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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(11): 556-558

www.thepharmajournal.com
Received: 09-09-2022
Accepted: 11-10-2022

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Cyantraniliprole toxicity to Indian honey bees, *Apis cerana indica* F

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Abstract
Bees take the part of a vital role in the maintenance of biodiversity, and in food and fibre production. Now a day, they are confronting risk due to non-selective use of pesticides. Laboratory study was conducted at Department of Agricultural Entomology, UAS, GKVK, Bengaluru to assess the risk of novel insecticide, cyantraniliprole to honey bee, *Apis cerana indica* F. through standard feeding technique. Diamide insecticide, cyantraniliprole was assessed at two different doses (300 ng/ bee and 600 ng/ bee). The cumulative mortality of honey bees was recorded at 4, 8, 18, 24 and 48 h after the treatment imposition. The tested insecticide witnessed mortality of honey bees in the study. Cyantraniliprole registered per cent cumulative mortality of 54 with the dose of 300 ng/bee at 24 h after treatment and 48 per cent cumulative mortality with the dose of 600 ng/bee at 8 h exposure. Results further demonstrated that, mortality of bees was maximum at higher doses of insecticide.

Keywords: Indian honey bee, toxicity, cyantraniliprole, mortality, diamide

Introduction
Pollination by wild animals is a key ecosystem service. Bees, including honey bees, bumble bees and solitary bees are the prominent and economically most important group of pollinators worldwide. About 35 per cent of the world's food crop production depends upon pollinators (Klein *et al*., 2007) [1]. Honey bees (*Apis mellifera* L.) provide important pollination services to a variety of crops including agricultural and horticultural crops (Klein *et al*., 2007) [1] and contribute significantly to human nutrition (Ellis *et al*., 2015) [2]. However, the number of managed honey bee colonies have declined in Europe and the United States due to multiple factors (Lexmond *et al*., 2015) [3]. Use of non-selective pesticides have more negative implications on the bees. The difference in the concentration and duration of the exposure to these pesticides decide the fate of honey bees. The assessment of newly released insecticides against honey bees is crucial as some studies reported the risk of neonicotinoid insecticides such as imidacloprid on bees has which recently received a lot of attention, since it can affect individual and colony fitness at sub-lethal levels. Cyantraniliprole is a novel anthranilic diamide insecticide that controls a spectrum of chewing and sucking insect pests by selectively activating insect ryanodine receptors (IRAC group 28) [4]. Laboratory studies shown that acute oral and contact toxicity of cyantraniliprole is harmful to honey bees and bumblebees. Screening exposure estimates show risks to honey bees as highly toxic for acute exposure. Modern agricultural technology's worrisome growth in pesticide use in India has resulted in a significant decline in bee populations (Bonmatin *et al*., 2005) [5]. Recent attention on global honey bee health has resulted in regulators from multiple countries requesting additional data to assess risk to bees. However, toxic hazards caused by widespread and indiscriminate use of cyantraniliprole and research studies on the impact of these insecticides on bees in India are scanty. The present investigation aimed to assess the toxicity of cyantraniliprole insecticides to Indian honey bee, *A. cerana indica* F.

Material and Methods
Laboratory experiment was conducted to assess the acute toxicity of cyantraniliprole on honey bee, *Apis cerana indica*. Cyantraniliprole toxicity was assessed at two doses. The experiment was conducted by following standard feeding technique as described by Suchail *et al*. (2001) [6]. This insecticide at specific doses *i.e*., 330 ng/ bee and 600 ng/ bee were mixed with sucrose and bees were allowed to feed on the insecticide mixed sucrose solution.

Untreated control was maintained with 50 per cent sucrose solution. The worker bees which were going out for foraging were collected from the colony using a polyethylene cover (15 cm X 15 cm) and thus collected were immediately brought to the laboratory and kept at 4 °C to inactivate the bees (Sharma and Abrol, 2005) [7]. The cumulative mortality of honey bees was documented at 4 h, 8 h, 18 h, 24 h and 48 h after the treatment imposition. The data recorded on mortality was converted to per cent cumulative mortality before statistical analysis. Data generated in cyantraniliprole feeding experiment was analyzed using Nested ANOVA.

Results and Discussion

Pesticides can produce four types of effects on honey bees: lethal effects and sub lethal effects from acute or chronic exposures. Chronic effects are like changes in mobility, changes in orientation, changes in foraging behaviuor, impaired visual learning, decreased predator avoidance and impaired navigation to the nest. Acute toxicity refers to adverse effects that result from a single exposure of chemical. Cyantraniliprole is a second generation diamide insecticide. This molecule is registered in India for both foliar sprays and seed treatment. Data related to this experiment is depicted in the Table 1 and Fig. 1. Mortality response of bees to cyantraniliprole described below.

Table 1: Mortality response of honey bee, *Apis cerana indica* to different doses of cyantraniliprole

Treatments (Doses)	Per cent cumulative mortality of honey bees during different exposure period					Mean
	4 h	8 h	18 h	24 h	48 h	
T1: 300 ng/ bee	12.00 (20.14) [b]	27.00 (31.27) [b]	33.00 (35.03) [b]	54.00 (47.30) [b]	68.00 (55.57) [b]	38.80 (37.86)
T2: 600 ng/ bee	28.00 (31.92) [a]	48.00 (43.85) [a]	57.00 (49.03) [a]	72.00 (58.08) [a]	85.00 (67.33) [a]	58.00 (50.04)
T3: Untreated Control	0.00 (0.00) [c]	0.00 (0.00) [c]	2.00 (5.77) [c]	3.00 (8.65) [c]	4.00 (12.76) [c]	2.00 (5.44)
Mean	13.33 (17.35)	25.00 (25.04)	30.67 (29.95)	43.00 (38.01)	52.67 (45.22)	
			S.Em±	CD @ 0.01		
	Treatments		0.69	2.62		
	Exposure periods		0.89	3.39		
	Treatment * Exposure period		1.54	5.87		

Note: n = 25 bees in each replication; Number of replications = 4; Figures in the parenthesis are arc sine transformed value

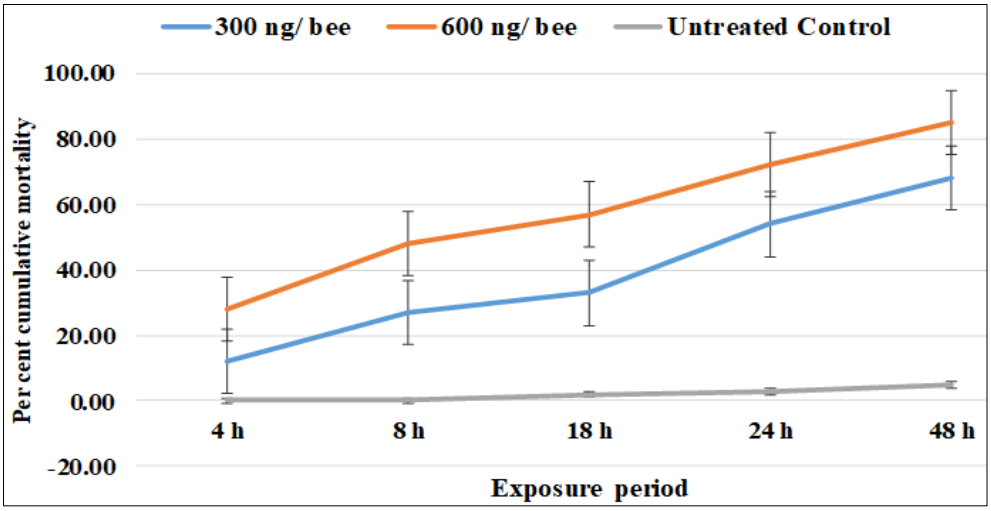

Fig 1: Mortality response of honey bee, *Apis cerana indica* to cyantraniliprole

Toxicity of cyantraniliprole to *A. cerana indica*

Toxicity of different doses of cyantraniliprole to *A. cerana indica* varied significantly at 4 h post treatment. Highest mortality (28.00%) was recorded with 600 ng/ bee, while the per cent mortality of 12.00 was observed with 300 ng/ bee. After 8 h of post exposure, mortality increased significantly. Maximum mortality was recorded with 600 ng/ bee (48.00%) and with 300 ng/ bee it was 27.00 per cent after 8 h of exposure. Similarly, the toxicity of cyantraniliprole to *A. cerana indica* was more with dose 600 ng/ bee (57.00%) than with 300 ng/ bee (33.00%). While in control maximum of 2.00 per cent mortality was recorded after 18 h of exposure. However, at 24 h post treatment, the dose 600 ng/ bee was recorded 72.00 Per cent mortality and per cent mortality of 54.00 was documented with lower dose (300 ng/ bee). After 48 h of post exposure, per cent mortality of 85.00 was recorded with the higher dose (600 ng/ bee) and per cent mortality of 68.00 was recorded with lower dose (300 ng/ bee). In control maximum of 4.00 per cent mortality was recorded after 48 h of exposure.

In present study, results revealed that cyantraniliprole was more toxic at both doses (300 ng/ bee and 600 ng/ bee). Dose 300 ng/ bee exhibited 54.00 per cent mortality after 24 h of post treatment, whereas 600 ng/ bee exhibited 48.00 per cent mortality after 8 h of post exposure. However, at low doses the mortality of bees is minimum, still they caused other negative effects like un co-ordinated movements, laying upside down, *etc.* Similar to the findings of this study, Pilling *et al.* (2018) reported that acute oral and contact ingestion of cyantraniliprole is toxic to honey bees and bumblebees under laboratory condition [8]. Contrarily, Neill *et al.*, 2016 reported no increased acute oral or contact honeybee mortality at 0.39 (oral) and 0.63 (contact) µg/ bee doses respectively [9]. Oral honeybee risk assessments indicate low risk for honeybees via oral exposure.

Conclusion

The toxicity of different doses of cyantraniliprole on Indian honey bee, *A. cerana indica* showed least mortality at early exposure period to insecticides. However, per cent cumulative mortality increased with the prolongation of exposure period. Cyantraniliprole exhibited 54 per cent cumulative mortality

with the dose of 300 ng/ bee at 24 h after treatment and 48.00 per cent cumulative mortality with the dose 600 ng/ bee at 8 h exposure. As cyantraniliprole is novel insecticide used against various insect pest, its safety to honey bees and other beneficial insects is also imperative. Experiments with various doses must be conducted to collect information on the reactions of bees in order to more fully evaluate the toxicity of cyantraniliprole.

Acknowledgement
Author wishes to extend heartfelt thanks to Dr. V.V. Belavadi and Dr. Eswarappa for providing immense support during the study.

References

1. Klein AM, Vaissiere BE, Cane JH, Steffan-Dewenter I, Cunningham SA, Kremen C, *et al*. Importance of pollinators in changing landscapes for world crops. Proc. R. Soc. B. 2007;274(1608):303-313.
2. Ellis AM, Myers SS, Ricketts TH. Do pollinators contribute to nutritional health? PloS. One. 2015;10(1):114799-114805.
3. Lexmond MB, Bonmatin JM, Goulson D, Noome DA. Worldwide integrated assessment on systematic pesticides: Global collapse of the entomofauna: exploring the role of systemic insecticides. Environ. Sci. Pollut. Res. 2015;22:1-4.
4. Insecticide Resistance Action Committee, group 28
5. Bonmatin JM, Marchand PA, Charvet R, Moineau I, Bengsch ER, Colin ME. Quantification of imidacloprid uptake in maize crops. J Agric. Food Chem. 2005;53:5336-5341.
6. Suchail S, Guez D, Belzunces L. Discrepancy between acute and chronic toxicity induced by imidacloprid and its metabolites in *Apis mellifera* L. Environ. Toxicol. Chem. 2001;20:2482-2486.
7. Sharma D, Abrol DP. Contact Toxicity of Some Insecticides to Honeybee, *Apis mellifera* (L) and *Apis cerana* (F.). J Asia-Pac. Entomol. 2005;8(1):113-115.
8. Pilling E, Kramer VJ, Neill B. Effects of cyantraniliprole oilseed rape seed treatment on honey bees and other pollinators. In Entomology. ESA; c2018.
9. Neill BF, Dinter A, Samel A. Global pesticide registration: What constitutes a bee data package for a globally registered insecticide. In 2016 International Congress of Entomology. ESA; c2016.