



EFFECT OF NEONOCOTINOIDS AND BIOPESTICIDES ON THE FORAGING BEHAVIOUR OF HONEY BEE *APIS MELLIFERA* L ON RAPESEED

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ABSTRACT

The present study is on the effect of neonicotinoids and biopesticides on the foraging behaviour of honey bee *Apis mellifera* L. on rapeseed (*Brassica rapa*). Four insecticides and two neonicotinoids (imidacloprid, thiamethoxam) and one bioinsecticide spinosad, and another botanical insecticide nimbecidine were sprayed during peak flowering period and the number of visiting bees on rapeseed flower compared with untreated control. The results revealed that reduction over control was found higher with neonicotinoids i.e., imidacloprid and thiamethoxam treated plots followed by spinosad and the lowest was in nimbecidine treated plots. The order of repellency of insecticides on honey bee foraging were neonicotinoids > spinosad > nimbecidine.

Key words: *Apis mellifera*, foraging, imidacloprid, thiamethoxam, spinosad, nimbecidine, spray, hazards, pollination, repellent

Insecticides one of the main agrochemicals, are useful for controlling pests; however, the indiscriminate use of insecticides has led to negative effects on non-target insects, especially honey bees, which are essential for pollination services. Pollinating insects are essential for the reproduction of the majority of flowering plants worldwide (Ollerton et al., 2011), and a wide variety of crops (Klein et al., 2007). It has been estimated that the value of pollination in agriculture to the world economy is €153 billion/year (Gallai et al., 2009) and € 4.2 billion in the economy of European Union countries along with the preservation of natural ecosystem (Corbet et al., 1992). Among insect pollination, bee pollination is one of the main alternatives for the improvement of crop productivity (Westcott and Nelson 2001; D'Ávila and Marchini, 2005). When foraging for pollen and nectar in flowering plants, honey bees can be exposed to a diverse array of pesticides, including insecticides, fungicides, and herbicides (Mullin et al., 2010; Jhonson, 2015). Different classes of insecticides, such as neonicotinoids, pyrethroids, organophosphate biopesticides play not only negatively effect on honey bee growth and development but also decrease their foraging activity and pollination services. In recent years, neonicotinoid insecticides have been raising global concern due to growing evidence that they have generated a series of adverse effects on honey bees including foraging behaviour of worker bees (Shi et al., 2020). In Bangladesh, the poisoning of honey bees by application of pesticides has increased from time to time,

and some beekeepers were also lost all their colonies due to agrochemical application. So the present study was undertaken to know the adverse effect of insecticides on *Apis mellifera* L., foraging on oilseed rapes *Brassica rapa*.

MATERIALS AND METHODS

The present experiment was conducted during rabi 2022-23 at the Oilseed Research Centre and OFRD Barind, Rajshahi. The treatments were two neonicotinoids 1) imidacloprid (imitaf 20 SL) @ 0.5 ml/ ℓ of water, 2) thiamethoxam (aktara 25 WG) @ 0.2 gm/ ℓ of water, one bio pesticides named 3) spinosad (success 2.5 SC) @ 1.2 ml/ ℓ of water, and another was botanical insecticide 4) nimbecidine @ 1.2 ml/ℓ of water and 5) untreated control. The insecticides were sprayed with knapsack sprayer on plots of 4 x 5 m size with var. BARI Sarisha -14 during its peak flowering period in randomized complete block design with three replications. The spray was done between 10.00-12.00 hr during the maximum activity period of bees. Initial observation on the number of foraging of bees were recorded before spraying, and then after 1, 2, 24, 48 hr, and one week after spraying of insecticidal application in 1 m² area for one minute in treated and control plots on the basis of visual counts.

RESULTS AND DISCUSSION

Table 1 shows that there was no honey bee found with neonicotinoid insecticides named imidacloprid and thiamethoxam and also spinosad treated plot

Table 1. Effect of insecticidal treatments on *A. mellifera* visiting flowers of mustard (2022-23)

Treatments	Mean No of honey bee					
	before spray	After 1 hr spray	After 2 hr spray	After 24 hr spray	After 48 hr spray	After 7 days spray
T ₁ =Imidacloprid (Imitaf 20SL) @ 0.5 ml/ l of water	44.33b	0b	0c	7.66c	10.33c	46.66b
T ₂ = Thiamethoxam (Aktara 25 WG) @ 0.2 gm/ l of water	44.33b	0b	0c	9.33c	14.33c	44.66b
T ₃ = Spinosad (Success 2.5 SC) @ 1.2 ml/ l of water	48.11ab	0b	0c	13.66c	16.00c	49.66b
T ₄ = Nimbecidine @ 1.2 ml/ l of water	46.35b	5.00b	7.00b	42.33b	46.00b	46.33b
T ₅ = Untreated control	63.12 a	77.33a	88.33a	68.00a	72.33a	67.00a
Level of significance	*	*	*	*	*	*
CV	16.22	41.61	8.32	21.34	17.28	15.18

*significance at p= 0.05

within 1 and 2 hr after spraying. The repellent effect of *A. mellifera* was observed significantly higher (100, 100, 82.72 and 76.69%) in imidacloprid treated plots followed by thiamethoxam (100, 100, 78.44 and 67.67%) treated plots. Spinosad had also repellent capacity (100, 100, 74.32 and 67.67%) and nimbecidine had lowest repellent effect (89.21 84.89, 63.30 and 0.75%) at 1, 2, 24, and 48 hr after spray, respectively. No repellent effect was found after 7 days of spraying.

Shi et al. (2020) found that uncontrolled use of insecticides hinders bee pollination and foraging, and contributes to reductions in bee populations, even when used at sublethal levels. Similar results were found by Sharma and Abrol (2014) with reduction in the number of honeybee visits up to third day of spraying over the *Brassica campestris* var. toria with imidacloprid treated plots.

Ram Bajiya and Abrol (2020) found that methyl-demeton followed by acetamiprid, imidacloprid, and diamethoate revealed more repellent effect and thiamethoxam having insecticidal properties was found to have less repellency of honey bee forager. Challa et al. (2019) found spinosad and imidacloprid have the dangerous effect on the bees whereas azadirachtin had the low toxic effect. The repellency on the foraging behaviour of *A. mellifera* was found higher with neonicotinoids imidacloprid, followed by thiamethoxam treated plots and spinosad also showed repellency. Botanical insecticide (nimbecidine) has lower repellent effect on honey bees.

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AUTHOR CONTRIBUTION STATEMENT

Study conception and design, data collection, analysis and interpretation of results, draft manuscript preparation by the author 1 and 2. Finally author 1, 2 reviewed the results and approved the final version of the manuscript.

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CONFLICT OF INTEREST

No conflict of interest.

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