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Bio-efficacy of new combination formulation against *Spodoptera litura* on groundnut

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Abstract
The study was carried out to know the impact of of new combination formulation against *Spodoptera litura* on Groundnut (*Arachis hypogaea* L.) during September to December 2014, at Research farm, oilseeds research station, Latur. Groundnut crop was infested by *Spodoptera litura* at moderate levels. The experiment was laid out in randomized block design with seven treatment and three replications with view to find out the effective insecticides combination formulation and it's most effective dose against *Spodoptera litura* of groundnut variety Phule Pragati (JL-24) was sown in September. The insecticide and combination formulation used for the treatment were Novaluron 5.25% + Indoxacarb 4.5% SC @ 825 ml/ha Novaluron 5.25% + Indoxacarb 4.5% SC @ 875 ml/ha, Novaluron 5.25% + Indoxacarb 4.5% SC @ 925 ml/ha, Novaluron 10% EC @ 750 ml/ha, Indoxacarb 14.5% SC @ 400 ml/ha, Methomyl 40% SP @ 850 g/ha, along with one untreated control. Among the treatments the results clearly indicated that the combination formulation Novaluron 5.25 + Indoxacarb 4.5% SC @ 875 & 925 ml/ha is equally effective in lowering the infestation of *Spodoptera litura*.

Keywords: *Spodoptera litura*, novaluron 5.25%+ indoxacarb 4.5% SC and groundnut

Introduction
Groundnut (*Arachis hypogaea* Linnaeus) is one of the significant a leguminous oilseed crops due to its nourishing and modern quality In India, groundnut possesses an overwhelming position and cultivated during *Kharif, Rabi* and summer seasons under various cropping systems. India has the largest groundnut growing area in the world and is the second largest producer after china. Gujarat, Andhra Pradesh, Tamil Nadu, Rajasthan, Karnataka and Maharashtra are the major groundnut growing states of India and together account for about 90% of the national area under groundnut. In India, groundnut crop is cultivated in *Kharif, Rabi* and summer seasons grown in an area of about 5.06 m ha with the production of 8.05 mt and productivity of 1583 kg/ha. In Maharashtra, the area under groundnut cultivation was 1.95 lakh hectare with production of 2.66 lakh metric tons and productivity comprises 883 kg per hectare (Anonymous, 2018) [1]. Rainfed groundnut cultivation coupled with attack by a variety of insect pests and diseases are the major reasons for lower productivity. As the crop and its pests are sensitive to extreme weather events, the crop productivity is determined by the interplay of weather and pests in each season. (NICRA team of Groundnut Pest Surveillance, 2011) [10].

The insect-pests in causing foliar damage to crop, are known as defoliator pests. Most important defoliator pests of groundnut in India are, tobacco caterpillar, groundnut leaf miner, gram pod borer and red-headed hairy caterpillar Sap-sucking pests namely, aphids, leafhoppers and thrips are major threat to groundnut cultivation. Aphids are principally a rainy season pest while, leafhoppers and thrips occur both in rainy and post-rainy seasons. Apart from causing direct damage to the crop, aphids and thrips act as vector for important viral diseases like, peanut stunt virus (PSV) and peanut bud necrosis virus (PBNV), respectively. Among sub-terranean pests, white grubs, termites, wireworms, and earwigs damage the pods. Bruchid, is of greater importance in storage. The crop annually incurs losses amounting to Rs. 238 crores due to insect-pests and diseases (Dutta *et al.*, 2020) [6]. Aphid, *Aphis craccivora* Koch, jassid, *Empoasca kerri* Pruthi, thrips, *Scirtothrips dorsalis* Hood, leaf eating caterpillar, *Spodoptera litura* (Fabricius) and gram pod borer, *Helicoverpa armigera* (Hubner) have been observed as a key pests of groundnut. The insect pest complex has been found to cause 30 to 100% yield loss. The avoidable yield loss due to major insect pests of groundnut was recorded to the tune of 48.57% in pod and 42.11% in fodder in untreated control plot. The data on yield in protected plots revealed that 94.45% additional yield in pod and 72.74%

additional yield in fodder could be realized over unprotected plots. (Dabhade *et al.* 2012) [12]. Insect pests of groundnut causes damage in both field and storage conditions of these, *Spodoptera litura*, *Aproaerema modicella*, white grub, thrips, aphid, jassids, gram caterpillar, red hairy caterpillar and termites are found to be economically important. Possible yield losses due to *A. modicella* are estimated 49.56%, Jassids 40%, aphid 16- 40%, thrips 17-40%, red hairy caterpillar 26-75%. *H. armigera* and *S. litura* are reported to cause damage on more than 180 crops (Islam *et al*., 2007) [8]. *S. litura* larvae feed gregariously scraping the chlorophyll soon disperse. Later stages feed voraciously on the foliage at night, hiding usually in the soil around the base of the plants during the day. Several insecticides were tested for their bio-efficacy against these pests. However, indiscriminate application of insecticides is causing serious threat of insect resistance as well as residual effect. The development of resistance and resurgence has limited the application of single insecticides and resort to tank mixtures. However, tank mixtures imply several problems like lack of knowledge about the compatibility of the components, probability of overdose of diluents in the mixture (Rodriguez, *et al*., 2002) [13], which can be overcome by promoting ready mix formulations. So the present experiment was conducted to evaluate the bio-efficacy of ready mix insecticide Novaluron 5.25% + Indoxacarb 4.5% SC against *Spodoptera litura* in groundnut.

Materials and Methods

A field experiment to study the bio-efficacy of new combination formulation against *Spodoptera litura* (Fabricius) on Groundnut (*Arachis hypogaea* L.) was studied during September to December 2014, at Research farm, oilseeds research station, Latur. The experiment was laid out in randomized block design with seven treatment and three replications with view to find out the effective insecticides combination formulation and it's most effective dose against *Spodoptera litura* (Fabricius) of groundnut. Variety Phule Pragati (JL-24) was sown in September. The insecticide and combination formulation used for the treatment were Novaluron 5.25% + Indoxacarb 4.5% SC @ 825 ml/ha, Novaluron 5.25% + Indoxacarb 4.5% SC @ 875 ml/ha, Novaluron 5.25% + Indoxacarb 4.5% SC @ 925 ml/ha, Novaluron 10% EC @ 750 ml/ha, Indoxacarb 14.5% SC @ 400 ml/ha, Methomyl 40% SP @ 850 g/ha, along with one untreated control. Groundnut crop was sown a gross plot of 4 m x 5 m maintaining net plot of 3.6 m x 4.8 m. The row-to-row distance of 30 cm and plant to plant distance of 15 cm was maintained. The dose of fertilizer at the rate of 20 kg N, 40 kg P_2O_5 and 40 kg K_2O per hectare was given at the time of sowing. The crop was grown under protective irrigation. Treatments were applied on appearance of *S.litura* and subsequent spray were given at 15 days interval using manually operated knapsack sprayer. The observations on total number of *S. litura* larvae was recorded per five plant from each on top, middle and bottom leaves of five randomly selected plants from each treatment at before spray and 1, 5, 7 and 10 days after each spray. The insect pest population was recorded on randomly selected 20 plants per treatment first and second application of insecticides. Observations on the predators and parasitoids were also done after simultaneously with bio-efficacy observation after each spray. The number of predators and parasitoids were counted on 20 plants in each treatment and averaged per plant. Spiders and Lady bird beetle are found most commonly predators while *Trichoderma spp.* and *Chelonus blackburnii* parasitoids were noticed. The observations were recorded in the field on the phytotoxicity symptoms, if any on groundnut crop due to different treatments with dosage of Novaluron 5.25 + Indoxacarb 4.5% SC @ 875 ml/ha with its higher dose 1750 and 3500 ml/ha. Effects on the crop health (*viz*., leaf chlorosis, wilting, vein clearing, necrosis, scorching, epinasty and hyponasty etc.) were recorded on 1, 3, 5, 7 and 10 days after spraying with treatment by using score (table 2). The data was analyzed for statistical significance as per the Gomez and Gomez 1984.

Table 1: Treatment details

Treatments	a. i. (g)	Dosages /ha	
		Formulation (ml)	Water volume (Lit)
T_1- Novaluron 5.25 + Indoxacarb 4.5% SC	(43.31+37.13)	825	500
T_2-Novaluron 5.25 + Indoxacarb 4.5% SC	(45.94+39.38)	875	
T_3-Novaluron 5.25 + Indoxacarb 4.5% SC	(48.56+41.63)	925	
T_4 - Novaluron 10% EC	75	750	
T_5 -Indoxacarb 14.5% SC	60	400	
T_6 - Methomyl 40% SP	350	850	
T_7-Untreated control	-	-	-

Table 2: Phytotoxicity score Scale

Score	% crop response/ crop injury
0	No adverse effect
1	1-10
2	11-20
3	21-30
4	31-40
5	41-50
6	51-60
7	61-70
8	71-80
9	81-90
10	91-100

Results and Discussion

The data on efficacy of different treatment schedules of novaluron 5.25% + indoxacarb 4.5% SC against *Spodoptera litura* infesting groundnut has been presented in table 3. There was no significant difference in larval population between treatments as well as control during 2014 (Table 3). All the treated plots with chemicals were significantly superior in their performance over that of control plots after application of insecticides. During 2014 at 10 days after first spraying, lowest *Spodoptera litura* population was recorded in novaluron 5.25%+ indoxacarb 4.5% SC sprayed @ 925 ml/ha followed by the same chemical sprayed @ 875 ml/ha with 1.68 and 1.76 larvae per twenty plants respectively. These two treatments were statistically at par with each other and were

followed by Indoxacarb 14.5% SC @ 400 ml/ha (2.55 larvae/ twenty plants), novaluron 10% EC @1000 ml/ha (2.64 larvae/ twenty plants), Methomyl 40% SP @ 850 g/ha (2.76 larvae/ twenty plants) and novaluron 5.25%+ indoxacarb 4.5% SC @ 825 ml/ha (2.88 larvae/ twenty plants). At 10 days after second imposition of treatment, larval population of *S. litura* ranged from 0.95 to 6.00 per twenty plants in various treatments and there was significant difference among the treatments. Novaluron 5.25%+ indoxacarb 4.5% SC sprayed @ 925 and 875 ml/ha showed lowest larval population of *Spodoptera litura* with 0.89 and 0.95 larvae/ twenty plants respectively. These two treatments were followed by indoxacarb 14.5% SC @ 400 ml/ha (1.84 larvae/ten plants) and novaluron 10% EC @ 750ml/ha (1.97 larvae/ ten plants). During third spray, At 10 days after imposing the treatment, lowest and nil *S. litura* population was recorded in the treatments where, novaluron 5.25%+ indoxacarb 4.5% SC sprayed @ 925 ml/ha and 875 ml/ha. These two treatments were followed by indoxacarb 14.5% SC @ 400ml/ha (0.82 larvae/twenty plants) and novaluron 5.25%+ indoxacarb 4.5% SC @ 750 ml/ha (0.96 larvae/ twenty plants). In all three sprays at one day after spray, five days after spray and seven days after treatment same trend was followed with respect to the larval population. However, A steady increase in the *S. litura* population was observed in untreated control plot throughout the experimental period.

Thus, overall it was observed that the insecticidal treatments suppress the *S. litura* population and the population of pest increased slowly in all three sprays in the treatment of untreated control. Among the insecticides tested Novaluron 5.25%+ Indoxacarb 4.5% SC sprayed @ 925 ml/ha followed by the same chemical sprayed @ 875 ml/ha were found most effective as it recorded significantly lowest population of *S. litura* larvae on groundnut at1,5,7 and 10 days after all spraying, respectively over rest of the insecticides (Table 3).

Table 4, shows that The extent larval parasitism did not vary in the untreated control and the treated plot with Novaluron 5.25 + Indoxacarb 4.5% SC (825, 875, & 925 ml/ha). The major parasitoids emerged from the field collected larvae were *Trichoderma spp.* and *Chelonus blackburnii* Also, the number of predator's *viz*., spiders and lady bird beetle did not vary significantly among the tested products.

Table no. 5 reveals that, No phytotoxicity symptoms *viz*., leaf chlorosis, wilting, vein clearing, necrosis, scorching, epinasty and hyponasty etc. were observed during the experiment after the application

The present results are in accordance with the results of Ghosal *et al*., (2016) [3-4] [ab] who reported that, technical formulation of Novaluron 5.25%+ Indoxacarb 4.5% SC (Plethora) @ 825 ml/ha and 875 ml/ha were excellently effective against *Helicoverpa armigera* of pigeon pea and were safe to the three important predator (*Menochilus sp., Syrphus sp.* and *Chrysoperla sp.* recorded in the pigeon pea field and he also reported that technical formulation of Novaluron 5.25%+ Indoxacarb 4.5% SC (Plethora) @ 875 ml/ha and 825 ml/ha can protect the tomato crop infesting with fruit borer complex (*Helicoverpa* and *Spodoptera*) more efficiently than that of their sole use by recording highest fruit yield and cost benefit ratio. Further, these results were almost similar to the findings of Shobharani *et al*. (2019) [14], who reported that mixed formulation of Novaluron 5.25+Indoxacarb 4.5 SC proved to be the most effective insecticides than that of their sole formulation against larval population of lepidopteron pests (*Spodoptera litura and Helicoverpa armigera*) and recorded highest grain yield. Das *et al*. (2015) [5], who reported that the Novaluron 5.25% + Indoxacarb 4.5% SC is highly vulnerable to lepidopteran insect pest with two novel modes of action *viz*. chitin biosynthesis inhibition creates abortive moulting by novaluron and blockage of axonal sodium channel causing rapid cessation of feeding and paralysis by indoxacarb. The Novaluron 5.25% + Indoxacarb 4.5% SC is highly vulnerable to lepidopteran insect pest with two novel modes of action *viz*. chitin biosynthesis inhibition creates abortive moulting by novaluron and blockage of axonal sodium channel causing rapid cessation of feeding and paralysis by indoxacarb.. Waykule *et al*. (2020) [11], Mishra (1986) [9] Bhatt and Patel (2002) [2] also reported similar result about the effect of these novel insecticides on *H. armigera* and *S. litura*. Looking into the literature and results of the present study, we can conclude that the technical formulation of novaluron 5.25%+ indoxacarb 4.5% SC @ 925 ml/ha and 875 ml/ha can protect the groundnut crop more efficiently than that of their sole use.

Table 3: Effect of Novaluron 5.25% + Indoxacarb 4.5% SC on population of *Spodoptera litura* during 2014

Treatments	Average larval population of *S. litura* per 20 plants												
	First Spray					Second Spray				Third spray			
	DBS	Days after spray				Days after spray				Days after spray			
		1	5	7	10	1	5	7	10	1	5	7	10
Novaluron 5.25% + Indoxacarb 4.5% SC @ 825 ml/ha	3.12	3.10	3.00	2.98	2.88	2.84	2.69	2.63	2.53	2.46	2.00	1.95	1.82
	(2.03)	(2.02)	(2.00)	(1.99)	(1.97)	(1.96)	(1.92)	(1.91)	(1.88)	(1.86)	(1.73)	(1.72)	(1.68)
Novaluron 5.25% + Indoxacarb 4.5% SC @ 875 ml/ha	2.78	2.70	2.00	1.94	1.76	1.70	1.54	1.15	0.95	0.89	0.31	0.12	0.00
	(1.94)	(1.92)	(1.73)	(1.71)	(1.66)	(1.64)	(1.59)	(1.47)	(1.40)	(1.37)	(1.14)	(1.06)	(1.00)
Novaluron 5.25% + Indoxacarb 4.5% SC @ 925 ml/ha	2.76	2.68	1.98	1.90	1.68	1.63	1.42	1.10	0.89	0.80	0.22	0.00	0.00
	(1.94)	(1.92)	(1.73)	(1.70)	(1.64)	(1.62)	(1.56)	(1.45)	(1.37)	(1.34)	(1.10)	(1.00)	(1.00)
Novaluron 10% EC @ 750 ml/ha	2.94	2.90	2.85	2.80	2.64	2.60	2.44	2.10	1.97	1.94	1.38	1.15	0.96
	(1.98)	(1.97)	(1.96)	(1.95)	(1.91)	(1.90)	(1.85)	(1.76)	(1.72)	(1.71)	(1.54)	(1.47)	(1.40)
Indoxacarb 14.5% SC @ 400 ml/ha	2.86	2.92	2.80	2.76	2.55	2.50	2.30	2.00	1.84	1.80	1.34	1.12	0.82
	(1.96)	(1.98)	(1.95)	(1.94)	(1.88)	(1.87)	(1.82)	(1.73)	(1.69)	(1.67)	(1.53)	(1.46)	(1.35)
Methomyl 40% SP @ 850 g/ha	3.00	2.96	2.88	2.85	2.76	2.70	2.55	2.28	2.09	2.00	1.54	1.60	1.28
	(2.00)	(1.99)	(1.97)	(1.96)	(1.94)	(1.92)	(1.88)	(1.81)	(1.76)	(1.73)	(1.59)	(1.61)	(1.51)
Control	3.00	3.40	4.00	4.48	5.00	5.20	5.72	5.88	6.00	6.18	6.41	6.52	6.54
	(2.00)	(2.10)	(2.24)	(2.34)	(2.45)	(2.49)	(2.59)	(2.62)	(2.65)	(2.68)	(2.72)	(2.74)	(2.75)
S. Em.	0.09	0.04	0.07	0.06	0.06	0.07	0.07	0.09	0.09	0.08	0.10	0.11	0.08
CD at 5%	NS	0.12	0.20	0.19	0.20	0.23	0.23	0.27	0.29	0.25	0.30	0.34	0.25

DBS: Day Before Spray, **NS:** Non significant, **Note:** Figures in the parenthesis are square root transformed values.

Table 4: Effect of Novaluron 5.25% + Indoxacarb 4.5% SC on some important natural enemies found in Groundnut during 2014

No.	Treatments	Avg. number of natural enemies/ 20 plants			
		Parasitoids		Predators	
		Trichoderma spp.	*Chelonus blackburnii*	Spiders	Lady bird beetle
1.	Novaluron 5.25% + Indoxacarb 4.5% SC @ 825 ml/ha	1.89 (1.70)	2.40 (1.84)	1.38 (1.54)	1.88 (1.70)
2.	Novaluron 5.25% + Indoxacarb 4.5% SC @ 875 ml/ha	2.00 (1.73)	2.45 (1.86)	1.56 (1.60)	1.90 (1.70)
3.	Novaluron 5.25% + Indoxacarb 4.5% SC @ 925 ml/ha	1.89 (1.70)	2.20 (1.79)	1.65 (1.63)	1.72 (1.65)
4.	Novaluron 10% EC @ 750 ml/ha	1.98 (1.73)	2.52 (1.88)	1.53 (1.59)	2.14 (1.77)
5.	Indoxacarb 14.5% SC @ 400 ml/ha	2.24 (1.80)	2.18 (1.78)	1.74 (1.66)	1.68 (1.64)
6.	Methomyl 40% SP @ 850 g/ha	1.57 (1.60)	2.52 (1.88)	1.46 (1.57)	2.00 (1.73)
7.	Control	2.16 (1.78)	2.48 (1.87)	1.68 (1.64)	1.84 (1.69)
	S. Em	0.14	0.13	0.09	0.10
	CD at 5%	NS	NS	NS	NS

Note: Figures in parentheses are square root transformed values, **NS:** Non significant

Table 5a: Effect of Novaluron 5.25 + Indoxacarb 4.5% SC on groundnut phytotoxicity at different doses, 2014

No.	Treatment	Chlorosis					Necrosis					Scorching				
		Days after spray					Days after spray					Days after spray				
		1	3	5	7	10	1	3	5	7	10	1	3	5	7	10
1	Novaluron 5.25 + Indoxacarb 4.5% SC @ 875 ml/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Novaluron 5.25 + Indoxacarb 4.5% SC @ 1750 ml/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Novaluron 5.25 + Indoxacarb 4.5% SC @ 3500 ml/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Control	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 5b: Effect of Novaluron 5.25 + Indoxacarb 4.5% SC on groundnut phytotoxicity at different doses, 2014

No.	Treatment	Epinasty & Hyponasty					Vein clearing					Wilting				
		Days after spray					Days after spray					Days after spray				
		1	3	5	7	10	1	3	5	7	10	1	3	5	7	10
1	Novaluron 5.25 + Indoxacarb 4.5% SC @ 875 ml/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Novaluron 5.25 + Indoxacarb 4.5% SC @ 1750 ml/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Novaluron 5.25 + Indoxacarb 4.5% SC @ 3500 ml/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Control	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Conclusion

Based on the above results, it can be concluded that the chemical insecticide Novaluron 5.25 + Indoxacarb 4.5% SC at a dose in the range of 925 and 875 ml/ha can be recommended for the effective management of *S. litura* Hub. of groundnut with no remarkable ill effects on natural enemy and No phytotoxicity symptoms.

References

1. Anonymous. Rabi/Summer groundnut Workshop, Progress Report, Project coordinating unit, Groundnut, National Research Centre for Groundnut, Junagadh. 2018. p. 20-34.
2. Bhatt NJ, Patel RK. Bioefficacy of various insecticides against Helicoverpa armigera onchickpea. Indian J Entomol. 2002;64:27-34.
3. Ghosal A, Dolai AK, Chatterjee ML. Bioefficacy of new ready mixed insecticide (Novaluron 5.25% + Indoxacarb 4.5% SC) against pigeon pea pod borer (*Helicoverpa armigera* Hubner). Legume Research. 2016a;39(1):135-139.
4. Ghosal A, Dolai AK, Chatterjee ML. Plethora (novaluron + indoxacarb) insecticide for themanagement of tomato fruit borer complex. Journal of Applied and Natural Science. 2016b;8(2):919-922.
5. Das BC, Patra S, Dhote VW, Alam SKF, Chatterjee ML, Samanta A. Mix formulations: An alternative option for management of gram pod borer, *Helicoverpa armigera* and pod fly, *Melanagromyza obtusa* in pigeon pea. Legume Res. 2015;38(3):396-401.
6. Dutta Ram, Nataraja MV, Thirumalaisamy PP, Harish G, Radhakrishnan T. Crop protection technologies generated through AICRP-Groundnut. ICAR-Directorate of Groundnut Research, Ivnagar Road, PB No. 5, Junagadh 362 001, Gujarat. Technology bulletin 02/2020. 2020. p. 30.
7. Gomez KA, Gomez, AA. Statistical procedures for agricultural research. John wiley and sons, New York. 1984. p. 680.
8. Islam MB, Machial CM, Miresmaill S, Bainyard LD. Essential oil based pesticides: New insights from old chemistry. In: Pesticide chemistry, H. Ohkawa and H. Migayava, (Eds): Wiley. Weinheim. 2007. p. 113.
9. Mishra PN. Studies on the bio-efficacy of some insecticides against the pest complex of tomato, Lycopersicon esculentus Mill. var. Pusa Ruby. Madras Agric. J. 1986;71:673-676.
10. NICRA team of Groundnut Pest Surveillance. Manual for Groundnut Pest Surveillance. Jointly published by National Centre for Integrated Pest Management, New Delhi, Central Research Institute for Dryland Agriculture, Hyderabad and Directorate of Groundnut Research, Gujarat. 2011. p. 29.
11. Waykule PK, Mutkule DS, Jadhav AS, Dhormare AP, Ingale AS. Bio-efficacy of different insecticides against gram pod borer (*Helicoverpa armigera* H.) on groundnut, Journal of Entomology and Zoology Studies. 2020;8(6):354-358.
12. Dabhade PL, Bapodra JG, Jethva DM, Rathod RT, Dabhi MV. Estimation of yield losses due to major insect pests of groundnut in Gujarat, Legume Res. 2012;35(4):354-356.

13. Rodriguez J C, Diazy O and Guzman P 2002 Rational use of low risk insecticide mixtures against chewing and sucking insect pests: Leverage (imidacloprid + cyfluthrin), Proceedings of the 16h International pepper conference. Tampico, Tamaulipas, Mexico. 2002 Nov 10-12.
14. Shobharani M, Sidramappa and Sunilkumar NM. Evaluation of different doses of Novaluron 5.25% + Indoxacarb 4.5% SC for the management of lepidopteron pests on soybean, Journal of Pharmacognosy and Phytochemistry. 2019;8(2):1528-1531.