The Pharma Innovation Journal 2022; SP-11(6): 2157-2163

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(6): 2157-2163

www.thepharmajournal.com
Received: 18-04-2022
Accepted: 21-05-2022

Greeshma Suresh
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Kerala Agricultural University, Trivandrum, Kerala, India

Thomas George
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Kerala Agricultural University, Trivandrum, Kerala, India

Corresponding Author
Greeshma Suresh
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Kerala Agricultural University, Trivandrum, Kerala, India

Persistence of chlorantraniliprole in coastal alluvium soils of Kerala under different moisture regimes

Greeshma Suresh and Thomas George

Abstract
Chlorantraniliprole, an anthranilic diamide insecticide effective against several lepidopteran as well as coleopteran, dipteran, and hemipteran pests belongs to carboxamide group. This compound is reported to have very high efficacy as an insecticide and in general possess low mammalian toxicity. These basic properties along with a broad -spectrum insecticidal action renders it to be the one of the most frequently used new generation insecticide against lepidopteran pests. Though Chlorantraniliprole, with a medium toxicity profile has proven efficacy in the field, the environmental impact of the insecticide needs to be studied in detail. The study focused on persistence of chlorantraniliprole in coastal alluvium soil of Kerala under two different moisture conditions *viz.* field capacity (M1) and flooded (M2) conditions in the laboratory at three different concentration levels, *viz.* C1(1 mg kg^{-1}), C2(2 mg kg^{-1}), C3 (4 mg kg^{-1}). The calculated half-life for coastal alluvium soil were 13.84 days (T1), 17.10 days (T2), 23.88 days (T3) under field capacity and 9.18 days (T4), 10.72 days (T5) and 13.35 days (T6) under flooded condition respectively. Data revealed that, half-life was lower under flooded condition than field capacity condition. The increased level of application had prominent effect on half-life and increased correspondingly. The data revealed that the mean residue content of chlorantraniliprole in soil considerably decreased with time and reached BQL within 75th day after the application for both the soil conditions.

Keywords: Chlorantraniliprole, persistence, coastal alluvium soil, laterite soil

1. Introduction
Chlorantraniliprole is an insecticide widely used for pest control and its environmental fate under different climatic conditions, soil types and moisture levels needs to be understood in detail. Soil Persistence of any chemical is the length of time it remains in soil without losing the molecular integrity, physical, chemical and biological characteristics through which it is transported and distributed [1]. The half-life is used to evaluate the persistence and it's the time taken for degrading half of the amount present. Pesticide degradation is influenced by several soil properties *viz.*, pH, clay content and organic carbon (OC) content in addition to environmental factors like soil temperature and moisture content [2]. When the organic matter content is higher, and the parent molecules may be bound to the soil more strongly than low organic matter soils. Similar studies were reported under high organic matter conditions [3, 4]. The presence of higher clay content is very important factor which influence the higher half-lives when compared to soils low on clay or sandy in nature [5, 6, 7].
Persistence study of chlorantraniliprole was carried out under laboratory conditions in order to understand the dissipation pattern of chlorantraniliprole in coastal alluvium soil. This was characterized by comparing the half-life of chlorantraniliprole under two different moisture conditions (Field capacity and flooded condition) for the soil by spiking varying levels of chlorantraniliprole into soil. The persistence pattern and half- life varies with organic matter content, soil, soil pH, climate and precipitation, dosage etc. [2, 8, 9]. Persistence of insecticides varies with environmental conditions like open field, green house and laboratory conditions [10, 11, 12] and the frequency of application and dosage as well [13, 14]. The presence of moisture increases the degradation and dissipation of the parent compound chlorantraniliprole [15]. The transformation and metabolite products are present for chlorantraniliprole, but studies show a higher degradation and lower persistence in soil than parent compound [16].

2. Materials and Methods
2.1 Method validation
The method of extraction, clean up and estimation of residues of chlorantraniliprole and the

metabolites in soil and water were standardized using LC-MS/MS. This was performed by conducting recovery experiments with soil and water by spiking at 0.05, 0.1, 0.5 and 1 ppm levels of standard chlorantraniliprole, each replicated 5 times, from which the most ideal method will be selected based on the recovery percentage of chlorantraniliprole and other validation parameters like linearity, RSD etc.

The analytical method used for estimation of chlorantraniliprole in coastal alluvium soil and water were validated by calculating and assessing various performance parameters such as analyte recoveries, limit of detection (LOD), limit of quantification (LOQ), linearity, accuracy, precision, repeatability and reproducibility.

2.2 Procurement of Certified Reference Material (CRM)
The CRM of chlorantraniliprole were procured from M/S. Dr. Ehrenstorfer, and required quantity of the standard were weighed to prepare the analytical standard solution of known concentrations.

2.3 Preparation of Standard Solution and working standards
Standard stock solution of chlorantraniliprole (1000 mg) were prepared in methanol and stored at -20℃ in deep freezer. Required quantities of the standards were accurately weighed to prepare 250 mL of the analytical standard solutions of 400 ppm concentration.

Intermediate standards of 100 mg kg^{-1} of chlorantraniliprole were prepared by diluting the required quantity of stock solution with methanol. The aliquots of intermediate standards were taken in separate standard flasks in order to prepare working standards of 10 mg kg^{-1} of the chlorantraniliprole. From this, working standard serial dilution was done to obtain 1, 0.5, 0.25, 0.1, 0.05, 0.025 and 0.01 mg kg^{-1} concentrations of the compound. The individual standards of the insecticide were injected in Liquid Chromatography - Mass Spectrometer and a calibration curve was prepared by plotting concentration *vs*. peak area.

2.4 Recovery Experiment
A recovery experiment was conducted to standardize the procedure for extraction and clean up processes. The experiment was conducted by adding a known quantity of insecticide mixture to soil and water trying the extraction process using different solvent systems. All the chemicals and solvents used in the research were analytical grade or HPLC grade.

2.5 Extraction procedure for residues in soil
The soil samples were extracted using acetonitrile and efficiency of the extractions were assessed. Qu ECHERS method was adopted for acetonitrile extraction of spiked pesticides from soil. For this purpose, 10 g of dried sieved (2 mm) soil was weighed in a 50 ml centrifuge tube and spiked with the standard insecticide and evaporated to release the solvent vapors.

The soil samples were spiked with 0.01, 0.05, 0.10, 0.50 and 1.00 mL each of 10 mg kg^{-1} solution to get 0.01, 0.05, 0.10, 0.50 and 1.00 mg levels of each of the spiked compounds. To this, 4 g magnesium sulphate, followed by l g sodium chloride (NaCl) and 20 ml acetonitrile were added, shaken for 2 minutes in a vortex shaker and was centrifuged for 4 minutes at 3300 rpm. A 10 ml supernatant was transferred to a 15 ml centrifuge tube using a micro pipette and 0.25 g primary secondary amine (PSA) and 1.5 g magnesium sulphate ($MgSO_4$) were added and was shaken for 30 seconds in vortex followed by centrifugation at 4400 pm for 10 minutes. After the centrifugation, 4 mL of the cleaned supernatant extract was transferred to a turbo tube and evaporated to dryness at 50 °C using turbo Vap. The dry residue was redissolved in methanol and the volume was made upto 1mL, filtered through 0.22 um poly vinylidene fluoride (PVDF) syringe filter and passed to a vial which was wrapped with parafilm to avoid evaporation.

2.6 Estimation using LC-MS/MS
The cleaned extracts were analyzed on Thermo Scientific TSQ Quantiva LC-MS/MS (Dionex Ultimate 3000 UHPLC). The samples as well as standards were injected into the equipment. The Thermo Scientific Dionex Ultimate 3000 UHPLC system was used for chromatographic separation of chlorantraniliprole using column Accucore aQ C_{18} (100 × 2.1, 2.6 micron particle size) placed in a column temperature at 30 ^oC. Elution was done using two elutents (solvent mixtures), *viz.*, A: 0.10 per cent formic acid + 5 mM ammonium formate in water B: 0.10 per cent formic acid + 5 mM ammonium formate in methanol The flow rate was maintained at 0.30 mL min^{-1} and 10 minutes run time.

Then the effluent from LC was introduced into Thermo Scientific TSQ Quantiva mass spectrometer. The source parameters were- Ion source type is H-ESI (Heated electrospray ionization), Sheath gas, 60.00 (Arbitrary units), Aux gas, 60.00 (Arbitrary units) and Sweep gas, 1.00 (Arbitrary units) with ion transfer tube temperature, 320^{o}C and ion spray voltage source of 3800 V (positive ion) and 2900V (negative ion). The vaporization temperature is 450^{0}C. The residues were quantified in MS/MS system. The compound dependent parameters used are shown in Table 1.

Table 1: Mass parameters for chlorantraniliprole

Parameters		Particulars of Chlorantraniliprole
Retention time(min)		6.74
Polaritty		Positive
Precursor (m/z)	Qualitative	484.035
	Quantitative	484.035
Product (m/z)	Qualitative	285.889
	Quantitative	452.926
Collision energy (V)	Qualitative	17.1
	Quantitative	19.6

2.7 Experimental details
Studies on the persistence of chlorantraniliprole in coastal alluvial soil of Kerala was done using Coragen 18.5 SC formulation at three levels (1, 2 and 4 mg kg:') in the laboratory condition along with control. The commercial formulation of chlorantraniliprole Coragen 18.5w/w SC manufactured by FMC India Pvt Ltd. was purchased from local market. For conducting the laboratory study, one kg soils each were brought to field capacity level and flooded level by adding measured quantity of distilled water in the conical flask and spiked separately at 1, 2 and 4 mg kg^{-1} levels of Chlorantraniliprole using the two formulations, homogenized and kept aside for 2 hours (0^{th} day). A 10 g soil was taken from the conical flask in triplicate and analyzed for the residue estimation. Likewise samples were drawn on 0^{th} , 1^{st} , 3^{rd}, 5^{th} , 7^{th} , 10^{th} , 14^{th} , 21^{st} , 28^{th} , 35^{th} , 40^{th} , 50^{th} and 75^{th} day for analysis of residues and to identify the

metabolites formed. The levels of Chlorantraniliprole persisting at different time intervals were recorded from which half- life value was calculated. The treatment details are given below:

2.7.1 Treatments

T1- Fortification with 1 mg kg^{-1} Chlorantraniliprole formulation in coastal alluvium soil at field capacity
T2- Fortification with 2 mg kg^{-1} Chlorantraniliprole formulation in coastal alluvium soil at field capacity
T3- Fortification with 4 mg kg^{-1} Chlorantraniliprole formulation in coastal alluvium soil at field capacity
T4- Fortification with 1 mg kg^{-1} Chlorantraniliprole formulation in coastal alluvium soil at Flooded condition
T5- Fortification with 2 mg kg^{-1} Chlorantraniliprole formulation in coastal alluvium soil at Flooded condition
T6- Fortification with 4 mg kg^{-1} Chlorantraniliprole formulation in coastal alluvium soil at Flooded condition

2.7.2 Calculation of Half Life Period

The pesticide residues in general decrease logarithmically with time, and the amount lost per unit time should be proportional to the total present at any time since they were exposed equally to weathering and degradation (Hoskins 1981). A graph should be plotted with time (1) against log of residue parameters (log D), D' indicating residue in ppm. The graph shows a linear trend which indicates that log D can be represented as a linear function of t (in days or weeks). The model is,

$D = k_1E + \log k_2$, that means $D = k_2$ where k_2 represent initial deposits. The time required to reduce D to D/2 is defined as half -life so it is calculated as $t_{1/2} = \log 2/k_1$

3. Results

The persistence of chlorantraniliprole in coastal alluvium soil was studied at three different levels of chlorantraniliprole *viz.*, 1, 2 and 4 mg kg^{-1} at two different soil moisture conditions *viz.* field capacity level and flooded condition. The half-life of the compounds at different treatment levels and soil moisture conditions were also found out after quantifying the residue level in the soil on the 0^{th}, 1^{st}, 3^{rd}, 5^{th}, 7^{th}, 10^{th}, 14^{th}, 21^{st} 28^{t}, 35^{th}, 40^{th}, 50^{th} and 75^{th} day. The results obtained after residue analysis are given in the Tables 4 and 5. Table 3 denotes the general soil parameters of coastal alluvium soil under study using standard analytical procedures.

3.1 Recovery Experiments

The results obtained after method validation in coastal alluvium soil is given in Table 2. It is evident from the data that the recovery percentage of chlorantraniliprole obtained for the soil was within the satisfactory range (70-120%) and the RSD values obtained were also in the satisfactory range (< 20%) for the different levels. Hence, the method was found to be suitable at 0.01, 0.05, 0.1, 0.5 and 1 mg kg^{-1} levels for residue determination in soil.

Table 2: Recovery of chlorantraniliprole at different fortification levels

Level of Fortification (mg kg^{-1})	Coastal Alluvium (S2)	
	Mean Recovery (%)	RSD
0.01	84.91	2.88
0.05	85.35	3.09
0.10	94.37	1.85
0.50	93.88	3.48
1.00	95.57	1.92

* Mean of five replications each

3.2 Persistence of chlorantraniliprole in coastal alluvium soil (S1)

The persistence study of chlorantraniliprole in coastal alluvium soil under two different soil conditions are presented in Table 4 and 5. The coastal alluvium soil was maintained under two different moisture conditions *i.e.*, field capacity and flooded soil, which were fortified with *i.e.*, 1 mg kg^{-1}, 2 mg kg^{-1}, 4 mg kg^{-1} of chlorantraniliprole. The data revealed that the mean residue content of chlorantraniliprole in coastal alluvium soils decreased considerably with time and reached BQL within 75^{th} day after application for both the soil conditions.

3.2.1 Dissipation and half-life of chlorantraniliprole under field capacity (M1)

Persistence data on chlorantraniliprole residues in coastal alluvium soil under field capacity revealed that the calculated half-life increased with the increase in level of concentration applied (Table 4). Coastal alluvium soil which was subjected to 1 mg kg^{-1} had lower period of half-life while a higher half-life period was obtained for higher concentration level *i.e.*, 4 mg kg^{-1} of fortification of chlorantraniliprole under field capacity.

The calculated half-life were 13.84 days (T1), 17.10 days (T2) and 23.88 days (T3) for treatments fortified with 1 mg kg^{-1}, 2 mg kg^{-1}, 4 mg kg^{-1} respectively. The amounts of residues on the 0^{th} day of application of chlorantraniliprole in field capacity condition at the rate of 1 mg kg^{-1} was 0.989 mg kg^{-1} and finally reduced to an amount of 0.063 mg kg^{-1} on 50^{th} day. (T1). At an application rate of 2 mg kg^{-1} in soil, the initial residue content was 1.778 mg kg^{-1} which was reduced further to 0.167 mg kg^{-1} (T2) and treatment with higher level, *i.e.*, 4 mg kg^{-1} in soil, the initial residue content was 2.697 mg kg^{-1} which was reduced further to 0.537 mg kg^{-1}(T3) at the 50th day of observation taken. The residue level of chlorantraniliprole under field capacity for coastal alluvium reached BQL by 75^{th} day after application for T1, T2 and T3.

3.2.2 Dissipation and half-life of chlorantraniliprole under flooded condition (M2)

Under flooded condition, the half- life of chlorantraniliprole increased with the increase in level of concentration applied as in case of field capacity condition (Table 5). But the half-life periods were found to be relatively lower in the flooded soil, fortified with same levels of treatment *i.e.*, 1 mg kg^{-1}, 2 mg kg^{-1} and 4 mg kg^{-1}. The calculated half-life were 9.18 days (T4), 10.72 days (T5) and 13.35 days (T6) for treatments fortified with 1 mg kg^{-1}, 2 mg kg^{-1}, 4 mg kg^{-1} respectively.

The application of chlorantraniliprole at the rate of 1 mg kg^{-1}, resulted in initial residue of 0.565 mg kg^{-1} which was finally reduced to an amount of 0.011 mg kg^{-1} on 50^{th} day (T4). At an application rate of 2 mg kg^{-1} in soil, the initial residue content was 0.973 mg kg^{-1} which was reduced further to 0.086 mg kg^{-1} (T5) whereas on treatment with higher level, *i.e.*, 4 mg kg^{-1} in soil, the initial residue content 1.662 mg kg^{-1} was reduced further to 0.245 mg kg^{-1} (T6) at the 50th day of observation taken. Treatments T4, T5, T6 reached BQL by 75^{th} day after application.

3.3 Metabolites of Chlorantraniliprole in Laboratory Condition

The data on the metabolites of chlorantraniliprole under laboratory condition revealed that no major metabolites were detected in the soil other than the parent compound chlorantraniliprole in all the treatments under field capacity and flooded condition.

3.4 Comparison of Half- life Values of Chlorantraniliprole as Influenced by the Treatment Levels, and Soil Conditions

The half-life of chlorantraniliprole at different concentrations (treatments) and soil conditions were analyzed and the results showed that the two soil conditions i.e., field capacity and flooded condition significantly influenced the half-life of the chemical compound. The higher half-life was determined for treatments under field capacity condition. Similarly, dissipation of chlorantraniliprole was found to occur at a faster rate under saturated condition than under field capacity coastal alluvium soils. On comparing the treatments, all treatments were found to be significantly different from each other.

Table 3: Physical and chemical properties of the soil

Soil Parameters	Coastal Alluvium Soil (S1)
Texture	Loamy sand
Sand	62.4%
Silt	23.2%
Clay	14.4%
Bulk Density (BD)	1.36 Mg m^{-3}
Particle density (PD)	2.57 Mg m^{-3}
Porosity	48.01%
Field Moisture	12.75%
Water Holding Capacity (WHC)	14.64%
pH	5.2 (Strongly acid)
Electrical Conductivity (EC)	0.28
Cation Exchange Capacity (CEC)	5.18
Organic Carbon (OC)	1.07%
Organic Matter	1.84%
Available Nitrogen (kg ha^{-1})	338.69
Available Phosphorus (kg ha^{-1})	14.48
Available Potassium (kg ha^{-1})	121
Available Calcium (ppm)	230
Available Magnesium (ppm)	132
Available Sulphur (ppm)	98

Table 4: Dissipation of Chlorantraniliprole in Coastal alluvium soil (S1) -Field capacity

Treatment/ Day	S1M1CI (T1)	Dissipation rate (%)	S1M1C2 (T8)	Dissipation rate (%)	S1MIC3 (T9)	Dissipation rate (%)
0^{TH}	0.989 ± 0.02	-	1.778 ± 0.02	-	2.697 ± 0.01	-
1^{ST}	0.967 ± 0.01	2.22	1.628 ± 0.02	8.44	2.573 ± 0.02	4.60
3^{RD}	0.914 ± 0.03	7.58	1.585 ± 0.01	10.85	2.166 ± 0.02	19.69
5^{TH}	0.859 ± 0.01	13.14	1.419 ± 0.02	20.19	1.928 ± 0.04	28.51
7^{TH}	0.757 ± 0.02	23.46	1.393 ± 0.02	21.65	1.863 ± 0.02	30.92
10^{TH}	0.696 ± 0.03	29.63	1.234 ± 0.04	30.60	1.736 ± 0.02	35.63
14^{TH}	0.610 ± 0.02	38.32	1.100 ± 0.01`	38.13	1.572 ± 0.01	41.71
21^{ST}	0.474 ± 0.01	52.07	0.944 ± 0.02	46.91	1.378 ± 0.02	48.91
28^{TH}	0.375 ± 0.01	62.08	0.833 ± 0.02	53.15	1.173 ± 0.02	56.51
35^{TH}	0.277 ± 0.02	71.99	0.572 ± 0.02	67.83	0.973 ± 0.01	63.92
40^{TH}	0.156 ± 0.01	84.23	0.379 ± 0.01	78.68	0.837 ± 0.04	68.97
50^{TH}	0.063 ± 0.01	93.63	0.167 ± 0.03	90.61	0.537 ± 0.01	80.83
75^{TH}	BQL	100.00	BQL	100.00	BQL	100.00
T ½ (Half-Life)	13.84		17.10		23.88	

***S1- Coastal Alluvium soil; M1- Field capacity; C1-1 mg kg^{-1}; C2-2 mg kg^{-1}; C3- 4mg kg^{-1}; BQL- Below Quantifiable Level

Table 5: Dissipation of Chlorantraniliprole in Coastal alluvium soil (S1) –Flooded

Day/Treatment	S1M2C1 (T10)	Dissipation (%)	S1M2C2 (T11)	Dissipation (%)	S1M2C3 (T12)	Dissipation (%)
0TH	0.565 ± 0.01	-	0.973 ± 0.02	-	1.662 ± 0.02	-
1ST	0.517 ± 0.04	8.50	0.880 ± 0.01	9.56	1.585 ± 0.03	4.63
3RD	0.497 ± 0.01	12.04	0.812 ± 0.02	16.55	1.436 ± 0.02	13.60
5TH	0.465 ± 0.02	17.70	0.756 ± 0.01	22.30	1.307 ± 0.01	21.36
7TH	0.399 ± 0.02	29.38	0.699 ± 0.02	28.16	1.248 ± 0.01	24.91
10TH	0.330 ± 0.02	41.59	0.567 ± 0.02	41.73	1.128 ± 0.01	32.13
14TH	0.288 ± 0.01	49.03	0.466 ± 0.01	52.11	0.938 ± 0.02	43.56
21ST	0.235 ± 0.02	58.41	0.402 ± 0.01	58.68	0.812 ± 0.01	51.14
28TH	0.177 ± 0.01	68.67	0.342 ± 0.01	64.85	0.738 ± 0.03	55.60
35TH	0.062 ± 0.01	89.03	0.274 ± 0.03	71.84	0.582 ± 0.01	64.98
40TH	0.028 ± 0.01	95.04	0.184 ± 0.01	81.09	0.366 ±0.03	77.98
50TH	0.011 ± 0.01	98.05	0.086 ± 0.02	91.16	0.245 ± 0.02	85.26
75TH	BQL	100.00	BQL	100.00	BQL	100.00
T ½ (Half-Life)	9.18		10.72		13.35	

***S1- Coastal Alluvium soil; M2- Flooded condition; C1-1 mg kg^{-1}; C2-2 mg kg^{-1}; C3- 4mg kg^{-1}; BQL- Below Quantifiable Level

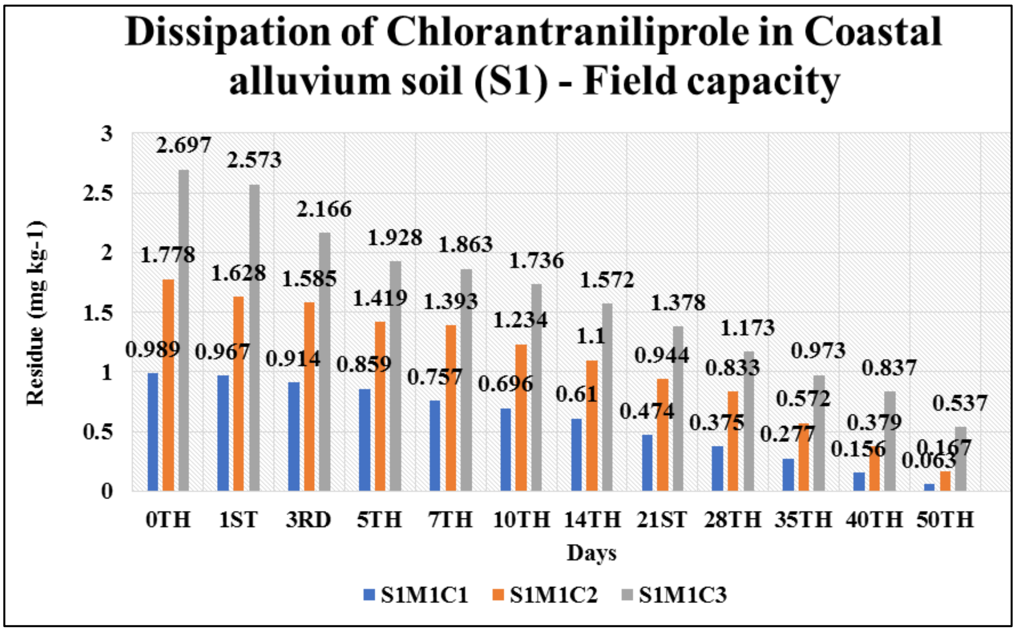

Fig 1: Dissipation model of chlorantraniliprole –Coastal Alluvium Soil under Field capacity

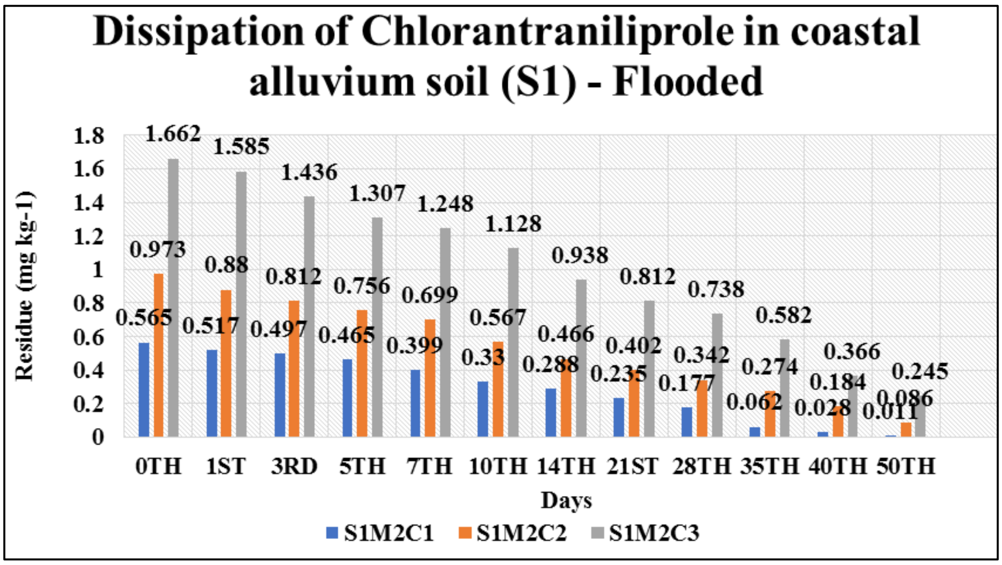

Fig 2: Dissipation model of chlorantraniliprole –Coastal Alluvium Soil under Flooded condition

4. Discussion

Soil physico-chemical properties influence the degradation and dissipation characteristics of the applied compound along with the environmental factors [1, 9]. The dissipation of chlorantraniliprole in coastal alluvium soil at three different levels of application rate at field capacity and flooded condition is presented in Fig 1 and Fig 2 respectively. The results revealed that, in all the treatments the half- life was increased with increase in spiked concentration of chlorantraniliprole. Several studies supported the fact that increased dosage or frequency increased the half-life as well [2]. Several studies stated the influence of organic matter content in pesticide degradation [2, 17]. For the same reason, chlorantraniliprole degradation occurred at a lower rate in coastal alluvium soils. The organic matter content was comparatively higher, and the parent molecules may be bound to the soil strongly. Similar studies were reported under high organic matter conditions [3, 4].

Similarly in a study, a higher half- life of fipronil was obtained in organic matter rich soils than in sandy loam soils [18]. Hence the calculated half- life of chlorantraniliprole were significantly different and higher than the treatments for respective concentrations and moisture conditions (T1 < T4; T2 < T5; T3 < T6) as shown in Fig 3.

Soil texture also played an important role in dissipation of chlorantraniliprole. Coastal alluvium had higher clay content in it. The presence of higher clay content might be one of the reason that coastal alluvium soils had higher half-lives when compared to red loam and laterite soil with sandy loam nature [5, 6, 7].

The impact of soil moisture was also prominent in the studies. The degradation and dissipation of chlorantraniliprole in flooded condition occurred at a higher rate than at field capacity. This faster dissipation might have occurred flooded soil condition due to the anaerobic condition [11]. Similar, findings were also observed [19, 20, 21, 22] where the effect of moisture was prominent and longer persistence was observed under air dry and field capacity moisture than under submerged condition. Pendimethalin also dissipated faster under submerged condition [23], also studies reported faster dissipation of cyfluthrin under anaerobic soil conditions [3] and chlorpyriphos was reported to have faster degradation in flooded condition [24].

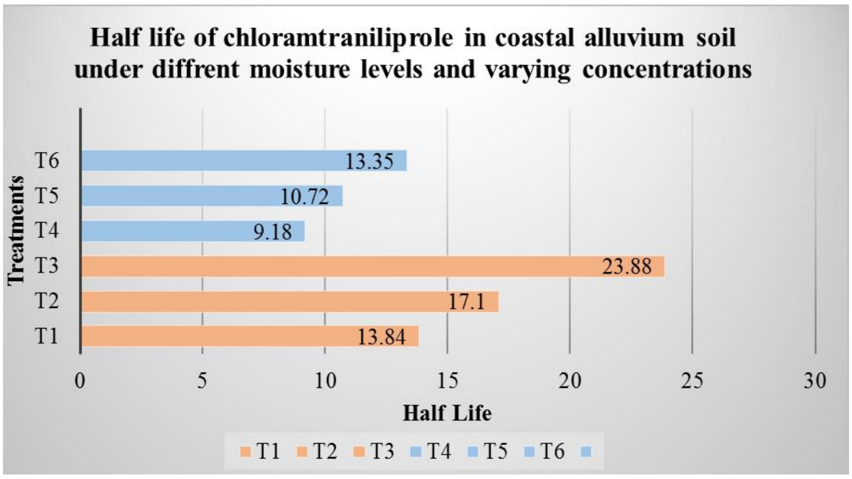

Fig 3: Half-life of chlorantraniliprole for coastal alluvium soil at different moisture conditions

Analysis of the data on dissipation of chlorantraniliprole showed that the soil moisture regimes do have an influence on the persistence in soil. Amount of soil organic matter and clay content also influence dissipation of chlorantraniliprole in soil, due to which calculated half-life were higher for coastal alluvium soils. The level of dosage also influences half -life of chlorantraniliprole in coastal alluvium soil under field capacity (T1<T2<T3) as well as flooded condition (T4<T5<T6).

5. Conclusion

The persistence of chlorantraniliprole under laboratory condition was assessed to understand impact of soil moisture and level of chlorantraniliprole concentration on persistence in coastal alluvium soil. The calculated half-life were 13.84 days (T1), 17.10 days (T2), 23.88 days (T3) under field capacity and 9.18 days (T4), 10.72 days (T5) and 13.35 days (T6) under flooded condition respectively for coastal alluvium soil. The research data revealed that the effect of soil moisture, level of concentration, soil type, soil texture *etc* had significant impact in the persistence in soil. The presence clay and higher organic matter in coastal alluvium soils were responsible for the higher persistence and higher half-life. The soil had faster dissipation and low value for calculated half-life under flooded condition than field capacity level because of higher degradation and microbial activity under flooded and anerobic condition.

6. Acknowledgement

The authors wish to express their sincere gratitude for the facilities availed from the Pesticide Residue Research and Analytical Laboratory, Kerala Agricultural University, all faculty members of the Department of Soil Science and Agricultural Chemistry, and The Dean, College of Agriculture, Vellayani, Thiruvanathapuram for the smooth conduct the research.

7. References

1. Navarro S, Vela N, Navarro G. An overview on the environmental behaviour of pesticide residues in. soils. Spanish J Agric. Res. 2007;5(3):357-375.
2. Kah M, Beulke S, Brown CD. Factors influencing degradation of pesticides in soil. J Agric. Food Chem. 2007;55(11):4487-4492.
3. Smith JS, Willis GH, Cooper CM. Cyfluthrin persistence in soil as affected by moisture, organic matter and redox potential. Bull. Environ. Contamination Toxicol. 1995;55(3):142-148.
4. Suyal A, Srivastava A, Srivastava PC. Influence of organic amendments on dissipation kinetics of two different pesticides in soil: A case study. Commun. Soil Sci. Plant Anal. 2018;49(14):1750-1760.
5. Dhanya MS. Persistence and transformation of carbosulfan in laterite and coastal alluvium soils of Kerala and its effect on soil organisms. M. Sc. (Ag.)

thesis, Kerala Agricultural University, Thrissur, 2016, 70p.
6. Sahu M, Adak T, Patil NB, Gowda GB, Yadav MK, Annamalai M. Dissipation of chlorantraniliprole in contrasting soils and its effect on soil microbes and enzymes. Ecotoxicology and Environmental Safety. 2019;180:288-294.
7. Spomer NA, Kamble ST, Coffelt MA, Scherer CW. Movement of chlorantraniliprole and indoxacarb termiticides in sandy loam and silty clay loam soil columns used against subterranean termites (Isoptera: Rhinotermitidae). Sociobiology. 2011;57(1):201-214.
8. Garrido I, Vela N, Fenoll J, Navarro G, Perez-Lucas G, Navarro S. Testing of leachability and persistence of sixteen pesticides in three agricultural soils of a semiarid Mediterranean region. Spanish J Agric. Res. 2015;81(4):324-336
9. Gavrilescu M. Fate of pesticides in the environment and its bioremediation. Eng. Life Sci. 2005;5(6):497-526.
10. Mariappan P, Kaithamalai B. Dissipation kinetics, decontamination and risk assessment of chlorantraniliprole in okra and soil under open field condition using GC-MS. International Journal of Environmental Analytical Chemistry, 2020, 1-13.
11. Pandey N, Rana D, Chandrakar G, Gowda GB, Patil NB, Annamalai M. Role of climate change variables (standing water and rainfall) on dissipation of chlorantraniliprole from a simulated rice ecosystem. Ecotoxicology and Environmental Safety. 2020;205:111324.
12. Ramasubramanian T, Paramasivam M, Jayanthi R, Nirmala R. Persistence and dissipation kinetics of chlorantraniliprole 0.4 G in the soil of tropical sugarcane ecosystem. Environ. Monitoring Assess. 2016;188(1): 33-39.
13. Neethipudi J, Vodur A, Kosnam K, Boinala A, Chennam KP. Persistence of tetraniliprole 480 fs seed treatment in maize and soil in Telangana. Pesticide Res. J. 2020;32(2):270-276.
14. Wu M, Li G, Chen X, Liu J, Liu M, Jiang C. Rational dose of insecticide chlorantraniliprole displays a transient impact on the microbial metabolic functions and bacterial community in a silty-loam paddy soil. Science of the Total Environment. 2018;616:236-244.
15. Redman ZC, Anastasio C, Tjeerdema RS. Quantum yield for the aqueous photochemical degradation of chlorantraniliprole and simulation of its environmental fate in a model california rice field. Environmental Toxicology and Chemistry. 2020;39(10):1929-1935.
16. Wu M, Li G, Li P, Jiang N, Wei S, Petropoulos E. Assessing the ecological risk of pesticides should not ignore the impact of their transformation byproducts–The case of chlorantraniliprole. Journal of Hazardous Materials. 2021;418:126270.
17. Redman ZC, Parikh SJ, Hengel MJ, Tjeerdema RS. Influence of flooding, salinization, and soil properties on degradation of chlorantraniliprole in California rice field soils. Journal of agricultural and food chemistry. 2019;67(29):8130-8137.
18. Mohapatra S, Ahuja AK, Deepa M. Effect of temperature on the degradation of fipronil in soil. Pesticide Res. J. 2010;22(2):120-124.
19. Gupta L, Keith L, Konkana RS. The persistence of thiomethoxam, the neonicotinoid insecticide under different soil conditions. Chemosphere. 2008;4:25-28.
20. Kumar N, Gupta S. Persistence and degradation of cyantraniliprole in soil under the influence of varying light sources, temperatures, moisture regimes and carbon dioxide levels. J. Environ. Sci. Health. 2020;55(10):1-9.
21. Miles JRW, Harris CR, Tu CM. Influence of moisture on the persistence of chlorpyrifos and chlorfenvinphos in sterile and natural mineral and organic soils. J. Environ. Sci. Health Part B. 1984;19(2):237-243.
22. Sarkar MA, Roy S, Kole RK, Chowdhury A. Persistence and metabolism of imidacloprid in different soils of West Bengal. Pest Manag. Sci. 2001;57:598-602.
23. Kulshrestha G, Singh SB. Influence of soil moisture and microbial activity on pendimethalin degradation. Bull. Environ. Contamination Toxicol. 1992;48:269-274.
24. George T, Naseema BS, Priya G. Persistence of chlorpyrifos in acid soils. Pesticide Res. J. 2007;19(1):113-115.