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Comparative efficacy and Resistance Levels to Certain Organophosphate Insecticides in the Pink Bollworm (*Pectinophora gossypiella*) (SAUNDERS)

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Abstract

The pink bollworm, *Pectinophora gossypiella* (Saunders) is an important pest of cotton crops. It has recently emerged as a serious concern for cotton production in the world. A Field experiment was conducted at different locations in Egypt, during 2020-2021and 2021-2022 to evaluate the comparative efficiency and levels of resistance to certain of organophosphate Insecticides against *P. gossypiella*. The results revealed that, among the tested insecticides chlorpyrifos (Dursban 48% EC) & (pyriban-A 48% EC) and profenofos (Cord 72% EC) and (Camecron 72% EC) have effective potency in management of pink bollworm at the selected governorates. The results of this study clearly indicate that Camecron had the very high resistance rate by 120.2 and 342.02 fold during 1st and 2nd season, respectively then Dursban, pyriban-A and the least resistance rate was Cord insecticide during the two seasons. Fayoum and Beni Suef strain has the highest resistance rate profenofos and chlorpyrifos. While, El-minya strain was the least resistant rate to the selected insecticides.

Keywords: Comparative efficacy**,** resistance levels, organophosphates compound, *Pectinophora gossypiella*.

INTRODUCTION

Cotton is the most significant crop producing natural fiber which is also known as the "King of fibres" or "White gold" since it is grown commercially to meet the demands of 111 nations both domestically and internationally. Approximately 130 distinct kinds of insects and mites, out of 1326 total insect pest species worldwide, attack crops (Parmar, and Patel, 2016). Pakistan's crop of cotton was reduced by 30% as a result of these pest insects (Bo, 1992). The pink bollworm, *P. gossypiella* (Saunders), has become more pronounced in recent years. Its disappearance is particularly noticeable in interspecific hybrid cottons, which are a major source of extra-long staple cotton and crucial for the textile industry and export. Additionally, pink bollworms emerge later in the cropping season. *P. gossypiella* is now the most commercially damaging pest of cotton and has known to cause 2.8 to 61.9 % loss in seed cotton yield, 2.1 to 47.1% loss in oil content and 10.7 to 59.2 % loss in normal opening of bolls (Patil, *et al*., 2003). By feeding on cotton crops, the pink bollworm *P. gossypiella* (Saund.) reduces quantity directly and indirectly reduces product quality by spreading several diseases. The primary method of control is the application of synthetic pesticides such imidacloprod, acephate, cyfluthrin, and lambada cyhalothrin. Each year, almost 80% of all agrochemicals are used to control *P. gossypiella*, which results in a variety of issues like pesticide resistance, pest resurgence, and secondary pest outbreak (Bakhetia *et. al*., 1996). A correlation between hydrolases activity and resistance to organophosphate was reported from *P. gossypiella* (Abdel-Baset, 2009). *P. gossypiella* has become resistant to the majority of insecticide classes, such as carbamates, organophosphates, and synthetic pyrethroids. (kranthi, *et al.*, 2001). Insecticide resistance is a major impediment to the effective management of field populations of the pink bollworm. Early detection of insecticide resistance provides a basis for the management of resistance pest populations (Khidr, *et al*., 2002). This study aims to investigated the resistance level of pink bollworm *P. gossypiella* to some organophosphate insecticides (Dursban48%EC, pyriban-A48%EC, Cord72%EC and Camecron72%EC) in El-Minia, Beni Suef and Fayoum, governorates during (2020-2021 and 2021-2022) seasons.

MATERIALS AND METHODS

Rearing of pink bollworm

Field experiment was conducted at three different locations, during season 2020-2021.and 2021-2022. Populations of *P. gossypiella* were randomly collected from different regions during the season in El-Minya, Beni Suef and Fayoum, governorates. A laboratory strain that has been used as a baseline in insecticidal assays obtained from the bollworms department at the Plant Protection Research Institute, Agricultural Research Center in Dokki, Egypt. All infected dry and green almonds were collected from cotton bushes at the end of the season (beginning in September) from the representative fields of the centers in the selected governorates. The almonds were dissected and the larvae were extracted from them, then the obtained larvae were placed in glass tubes containing an artificial diet as described by Sameh (2009). The artificial diet used to be composed of water, agar, yeast, kidney bean, ascorbic acid, methyl paraben, sorbic acid and formaldehyde. The larvae were kept under laboratory conditions at 26 ± 1ºC, lighting for 14 hours, and 80 ± 5% RH to break the dormancy phase. The pupae were then placed in clean tubes until the adults come out to conduct the treatment.

Insecticides

Four insecticides (with two active ingredients) were used in this evaluation chloripyrifos (Dursban 48% EC and pyriban-A 48% EC) using recommended rate of application (1 liter/ fed.), and profenofos (Cord 72% EC and Camecron 72% EC) with its recommended rate (0.75 liter/ fed.).

Bioassay methods

The efficiency of the selected insecticides was tested against *P. gossypiella* adults using residual thin film method. Five aqueous series concentrations of each tested insecticides were used (Dursban 3840, 1920, 960, 480, 240 ppm) pyriban-A (1920, 960, 480, 240,120 ppm) (Cord and Camecron 288,144,72,36,18 ppm). Each treated glass vial contains ten adults (1-2 days old). In addition to the control, which involved treating the vials with distilled water, each treatment was replicated five times. After a day, mortality percentages were calculated and corrected according to Abbott's formula (Abbott, 1952). The results were analyzed statistically by Finney 1971 method, in which the LC_{50} of the tested pesticides for field population and the sensitive strain and the value of the regression of the toxicity lines as well as the use of the most efficient pesticides on the field population were used in calculating the toxicity index by Sun 1950, the Resistance Ratio (RR) was calculated according to Ministry of Agriculture protocols.

RESULTS

The effectiveness of tested organophosphate insecticides on susceptible strain of *P. gossypiella*.

The efficiency of selected insecticides on the susceptible strain of *P. gossypiella* is presented in table (1). Camecron found to be the most effective insecticide against the susceptible strain (LC_{50} 0.5 ppm) followed by Dursban (4.8), Cord (6.2) and Pyriban (7.2). These results are in agreement with that obtained by Seleman, (2014), who found that the discriminating concentration of the organophosphate insecticide; profenofos (LC_{99}) caused 48, 40, 60, and 56 % mortality for the 4th instar larvae of *P. gossypiella* collected from Dakahlia, Gharbia, Kafr EL-Sheikh and Menoufia Governorates; respectively.

Table 1: Toxicity of certain organophosphate pesticides on susceptible strain of *P. gossypiella*.

Insecticides	LC_{50} (ppm)	LC_{90} (ppm)	Slope
Camecron	0.5	7.6	1.1
Dursban	4.8	130.9	0.9
Cord	6.2	65.3	1.3
Pyriban-A	7.2	58.8	1.4

The effectiveness of tested organophosphate insecticides against field population of the pink bollworm *P. gossypiella* collected from different locations during cotton seasons.

Data in Table (2) represented the insecticidal efficiency of the tested organophosphate insecticide against *P. gossypiella* collected from El-Mania, Benisuef and fayoum governorates during (2020-2021) and (2021-2022) from these data we showed that, Cord was the most effective against the field collected population during the two seasons (2020/2021 and 2021/2022) compared to the other selected insecticides. Dursban showed the less effective insecticide against the field population during the first season (2020/2021). However, in the second season 2021/2022, Camecron found to be the less effective against El-Mania and Fayoum population, while Dursban was the less effective against Benisuef population. Results are agreed with (Hegab *et al*., 2020) who studied the effect of different insecticides (Chlorpyrifos+Chlorfluazeron then Lambda-Cypermethrin and then Chlorpyrifos) on *P. gossypiella* larvae. The highest value of the reduction percentage was 88.56 % at ^{2}nd spray followed by 69.79

at 3rd spray, while the lowest mean of reduction was 87.33 % recorded at 1st spray.

Yousif-Kalil, *et al*., 2008, found that Chlorpyrifos caused high reduction to bollworm. Also, results are agreed with (Ibrahim, *et al*., 2017) who reported the relatively highest reduction percentage for (Chloropyrifose) on *P. gossypiella* larvae. The results of this study agreed with the researchers' findings, and it was scientifically proven that the treatment of pink bollworm larvae with conventional insecticides reduced the incidence of cotton boll infection. Naik, *et. al.,* (2023), that the most successful combination for reducing the number of larvae/plant (0.3 to 1.0) and the percentage of localized damage (1.3 to 7.3%) in green bolls was Profenofos 40% + Cypermethrin 4% EC. Thiodicarb 70 SP (750 g a.i/ha) and profenophos 50 EC (500 g a.i/ha) both considerably reduced the percentage of localized damage to 8.88 and 9.50, respectively, indicating effective management of PBW, according to Patil, *et al.,* (2009).

Table 2. The effect of different organophosphate insecticides and resistance level of *P. gossypiella* on different location.

season	Pesticides	El-Minia Governorate.			Beni-Suef Governorate			Fayoum Governorate		
		LC_{50} (ppm)	Slope	Toxicity index %	LC_{50} (ppm)	Slope	Toxicity index %	LC_{50} (ppm)	Slope	Toxicity index %
2020-2021	**Cord**	12.56	2.51	100	19.84	5.56	100	31.21	2.63	100
	Camecron	25.44	1.84	49.37	42.18	3.30	47.04	60.11	2.72	51.92
	Pyriban-A	46.71	2.74	26.88	258.69	2.85	7.7	71.167	1.74	43.85
	Dursban	244.89	3.81	5.12	298.08	8.09	6.7	223.45	4.95	13.97
2021-2022	**Cord**	20.75	2.01	100	34.00	1.80	100	80.44	2.24	100
	Camecron	87.25	2.24	23.78	40.03	1.98	84.93	171.01	2.08	47.03
	Pyriban-A	58.27	1.23	35.61	75.36	2.80	45.11	99.68	2.42	80.69
	Dursban	44.76	2.02	46.35	120.44	2.26	28.22	81.22	2.16	99.03

Monitoring of resistant ratio in different population of *P. gossypiella* to certain insecticides.

Data in Table (3) show that when studying the effect of certain insecticides on field population of different locations compared to the sensitive strain, high resistant ratio of 174.5 against Camecron insecticide was recorded for El-Mania population in 2021/2022 season, while in the first season 2020/2021 the highest resistant ratio was recorded against Dursban (51.02) followed by Camecron (50.88). Benisuef population showed high resistant ratio against Camecron in the first season (84.36 RR) and the second season (80.06 RR). The same trend was observed in Fayoum population with resistant ratio 120.22 and 342.02 in the two seasons respectively. According to Kranthi, *et. al*., (2002), the overall resistance of the pink bollworm *P. gossypiella* (Saunders) to pyrethroids was low. According to Seleman, (2014), field strains of *P. gossypiella* were shown to be resistant to profenofos. Between 31.31 and 59.60% of the tested strains exhibited resistance. When compared to the other field strains, the individuals collected from Gharbia Governorate exhibited the highest percentage of profenofos resistance, while

the individuals collected from Kafr El-Sheikh Governorate showed the lowest percentage of resistance. When studying the effect of dursban and pyriban-A insecticides on field strains of different locations compared to the sensitive strain, Fayoum strain was the least resistant rate by 46.55 & 9.88 fold, followed by El-minya strain with a rate 51.02 & 20.38 fold, while Beni Suef strain was the highest resistance rate by 62.1 & 35.93 fold to both insecticides, respectively. These results are in agreement with that obtained by Kranthi, *et. al*., (2002), reported that high resistance levels of 23–57-fold to endosulfan were recorded in some areas of Central India. Resistance to chlorpyriphos on *P. gossypiella* was high in the Medak, Bhatinda and Sirsa strains from North India. Kranthi, *et. al.,* (2001), showed that most of the strains of *P. gossypiella* examined had a high level of resistance to quinalfos. Of the 7 strains of *E. vittella*, two strains from northern India showed more than 70-fold resistance to monocrotophos.

Table 3. Resistance ratio for certain insecticides on different field strains of *P.gossypiella* collected from different governorates in Egypt.

Strains	Resistance Ratio (RR)							
	Camecron		Cord		Dursban		Pyriban-A	
	2020-2021	2021-2022	2020-2021	2021-2022	2020-2021	2021-2022	2020-2021	2021-2022
Susceptible strain	---	---	---	---	---	---	---	---
El-minia strain	50.88	174.5	2.04	3.34	51.02	9.32	6.48	8.09
Fayoum strain	120.2	342.02	5.03	12.97	46.55	37.6	9.88	13.84
Beni-Suef strain	84.36	80.06	3.2	5.48	62.1	25.09	35.93	10.46

CONCLUSION

Evaluation of different insecticides against pink bollworm in different locations indicated that all the insecticides were found significantly superior over untreated control. The results indicated that among all insecticides found most effective for control *P. gossypiella* at the selected population. The results of this study clearly indicate that Camecron was the highest resistant rate than other insecticides during the two seasons. Fayoum and Beni Suef population has the highest resistant rate to profenofos and chlorpyrifos. Generally, due to the application of IPM by rotation of insecticide usage result in the fluctuation of resistance ratio in tested insects during the evaluation seasons.

REFERENCES

Abbott, W, S. (1925). A method of computing the effectiveness of an insecticide. Journal of Economic, Entomology, 18:265-267.

Abdel- Baset, T.T. (2009). Comparative to toxicological and molecular studies on the pink bollworm *Pectinophera gossupiella* and Mosquito *Culex Pipiens*. Ph. Thesis, faculty of Science, Cairo Univ. Egypt.

Bakhetia, D.R.C., Singh, J., Sohi, A.S. and Singh, J. (1996). Integrated pest management in sustainable Agrico: Punjab Scenario. Pest Manage. Ecol. Zool., 4: 1-13.

Bo, D.Y. (1992). IPM on cotton in Asia and Pacific regions. Pak. Cottons, 36: 87-100.

Finney, D, J (1971). Probit Analysis Cambridge university press. London

Hareesha K. B., S. B. Patil, S. S. Udikeri, D. P. Biradar, S. N. Chattannavar, C. P. Mallapur and B. R. Patil, (2011). Comparative efficacy of interspecific cotton hybrids containing single and stacked Bt genes against pink bollworm, *Pectinophora gossypiella* (Saund.) and tobacco caterpillar, Spodoptera litura (Fab.) Karnataka J. Agric. Sci.,24 (3): 320 – 324.

Hegab M.E. M. A., Zaki, A. A. T., El-Sayed, A. A. A. and Amer, A. A. (2020). Impact of Certain Insecticides Against Pink Bollworm *Pectinophora gossypiella*, Sucking Pests, and Their Associated Predators in Cotton Fields. Syrian Journal of Agricultural Research – SJAR 7(3): 467-479.

Ibrahim, M.M.A.; H.M.H. Al-Shannaf; A.A.A. Zaki and M.E.M.A. Hegab (2017). Impact of garlic extract in comparison with chloropyrifose insecticide against certain pests and associated predators in cotton fields at Sharkia Governorate, Egypt. Zagazig j. Agric. Res., 44 (1): 281-293

Khidr, A. A.; Abdel-Karim, H. E.; Abo-Elghar, E. G.; Mater, M.; Ali and Abdel-Halim, A. A. (2002): Development of Discriminating Monitoring techniques for Moths insecticide resistance in *Pectinophora gossypiella* (Lepidoptera: Noctuidae) in cotton. 2nd International Conference, Plant protection Research Institute. Cairo, Egypt, 21- 24 December.

Knanthi, K.R.; Jadhav, D.R.; Wanjari, L.R.; Alis, S.S., Russel, D. (2001): Carbamate and organophosphate resistance in cotton pests in India 1995 to 1999. Bull Entomol. Res. 91, 37-46.

Kranthi, K.R., D.R. Jadhav, S. Kranthi, R.R. Wanjari, S.S. Ali and D.A. Russell (2002). Insecticide resistance in five major insect pests of cotton in India. Crop Protection. Volume 21 (6): 449-460.

Naik, V.C., Narode, M.K., Kumbhare, S., Ghongade, D.S., Madhu, T. N., Murthy, J. S. V., Gokte-Narkhedkar, N. and Prasad, Y. G. (2023). Efficacy of novel insecticides and their combinations against pink bollworm, *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae) in cotton. International Journal of Tropical Insect Science. 43 (2):397-407.

Parmar, V. R. and, C. C. Patel, (2016). Pink Bollworm: A notorious pest of cotton: a review. AGRES – An International e-Journal, 5(2): 88-97 ISSN 2277-9663.

Patil, S. B., S. S. Udikeri and, B. M. Khadi, (2003). Integrated pest management with genetically modified cotton hybrids in India. In: Proc. World Cotton Res. Conf. - III. 9-13 March, 2003, Cape Town, South Africa, pp. 959-966.

Patil, S. B., S. S. Udikeri, R. B. Hirecurubar, G. S. Guruprasad and, C. C. Abhilash (2009). Thiodicarb and Profenophos: Promising Insecticides for Management of Pink Bollworm, *Pectinophora gossypiella* (Saunders) in Cotton. Indian J. Ent., 71(2): 183-185.

Sameh, Sh. Hafez (2009). Biological studies on insecticide resistance in populations of Egyptian cotton leaf worm *Spodoptera littorals* (Boisd) M. SC, Thesis. Fac. Agric.AL. Azhar, Univ., Egypt

Seleman, Laila E. (2014). Monitoring resistance in different strains of pink bollworm, *Pectinophora gossypiella* (Saund.) to profenofos and its relationship of some biochemical aspects. Egypt. Acad. J. Biolog. Sci., 7(1): 141 – 152.

Sun, Y. P. (1950). Toxicity index an improved method of comparing the relative toxicity of insecticides. J. Econ. Entomol., 43, 45−53.

Yousif-Khalil, S.I.; S.A.A. Raslan; Ola, I. Hegab and Omnia S. Abd-Elsttar (2008). Efficiency of spinosad and runner against pink bollworm and predators' population on cotton fields. Zagazig J.Agric.Res., 35 (2): 407- 422.