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BIO EFFICACY CHECK OF DIFFERENT SYNTHETIC CHEMICALS APPLIED AGAINST WHITEFLY (*BEMISIA TABACI* GENNADIUS) IN TOMATO TO ENHANCE VEGETABLE PRODUCTION FOR GROWING HUMAN POPULATIONS

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ABSTRACT
Among the sucking insect pests whitefly, *Bemisia tabaci* is one of the key sucking pests in Punjab area of sub-continent. The bio-efficacy check of different pesticides against whitefly, *Bemisia tabaci* in tomato cv. GT. 2 based in field analysis was carried out at Agricultural University, of Punjab, during Rabi 2019-20. Eight treatments were selected to evaluate the efficacy including untreated control in Randomized Block Design with four replications. The low number of whitefly population (2.17adults/leaf) was observed for the chemical imidacloprid 17.8 SC @ 0.005% (2.7 ml/10 L of water) followed by 2.24 adults/leaf in dimethoate 30 EC @ 0.03% (10 ml/10 L of water) which were significantly at par with each other. Neem extract (azadirachtin) was at the third position 3000 ppm with concentration of 3 ml/litre of water (5.67 adults/leaf).
Keywords: Pesticide, tomato, whitefly, *Bemisia tabaci,* treatments, chemical, adults/leaf

INTRODUCTION

Cultivation of vegetables has got a prime importance in Indian agriculture owing to their nutritional, medicinal and commercial value (Choudhary, 1977). It suffices 2-6 per cent of the total cropped area in the country. Tomato (Solunum *Lycopersiconum* Mill.) is widely consumed vegetable crop which belongs to the family Solanaceae. Tomato (poor man orange) is usually rich source of many nutritional elements like vitamins, minerals, organic acids, etc (Yan-Jie et al., 2021). It has got huge importance due to its widely cultivable nature in both tropical and sub-tropical regions of the world (Govindappa et al., 2013). Tomato being an important crop is cultivated in nearly all parts of Punjab in 49,000 ha acreage with an annual production of 13.58 lakh tonnes (Anonymous, 2018). The total area under cultivation in India is 7.89 lakh ha area with annual production of 201 lakh tonnes and productivity of 27 tonnes per hectare (Anonymous, 2018). Dampc *et al*., (2021) opined that in Punjab, this crop is grown widely all over the state but still the productivity is down as compared to other tomato growing states prominently due to

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the presence of insect-pests on the crop. The crop is invaded by number of insect pests usually by sucking ones causing considerable loss (Butani and Jotwani, 1984 and Kalloo, 1986). The most prominent attacking pest infesting crop viz; whitefly, aphid, thrips, leaf miner, fruit borer and red spider mite are widely documented on tomato crop (Anonymous, 2012).

Whitefly, *B. tabaci* is one of the most destructive pests among the sucking insects. Infestation and dispersal of the tomato leaf curl virus (TLCV) was correlated directly with whitefly population in tomato field (Dempsey et al., 2017; Gupta et al., 2007). Among the order soft bodied order hemiptera, whitefly is a quintessential insect-pest with mouth parts of piercing and sucking type specially made to suck the sap heavily (David et al., 2006). The pest conferred commendable damage in a direct fashion as well as indirectly to the tomato crop especially in the early crop development stage. Being a polyphagous pest it attacks more than 650 different plant species across the world (Bayhan et al., 2006; Oliveira et al., 2001; Stansly and Natwick, 2010). Immatures stages as well as adults suck the sap conveniently from lower portion of the leaf surface. Besides, they also pose a huge problem to the conduction in vessels and apparently injects a toxin that brings down the photosynthesis rate in proportion to the amount of feeding (Sharma and Chander, 1998).

When heavy infestation occurs, all the foliage becomes crinkled or twisted with dreadful reduction in photosynthesis which ultimately renders the plant to yield reduction (Sahin and Isil, 2021). In addition, immature stages and adult pest sucks the cell sap continuously and secret honey dew which not only invites black ants but also favours growth of other fungi also such as sooty mould, which blocks the photosynthesis thus leads to reduction in the yield (Butani and Jotwani, 1984 and Sharma and Chander, 1998). However, the multiple tactics used for whitefly control, the usage of plant products and chemical insecticides is widely done. Bonnie preston (2021) authored that systemic insecticides proves out to be better over contact ones because they propose the long term protection through major period of the growing season without going for continuous repetition of chemicals.

The incorporation of neonicotinoid (imidacloprid) was extremely efficacious in managing the the whitefly population on tomato (Jha and Kumar, 2017). Studies done by Meena and Ranju (2014) revealed that optimum control of the pest was observed by application of profenophos followed by indoxacarb and NSKE. Hossain et al. (2013) revealed that imidacloprid lead to the significant reduction in whitefly population as compared to control ones. The action potential of imidacloprid was very swift in terms of reduction of whitefly (Das and Islam, 2014). Ahirwar et al. (2009) put forth that neem based products such as NSKE and neem oil lessens the nymph and adult population prominently. NSKE at 5 per cent control the whitefly infestation up to 10 days of spray (Lal and Jat, 2015). The first chemical application done of the insecticide imidacloprid 17.8 SL @ 0.3

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ml/L followed by second spray with dimethoate 30 EC @ 1.5 ml/L of water was highly beneficial in reducing the whitefly population and obtaining higher fruit yield (Kumar, 2018). Thus on the basis of study conducted earlier by several authors, the importance of sucking insect pests on tomato and technological gap analysis, the experiment was laid on “Bio-efficacy of different chemical pesticides”.

Chemical treatment is to be taken care during pollination; therefore organic control of insect pests if of high value and demand (Dar *et al*. 2020 a, b, c, d, e, f; Dar et al. 2021 a, b). Potatoes and tomatoes have similar flowers and pollination, potatoes are self-pollinated, which means they have the male and female flowers on one plant. Pollination can occur from wind and from insects. However, for potatoes, this pollination does not have to take place to form the underground tubers.

Managed pollination is an essential input in enhancing the crop productivity. In recent ye ars, there has been an increase in the accumulation of data to indicate that seed yields of insect pollinated crops may often be lower than the expected, not because of adverse climatic, edaphic or cultural factors, but simply because the reduced pollinator/bee populations due to disease and pests (Tlak Gajger *et al*, 2014; Tlak Gajger *et al*, 2013a, b; Tlak Gajger *et al*, 2011 a. Tlak Gajger 2011; Tlak Gajger *et al*. 2015; Tlak Gajger *et al,* 2018; Tlak Gajger and Susec 2019; Tlak Gajger *et al*, 2010 a,b; Tlak Gajger and Dar 2021).

MATERIALS AND METHODS

The analysis was done under field condition at Agriculture University of Punjab during Rabi 2019-20. In the experiment the tomato variety GT-2 carried in randomized block design with 3 x 2 m plot size using four replicates of eight treatments viz., dimethoate 30 EC 0.03% (10 ml/10 L of water), lambdacyhalothrin 5 EC 0.004% (6 ml/10 L of water), novaluron 10 EC 0.01 % (10 ml/10 L of water), imidacloprid 17.8 SC 0.004% (2.8 ml/10 L of water), indoxacarb 14.5 SC 0.005% (4.8 ml/10 L of water), azadirachtin 3000 ppm 0.3% (30 ml/10 L of water), HaNPV 250 Larval Equivalent per ha and untreated control (water spray). Disease free seedlings of 8-10 cm length and twenty five days old were transplanted at 60 × 50 cm spacing. Hoeing and weeding operations were also carried out timely at proper crop growth development stage. Irrigations were done at regular intervals. In the form of foliar spray all the treatments were employed with the help of knapsack sprayer. First treatment application was applied after the pest crossed the Economic Threshold Level (ETL) (3-5 flies/leaf) (Shivalingaswamy et al., 2006). The tomato crop was also treated with recommended dosage of NPK in the ratio of 170:60:60 kg/ha, respectively in three split doses. The adult pest was beholded on five randomly selected plants on three randomly selected leaves in the three different straita (upper, middle and lower) with the help of hand lens of magnifying power of 10X at early

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morning hours, one day before as well as on 1st , 3rd, 5th, 7th and 15 days of time span after treatment application. At the end of the experiment the data was expressed in terms of population mean per leaf in every plant. The results were statistically analysed based on population built up of adult pest at multiple intervals after spraying in randomized block design and overall population irrespective of post spray interval was thus analysed.

RESULTS AND DISCUSSION

The study conducted on the said problem was carried out under open field condition during Rabi 2020-21. The data on whitefly was recorded on different intervals as discussed earlier after spraying of the insecticide. From the results generated in Table 1 and depicted in Figure 1 put forth that mean of the whitefly population before application of treatments are at par among the various plots ratify the homogeneity of the population undertaken. The data in Table 1 shown that one day after spraying (DAS), all the treatments recorded significantly lower whitefly population than untreated control. However, the population of the pest was quite low (2.05/leaf) in dimethoate 0.03 percent followed by imidacloprid 0.005 percent (2.71 /leaf) which was at par from each other. The less responsive treatment was in HaNPV 250 LE/ha showing the huge population built up (6.91/leaf). After three days spraying the chemicals, all the treatments recorded immensly lower whitefly population as compared to control (water spray) whereas lowest whitefly population (1.71/leaf) was recorded in imidacloprid 0.005 percent followed by dimethoate 0.03 percent as 1.96/leaf which did not differ significantly with it. Nevertheless, highest population of the pest was recorded in HaNPV (6.91/leaf). After five days of spraying, meager amount of pest population was observed in imidacloprid 0.005 percent as 1.80/leaf and dimethoate 0.03 percent with 1.80/leaf application treatments though, it remained highest in HaNPV (10.97/leaf). Similarly, after seven days of application, lowest whitefly population was documented in the insecticide imidacloprid 0.005 percent (2.25/leaf) followed by 2.65 in dimethoate 0.03 percent which were at the same rank of infestation statistically. The huge pest population was recorded after the application of HaNPV treatment (17.20/leaf). Significantly lowest whitefly population (2.43/leaf) was observed in imidacloprid (0.005) percent followed by dimethoate 0.03 percent as 2.62/leaf, which in turn were at par with each other after fifteen days of spray application. The application of the HaNPV (250LE/ha) rendered it minimal responsive indicating highest number of whiteflies (14.85/leaf).

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Table 1: Bio-efficacy of various pesticides used against the whitefly infestation in tomato crop

Sr. No.	Treatment	Dose (%)	Mean adult whitefly/leaf						
			Before Spray	1 DAS	3 DAS	5 DAS	7 DAS	15 DAS	Pooled over DAS
1	Dimethoate 30 EC	0.03	3.35* (10.90)	1.40* a (2.01)	1.41* ab (1.92)	1.32* ab (1.77)	1.62* ab (2.61)	1.63* ab (2.62)	1.50* ab (2.20)
2	Lambda-cyhalothrin 5 EC	0.003	3.35 (11.09)	2.17 cde (5.11)	2.03cde (4.22)	3.03cde (8.86)	3.18d (9.61)	3.35def (12.9)	2.72de (8.11)
3	Novaluron 10 EC	0.01	3.30 (10.92)	2.23cdef (5.03)	2.05cdef(4.27)	3.07cdef (9.25)	3.33def (10.8)	3.14d (12.1)	2.76def (8.31)
4	Imidacloprid 17.8 SC	0.005	3.42 (11.64)	1.65ab (2.71)	1.38a (1.71)	1.35a (1.81)	1.56a (2.26)	1.57a (2.46)	1.49a (2.20)
5	Indoxacarb 14.5 SC	0.005	3.49 (11.70)	2.20cd (4.96)	1.96cd (4.16)	2.99cd (8.51)	3.14de (9.94)	3.27de (12.71)	2.73d (8.08)
6	Azadirachtin 3000 ppm	0.3	3.57 (12.40)	2.13c (4.07)	1.93c (3.42)	2.67c (7.91)	2.67c (7.02)	2.38c (5.92)	2.37c (5.70)
7	HaNPV	250 LE/ha	3.30 (10.65)	2.68g (6.92)	2.69g (6.91)	3.38 defg (10.9)	4.17g (17.21)	3.65defg (14.84)	3.33g (11.38)
8	Control (Water spray)	-	3.30 (10.70)	2.96h (8.74)	3.05gh (9.16)	3.60gh (12.70)	4.37gh (18.66)	4.09gh (16.91)	3.64h (13.25)
	SEm+ (T)	-	0.15	0.14	0.13	0.19	0.15	0.24	0.13
	CD at 5 % (T)	-	NS	0.33	0.38	0.51	0.44	0.68	0.30
	SEm+ (P x T)	-	-	-	-	-	-	-	0.15
	CD at 5 % (P x T)	-	-	-	-	-	-	-	**NS**
	CV (%)	-	7.15	9.75	11.84	12.45	9.43	15.58	11.18

However, if we look at overall effectiveness, consistency in the order of effectiveness was recorded that of several treatments at various intervals after spraying. Statistically insignificant lowest population was observed between imidacloprid 0.005 percent (2.17/leaf) followed by 2.24 adults in dimethoate at 0.03 percent concentration. The azadirachtin 3000 ppm was highly efficacious at 3 mL/litre of water (5.67/leaf) followed by indoxacarb 0.005 percent (8.08/leaf) followed by 8.15 and 8.31 individuals in the insecticide lambda-cyhalothrin 0.003 percent and novaluron 0.01 percent, respectively which were statistically insignificant. The minimal effective treatment was HaNPV depicted 11.36 number of whiteflies per leaf on a plant. Similarly, control plot was observed with whiteflies highest in number to the extent of 13.23 individuals per leaf

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(Table 1 and Fig. 1). In addition to that, data presented in Table-1 depicted in Figure 1 revealed that the imidacloprid insecticide 0.005 percent was highly efficacious against the pest followed by the systemic insecticide dimethoate 0.03 percent. The biopesticides used against the pest showed that, azadirachtin was ranked third after imidacloprid and dimethoate and differ significantly over the rest of treatment given. Furthermore HaNPV was not specifically used for whitefly, so it was least effective against the pest population and less efficacious one at all intervals of spraying. Some researchers (Raghuraman and Birah, 2011; Gupta et al., 2007; Singh et al., 2010; Garmonyou et al., 2014 and Idris and Mandal, 2014) put forward that the insecticide dimethoate 30 EC (0.03%), imidacloprid 17.8 SL (0.005%), thiamethoxam 25 WG (0.025 %), novaluron 10 EC (0.02%), lambda-cyhalothrin 5 EC (0.005%) and fenthion were superior in the control of whitefly and disease infestation with higher yield in the crop. While as, other researchers (Chaudhari *et al*., 2015 and Bharati *et al*., 2015) studied that imidacloprid 17.8 SL 0.004 percent and dimethoate 30 EC 0.03 percent was highly effective chemical in management of pest in brinjal and Indian bean also. The current study revealed that imidacloprid 17.8 SL (0.005%) and dimethoate 30 EC (0.03%) were the insecticides with phenomenal activity against whitefly which also support the work of earlier authors thus concur the present experiment laid.

CONCLUSION

In the current time, the human populations are falling short of food requirement. All the treatments employed put forth that imidacloprid 17.8 SL at 0.005 percent and dimethoate 30 EC at 0.03 percent were observed to be the most outstanding chemicals for decreasing the whitefly infestation in tomato crop under open field conditions.

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