	15.25	57.77 (49.48)	60.89 (51.29)	59.00 (50.19)	15.00	60.22 (50.92)	62.00 (51.95)	61.26 (51.52)
Azadirachtin 10000 ppm	2ml/l	14.67	55.20 (47.99)	58.22 (49.73)	57.25 (49.17)	14.66	57.00 (49.02)	60.00 (50.79)	58.25 (49.75)
NSKE 5% +B. bassiana	2ml/l	14.33	68.00 (55.55)	71.15 (57.52)	69.50 (56.49)	14.02	70.05 (56.83)	72.50 (58.41)	71.20 (57.64)
Control		13.20	-	-	-	13.33	-	-	-
SEm±		0.47	1.68	2.17	1.79	0.41	1.54	2.75	2.45
CD (p=0.05)		NS	4.91	6.38	5.24	NS	4.52	8.07	7.18

- Pre-treatment population **Figures in parenthesis are retransformed per cent values DAS-Days after spray NS=Non-significant

Bio-efficacy of newer insecticides and neem derivatives against Tobacco caterpillar population

During first spraying as presented in Table 7 & 8 spray of Spinosad 45 SC @ 0.4ml/lit recorded significantly maximum reduction of tobacco caterpillar with mean reduction of 92.75,93.00 and 91.20 and 88.58,90.22 and 89.89 per cent was at 3, 7 and 14 days respectively during both the years. It was followed by chlorantraniliprole 18.5 EC. During second

spraying the highest mean reduction in population of tobacco caterpillar was recorded in Spinosad 45 SC @ 0.4ml/lit i.e 93.00, 93.75 and 92.80 and 90.89, 91.25and 91.00 per cent at 3,7 and 14 days after spray respectively during both the years. It was followed by chlorantraniliprole 18.5 EC. The findings of present study more or less are in accordance with Narayanamma and Reddy (2014) [8] Patil *et al.* (2014) [9] and (Joshi and Patel, 2011 [5]

Table 7: Bio efficacy of newer insecticides & neem derivatives against tobacco caterpillar during *kharif* 2014

Treatments	Dosage (ml or g/ha)	PTP *	Mean reduction (%) in population after 1 st spray			PTP *	Mean reduction (%) in population after 2 nd spray		
			3 DAS	7 DAS	14 DAS		3 DAS	7 DAS	14 DAS
Chlorantraniliprole 18.5 EC	0.2ml/l	10.06	87.25 (69.14)	91.25 (74.19)	88.75 (70.44)	10.32	88.50 (70.21)	91.35 (73.89)	89.14 (71.23)
Emamectin benzoate 5 SG	0.35 g/l	10.00	82.46 (65.27)	85.46 (67.74)	83.25 (65.85)	10.38	83.30 (65.94)	85.75 (67.94)	84.20 (66.71)
Flubendiamide 39.35 SC	0.2ml/l	10.20	72.58 (58.46)	77.79 (61.99)	73.20 (58.84)	10.64	73.00 (58.80)	76.00 (60.70)	75.37 (60.29)
Novaluron 10 EC	2.0ml/l	10.33	59.57 (50.52)	64.00 (53.14)	61.25 (51.51)	11.00	60.00 (50.77)	64.50 (53.46)	63.25 (52.69)
Spinosad 45 SC	0.4ml/l	9.33	92.75 (74.92)	93.00 (74.96)	91.20 (73.48)	10.00	93.00 (74.73)	93.75 (46.82)	92.80 (75.14)
Triazophos 40 EC	1.6ml/l	9.50	78.65 (62.50)	83.50 (66.16)	80.57 (64.03)	10.00	80.12 (63.56)	84.00 (66.55)	82.73 (65.56)
Neem leaf extract 10 %	10%	9.05	48.75 (44.28)	54.25 (47.44)	52.70 (46.55)	9.69	50.05 (45.03)	55.00 (47.87)	53.25 (47.87)
Neem cake extract 10 %	10%	10.25	50.79 (45.45)	55.55 (48.19)	52.65 (46.52)	10.66	52.00 (46.15)	56.57 (48.78)	54.25 (47.44)
NSKE 5%	5%	9.72	56.84 (48.94)	62.75 (52.39)	60.08 (50.82)	10.32	58.10 (49.66)	62.00 (51.95)	60.75 (51.22)
Azadirachtin 10000 ppm	2ml/l	10.37	55.59 (48.21)	59.75 (50.63)	57.28 (49.19)	10.67	56.72 (46.83)	60.25 (50.94)	58.64 (49.98)
NSKE 5% +B. bassiana	2ml/l	9.68	64.40 (53.37)	66.78 (54.81)	65.12 (53.81)	10.32	65.12 (53.81)	67.20 (55.08)	64.75 (53.62)
Control		8.33	-	-	-	9.32	-	-	-
SEm±		0.32	1.69	2.22	1.83	0.31	1.47	2.63	2.22
CD (p=0.05)		NS	4.94	6.50	5.38	NS	4.32	7.70	6.50

- Pre-treatment population **Figures in parenthesis are retransformed per cent values DAS- Days after spray NS=Non-significant

Table 8: Bioefficacy of newer insecticides & neem derivatives against tobacco caterpillar during *kharif* 2015

Treatments	Dosage (ml or g/ha)	PTP *	Mean reduction (%) in population after 1 st spray			PTP *	Mean reduction (%) in population after 2 nd spray		
			3 DAS	7 DAS	14 DAS		3 DAS	7 DAS	14 DAS
Chlorantraniliprole 18.5 EC	0.2ml/l	8.66	85.00 (67.25)	87.36 (69.17)	86.75 (68.68)	10.32	87.12 (68.99)	90.25 (72.56)	89.25 (71.34)
Emamectin benzoate 5 SG	0.35 g/l	8.75	80.21 (63.61)	82.50 (65.38)	81.25 (64.35)	10.40	82.40 (65.25)	85.12 (67.41)	84.10 (66.63)
Flubendiamide 39.35 SC	0.2ml/l	8.05	71.50 (57.76)	75.75 (60.58)	73.33 (58.92)	10.66	72.12 (58.22)	75.00 (60.03)	74.25 (59.55)
Novaluron 10 EC	2.0ml/l	8.33	57.60 (49.37)	61.25 (51.51)	59.12 (50.26)	11.00	59.00 (50.19)	63.02 (52.58)	60.75 (51.21)

Spinosad 45 SC	0.4ml/l	7.33	88.58 (70.46)	90.22 (71.94)	89.89 (72.02)	9.99	90.89 (72.48)	91.75 (74.78)	91.00 (72.79)
Triazophos 40 EC	1.6ml/l	7.52	77.05 (61.39)	81.18 (64.38)	79.64 (63.34)	10.32	81.25 (64.38)	82.85 (65.65)	81.57 (64.67)
Neem leaf extract 10 %	10%	7.00	46.50 (42.99)	50.25 (45.14)	49.25 (44.57)	9.45	50.75 (45.43)	52.53 (46.45)	51.02 (45.58)
Neem cake extract 10 %	10%	8.00	49.00 (44.43)	52.75 (46.58)	50.00 (45.00)	10.66	52.35 (46.35)	56.10 (48.51)	54.27 (47.45)
NSKE 5%	5%	7.66	55.10 (47.93)	59.20 (50.30)	58.25 (49.75)	10.33	58.64 (46.98)	62.50 (52.24)	60.67 (51.17)
Azadirachtin 10000 ppm	2ml/l	8.00	53.65 (47.09)	57.05 (49.06)	55.24 (48.01)	10.66	56.75 (48.88)	60.51 (51.09)	58.39 (49.83)
NSKE 5% +B. bassiana	2ml/l	7.25	62.75 (52.39)	65.72 (54.17)	64.94 (53.70)	10.32	62.13 (52.02)	65.75 (54.20)	63.64 (52.96)
Control		6.69 (2.68)	-	-	-	9.33 (3.19)	-	-	-
SEm±		0.26	1.63	1.75	1.79	0.31	1.46	2.74	2.16
CD (p=0.05)		NS	4.78	5.12	5.25	NS	4.28	8.03	6.32

- Pre-treatment population **Figures in parenthesis are retransformed per cent values DAS-Days after spray NS=Non-significant

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