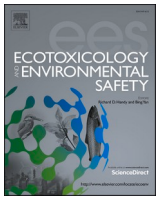
Ecotoxicology and Environmental Safety 205 (2020) 111324

Contents lists available at ScienceDirect

Ecotoxicology and Environmental Safety

journal homepage: www.elsevier.com/locate/ecoenv



Role of climate change variables (standing water and rainfall) on dissipation of chlorantraniliprole from a simulated rice ecosystem

Niyati Pandey [a,b], Dhanendra Rana [b], Gajendra Chandrakar [b], G. Basana Gowda [a], Naveenkumar B. Patil [a], Guru P. Pandi G [a], M. Annamalai [a], Somnath S. Pokhare [a], P.C. Rath [a], Totan Adak [a,*]

[a] Crop Protection Division, ICAR- National Rice Research Institute, Cuttack, 753006, Odisha, India
[b] Entomology Department, Indira Gandhi Krishi Vishwavidhyalaya, Raipur, 492012, Chhattisgarh, India

ARTICLE INFO

Keywords:
Leaching
Dissipation
Half-life
First-order kinetics
Lysimeter

ABSTRACT

Chlorantraniliprole (CAP) is extensively used for rice pest management. Lack of information on the role of standing water and amount and timing of rainfall on CAP dissipation in rice ecosystem could hamper its prospective use. Present study was performed to investigate the effects of different water regimes (saturated, 5 and 10 cm standing water) and simulated rainfall (40 and 100 mm occurred at 4, 8 and 24 h after CAP application) on leaching, surface runoff and dissipation of CAP into components of rice ecosystem. The results showed highest concentration of CAP residues in soil and plant under saturated condition followed by 5 and 10 cm standing water conditions. Whereas, the highest concentration of CAP in leachates was detected under 10 cm standing water (12.19 ng mL^{-1}). The results revealed large amount of leaching (21.99 ng mL^{-1}) and surface runoff (42.25 ng mL^{-1}) losses of CAP when 100 mm rainfall occurred at 4 h after pesticide application. The total quantity of CAP residues in soil and plant was highest when rainfall occurred at 24 h after pesticide application under both the rainfall amounts. Water stagnation and high intensity rainfall occurred shortly after pesticide application will contribute to pesticide loss to non-target sites through surface run-off and leaching. There will be less pesticide available in soil for plant uptake which may not be sufficient to kill the target organisms.

1. Introduction

Scientific evidences prove that climate change is happening and it is unequivocal. The consequences of climate change can be noticed in different components of environment. For example, increased erraticism in rainfall and gradual increase in temperature will interrupt crucial ecosystem processes (IPCC, 2018). Future food security and sustainability are in crossroads due to climate variability which leads to uncertainties in agricultural production system. Pesticides play imperative role in agriculture to enhance the quantity and quality of produce. Changing climate will also have an impact on the pesticides, their effective functioning on the targeted pests. There will be also concerns related to pesticide residues on agricultural crops and on health of consumers. The fate of any pesticide applied in agricultural fields is governed mainly by abiotic and biotic factors (Khalid et al., 2020). Among abiotic factors, amount and intensity of rainfall influence the mechanism of dissipation and transport of pesticides to a greater extent (Zisis, 2018). Due to rapid flow pathways and episodic preferential flow during erratic rainfall, the pesticides feebly attached to soil particles will be lost (Farha et al., 2016). It is likely that pesticides introduced to agricultural fields are carried to other environmental compartments through surface run-off and leaching leading to contamination of both surface and ground water resources. Croplands witnessed large pesticide losses if runoff producing rainfall happens just after pesticide application. In this context, rainfall simulation experiments have been broadly used to assess the pesticide dissipation and studies showed that transportation depends chiefly on sorption characteristics and persistence of pesticides in soil (Pérez-Lucas, 2018). Chen et al. (2019) stated that quantity and intensity of rainfall has substantial impact on pesticide transport in context to activation of macropore flow in soil. Potter et al. (2006) conducted experiment with constant and variable intensity rainfall patterns and witnessed greater pesticides run-off losses with variable-intensity rainfall patterns. Nolan et al. (2008) found large rain events just after application influenced leaching of pesticides.

* Corresponding author. Crop Protection Division, ICAR-National Rice Research Institute, Cuttack, 753006, India.
E-mail addresses: totanadak@gmail.com, Totan.Adak@icar.gov.in (T. Adak).

https://doi.org/10.1016/j.ecoenv.2020.111324
Received 18 June 2020; Received in revised form 10 August 2020; Accepted 10 September 2020
Available online 21 September 2020