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Studies on some insecticides with novel mode of action for the management of tomato fruit borer (*Helicoverpa armigera* Hub.)

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ABSTRACT

Field experiments were conducted to observe, the efficacy of some pesticides with novel mode of action (spinosad, rynaxypyr, indoxacarb, flubendiamide) for the management of Helicoverpa armigera on tomato (Var. Pathorkuchi) in field condition, during the rabi season of 2010 and 2011 at Horticultural Research Station, Mondouri B.C.K.V, W.B. Results of insecticides applied thrice at 15 days interval after borer population build up showed that rynaxypyr 18.5% SC @ 40 g a.i. ha^{-1} was superior over other treatments against Helicoverpa, with 98.04% reduction, closely followed by spinosad 45% SC @ 60 g a.i. ha^{-1} (88.03%), flubendiamide 20% WG @ 30 g a.i. ha^{-1} (87.96%), rynaxypyr 18.5% SC @ 20 g a.i. ha^{-1} (85.84%) and indoxacarb 14.5 SC @ 75 g g a.i. ha^{-1} (80.21%). The same trend was followed in case of yield also, rynaxypyr @ 40 g a.i. ha^{-1} recorded the highest fruit yield of 34.74 q ha^{-1}.

Key words: Flubendiamide, *Helicoverpa armigera*, rynaxypyr, spinosad, tomato

Among the different insect pests attacking tomato (*Lycopersicon esculentum* L.), tomato fruit borer, *Helicoverpa armigera* Hubner (Lepidoptera: Noctuidae) is one of the most serious pest. It causes as high as 70 per cent loss in fruit yield (Kakar *et al*., 1990). *H. armigera* is a polyphagous pest attacking cotton, tomato, okra, chilli, cabbage, pigeon pea, gram etc. throughout the world as well as in India. High fecundity, polyphagous nature, quick adaptation against insecticides makes it difficult and rather impossible to control with any single potent toxicant for a long time. Now it develops cross resistance to many insecticides. This has promoted the necessity for the development of new, safer, biodegradable insecticides and known insecticidal alternatives that could be feasible and effective for insect pest management of tomato.

MATERIALS AND METHODS

Field experiment was under taken for two consecutive years during *rabi* season (September-December) of 2010 and 2011 in a randomized block design with six treatments replicated three times at Horticultural Research Station, Mondouri, B.C.K.V., Nadia, West-Bengal (23.5^0 N latitude, 89^0 E longitude, having average altitude of 9.75 MSL, new alluvial soil; Soil type: sandy loam). The insecticide treatments included spinosad 45% SC (Spinosyn A 50% minimum and spinosyn D 50% maximum) @ 60 g a.i. ha^{-1}, rynaxypyr 18.5% SC at 40 g a.i. ha^{-1}, flubendiamide 20% WG at 30 g a.i. ha^{-1}, rynaxypyr 18.5% SC @ 20 g a.i. ha^{-1} and indoxacarb 14.5 SC a@ 75 g a.i. ha^{-1} (Table 1) along with an untreated control. Tomato cultivar 'Pathorkuchi' was grown in plot of size 12 m^2 at spacing of 60 cm. × 60 cm. with recommended package of practices excluding plant protection. A blanket of application was done for checking of sucking insect pests *viz*., hopper and whitefly by acetamiprid 20 SP @ 25 g a.i. ha^{-1}. After built up of quantity borer population the required insecticides were sprayed and thereafter two sprays at fifteen days interval with a high volume knack sac sprayer using 500 litres of spray fluid per hectare. The control plot was sprayed with water only. Five (out of 35 plant plot^{-1}) randomly selected plants plot^{-1} were chosen to count the number of *H. armigera* at one day before and 3 and 7 days after each insecticide application. The rate of infestation of fruits by *H. armigera* was taken into account at each picking.

RESULTS AND DISCUSSION

There was no significant difference in the pre-application count of borer population between the treatments as well as control during the experiment. All the treated plots with chemicals were significantly superior in their performance over control plots. During the year 2010 at 3 days after spraying, highest percentage of reduction (98.04%) of *H. armigera* population was recorded in rynaxypyr @ 40 g a.i. ha^{-1} followed by spinosad (90.42%), flubendiamide (86.80%), indoxacarb (80.77%) and rynaxypyr @ 20 g a.i. ha^{-1} (80.69%), where as at 7 days after spraying, rynaxypyr @ 40 g a.i. ha^{-1} showed highest parentage of reduction of *H. armigera* population (98.72%) while spinosad and indoxacarb recorded decreased percent reduction of *H. armigera* population (84.58% and 79.02%, respectively) than 3 days after spraying. In case of overall mean percent reduction of *Helicoverpa* population after three sprays, rynaxypyr @ 40 g a.i. ha^{-1} recorded the best treatment with 96.50% protection over control plot, followed by spinosad (92.02%). Percentage of fruit infested by *H. armigera* was also lowest (2.55%) in rynaxypyr @ 40 g a.i. ha^{-1}.

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Table 1: Effect of insecticides on *H. armigera* of tomato and on yield, 2010

Treatment	Dose g a.i. ha^{-1}	Pre treatment count (borers plant $^{-5}$)	% reduction or increase (+) in borers after spray		Mean of % reduction or increase (+) in borers after spray	% fruit infested by borer	% protection over control	Marketable yield (q ha^{-1})
			3rd	7th				
Spinosad 45% SC	60	5.03 (12.92)	90.42 (71.95)	84.58 (66.89)	87.50 (69.30)	5.81	92.02	31.14
Rynaxypyr 18.5% SC	40	4.2 (11.33)	98.04 (82.73)	98.72 (83.45)	98.38 (82.73)	2.55	96.50	34.41
Rynaxypyr 18.5% SC	20	6.13 (14.30)	80.69 (63.94)	90.49 (72.05)	85.59 (67.70)	7.40	89.84	31.16
Flubendiamide 20% WG	30	5.02 (13.18)	86.80 (68.61)	88.13 (69.12)	87.46 (69.30)	6.49	91.09	32.57
Indoxacarb 14.5% SC	75	6.11 (14.30)	80.77 (64.01)	79.02 (62.73)	79.90 (63.36)	16.07	77.95	27.89
Control		5.75 (13.94)	+51.50 (45.86)	+66.75 (54.82)	+59.12	72.88		9.62
SEm (±)			**1.00**	**1.44**		**0.78**		**1.36**
LSD (0.05)		**NS**	**2.229**	**3.210**		**1.75**		**3.02**

Note: Figures in the parenthesis are angular transformed values

Maximum marketable fruit yield (34.41 q ha^{-1}) was also highest in rynaxypyr @ 40 g a.i. ha^{-1} treated plot (Table 1). In the year 2011, similar trend was followed as in the case of the previous year in respect to all parameters (Table 2).

Table 2: Effect of insecticides on *H. armigera* of tomato and on yield, 2011

Treatment	Dose g a.i. ha^{-1}	Pre treatment count (borers plant^{-5})	% reduction or increase (+) in borers after spray		Mean of % reduction or increase (+) in borers after spray	% fruit infested by borer	% protection over control	Marketable yield (q ha^{-1})
			3rd	7th				
Spinosad 45% SC	60	5.43 (13.44)	89.81 (71.37)	87.32 (69.12)	88.56 (70.27)	6.49	91.18	29.81
Rynaxypyr 18.5% SC	40	6 (14.18)	97.38 (80.72)	98.04 (81.87)	97.71 (81.28)	1.88	97.45	35.07
Rynaxypyr 18.5% SC	20	6.37 (14.65)	80.29 (63.51)	91.86 (73.46)	86.08 (63.11)	6.71	90.89	31.52
Flubendiamide 20% WG	30	5.56 (13.69)	87.80 (69.56)	89.13 (70.72)	88.46 (70.18)	6.63	90.99	31.23
Indoxacarb 14.5% SC	75	5.89 (14.06)	82.77 (65.50)	78.28 (62.24)	80.52 (63.79)	15.27	79.27	28.63
Control		5.65 (13.81)	+53.16 (46.78)	+68.09 (55.61)	+60.63 (51.12)	73.68		8.95
SEm (±)			**1.22**	**1.77**		**0.54**		**1.45**
LSD (0.05)		**NS**	**2.73**	**3.96**		**1.19**		**3.23**

Note: Figures in the parenthesis are angular transformed values

Table 3 revealed highest mean percentage (98.04%) of reduction of *H. armigera* population was recorded in rynaxypyr @ 40 g a.i. ha^{-1} followed by spinosad (88.03%), flubendiamide (87.96%), rynaxypyr @ 20 g a.i. ha^{-1} (85.84%) and indoxacarb (80.21%). Rynaxypyr @ 40 g a.i. ha^{-1} recorded lowest fruit infestation (2.21%) by *Helicoverpa* larvae with 96.98% protection over control plot, followed by spinosad, flubendiamide, rynaxypyr @ 20 g a.i. ha^{-1}, and indoxacarb with 91.6%, 91.04%, 90.38% and 78.62% protection over control respectively. A steady increase in the *H. armigera* population was observed in untreated control plot throughout the experiment (+59.88%). Maximum marketable fruit yield was also highest in rynaxypyr @ 40 g a.i. ha^{-1} treated plot (34.74 q ha^{-1}) as compared to untreated control plot (9.29 q ha^{-1}) followed by flubendiamide (31.9 q ha^{-1}), rynaxypyr @ 20 g a.i. ha^{-1} (31.34 q ha^{-1}), spinosad (30.48 q ha^{-1}) and indoxacarb (28.26 q ha^{-1}). It is clear from the table 3 that rynaxypyr @ 40 g a.i. ha^{-1} was at per with flubendiamide in terms of yield.

Rynaxypyr is the first insecticide from a new chemical class, the anthranilic diamides, controlling almost all economically important lepidoptera and some other species. When used early in the pest life cycle, rynaxypyr prevents the build-up of pest populations, maximizing yield potential. The high larvicidal potency and long-lasting activity of rynaxypyr provide excellent crop protection. It controls insect pests through a new mode of action, activation of insect ryanodine receptors (RyRs). Rynaxypyr binds to the RyR, causing uncontrolled release and depletion of internal calcium, preventing further muscle contraction.

Table 3: Effect of insecticides on *H. armigera* of tomato and on yield (mean data of two years)

Treatment	Dose g a.i. ha^{-1}	Pre treatment count (borers 5 plant^{-1})	% reduction or increase (+) in borers after spray		Mean of % reduction or increase (+) in borers after spray	% fruit infested by borer	% protection over control	Marketable yield (q ha^{-1})
			3rd	7th				
Spinosad 45% SC	60	5.23 (13.18)	90.12 (71.66)	85.95 (63.03)	88.03 (70.00)	6.15	91.60	30.48
Rynaxypyr 18.5% SC	40	5.1 (13.05)	97.71 (81.09)	98.38 (82.73)	98.04 (82.73)	2.21	96.98	34.74
Rynaxypyr 18.5% SC	20	6.25 (14.54)	80.49 (63.79)	91.18 (72.74)	85.84 (67.86)	7.05	90.38	31.34
Flubendiamide 20% WG	30	5.29 (13.31)	87.30 (69.12)	88.63 (70.27)	87.96 (69.73)	6.56	91.04	31.90
Indoxacarb 14.5% SC	75	6.0 (14.18)	81.77 (64.75)	78.65 (62.51)	80.21 (63.58)	15.67	78.62	28.26
Control		5.7 (13.31)	+ 52.33 (46.32)	+ 67.42 (55.18)	+ 59.88 (50.71)	73.28	91.60	9.29
SEm (±)			**0.76**	**1.51**		**0.6**		**1.34**
LSD (0.05)		**NS**	**1.7**	**3.37**		**1.34**		**2.98**

Note: Figures in the parenthesis are angular transformed values

Insects treated with rynaxypyr exhibit rapid cessation of feeding, lethargy, regurgitation and muscle paralysis, ultimately leading to death. Due to its unique chemical structure and novel mode of action, rynaxypyr shows excellent control of pest populations resistant to other insecticides. Chowdary *et al*., 2010 reported that Rynaxypyr 20 SC @ 30 g a.i. ha^{-1} and rynaxypyr 20 SC @ 20 g a.i. ha^{-1} were superior in recording less larval populations, lower fruit damage against okra fruit borer, *Helicoverpa armigera* (Hubner).

Spinosad, an extract of the fermentation product of soil actinomycetes, *Saccharopolyspora spinosa*, containing a naturally occurring mixture of spinosyn A and spinosyn D. It uniquely combines the efficacy of synthetic products with the benefits of biological insect pest control products. It is active by ingestion and contact exposure. Spinosad provides good control at low rates causing excitation of the insect nervous system, leading to involuntary muscle contraction, prostration with tremor, and finally paralysis. It provides good control over lepidopteran, dipteran, thysanopteran, and some coleopteran, homopteran, hymenopteran and orthopteran pest. Spinosad is relatively low toxic to mammals and birds and relatively safer to the beneficial insect (Thompson and Hutchins, 1999). Biological activities of Spinosad to larvae of *H. virescens* and other lepidopteran insects were described by Sparks *et al*. (1995). Our present findings on the efficacy of Spinosad are similar with the findings of Sidde Gowda *et al.* (2003).

It is evident from field experiment that the infestation of *Helicoverpa* on tomato could effectively be controlled by the use of Flubendiamide. Flubendiamide shows extremely strong insecticidal activity essentially against lepidopteran pests including resistant strains (Tohnishi *et al.,* 2005). They are recently developed new molecules having novel mode of action with strong broad-spectrum activity against harmful pests including Lepidoptera. High efficacy of Flubendiamide against *Helicoverpa* in our experiment is also conformity with Lakshmi Narayana and Rjashri (2006) and Meena *et al. (*2006). On the other hand Indoxacarb also exhibited good larvicidal property by inhibiting sodium ion entry into nerve cells of the insects, resulting in paralysis and death of target test species.

Our present investigation showed that all the insecticidal treatments were effective against *Helicoverpa armigera* of tomato. It can be concluded that, application of rynaxypyr @ 40 g a.i. ha^{-1} may give the better result against *Helicoverpa* of tomato.

REFERENCES

Chowdary, L. R., Bheemanna, M. and Kumar, L.R. 2010. Bioefficacy of rynaxypyr (Coragen) 20 SC against fruit borer *Helicoverpa armigera* (Hubner) in okra. *Int. J. Pl. Protec.,* **3**: 379-81.

Lakshmi Narayana, S. and Rajasri, M. 2006. Flubendiamide 20 WDG (RIL- 038)- A new molecule for the management of American Bollworm, *Helicoverpa armigera* on cotton. *Pestology,* **30**: 16-18.

Meena, R. S., Srivastava, C. P. and Joshi, N. 2006. Bioefficacy of some newer insecticides against the major insect pests of short duration pigeonpea. *Pestology*, **30**: 13-16.

Gowda, S. D. K., Yelshetty, S. and Patil, B. V. 2003. Spinosad 45 SC: An effective insecticide against pigeonpea fruit borer, *Helicoverpa armigera* (Hubner). *Pestology*,**27** : 21-22.

Kakar, K. L., Bhalla, O. P., and Dhaliwal, H. S. 1990. Screening of tomato germplasm and breeding for resistance against fruit borer (*Helicoverpa armigera*). *Indian J. Insect Sci.*, **3**: 57.

Sparks, T. C., Thompson, G. D., Larson, L. L., Kirst, H. A., Jantz, O. K., Worden, T. V., Hertlein, M. B. and Busacca, J. D. 1995. Biological characteristics of the spinosyns: a new naturally derived insect control agents. *Proc. Beltwide Cotton Conf. San Antonio,* USA **2** : 903- 907.

Thompson, G. and Hutchins, S. 1999. Spinosad. *Pestic. Outlook,* **10**2: 78-81.

Tohnishi, M., Nakao, H., Furnya, T., Seo, A., Kodama, H., Tsubata, K., Fujioka, S., Kodama, H., Hirooka, T. and Nishimastsu, T. 2005. Flubendiamide, a novel insecticide highly active against lepidopterous insect pests. *J. Pesticidal Sci.,* **30** : 354-60.