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Dissipation Kinetics of Etoxazole 10 SC in/on Brinjal

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ABSTRACT

The persistence behavior of Etoxazole 10 SC in Brinjal was investigated at Chella, Birbhum, WB during two consecutive seasons, 2014-15 and 2015-16. Etoxazole was foliar sprayed in two doses viz. 350 ml/ha (recommended dose-T_1) and 700 ml/ha (double the recommended dose-T_2) along with untreated control (T_3). Fruit and soil samples were collected from plots at 0 (2 h), 1, 3, 5, 10, 15 and 20 days after spraying and blended using Polytron homogenizer separately. More than 50% of the initial deposit from brinjal fruit and soil dissipated within 3 days irrespective of any doses. The half-life of Etoxazole was found in the range of 2.22 to 2.48 days and 1.92 to 2.48 days in fruit and soil respectively. No residue of Etoxazole was detected in harvest fruit and soil. The present study clarified that application of Etoxazole will not have any residual toxicity at its recommended dose.

Keywords Pesticide, Dissipation, Half-life, Persistence, Egg plant.

INTRODUCTION

Brinjal (*Solanum melongena* L.) is an important, highly cosmopolitan and popular vegetable grown throughout the year in all parts of the country. In India, brinjal is grown over an area of 7.23 lakh hectare producing 12.345 m MT having productivity of 17.1 MT/ha (Indiastat 2020) with West Bengal accounting for 23.0% of total production of brinjal in the country. Among various limiting factors of successful brinjal production, the insect pests and mites are very important. As brinjal is grown in all season, it is subjected to attack by number of insect and non-insect pests' right from nursery stage till harvesting (Karmakar and Patra 2013). Mites are probably the most notorious ones causing devastating damage in the recent years. On vegetables alone spider mites damage accounts for 18-25% yield loss (Anonymous 2017). Out of the 37 mite species known to feed on vegetable crops, six

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species are serious pests of vegetable crops including brinjal in major part of the country (Gupta 2015). Low relative humidity favors mite multiplication (Dhooria and Bindra 2016). Different stages of mites are found in colonies by white silky webs in lower surface of the leaves. Nymphs and adults suck cell sap and white patches appear on leaves. Affected leaves becomes mottled, turn brown and fall. In severe infestation, this mite web profusely and may form a thick sheath of webbing that covers the entire plant canopy (Jeppson *et al.* 1975).

Etoxazole [(RS)-5-tert-butyl-l-[2-(2.6-difluorophenyl)-4, 5-dihydro-1, 3-oxazol-4-yl] phenetole] is an Oxazole acaricide belonging to the diphenyloxazoline group of chemicals. It is an IGR with contact activity against egg, larvae and nymph of mites. It has very little activity against adult but can exert ovicidal activity in adult mites. The eggs and the larvae are particularly sensitive to the product, which acts by inhibiting respiratory organ formation in the eggs and moulting in the larvae. Some analytical methods regarding the estimation of Etoxazole are recently reported. A high-performance Gas chromatography with mass system method was developed (Anonymous 2014) for the quantification of Etoxazole in plant system.

The degradation of pesticides in plant system is mainly dependent on plant metabolism and degradation in soil is dependent on various mechanism like microbial degradation, chemical hydrolysis, photo-degradation, volatility, leaching, surface runoff (Gupta *et al.* 2008). In this context, the present investigation was undertaken to determine the persistence behavior of Etoxazole in brinjal under field conditions during the period 2014-2015 and 2015-2016.

MATERIALS AND METHODS

In the present investigation, Etoxazole was applied @ 350 and 700 ml/ha. Each treatment was replicated thrice along with untreated control. Field trials were conducted at Chella Kamarpara G.P.- Chella, Mouza-Chella, P.O.- Daranda, Block- Illambazar, Birbhum, West Bengal to estimate the persistence of Etoxazole 10 SC in/on brinjal fruit and field soil during the *rabi* season of 2014-2015 and 2015-2016. To study the dissipation pattern in brinjal and field soil, the samples were collected from each treated plot as well as from the control plot at 0 (2 hr.), 1, 3, 5, 10, 15 and 20 days after the application of Etoxazole 10 SC as foliar spray by knapsack sprayer in two different doses viz. 350 ml/ha (recommended dose or T_1) and 700 ml/ha (double the recommended dose or T_2) along with untreated control (T_3).

The brinjal fruit samples and soil samples were blended using Polytron homogenizer separately. Five gram (5 g) of the homogenized sample was taken in a 50 ml centrifuge tube and 10 ml of water and 10 ml (Ethyl Acetate: Cyclohexane) mixture was added and subjected to vortex for 2 minute. After that adding 5 g of activated Na_2SO_4, the sample was again vortex for 3 minute. Then the sample was centrifuged for 15 min at 10,000 rpm and then 5 ml supernatant liquid was taken in 10 ml centrifuge tube. Afterwards, 25 mg florisil & 25 mg PSA was added to it and vortex for 2 min and the sample was again centrifuged for 10 min at 5000 rpm. Then, 3 ml supernatant liquid was collected from it and evaporated to dryness in N_2 – evaporator at 25°C. The residue was then reconstituted in 3 ml of Ethyl acetate. The sample was then filtered through 0.22 µ membrane filter and the final analysis was done in GC-MS on a capillary column (VF-5 MS, 30 m, 0.25 mm id, 0.25 µm film thickness; Varian, Middelburg, The Netherlands) with the following conditions: constant flow of Helium at 1.0 ml/min; initial inlet temperature 70°C ramped to 200°C at 150°C/min after a 15 s delay; injection volume, 9 µL (LVI) onto a Carbofrit plug in the liner with an open purge valve (40:1 split ratio) for 15 s, closed until 3.5 min, and open again (30:1) until the end of the run. The oven temperature program included initial temperature of 70°C (hold for 2 min), ramped to 200°C at 10°C/min (total run time: 15.0 min). The temperature of the transfer line, ion trap and manifold were set at 200°C, 230°C and 60°C, respectively. Quantification was done on the basis of diagnostic ion and the peak assignments and integration were automatically done through workstation toolbar software.

Recovery studies were carried out in order to establish the reliability of the analytical method and to know the efficiency of extraction and clean up steps employed for the present study by fortifying the brin-

Table 1. Dissipation of Etoxazole in brinjal fruits in 2014-2015 (Season I). BDL: Below detectable Limit.

Days after application	Treatment	Residues in ppm (µg g^{-1}) R_1	R_2	R_3	Mean ± SD	Dissipation (%)
0		0.86	0.79	0.84	0.83±0.029	-
1		0.56	0.51	0.47	0.51±0.036	38.55
3	T_1	0.34	0.35	0.29	0.32±0.026	61.44
5	(350 ml	0.16	0.19	0.15	0.16±0.016	80.72
10	ha^{-1})	0.04	0.05	0.03	0.04±0.008	95.18
15		BDL	BDL	BDL	-	-
0		1.75	1.91	1.86	1.84 ± 0.066	-
1		1.06	1.12	1.09	1.09 ± 0.024	40.76
3	T_2	0.71	0.65	0.72	0.69 ± 0.031	62.50
5	(700 ml	0.41	0.38	0.34	0.37 ± 0.028	79.89
10`	ha^{-1})	0.11	0.09	0.12	0.10 ± 0.012	94.56
15		BDL	BDL	BDL	-	

T_1: Y = -0.329x+2.8904 $T_{1/2}$ = 2.27 Days

T_2: Y = -0.1307x+3.2239 $T_{1/2}$ = 2.48 Days

Table. 2. Dissipation of Etoxazole in brinjal fruits in 2015-2016 (Season II). BDL: Below detectable limit.

Days after application	Treatment	Residues in ppm (µg g^{-1}) R_1	R_2	R_3	Mean ± SD	Dissipation (%)
0		0.86	0.79	0.84	0.83 ± 0.029	-
1		0.56	0.51	0.47	0.51 ± 0.036	38.55
3	T_1	0.34	0.35	0.29	0.32 ± 0.026	61.44
5	(350 ml	0.16	0.19	0.15	0.16 ± 0.016	80.72
10	ha^{-1})	0.04	0.05	0.03	0.04 ± 0.008	95.18
15		BDL	BDL	BDL	-	
0		1.75	1.91	1.86	1.84 ± 0.066	-
1		1.06	1.12	1.09	1.09 ± 0.024	40.76
3	T_2	0.71	0.65	0.72	0.69 ± 0.031	62.50
5	(700 ml	0.41	0.38	0.34	0.37 ± 0.028	79.89
10	ha^{-1})	0.11	0.09	0.12	0.10 ± 0.012	94.56
15		BDL	BDL	BDL	-	-

T_1: Y = -0.1354x+2.9309 $T_{1/2}$ = 2.22 Days

T_2: Y = -0.134x+3.268 $T_{1/2}$ = 2.25 Days

jal fruit and field soil samples with 0.01, 0.05 and 0.10 ppm of standard solution of Etoxazole. A linearity check study was carried out with the help of standard solution of Etoxazole. In this study a calibration curve was prepared by taking the areas corresponding to different concentrations of standard solution of Etoxazole. Also, to know the interference of each substrate, matrix match calibration standard for each substrate was prepared. In this study calibration curve was prepared by taking the areas corresponding to different concentrations of matrix match calibration standard, against which final quantification was done. The Limit of Detection (LOD) of the compound was 0.005 ppm and Limit of Quantification (LOQ) of Etoxazole for all the substrate was 0.01 ppm.

RESULTS AND DISCUSSION

From the results, it was found that the dissipation of Etoxazole follows first order kinetics in brinjal fruit and field soil. The regression equation and half-life values of Etoxazole in brinjal fruits are presented in Tables 1 and 2 respectively for the years 2014-2015 and 2015-2016. The residue declines progressively with time taking residues at 0 days as initial deposit. The initial deposits of Etoxazole in brinjal fruit after two hour of spray were found to be 0.83 and 1.84 µg g^{-1} corresponding to the T_1 and T_2 respectively. More than 50% of the initial deposit was dissipated within

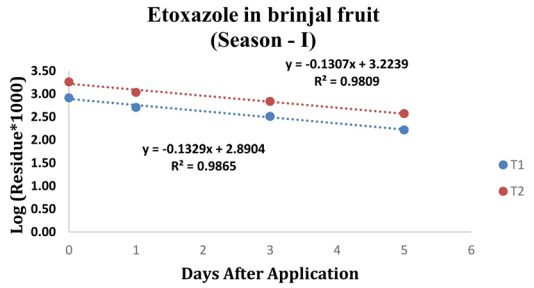

Fig. 1. Linear plot of dissipation of Etoxazole in brinjal fruit (Season - I).

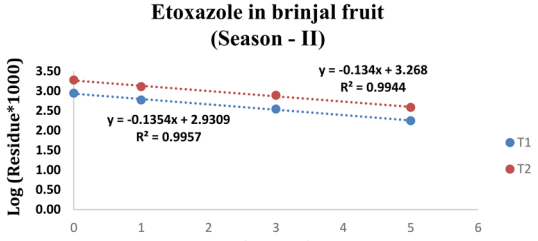

Fig. 2. Linear plot of dissipation of Etoxazole in brinjal fruit (Season - II).

Table 3. Dissipation of Etoxazole in brinjal field soil in 2014-2015 (Season I).

Days after application	Treatment	Residues in ppm (µg g^{-1}) R_1	R_2	R_3	Mean ± SD	Dissipation (%)
0		0.50	0.49	0.44	0.48±0.026	-
1		0.29	0.34	0.30	0.31±0.022	35.42
3	T_1	0.17	0.18	0.16	0.17±0.008	64.58
5	(350 ml	0.10	0.07	0.11	0.09±0.016	81.25
10	ha^{-1})	BDL	BDL	BDL	-	-
15		BDL	BDL	BDL	-	-
0		0.91	0.86	0.89	0.89±0.021	-
1		0.65	0.62	0.59	0.62±0.024	30.34
3	T_2	0.41	0.34	0.37	0.37±0.029	58.43
5	(700 ml	0.25	0.18	0.21	0.21±0.028	76.40
10	ha^{-1})	BDL	BDL	BDL	-	-
15		BDL	BDL	BDL	-	-

T_1: Y = -0.139x+2.6552, $T_{1/2}$ = 2.16 Days

T_2: Y = -0.1213x+2.9332, $T_{1/2}$ = 2.48 Days

Table 4. Dissipation of Etoxazole in brinjal field soil in 2015-2016 (Season II).

Days after application	Treatment	Residues in ppm (µg g^{-1}) R_1	R_2	R_3	Mean ± SD	Dissipation (%)
0		0.47	0.45	0.42	0.45 ± 5.63	-
1		0.30	0.32	0.27	0.30 ± 8.48	33.58
3	T_1	0.19	0.17	0.15	0.17 ± 11.76	61.94
5	(350 ml	0.08	0.07	0.06	0.07 ± 14.29	84.33
10	ha^{-1})	BDL	BDL	BDL	-	-
15		BDL	BDL	BDL	-	-
0		0.93	0.88	0.87	0.89 ± 3.60	-
1		0.64	0.61	0.58	0.61 ± 4.92	31.72
3	T_2	0.40	0.35	0.31	0.35 ± 12.76	60.45
5	(700 ml	0.20	0.17	0.15	0.17 ± 14.52	80.60
10	ha^{-1})	BDL	BDL	BDL	-	-
15		BDL	BDL	BDL	-	-

T_1: Y = -0.1563x+2.6512, $T_{1/2}$ = 1.92 Days

T_2: Y = -0.1392x+2.9441, $T_{1/2}$ = 2.16 Days

3 days irrespective of any doses. Saber *et al.* (2020) observed the half-life of Etoxazole was 2.8 days in strawberry and its most of the residues were dissipated after 14 days of application in strawberry field which are in accordance with the present study. The half-life values of Etoxazole in brinjal fruit were determined as 2.27 and 2.48 days for T_1 and T_2 respectively in first season and 2.22 and 2.25 days for T_1 and T_2 respectively in second season (Figs 1-2).

The regression equation and half-life values of Etoxazole in brinjal cropped soil during both the seasons are presented in Tables 3 and 4 respectively. The initial deposits of Etoxazole in brinjal cropped soil after two hour of spray were found to be 0.48 and 0.89 µg g^{-1} for T_1 and T_2 respectively for first season and 0.45 and 0.89 µg g^{-1} for T_1 and T_2 respectively for second season. More than 50% of the initial deposit was dissipated within 3 days irrespective of any doses. The half-life values of Etoxazole in brinjal cropped soil sample were determined as 2.16 and 2.48 days for T_1 and T_2 respectively in first season and 1.92 and 2.16 days for T_1 and T_2 respectively in season 2.

All the data regarding residues of Etoxazole in harvest brinjal fruit and cropped soil samples have been also calculated. Etoxazole concentration was found below detectable limit in all the harvest time samples of brinjal and field soil as well as in all control samples for both treatments. So, it may be concluded from the study that Etoxazole does not translocate in brinjal plant when applied at the recommended dose

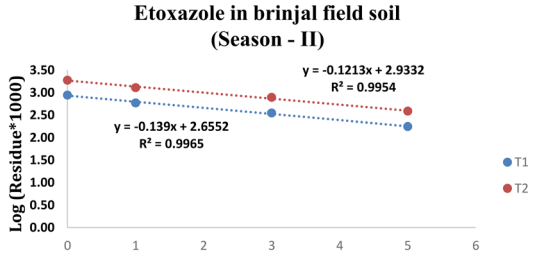

Fig. 3. Linear plot of dissipation of Etoxazole in brinjal field soil (Season - I). SSS

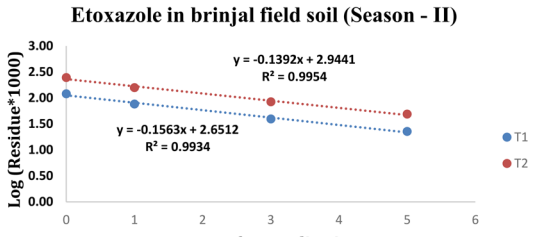

Fig. 4. Linear plot of dissipation of Etoxazole in brinjal field soil (Season - II).

and does not possess any residual toxicity problem (Figs 3-4).

CONCLUSION

Etoxazole is readily absorbed by the plant and translocate locally in the leaf. The persistence behaviour of Etoxazole in brinjal under field conditions during the 2 years of study showed no detectable limits of pesticide in fruit and soil. When applied in recommended doses Etoxazole 10 SC, rapidly dissipated and withered off from brinjal fruits and cropped soil after 10 days. Thus, it can be concluded to mention Etoxazole 10 SC @ 350 ml/ha to safely use for control of mites in brinjal.

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REFERENCES

Anonymous (2014) United States Environmental Protection Agency (US EPA), Washington DC, Environmental Chemistry Laboratory.

Anonymous (2017) Mites of agricultural importance in India and their management. Technical Bulletin No.1. All India Coordinated Research Project on Agricultural Acarology, UAS, Bangalore, pp 18.

Dhooria MS, Bindra OS (2016) Incidence of Tetranychus neocaledonicus Andre Tetranychus cinnabarinus (Boised) on different varieties of brinjal. *Agricult Res J* 14: 63-65.

Gupta S, Gajbhiye VT, Gupta RK (2008) Soil dissipation and leaching behavior of a neonicotinoid insecticide thiamethoxam. Bull Environm Contam Toxicol 80 (5) : 431-437.

Gupta SK (2015) The mites of agricultural importance in India with remark on their economic status In: (Eds. Dushabek F Bukva U (eds). Modern Acarology. Academic Press, Itague, pp 509-522.

Indiastat (2020) Area, Production and Productivity of Brinjal in India (1987-1988, 1991-1992 and 1993-1994 to 2019-2020- 3rd Advance Estimates). URL: https://www.indiastat.com/table/agriculture/area-production-productivity-brinjal-india-1987-19/14880, Accessed on 24/02/2021

Jeppson LR, Keifer HH, Baker EW (1975) Mites Injurious to Economic Plants. University of California Press, Barkeley, pp 614.

Karmakar K, Patra S (2013) Bio-Efficacy of New Acaricide Molecule, Etoxazole 10% Sc (W/W) Against Red Spider Mite, Tetranychus urticae Koch in Brinjal. Vegetos- *An Int J Pl Res.* 26 : 396. DOI: 10.5958/j.2229-4473.26.2.104.

Saber AN, Malhat F, Anagnostopoulos C, Kasiotis KM (2020) Evaluation of dissipation, unit–unit-variability and terminal residue of etoxazole residues in strawberries from two different parts in Egypt. *J Consumer Prot Food Safety* 1-8.