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Bio efficacy of different pesticides against whitefly (*Bemisia tabaci* Gennadius) in tomato

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Abstract
Whitefly, *Bemisia tabaci* is one of the major injurious sucking pests in Gujarat as well as in India. The field experiment based on bio-efficacy of different pesticides against whitefly, *Bemisia tabaci* in tomato cv. GT. 2 was conducted under field condition at Navsari Agricultural University, Navsari, Gujarat during *Rabi* 2014-15. Eight treatments including untreated control were imposed in Randomized Block Design with four replications. Lowest whitefly population (2.18 adults/leaf) was recorded in imidacloprid 17.8 SC @ 0.005% (2.8 ml/10 L of water) followed by 2.22 adults/leaf in dimethoate 30 EC @ 0.03% (10 ml/10 L of water) which were significantly at par with each other. Next in the order of effectiveness was azadirachtin 3000 ppm at 3 ml/litre of water (5.69 adult/leaf).

Keywords: *Pesticide, tomato and whitefly*

Introduction

Tomato (*Lycopersicon esculentum* Mill.) belongs to the family Solanaceae. It is often described as "poor man orange" having rich source of minerals, vitamins, organic acids, etc. It is one of the most popular and widely grown vegetable crops in both tropical and sub-tropical regions of the world (Govindappa *et al.*, 2013) [13]. Tomato is an important vegetable crop grown in almost all parts of Gujarat in 46, 000 ha area with annual production of 13.57 lakh tonnes (Anonymous, 2018) [3]. In India, the total area under cultivation is 7.89 lakh ha area with annual production of 197 lakh tonnes and productivity of 25 tonnes per hectare (Anonymous, 2018) [3].

In Gujarat, tomato is grown all over the state but still the productivity remains low as compared to other states mainly due to the prevalence of insect-pests. The crop is attacked by several sucking pests causing considerable damage (Butani and Jotwani, 1984 and Kalloo, 1986) [7, 18]. Among various insect-pests reported from India, sixteen have been observed feeding from germination to the harvesting stage, which not only reduce its yield but also deteriorate the quality (Butani, 1977) [6]. The major pests *viz*; whitefly, aphid, thrips, leaf miner, fruit borer and red spider mite are reported on tomato (Anonymous, 2012) [2]. Among the sucking insects, whitefly, *B. tabaci* is one of the most damaging pests. Incidence and spread of the tomato leaf curl virus (TLCV) was directly correlated with whitefly population in tomato field (Gupta *et al.*, 2007 and Dempsey *et al.*, 2017) [14, 11]. Whitefly is an important insect-pest under the order hemiptera possessing piercing and sucking type of mouthparts (David *et al.*, 2006) [10]. It cause direct and indirect damage to the tomato crop especially in the early growth stage. The whitefly is a polyphagous pest on more than 600 different plant species (Oliveira *et al.*, 2001; Bayhan *et al.*, 2006; Stansly and Natwick, 2010) [22, 4, 27]. Both nymphs and adults suck cell sap from lower leaf surface. In addition, they disrupt transportation in conducting vessels and apparently introduce a toxin that impairs photosynthesis in proportion to the amount of feeding (Sharma and Chander, 1998) [24]. In case of severe damage, all leaves of the plants become crinkled or twisted with drastic reduction in photosynthesis which ultimately causes severe yield reduction. On the other hand, both nymph and adult suck cell sap and secret honey dew which not only attract black ants but also favours growth of sooty mould, giving the plants a sticky appearance, which inhibits photosynthesis thus reducing the yield. (Butani and Jotwani, 1984 and Sharma and Chander, 1998) [7, 24].

Among the numerous approaches of whitefly management, use of plant products and chemical insecticides are the most common. The benefit of using systemic insecticides over contact insecticides is that in most cases they provide continuous protection through major period of the growing season without need for repeated applications.

Application of imidacloprid was extremely effective to control the whitefly population on tomato (Jha and Kumar, 2017) [17]. According to Meena and Ranju (2014) [21] very good management of whitefly was observed by profenophos followed by indoxacarb and NSKE. Hossain *et al.* (2013) [15] found imidacloprid significantly reducing whitefly population as compared to untreated control. The action of imidacloprid was very fast in terms of reduction of whitefly (Das and Islam, 2014) [9]. Ahirwar *et al.* (2009) [1] revealed that neem products such as NSKE and neem oil reduce nymph and adult population of whitefly significantly. NSKE 5% manage whitefly population up to 10 days of spray (Lal and Jat, 2015) [20]. The first spray with imidacloprid 17.8 SL @ 0.3 ml/L and second spray with dimethoate 30 EC @ 1.5 ml/L water was more effective in reduction of whitefly population and obtaining higher fruit yield (Kumar, 2018) [19]. Hence, based on reviews, importance of sucking insect pests on tomato and technological gap analysis, the experiment was carried out on 'Bio-efficacy of different pesticides against whitefly, *Bemisia tabaci* in tomato under field condition.

Materials and methods

The experiment was carried out under field condition at College farm of N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat during *Rabi* 2014-15. The tomato variety GT-2 was used in the experimentation. The experiment was laid out 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), lambda-cyhalothrin 5 EC 0.003% (6 ml/10 L of water), novaluron 10 EC 0.01 % (10 ml/10 L of water), imidacloprid 17.8 SC 0.005% (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), *Ha*NPV 250 Larval Equivalent per ha and untreated control (water spray). Twenty five days old disease free seedlings of 8-10 cm length were transplanted at 60 × 40 cm spacing and gap fillings were done as and when required. Timely hoeing and weeding operations were also carried out at appropriate crop stage. Timely irrigations were given at different stages of the crop. All the treatments were applied in the form of foliar spray with the help of knapsack spryer. First spray was given immediately after the white fly crossed the Economic Threshold Level (ETL) (3-5 flies/leaf) (Shivalingaswamy *et al.*, 2006) [25]. The crop was applied with recommended NPK doze of 180:60:60 kg/ha, respectively in three splits. Whitefly adults were recorded on five randomly selected plants on three randomly selected leaves (upper, middle and lower) during early morning hours with the help of hand lens of 10X magnification, one day before as well as 1, 3, 5, 7 and 15 days after spraying. Finally, the results were expressed as mean populations per leaf per plant. The data based on population of adult whitefly were statistically analysed at different intervals after spraying in randomized block design and overall population irrespective of post spray interval was thus assessed.

Results and discussion

The field experiment based on 'Bio-efficacy of different pesticides against whitefly, *Bemisia tabaci* in tomato was conducted under field condition during *Rabi* 2014-15. The observations on whitefly were recorded before as well at 1, 3, 5, 7 and 15 days after spraying. It is evident from the data presented in the Table 1 and depicted in Figure 1 that mean whitefly population before application of treatments did not differ significantly among the various plots confirming the homogeneity of the test population.

The results presented in Table 1 revealed that One day after spraying (DAS), all the treatments recorded significantly lower whitefly population than untreated control. The lowest population (2.05/leaf) was observed in dimethoate 0.03 percent which was followed by imidacloprid 0.005 percent (2.70 /leaf) which did not differ significantly from each other. The least effective treatment was in *Ha*NPV 250 LE/ha indicating highest population (6.90/leaf). Three days after spraying, all the treatments recorded significantly lower whitefly population as compared to control (water spray) wherein lowest whitefly population (1.70/leaf) was recorded in imidacloprid 0.005 percent followed by dimethoate 0.03 percent (1.95/leaf) which in turn was at par with it. On the other hand, highest population was observed in *Ha*NPV (6.90/leaf). Five days after spraying, lowest whitefly population was observed in imidacloprid 0.005 percent (1.80/leaf) and dimethoate 0.03 percent (1.80/leaf) treatments while, it remained highest in *Ha*NPV (10.95/leaf). Likewise, seven days after spraying, lowest whitefly population was observed in imidacloprid 0.005 percent (2.25/leaf) followed by 2.65 in dimethoate 0.03 percent which was at par with it. Highest population was observed in *Ha*NPV treatment (17.20/leaf). Fifteen days after spray, significantly lowest whitefly population (2.45/leaf) was observed in imidacloprid 0.005 percent followed by 2.65/leaf in dimethoate 0.03 percent which in turn were at par with each other. The treatment of *Ha*NPV (250LE/ha) was found least effective indicating highest number of whiteflies (14.85/leaf).

Looking to the overall effectiveness, there was similarity or consistency in the order of effectiveness of various treatments at various intervals after spraying. Lowest whitefly population was observed in imidacloprid 0.005 percent (2.18/leaf) followed by 2.22 in dimethoate 0.03 percent which in turn was at par with it. Next in the order of effectiveness was azadirachtin 3000 ppm at 3 mL/litre of water (5.69/leaf). This was followed by indoxacarb 0.005 percent (8.06/leaf) followed by 8.13 and 8.29 whiteflies in lambda-cyhalothrin 0.003 percent and novaluron 0.01 percent, respectively which were at par with it. Least effective treatment was *Ha*NPV indicating 11.36 whiteflies per leaf. On the other hand, untreated control plot observed highest whiteflies to the tune of 13.23 per leaf (Table 1 and Fig. 1).

It is evident from the data presented in Table 1 and depicted in Figure 1 that imidacloprid 0.005 percent was the most effective treatment against whitefly which was closely followed by dimethoate 0.03 percent. Amongst the biopesticides tested against the pest under discussion, azadirachtin was ranked third behind imidacloprid and dimethoate and was significantly superior over rest of the treatments. As *Ha*NPV was not specific to the whitefly, so it was not found effective against the pest and was the least effective treatment at all the intervals after spraying.

The findings of earlier workers (Gupta *et al.*, 2007; Singh *et al.*, 2010; Raghuraman and Birah, 2011; Garmonyou *et al.*, 2014 and Idris and Mandal, 2014) [14, 26, 23, 12, 16] revealed that dimethoate 30 EC (0.03%), imidacloprid 17.8 SL (0.005%), thiamethoxam 25 WG (0.025 %), lambda-cyhalothrin 5 EC (0.005%), novaluron 10 EC (0.02%) and fenthion were significantly superior in the control of whitefly and disease incidence and recorded higher yield in tomato crop. Whereas, other workers (Bharati *et al.*, 2015 and Chaudhari *et al.*, 2015) [5, 8] reported that imidacloprid 17.8 SL 0.004 percent followed by dimethoate 30 EC 0.03 percent were the most effective insecticides in controlling whitefly in brinjal and Indian bean. In the current findings, imidacloprid 17.8 SL (0.005%) and dimethoate 30 EC (0.03%) were proved most effective insecticides against whitefly which is also reported by earlier workers thus conforms the current investigation.

Table 1: Bio-efficacy of various pesticides against whitefly in tomato

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	3.37* (10.95)	1.43*^{a} (2.05)	1.44*^{ab} (1.95)	1.36*^{ab} (1.80)	1.65*^{ab} (2.65)	1.65*^{ab} (2.65)	1.51*^{ab} (2.22)
2.	Lambda-cyhalothrin 5 EC	0.003	3.38 (11.10)	2.19^{cde} (5.10)	2.01^{cde} (4.20)	3.01^{cde} (8.85)	3.16^{d} (9.60)	3.37^{def} (12.90)	2.75^{de} (8.13)
3.	Novaluron 10 EC	0.01	3.33 (10.95)	2.20^{cdef} (5.00)	2.02^{cdef}(4.25)	3.06^{cdef} (9.25)	3.31^{def} (10.80)	3.11^{d} (12.15)	2.74^{def} (8.29)
4.	Imidacloprid 17.8 SC	0.005	3.45 (11.65)	1.63^{ab} (2.70)	1.35^{a} (1.70)	1.32^{a}(1.80)	1.53^{a}(2.25)	1.54^{a}(2.45)	1.47^{a} (2.18)
5.	Indoxacarb 14.5 SC	0.005	3.46 (11.70)	2.18^{cd} (4.95)	1.94^{cd} (4.15)	2.96^{cd} (8.50)	3.16^{de} (9.95)	3.24^{de} (12.75)	2.70^{d} (8.06)
6.	Azadirachtin 3000 ppm	0.3	3.54 (12.40)	2.10^{c} (4.05)	1.91^{c} (3.40)	2.64^{c} (7.90)	2.65^{c} (7.00)	2.36^{c} (5.90)	2.33^{c} (5.69)
7.	*Ha*NPV	250 LE/ha	3.27 (10.65)	2.66^{g} (6.90)	2.67^{g} (6.90)	3.36^{defg} (10.95)	4.15^{g} (17.20)	3.67^{defg} (14.85)	3.30^{g} (11.36)
8.	Control (Water spray)	-	3.30 (10.70)	2.98^{h} (8.75)	3.00^{gh} (9.15)	3.61^{gh} (12.70)	4.33^{gh} (18.65)	4.07^{gh} (16.90)	3.60^{h} (13.23)
	SEm± (T)	-	0.12	0.11	0.12	0.17	0.14	0.22	0.10
	CD at 5 % (T)	-	NS	0.31	0.36	0.49	0.42	0.66	0.28
	SEm± (P x T)	-	-	-	-	-	-	-	0.13
	CD at 5 % (P x T)	-	-	-	-	-	-	-	NS
	CV (%)	-	7.17	9.77	11.86	12.48	9.49	15.57	11.21

*Data in the parenthesis indicate re-transformed values, while outside are Sq. root values. Treatment ranking $^{a, b...}$ as per DNMRT

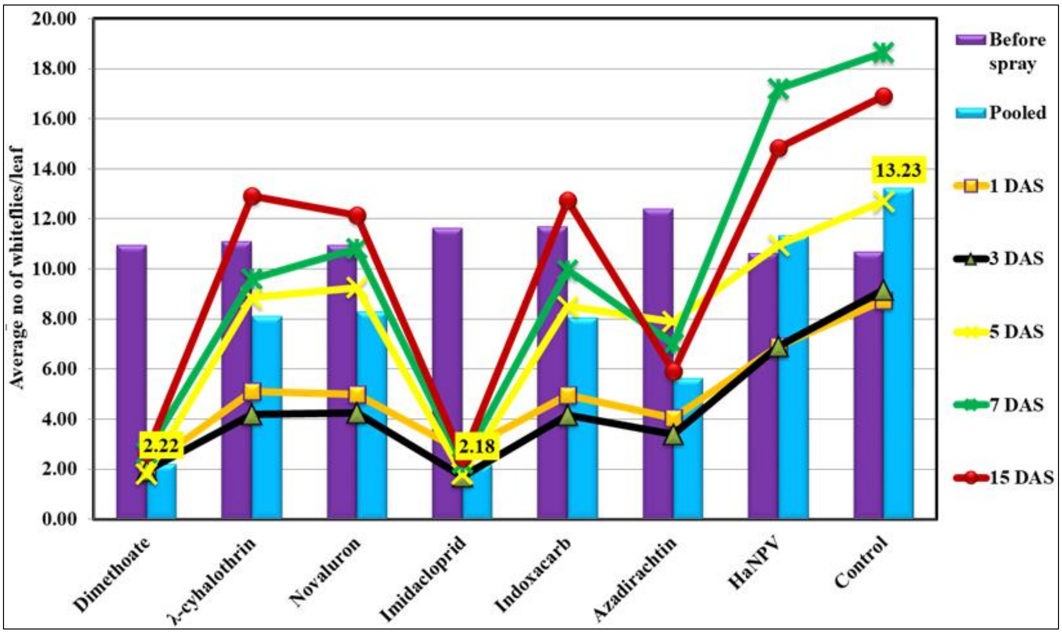

Fig 1: Bio- efficacy of various insecticides against whitefly on tomato

Conclusion

Among all the treatments, imidacloprid 17.8 SL at 0.005 percent and dimethoate 30 EC at 0.03 percent remained most effective for suppressing the whitefly population in tomato crop under field condition.

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