Indian Journal of Entomology 85(4): 1069-1072 (2023) DoI. No.: 10.55446/IJE.2021.134

EFFICACY OF NEEM BASED FORMULATIONS AGAINST WHEAT APHIDS UNDER SEMI-ARID IRRIGATED CONDITIONS IN SOUTH-WEST PUNJAB

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ABSTRACT

Neem formulations viz. aqueous extract of neem and NSKE along with standard check thiamethoxam were evaluated for their efficacy against wheat aphids *Rhopalosiphum padi* (L.) and *Rhopalosiphum maidis* (Fitch). It was observed that aphids' incidence on shoots started in the first week of January with a peak (40.90 aphids/ shoot) during third week of March. Thiamethoxam 25 WG @ 50 g/ ha was found significantly superior giving 93.53% reduction after 7 DAS (days of spray). Different formulations of neem also yielded comparable results in controlling wheat aphids. Aqueous extract of neem @ 5 l/ ha resulted maximum (74.21%) reduction followed by NSKE @ 10% (69.04%) after 7 DAS. Occurrence of coccinellids was more in treatments with neem formulations than in thiamethoxam. The treatments resulted in 2.48- 9.25% increase in yield and it can be concluded that aqueous extract of neem and NSKE can be recommended over the most commonly used thiamethoxam for controlling wheat aphids.

Key words: Wheat, aphids, *Rhopalosiphum padi*, *R. maidis*, coccinellids, neem formulations, thiamethoxam, incidence, population dynamics, efficacy, NSKE, yield

In Punjab wheat (*Triticum aestivum* L.) is cultivated as a major rabi crop on about 35.20 lakh haa with the production of 182.62 lakh mt (Anonymous 2019). Several abiotic and biotic factors like insect pests and diseases are responsible for the low productivity of wheat. Among insect pests, commonly aphids and termites affect the crop. In India, aphids cause yield losses and became regular pest of wheat in almost all the wheat cultivating zones. Out of the nine aphid species infesting wheat crop in India, *Sitobion avenae* (F.), and *Rhopalosiphum maidis* (Fitch) are the major ones (Joshi and Sharma 2009). However, bird cherry oat aphid *Rhopalosiphum padi* L. and corn leaf aphid *R. maidis* are the major ones in Punjab (Singh, 1983; Singh et al., 2018). The severe incidence of wheat aphid complex causes 3.53-21.05% yield losses in wheat varieties in Punjab (Singh and Deol, 2003). Aphids can be successfully managed with foliar sprays of neonicotinoids; however, because of their frequent usage certain issues like their persistence in soil and water, side effects to pollinators and natural enemies and residue in grains are the foremost environmental concerns (Goulson, 2013). To avoid or to minimize these ill effects, ecofriendly and cost effective control methods are required. Among the available non-chemical options, neem (*Azadirachta indica* L.) has shown the potential to be used as a substitute of synthetic insecticides (Schmutterer, 1995). Seeds, leaves, kernels and other parts of the neem tree are rich source of azadirachtin and various other compounds (Shafeek et al., 2004; Adhikari et al., 2020). These were found promising against many insects in different crops (Gahukar, 2000; Liang et al., 2003; Nathan et al., 2005). The present study evaluates different neem based formulations for the management of wheat aphids and also to verify their effects on arthropod natural enemies.

MATERIALS AND METHODS

The experiments were done during the winters of 2019 and 2020, at the experimental farm of Punjab Agricultural University Regional Research Station, Bathinda, India (30°17'N, 74°58'E, 211 masl). This station is in the extreme south west of Punjab. The fields selected had long history of wheat and cotton in rotation. Four set of experiments were laid out in randomized block design (RBD) with each treatment replicated thrice, in plots of size of 5 x 5 m. Seeds of variety Unnat PBW343 @ 100 kg/ ha was sown at 20 cm row to row spacing, and the crop raised as per the recommended practices of Punjab Agricultural University (Anonymous, 2019) except for crop protection. Treatments include- T1: NSKE @ 5%, T2: NSKE @ 7.5%; T3: NSKE @ 10%; T4: aqueous extract of neem @ 3 l/ ha; T5: aqueous extract of neem

@ 3.75 l/ ha; T6: aqueous extract of neem @ 5l/ ha; T7: Thiamethoxam 25 WG @ 50 g/ ha; and T7: untreated control. The NSKE was soaked in water overnight and the extract collected during next morning was used for the spray after diluting it to required dosages. To make aqueous extract of neem 4 kg of terminal parts of shoots of neem trees including leaves, green branches and fruits were boiled in 10 l of water for 30 min and then filtered through muslin cloth, and the filtrate was used. Thiamethoxam (Actara 25 WG, Syngenta India Pvt. Ltd.) procured from local market was taken as a standard. The treatments were applied at heading stage when the aphid infestation exceeds economic threshold level of 5 aphids/ earhead. Aphid counts were taken from ten tagged plants/ replication before and 1, 2, 7 days of spray application (DAS). The counts of coccinellids grubs and adults/ m^2 were also recorded from five spots in each treatment. At the harvest, grain yield was recorded and % increase in yield over untreated control was worked out. The % data were subjected to arc sine transformation and numerical data to square root transformation for statistical analyses. The data generated from four trials was pooled and subjected to ANOVA to evaluate the treatment effects with the means separated using Least Significant Difference (LSD, p=0.05).

RESULTS AND DISCUSSION

The pooled data of 2019-20 on aphid's incidence in wheat given in Fig. 1 reveals that it ranged from

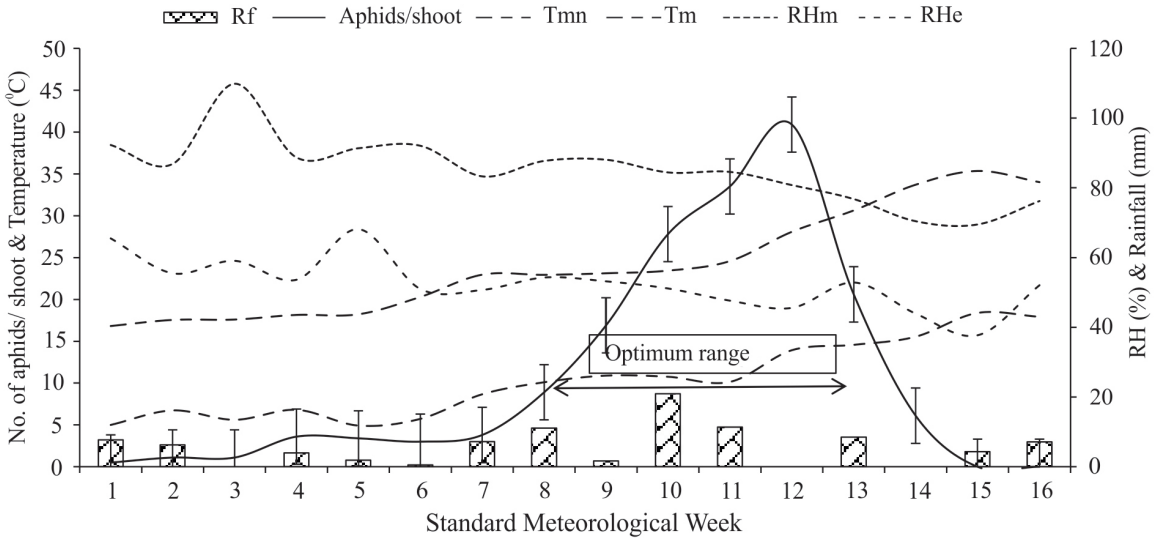

Fig. 1. Population dynamics of *R. maidis* and *R. padi* in wheat cv. *Unnat* PBW 343 (2019-2020)

Table 1. Efficacy of neem formulations against *R. maidis* and *R. padi* in wheat (pooled data, 2019-20)

Treatment	No. of aphids/ plant (10 plants/ replication)				% reduction after 7 DAS	No. of coccinellids/ sq. m			Yield (q/ ha)	% Increase in yield over control
	BS	1 DAS	2 DAS	7 DAS		BS	1 DAS	7 DAS		
T1	20.53^{a}	14.10^{c}	7.80^{c}	8.38^{c}	59.20	3.65^{a}	2.45^{b}	3.55^{a}	58.30	4.05
T2	20.60^{a}	13.48^{c}	6.65b^{c}	7.03^{c}	65.90	4.45^{a}	3.30^{ab}	3.60^{a}	57.35	2.48
T3	18.25^{a}	10.28^{b}	5.58^{b}	5.65^{bc}	69.04	3.95^{a}	3.60^{ab}	3.30^{a}	61.62	9.25
T4	20.13^{a}	13.18^{c}	6.95b^{c}	7.85^{c}	60.99	4.35^{a}	2.75^{b}	3.35^{a}	57.57	2.84
T5	20.10^{a}	13.13^{c}	6.03b^{c}	6.60^{b}	67.16	4.20^{a}	3.90^{a}	3.80^{a}	59.22	5.55
T6	20.28^{a}	13.08^{c}	5.20^{b}	5.23^{b}	74.23	3.70^{a}	3.15^{ab}	3.25^{a}	60.00	6.79
T7	21.25^{a}	7.75^{a}	3.20^{a}	1.38^{a}	93.53	3.55^{a}	0.80^{c}	0.55^{b}	59.95	6.71
T8	20.55^{a}	22.33^{d}	24.53^{d}	30.63^{d}	-	4.30^{a}	3.00^{b}	3.70^{a}	55.92	-

T1: NSKE @ 5%, T2: NSKE @ 7.5%; T3: NSKE @ 10%; T4: aqueous extract of neem @ 3 l/ ha; T5: aqueous extract of neem @ 3.75 l/ ha; T6: aqueous extract of neem @ 5l/ ha; T7: Thiamethoxam 25 WG @ 50 g/ ha; and T7: untreated control.

0.00- 40.90± 1.43 (mean ± SE; N=30) from 1st SMW (Standard Meteorological Week) 1 to 16th SMW; peak was during 12th SMW, then it declines and almost disappeared in second week of April. These data revealed that the corresponding weather are- optimum temperature (T_{max} 22.96- 28.08 °C; T_{min} 8.66-13.93 °C) and humidity (RHm 80.79- 88.06%; RHe 45.57%-51.14%). Thus, the peak was in the third week of March during the heading stage of the wheat, and declined with maturity during the first fortnight of April. Karimullah and Ahmad (1989) observed that aphids' infestation started in the beginning of February with its peak in the latter half of March. Such an increase in population towards heading stage was also observed by Xiong (1990) and Nawaz (2000). Table 1 depicts the reduction in incidence due to treatments with neem, which reveal that all the treatments were found effective; significant differences were observed after 1 ($F_{7,21}$ = 42.66, p < 0.01), 2 ($F_{7,21}$ = 158.77, p < 0.01) and 7 ($F_{7,21}$ = 395.17, p < 0.01) DAS. Foliar application of thiamethoxam 25WG @ 50 g/ ha was found significantly superior, followed by aqueous extract of neem @ 5 l/ ha and NSKE @ 10%. A little increase in aphid's population in neem treated plots was recorded after 7 days of spray so it is advised to repeat the spray of botanicals after seven days. Overall, the spray of aqueous extract of neem @ 5 l/ ha and NSKE @ 10% brings about 74.23 and 69.04% reduction after 7 DAS. Babu and Sharma (2003) advocated that thiamethoxam was most effective. Shah et al. (2017) evaluated the neem seed extract (NSE), moringa leaf extract (MLE) and used imidacloprid as check for aphid management in late sown wheat and found that imidacloprid was the best followed by neem seed extract. Homemade formulations of neem viz. aqueous extracts of neem, NSKE and neem seed cake etc. have been successfully used against insect pests (Dougoud et al., 2019). These are comparatively safe to natural enemies, economical, easy to prepare at farmer levels and would reduce the harmful effects of pesticides to humans and environment (Agbo et al., 2019).

The results reveal that the counts of coccinellids (grub and adult) varied from 3.55 to 4.45 in different treatments before spray (Table 1); and significant differences between insecticide and botanicals were observed after one ($F_{7,21}$ = 6.81, p < 0.01) and seven DAS ($F_{7,21}$ = 15.12, p < 0.01). All the botanical treatments were at par with each other in bringing 2.74-22.99% reduction in coccinellids grubs/ m^2 after 7 DAS; thiamethoxam 25 WG @ 50 g/ ha caused maximum reduction (84.51%). These results are in accordance with those of Jiang et al. (2018) on the sublethal and transgenerational effects of thiamethoxam on *Coccinella septumpunctata*. Khan et al. (2011) reported that neem oil formulations were safer for beneficial insects. The results ont the yield were statistically non-significant but maximum yield was in plots treated with NSKE @ 10 % (61.62 q/ ha) followed by aqueous extract of neem @ 5 l/ ha (60 q/ ha), thiamethoxam 25 WG @ 100 g/ha (Table 1).

ACKNOWLEDGEMENTS

The authors thank the Director, Punjab Agricultural University Regional Research Station, Bathinda for providing necessary facilities.

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(Manuscript Received: May, 2021; Revised: September, 2021;
Accepted: September, 2021; Online Published: January, 2022)
Online First in www.entosocindia.org and indianentomology.org Ref. No. e21117