INTERNATIONAL JOURNAL OF PLANT PROTECTION | VOLUME 6 | ISSUE 2 | OCTOBER, 2013 | 367-372

IJPP

RESEARCH ARTICLE

Utilization of newer insecticides for management of cotton bollworms

■ YOGESH PATEL

College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidhyalaya, Ganj-Basoda, VIDISHA (M.P.) INDIA

ARITCLE INFO

Received : 25.06.2013
Revised : 05.08.2013
Accepted : 28.08.2013

Key Words :
Cotton, Bollworm, Efficacy, Insecticide, Biorational

Email: yogeshpatelt2@rediffmail.com

ABSTRACT

A field trial were conducted in two crop seasons (*Kharif*) during 2005-06 and 2006-07 with american cotton veriety, JK-4 to study the bioefficacy of six insecticides against bollowrms of cotton. A newer insecticides of Avermectine class, Emamectin benzoate 5 WSG @ 9.8 g ai/ha was found most effective spray, giving maximum reduction in population and registered maximum increase in yield over control, net profit and relatively safer against potent predator of cotton bollworms. However, Spinosad 45 SC @ 100 g ai/ha and Lamadahalothrin 5 EC @ 25 g ai/ha were found next effective. The result revealed that Emamectin benzoate 5 WSG 9.8 g ai/ha and Spinosad 45 SC @ 100 g ai/ha were good substitute for conventional insecticides, which can be incorporated in the intergrted pest management strategy to achieve the desired control against cotton bollworms.

How to view point the article : Patel, Yogesh (2013). Utilization of newer insecticides for management of cotton bollworms. *Internat. J. Plant Protec.*, **6**(2) : 367-372.

INTRODUCTION

Cotton is the world's most important fibre crop and plays a vital role in social and economical affairs of the world. Insect-pests are among the various constraints for successful cotton cultivation and bollworms are the most important of them. The different bollworm include American bollworn *Hellcoverpa armigera* (Hubner), spotted bollworm, *Earias vitiella* (Fabricius) and pink bollworm, *Pectinophora gossypiella* (Saunders) which cause considerable damage to the crop. Dhawan *et al.* (1998) reported 44.5 per cent avoidable losses due to bollworm in Punjab. The use of insecticides' played a major role in increasing cotton productivity for the last two decades as a best component of integrated pest management (IPM). However, the indiscriminate use of insecticides has led to many problems including resurgence of sucking pest and development of resistance bollworm, *Helicoverpa armigera* (Hubner) against several insecticides (Kranti *et al.*, 2002). Hence, there is need to explore the possibility of usesing new molecules and decrease the dependence on conventional insecticide. In the present studied, a new insecticide Emamectin Benzoate 5% WSG was evaluated for the control of bollworm comples on cotton.

MATERIAL AND METHODS

A field experiment was conducted at the J.N. Krishi Vishwa Vidhyalaya, Cotton Research Station, Khandwa M.P. during 2005-06 – 2006-07 to evaluate the efficacy and economics of six insecticides against the cotton bollworms. The american cotton variety JK-4 was sown on 27th June and 28th June during 2005 and 2006, respectively at a spacing of 60×60 cm in the plot size 6×4.8 sqm. Normal agronomic practices recommended for the region, were followed for raising the crop. The experiment was laid out in Randomized Block Design (RBD) with eleven treatments including untreated control. The treatments were imposed three times at 14 days interval commencing from 48th day after sowing. A high volume hand compression Knapsack sprayer was used for application of insecticides at their respective doses. The sprayer was calibrated to deliver the required quantity of spray solution per plot. Applications were done during morning in

such a way to give uniform coverage on foliage and to avoid drift and photo oxidation of the insecticides.

The observations were recorded on five randomly selected tagged plants from each plot. Post treatment observations were recorded two, five and seven days after treatment. Pretreatment observation was recorded one day before the spray of insecticide. The per cent damage caused by bollworms was recorded by counting total number of damaged and healthy intact fruiting body *viz.*, squares. green boll, open boll and locule per plant. Shaded fruiting bodies were also collected from these plants and dissected to record bollworms damage. At each picking, all the pickable bolls on these plants were removed and dissected to examine the bollworm damage. The observation on the population of American bollworm, *H. armigera* (larva), lady bird beetle, C. *septumpuctata* (adults and larva) and green lacewing, *C. cornea* (stalked egg) recorded separately, on per plant bases. The seed cotton yield was recorded at each picking and was extrapolated to give the value of kg/ha. To evaluate the economics of treatment, current market rates of insecticides were obtained and the expenditure on treatment per plot was calculated based on the doses/concentration dissolved in the required quantity of water for the treatment. The date for each season and the pooled data for the two seasons were transformed as suggested by Gomez and Gomez (1984) for statistical analysis and analysis of variance was carried out by Randomized Block Design.

RESULTS AND DISCUSSION

The result obtained from the present investigation are presented below :

Effect of insecticides on bollworm complex in cotton :

The pooled average data of two years 2005-06 and 2006-07 are presented in Table 1, which clearly indicate that all the insecticides treatments were significantly superior in suppressing incidence of bollworm as compared to untreated control. Significantly lowest 7.14%, 8.38% and 9.45 square damage in 2,5 and 7 days after spraying (DAS), respectively was found in plots treated with Emamectin benzoated 5 WSG @ 9.8 g ai/ha followed by significantly suppressed the incidence of bollworm by Spinosad 45 SC @ 100 g ai/ha and Lamadacyhalothrin 5 EC @ 25 g ai/ha but were at par with each other, however they were significantly superior from rest of the treatement.In green boll and open boll damage, Emamectin benzoated 5 WSG @ 9.8 g ai/ha significantly suppressed the incidence of bollworm which was followed by Spinosad 45 SC @ 100 g ai/ha and Lamadacyhalothrin 5 EC @ 25 g ai/ha.

The observations recorded on the population of American bollworm also showed that Emamectin benzoate @ 9.8 g ai/ha was significantly superior over all the treatments where the population of American bollworm was found to be significantly lowest which was followed by Spinosad 45 SC @ 100 g ai/ha and Lamadacyhalothrin 5 EC @ 25 g ai/ha, respectively.

In all, newer insecticide of Avermectin group, Emamectin benzoate @ 9.8 g ai/ha was found most effective. Its recorded minimum bollworm population, minimum per cent bollworm damage to square, bolls and locules with highest seed cotton yield and also was found to be economical. This avermectin derivative acts on GABA receptor affecting the diversity of insects such as mites, lepidopterans and thrips (Ishaaya *et al.*, 2001). These findings confirm the results of Udikeri *et al.* (2004), Gupta. *et al.* (2005), Mallah and Korejo (2005) who also reported that Emamectin benzoate effectively protected the cotton crop against bollworm of cotton. It is an analog of abamectin, produced by fermenation of metabolites of *Streptomyces avermitilis* having wide range spectrum activity against nematodes, arthropods and mites. It is both stomach and contact insecticides used primarily for control of caterpillars. It is inhibiting signal transmission at neuromuscular junction. Shortly after exposure, larva stops feeding and becomes irreversibly paralyzed, dying 3-4 days (Patil and Rajanikanta 2004) A Spinosyn class biorational insecticides, Spinosad 45SC @ 100 g ai/ha was found to be next affective insecticide. Toxicity of this biorational may be attributed to its novel mode of action, which acts primarily at the nicotinic acetylcholine receptor in the nerve synapse (Ishaaya *et al.*, 2001). These finding also confirm the observations of Peterson *et al*. (1996) who reported the use of Tracer (spinocid) effectivelly controlled budworms (*Heliothis virescens*) and bollworm (*Helicoverpa zea*) in cotton and reduced square damage, with conserved beneficial arthropods, minimized secondary insect pests, increased spray intervals and provided maximum yield. This biorational insecticide acts on both acetylcholine and GABA receptors affecting diversity of insect species (Ishaaya *et al.*, 2001). Some other workers Pan-Deng Ming. *et al.* (2000). Ahmed *et al.* (2004) also recorded similar observations. Oregano phosphates group insecticide, Lamadacyhalothrin 5 EC @ 25 g ai/ha and Oxadiazines group of insecticide, Indoxacarb 14.5 SC @ 1000 g ai/ha were also found to be significantly better over conventional insecticides Cypermethrin and Profenophos. These results are in accordance to the findings of Cheema (2004) and Mallah and Korejo (2005) who also reported that Steward 150 EC (indoxacarb; 175 m1/a) provided excellent control against bollworm of cotton. However, Fennimore *et al*. (1988) recorded that the synthetic pyrethroid, Karate 1E (Iambda-cyhalothrin) gave effective control of the noctuids Heliothis spp.

Impact of insecticides on the predators of cotton pest :

The pooled average data of two years 2005-06 – 2006-07 presented in Table 2 clearly reveled that the maximum population

Table 1 : Effect of insecticide treatments on damage due to bollworm complex (Pooled of two years)

Treatments	Dose gai/ha.	Percentage of square damage due to bollworm complex				Percentage of green boll damage due to bollworm complex				Percentage of locule damage due to bollworm complex			
		PT*	2DAS**	5DAS**	7DAS**	PT*	2DAS**	5DAS**	7DAS**	PT*	2DAS**	5DAS**	7DAS**
Emamectin benzoate	8	19.79	7.44	8.38	9.45	20.93	8.96	9.71	9.79	22.79	10.62	11.40	12.70
5 WSG		(26.40)	(15.83)	(16.81)	(17.88)	(27.21)	(17.39)	(18.10)	(18.23)	(28.50)	(19.01)	(19.71)	(20.87)
Emamectin benzoate	9.8	18.87	4.12	5.16	6.30	19.90	5.68	6.64	9.36	21.76	7.08	8.04	9.83
5 WSG		(25.74)	(11.66)	(13.09)	(15.40)	(26.49)	(13.75)	(14.82)	(17.81)	(27.79)	(15.40)	(16.39)	(18.26)
Spinosad 45 SC	75	19.89	8.93	9.36	10.93	21.14	9.96	10.87	11.40	22.76	11.78	12.91	13.89
		(26.48)	(17.39)	(17.79)	(19.28)	(27.36)	(18.38)	(19.20)	(19.73)	(24.89)	(20.02)	(21.03)	(21.88)
Spinosad 45 SC	100	19.76	5.22	6.17	7.35	20.93	6.69	7.67	9.89	22.82	8.77	9.79	10.66
		(26.39)	(13.19)	(14.35)	(15.71)	(27.22)	(14.97)	(16.05)	(18.33)	(28.52)	(17.18)	(18.21)	(19.04)
Lamada	20	18.76	8.31	9.19	10.25	19.83	9.68	10.66	10.89	20.99	10.90	11.99	13.69
Cyhalothrin 5 EC		(25.66)	(16.75)	(17.65)	(18.66)	(26.44)	(18.06)	(19.04)	(19.27)	(27.25)	(19.26)	(20.25)	(21.71)
Lamada	25	18.68	5.46	6.25	7.34	19.89	6.74	7.85	11.23	20.99	8.62	9.82	10.81
Cyhalothrin 5 EC		(25.60)	(13.51)	(14.47)	(15.68)	(26.49)	(14.93)	(16.25)	(19.58)	(27.25)	(17.06)	(18.25)	(19.15)
Indoxacarb 14.5 SC	75	20.75	11.91	12.37	14.11	21.82	12.92	13.84	15.34	23.71	14.91	15.79	16.91
		(27.08)	(20.18)	(20.59)	(22.04)	(27.84)	(21.05)	(21.83)	(23.06)	(29.14)	(22.70)	(23.41)	(24.26)
Indoxacarb14.5 SC	100	19.73	10.85	11.89	13.08	20.89	12.56	12.91	15.36	21.94	13.79	14.96	15.89
		(26.35)	(19.22)	(20.17)	(21.21)	(27.20)	(20.74)	(21.05)	(23.07)	(27.93)	(21.79)	(22.75)	(23.46)
Profenophos50EC	1000	20.79	13.22	14.28	15.28	21.82	14.78	15.84	16.87	23.72	16.65	17.62	18.75
		(27.11)	(21.31)	(22.21)	(23.00)	(27.84)	(22.58)	(23.44)	(24.25)	(29.14)	(24.08)	(24.82)	(25.64)
Cypermethrine	75	19.74	13.25	14.42	15.41	21.02	14.82	15.77	18.19	22.75	16.74	17.79	18.71
10EC		(26.37)	(21.34)	(22.32)	(23.11)	(27.28)	(22.61)	(23.39)	(25.24)	(28.49)	(24.15)	(24.94)	(25.63)
Untreated control		18.96	19.64	20.33	21.88	19.76	19.70	19.92	13.95	20.98	21.03	20.99	22.00
		(25.81)	(26.30)	(26.80)	(27.88)	(26.39)	(26.33)	(26.51)	(21.91)	(27.24)	(27.28)	(27.25)	(27.96)
Mean		19.61	9.85	10.71	11.94	20.72	11.14	11.97	12.93	22.29	12.81	13.74	14.90
		(26.27)	(17.88)	(18.75)	(19.90)	(27.07)	(19.16)	(19.97)	(20.95)	(28.16)	(20.72)	(21.55)	(22.53)
S.Em. ±		0.64	0.38	0.44	0.67	0.49	0.88	0.80	0.35	0.71	0.70	0.72	0.73
S.Ed. ±		0.90	0.54	0.62	0.94	0.69	1.25	1.13	0.49	1.00	0.99	1.02	1.03
CD (P=0.05)		NS	1.11	1.26	1.93	NS	2.55	2.32	1.00	NS	2.03	2.08	2.10

()=Figures in parentheses are Arcsine-transformed value, DAS= Days after spraying, NS=Non–significant , *Mean based of 2 observations, ** Mean based of 6 observations

of Coccinelids, lady bird beetle and Chrysopids, green lacewing recorded in untreated control plots. However among the treatments significantly highest population was recorded in plot treated with Emamectin benzoate @ 8 g ai/ha followed by Emamectin benzoate @ 9.8 g ai/ha Spinosad 45 SC @ 75 g ai/ha and Spinosad 45 SC @ 100 g ai/ha. An, insecticide of Avermectine class, Emamectin benzoate was found safest against predator of cotton pest Coccinelids, Lady bird beetle and Chrysopids, green lacewing among the tested insecticides. It is a biological insecticide and it is highly selective nature in comparison to other chemical insecticides. The present study also revealed that, Spinosad was, the next safer insecticide to natureal enemies. This is probably due to its unique property. It is a mixture of tetracyclic-macrolide compound produced by a soil actinomycete and has been classified as a biological insecticide. It is highly active against Lepidoptera but is reported to be practically nontoxic to insect natural enemies (Cisneros *et al.* 2002). Similar finding have been reported by Medina *et al.,* 2001. Udikeri *et al.,* 2004 Mallah and Korejo, 2005 abnd Xu-JianJun *et al.,* 2005. The organophosphate, Lamada cyhalothrin was found effective to resricted the bollworm infestation and gave highest cost; benefit ratio but was found to be highly toxic to the predators.

Seed cotton yield and economics of cotton :

The data presented in Table 3 clearly indicate that maximum seed cotton yield was obtained from plots treated with Emamectin benzoate @ 9.8 g ai/ha (1073.13kg/ha) followed by Spinosad 45 SC @ 100 g ai/ha and Lamadacy halothrin 5 EC @ 25 g ai/ha. Highest percentage increase in yield over untreated control (126.43%) and net profit (Rs. 1038737 /ha) was also recorded in Emamectin benzoate @ 9.8 g ai/ha treated plots. However, highest cost; benefit ratio 1:17:44 was recorded in plot treateds ith Lamadacyhalothrin 5 EC @ 25 g

Table 2 : Effect of insecticide treatment on population of natural enemies of cotton bollworm (Pooled of two years)

Treatments	Dose gai/ha.	Population of lady bird beetle par five plant				Population of green lacewing par five plant			
		PT*	2DAS**	5DAS**	7DAS**	PT*	2DAS**	5DAS**	7DAS**
Emamectin benzoate 5	8	31.03	26.92	27.99	29.62	11.98	8.41	9.13	9.79
WSG		(5.61)	(5.23)	(5.34)	(5.49)	(3.52)	(2.98)	(3.09)	(3.20)
Emamectin benzoate 5	9.8	30.98	25.77	26.84	28.68	12.10	7.95	8.36	9.17
WSG		(5.61)	(5.12)	(5.23)	(5.40)	(3.55)	(2.90)	(2.97)	(3.11)
Spinosad 45 SC	75	30.84	25.89	26.96	27.58	10.99	7.98	8.49	9.18
		(5.60)	(5.14)	(5.24)	(5.30)	(3.38)	(2.90)	(2.99)	(3.11)
Spinosad 45 SC	100	30.94	24.90	26.66	27.82	11.15	7.46	8.31	9.00
		(5.61)	(5.04)	(5.21)	(5.32)	(3.41)	(2.81)	(2.96)	(3.08)
Lamada	20	29.93	24.75	25.73	26.82	11.22	7.17	8.12	8.38
Cyhalothrin 5 EC		(5.52)	(5.02)	(5.12)	(5.23)	(3.42)	(2.77)	(2.92)	(2.98)
Lamada	25	31.16	21.79	22.69	25.69	11.12	6.07	6.32	7.07
Cyhalothrin 5 EC		(5.63)	(4.72)	(4.81)	(5.12)	(3.41)	(2.56)	(2.61)	(2.75)
Indoxacarb 14.5 SC	75	32.15	24.83	25.99	27.39	12.06	7.34	8.33	9.02
		(5.71)	(5.03)	(5.15)	(5.28)	(3.54)	(2.80)	(2.97)	(3.08)
Indoxacarb14.5 SC	100	31.30	23.89	24.85	26.59	12.22	7.21	7.50	8.31
		(5.64)	(4.94)	(5.03)	(5.20)	(3.56)	(2.77)	(2.82)	(2.96)
Profenophos50EC	1000	30.27	24.75	25.91	26.90	11.12	7.32	8.28	8.35
		(5.55)	(5.02)	(5.14)	(5.23)	(3.41)	(2.79)	(2.96)	(2.96)
Cypermethrine 10EC	75	32.03	19.92	20.88	22.48	12.03	5.10	5.39	6.08
		(5.70)	(4.52)	(4.62)	(4.79)	(3.54)	(2.36)	(2.42)	(2.56)
Untreated control		30.32	31.74	33.63	31.54	11.02	11.11	11.30	10.43
		(5.55)	(5.68)	(5.84)	(5.66)	(3.39)	(3.40)	(3.43)	(3.30)
Mean		30.99	25.01	26.19	27.37	11.54	7.56	8.14	8.61
		(5.61)	(5.04)	(5.16)	(5.27)	(3.47)	(2.82)	(2.92)	(3.01)
S.Em. ±		0.08	0.09	0.08	0.07	0.11	0.14	0.14	0.12
S.Ed. ±		0.11	0.12	0.11	0.10	0.15	0.20	0.20	0.16
CD (P=0.05)		NS	0.25	0.23	0.21	NS	0.42	0.40	0.33

()=Figures in parentheses are Arcsine-transformed value, DAS= Days after spraying, NS=Non–significant , *Mean based of 2 observations, ** Mean based of 6 observations

Table 3 : Seed cotton yield and economics of different insecticide treatment (Pooled of two years)

Treatments	Dose gai/ha.	Yield of seed cotton (Kg/ha.)	Increased in yield over control (%)	Cost of increased yield (Rs/ha)	Cost of inputs (Rs/ha)	Cost: Benefit Ratio (Rs)	Net Profit (Rs)
Emamectin benzoate 5 WSG	8	924.17	95.00	8833.77	1120.00	1:7.89	7716.03
Emamectin benzoate 5 WSG	9.8	1073.13	126.43	11756.37	1372.00	1:8.57	10387.37
Spinosad 45 SC	75	876.46	84.94	7897.77	1222.22	1:6.46	6677.56
Spinosad 45 SC	100	1028.31	116.98	10877.07	1833.33	1:5.93	9046.51
Lamada	20	601.95	27.01	2511.72	159.20	1:15.78	2353.16
Cyhalothrin 5 EC							
Lamada	25	650.82	37.32	3470.55	199.00	1:17.44	3272.43
Cyhalothrin 5 EC							
Indoxacarb 14.5 SC	75	598.80	26.35	2450.08	931.03	1:2.63	1519.67
Indoxacarb14.5 SC	100	649.08	36.96	3436.44	1396.55	1:2.46	2040.77
Profenophos50EC	1000	538.63	13.65	1269.51	850.00	1:1.49	419.84
Cypermethrine 10EC	75	554.01	16.90	1571.30	187.50	1:8.38	1384.20
Untreated control		473.93		0.00			
Mean		724.48					
S.Em. ±		12.24					
S.Ed. ±		17.26					
CD (P?0.05)		35.35					

ai/ha, probably due its low market prize.

From the present study, it can be inferred that all the insecticides tested were found to be significantly superior over control, however newer insecticides of Avermectine class, Emamectin benzoate @ 9.8 g ai/ha was found most effective in its spray giving maximum reduction in population and registered maximum increased in yield over control and net profit and relatively safer against potent predator of cotton bollowrms. However, Spinosad 45 SC @ 100 g ai/ha was found next effective. Such compounds can be incorporated in the integrated pest management strategy to achieve the desirecd control.

REFERENCES

Ahmed, Sohail, Khurram, Zia and Nacem-ur-Rehman, Shah (2004). Validation of chemical control of gram pod borer, *Helicoverpa armigera* (Hub.) with new insecticides. *Internat. J. Agric. & Biol.,* **6**(6) : 978-980.

Cheema, G.M., Abida, N. and Muhammad, A. (2004). Application of selective insecticides control first generation of Helicoverpa armigera (Hubner) on cotton. *Pakistan-Entomologist* **26**(1): 35-37.

Cisneros, J., Goulson, D., Derwent, L.C., Penagos, D.I., Hernandez, O. and Williams, T. (2002). Toxic effects of Spinosad on predatory insects *Biological Control,* **23**(2): 156-163.

Dhawan, A. K., Sidhu, A.S., and Simbat, G.S. (1998). Utilization of newer insecticides for management of fennimore. S., B Rogers, and D. Anderson (1988). Karate 1E : results of cotton Heliothis spp. and bollwevil studies across the cotton belt. Proceedings. Beltwide Cotton Production Conference, New Orleans. pp:94-95.

Gomez, K.A. and Gomez, A.A. (1984). *Statistical procedures for agricultural research,* John Willey and Sons, New York. 680 pp.

Gupta, G.P., Birah, Ajanta, Rani, Seema, and Raghuraman, M. (2005). Utilization of newer insecticides for management of spotted bollworm *Earias vittella* (Fabricius) (Lepidoptera: Noctuidae). *Entomon.,* **30**(1) : 97-100.

Ishaaya, I., Kontsedalov, S., Mazirov, D., and Horowitz, A.R. (2001). Biorational agents – mechanism and importance in IPM and IRM programs for controlling agricultural pests Mededelingen Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen, *Universiteit Gen*., **66** (2a) : 363-374.

Mallah, G.H. and Korejo, A.K. (2005). Evaluation of different new chemistry against *Helicoverpa armigera* on cotton in relation to their efficacy and safety aspects to beneficial insects. *Indus Cottons*., **2**(2) : 140-143.

Medina, P., Budia, F., Tirry, L., Smagghe, G. and Vinuela, E. (2001). Compatibility of spinosad, tebufenozide and azadirachtin with eggs and pupae of the predator, *Chrysoperla carnea* (Stephens) under laboratory conditions. *Biocontrol Sci. & Technol.,* **11** (5) : 597-610.

Pan Deng Ming, Ma Yan and Jia-HaiQing (2000). An experiment on the application of 48% spinosad solution for the control of bollworm. *China Cottons,* **28**(1): 15-16.

Patil, B. V. and Rajanikantha, R. (2004). New class of insecticides: Mode of action and their Bioefficacy. Paper presented in International Symposium on "Strategies for sustainable cotton production-A global vision" during 23-25, November 2004, at UAS, Dharwad, Karnatak pp: 77-85.

Peterson, L.G., Porteous, D.J., Huckaba, R.M., Nead, B.A., Gantzz, R.L., Richardson, J.M. and Thompson, G.D. (1996). Beneficial insects, their role in cotton pest management systems founded on naturalyte insect control, Proceedings Beltwide Cotton Conference, Nashville, T.N., USA, January 9-12, 1996 pp: 872-874.

Udikeri, S.S., Patil, S.B., Rachappa, V. and Khad, B.M. (2004). Emamectin benzoate 5SG : A safe and promising biorational against cotton bollworms. *Pestol.*, **28**(6) : 78-81.

Vadoria, M.P., Patel, U.G., Maisuria, I.M., Patel, C.J. and Patel, R.B. (2001). Bio efficacy of a new insecticide, Spinocad against bollworm of cotton. *Pestol.*, **25**(9) : 24-28.

Xu-Juian, Jun, Guo-WenChao, He-Jiang, Tuerxun and Li-HaoBin (2005). Study on the safety of tracer to major predatory natural enemies in Xinjiang cotton field. *Xinjiang Agric. Sci.*, **42**(3): 171-174.

6th Year
★★★★★ of Excellence ★★★★★