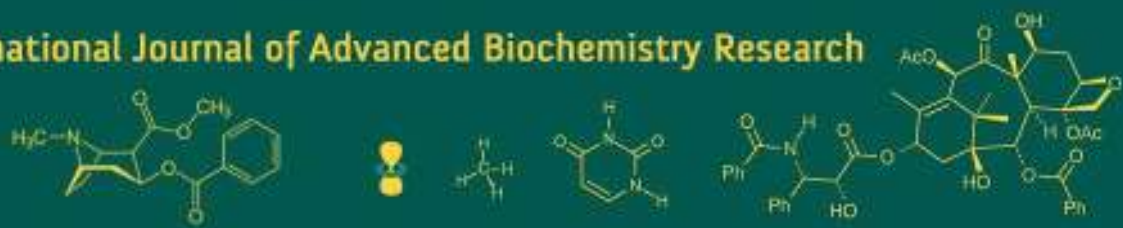


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Impact of abamectin 1.9% EC and diafenthiuron 50% WP on natural enemies and plant health while managing mites and thrips in mulberry

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Abstract

Experiment to evaluate the molecules with novel mode of action i.e., abamectin 1.9% EC and diafenthiuron 50% WP for safety period on mulberry silkworm, *Bombyx mori* L. against thrips and mites population, this doesn't produce any phyto-toxicity symptoms on mulberry plant at 1, 3, 8, 15 and 21 days after spraying indicating their suitability for safe use in mulberry for effective management of thrips and mites population and the natural enemy population was significantly higher upon spraying abamectin 1.9% EC @ 0.75 ml/l (4.75, 3.25, 3.75, 4.00 and 4.50 predators/plant during Jan-Feb, 2023 and 3.25, 3.25, 4.75, 5.25 and 4.25 predators/plant, during Mar-April, 2023 on 1, 3, 8, 15 and 21st DAS, respectively) that was on par with diafenthiuron 50% WP spray @ 1 g/l (4.50, 3.75, 4.50, 3.50 and 3.25 predators/plant during Jan-Feb, 2023 and 2.25, 3.50, 5.50, 4.50 and 4.25 predators/plant during Mar-April, 2023 on 1, 3, 8, 15 and 21st DAS, respectively) The estimated leaf yield (kg/ha/year) was significantly highest in abamectin 1.9% EC (@ 0.75 ml/l) followed by diafenthiuron 50% WP (@ 1 g/l) and cyenopyrafen 30% EC (@ 0.5 ml/l) (58244.11, 56757.62 and 56616.24 kg/ha/year, respectively) while the least yield was reported in azadiractin (52242.12 kg/ha/year).

Keywords: Novel insecticide, mulberry thrips, mites, sucking pests, phyto-toxicity, and natural enemies

1. Introduction

Mulberry (*Morus* spp.) is a versatile, fast-growing deciduous tree that is believed to have originated in the Himalayan foothills of India and China (Khan *et al.*, 2013; Yuan and Zhao, 2017; Rohela *et al.*, 2020) [10, 24, 13]. Mulberry is a unique plant that can adopt to a wide range of climates, soil conditions, and altitudes ranging from 0 to 4000 meters above sea level (Sarkar *et al.*, 2017) [16] and has over 1000 cultivated varieties, mainly in Asia (Sanchez, 2001) [15]. Southern Indian states like Karnataka, Andhra Pradesh, Tamil Nadu and Kerala have embraced sericulture, dedicating approximately 2,42,244 hectares to mulberry cultivation. However, the industry faces significant threats from sucking pests in mulberry cultivation especially; thrips are causing 42.55% infestation followed by mealy bugs 20.88%. Globally, 35 species of thrips pose a substantial threat and 21 reported from India. Mites, once considered as minor pests are now causing 5-10% of damage, worsened by climate change, creating a severe mite and thrips complex in sericulture regions. Climate change exacerbates this problem, impacting cocoon production and industry sustainability, demanding urgent measures to safeguard mulberry cultivation and the silk industry's future. The pesticide use pattern in the present day situation has led to pesticide residues in the harvestable produce, resistance build-up by pests and eradication of non-target organisms, which demands newer and safer pesticides with different modes of action. Abamectin (Avermectin B1) and diafenthiuron (1-tert-butyl-3-(2,6-diisopropyl thio-urea)) are two such newer molecules having novel insecticide and acaricidal activity against insect pests and mites either as neurotoxins (Abamectin) or by inhibiting or enhancing the metabolic processes such as respiration (diafenthiuron). Abamectin 1.9% EC is reported to be effective against phytophagous mites and insect pests on a variety of agricultural and horticultural crops worldwide (Lasota and Dybas, 1990) [11] and diafenthiuron 50% WP is reported to be

effective against whiteflies and leaf hoppers in brinjal, whiteflies, aphids and thrips in tomato, thrips and mites in chillies, tea and all sucking pests in cotton, diamond back moth (DBM), shoot and capsule borer and thrips in cardamom (Stanley *et al.*, 2016) [18] and thrips and mites in mulberry (Kalpana *et al.*, 2022) [8].

In light of this context, a comprehensive research endeavour has been formulated with the following primary goals to identify promising chemical compounds that can effectively replace DDVP in countering the infestation of thrips and mites in mulberry. This study aims to evaluate chemicals exhibiting dual insecticidal and acaricidal properties, with a specific focus on their compatibility and indigenous natural

predators within the mulberry ecosystem.

2. Materials and Methods

2.1 Experiment and site description

The experiment was conducted during 2022-23 in a well-established V-1 mulberry garden ((90+150)*60 cm (Paired row system)) following Randomized Complete Block Design (RCBD) with 7 treatments (Table 1) and four replications. The population of mites and thrips were recorded one day before and 1, 3, 8, 15, and 21 days after spraying (DAS) of the chemicals by visual scoring method. A total of five plants were selected and tagged in each replication for recording the observations.

Table 1: Treatment details

Treatments	Description	Group	Mode of Action	Dosage
T ₁	Diafenthiuron 50% WP	Thiourea derivatives	Inhibitors of mitochondrial ATP synthase	1 g/l
T ₂	Abamectin 1.9% EC	Macrocyclic lactones	Chloride channel activators	0.75 ml/l
T ₃	Diamethoate 30% EC	Organophosphate group	Acetylcholine esterase inhibitors	2 ml/l
T ₄	Cyanothiazin 30% EC	Pyrazole group	Mitochondrial electron transport inhibitor (METI)	0.5 ml/l
T ₅	Azadirachtin 10000 ppm	Limonoid group	Anti-feedant	1 ml/l
T ₆	Control (water spray)	-	-	-
T ₇	Absolute control	-	-	-

2.2 Statistical analysis

The data collected from the experimental field and silkworm rearing were analysed statistically by using one-way RCBD and CRD for testing of significance by Fisher's method of analysis of variance as outlined by Sundaraaj *et al.* (1972) [19]. The level of significance used in the F-test was $P = 0.05$. The critical difference (CD) values were computed to compare significance of the treatments.

2.3 Phytotoxicity

Phytotoxicity symptoms like leaf injury on tips or surface of leaves, wilting of the plants, vein clearing or discolouration on the leaves, necrosis (Figure 1), epinasty and hyponasty was taken into consideration and observations were made on these symptoms on 1st, 3rd, 8th, 15th and 21st DAS of insecticides. These symptoms were recorded based on the standard scoring method with 0-10 scale (Mazarura, 2001) [12] (Table 2).

2.4 Safety on natural enemies

The population of natural enemies was recorded before and after application of chemicals in the experimental site in order to study the safety of chemicals on their population. Pre-treatment count was recorded one day prior to spraying (DBS) and post treatment count was recorded on 1st, 3rd, 8th, 15th and 21st DAS.

Table 2: Standard score of phytotoxicity (Mazarura, 2001) [12]

Scale	Percentage of phytotoxicity symptoms
0	None
1	0 -10
2	11-20
3	21-30
4	31-40
5	41-50
6	51-60
7	61-70
8	71-80
9	81-90
10	91-100



A. Diamethoate 30% EC (@ 2 ml/l)



B. Cyanopyrafen 30% EC (@ 0.5 ml/l)

Fig 1: Necrotic symptoms in mulberry leaves due to pesticide spray

3. Results and Discussions

3.1 Phytotoxicity effect of chemical pesticides on mulberry under field condition

The chemicals not only act on the pests but also may cause injury to the plant if not used with right dosage and appropriate time. Further, if left to nature, the natural enemies like predators and parasitoids would kill different stages of pests without affecting the plant. An ideal chemical should therefore be safe for the plant and the natural enemies when used in the mulberry ecosystem. The chemicals abamectin 1.9% EC and diafenthiuron 50% WP

were evaluated for their phytotoxicity and safety to natural enemies and the observation are discussed in this section.

The chemicals were sprayed on mulberry plants as per the treatments and the phytotoxicity symptoms like injury on leaf tip or surface, wilting of the plants, vein clearing or discolouration on the leaves, necrosis, epinasty and hyponasty were observed at 1, 3, 8, 15 and 21 DAS through scoring method. The plants exhibited phytotoxicity symptoms in the form of necrosis as a result of spraying different pesticides.

The degree of necrosis found in the different treatments varied significantly. It was observed that the most

recommended insecticide, diamethoate 30% EC reported a necrosis score of 0.00, 0.25, 1.50, 2.00 and 1.75 during Jan-Feb, 2023 and 0.00, 0.25, 1.00, 0.50 and 1.75 during March-April, 2023, respectively on 1, 3, 8, 15 and 21 DAS when sprayed @ 2 ml/l. Similarly, the acaricide, cyenopyrafen 30% EC (@ 0.5 ml/l) reported a necrosis score of 0.00 on 1, 3 and 8 DAS, 0.75 and 0.50 respectively on 15 and 21 DAS during Jan-Feb, 2023 and 0.00, 0.25, 0.25, 1.00 and 0.5075, respectively on 1, 3, 8, 15 and 21 DAS during Mar-April, 2023. However, that effect was not noticed in any other treatments during both the seasons (Table 3, Figure 2).

Table 3: Phytotoxicity effect of selected pesticides on mulberry at different days after spray

Treatments	Period of treatment										Average				
	Jan - Feb, 2023					March- April, 2023									
	1 DAS	3 DAS	8 DAS	15 DAS	21 DAS	1 DAS	3 DAS	8 DAS	15 DAS	21 DAS	1 DAS	3 DAS	8 DAS	15 DAS	21 DAS
T ₁	0.00	0.00	0.00 ^b	0.00 ^b	0.00 ^b	0.00	0.00	0.00 ^b	0.00 ^b	0.00 ^b	0.00	0.00	0.00 ^b	0.00 ^b	0.00 ^b
T ₂	0.00	0.00	0.00 ^b	0.00 ^b	0.00 ^b	0.00	0.00	0.00 ^b	0.00 ^b	0.00 ^b	0.00	0.00	0.00 ^b	0.00 ^b	0.00 ^b
T ₃	0.00	0.25	1.50 ^a	2.00 ^a	1.75 ^a	0.00	0.25	1.00 ^a	0.50 ^{ab}	1.75 ^a	0.00	0.25	1.25 ^a	1.25 ^a	1.25 ^a
T ₄	0.00	0.00	0.00 ^b	0.75 ^b	0.50 ^b	0.00	0.25	0.25 ^b	1.00 ^a	0.50 ^b	0.00	0.00	0.13 ^b	0.88 ^a	0.88 ^a
T ₅	0.00	0.00	0.00 ^b	0.00 ^b	0.00 ^b	0.00	0.00	0.00 ^b	0.00 ^b	0.00 ^b	0.00	0.00	0.00 ^b	0.00 ^b	0.00 ^b
T ₆	0.00	0.00	0.00 ^b	0.00 ^b	0.00 ^b	0.00	0.00	0.00 ^b	0.00 ^b	0.00 ^b	0.00	0.00	0.00 ^b	0.00 ^b	0.00 ^b
T ₇	0.00	0.00	0.00 ^b	0.00 ^b	0.00 ^b	0.00	0.00	0.00 ^b	0.00 ^b	0.00 ^b	0.00	0.00	0.00 ^b	0.00 ^b	0.00 ^b
F-test	NS	NS	*	*	*	NS	NS	*	*	*	NS	NS	*	*	*
S. Em ±	-	-	0.730	0.761	0.620	-	-	0.511	0.592	0.622	-	-	0.548	0.536	1.071
CD _{0.05}	-	-	0.241	0.250	0.207	-	-	0.171	0.190	0.212	-	-	0.183	0.179	0.358
CV	-	-	7.712	8.501	8.501	-	-	9.971	5.920	8.510	-	-	6.30	4.290	6.291

T₁= Diafenthiuron 50% WP (@ 1 g/l); T₂= Abamectin 1.9% EC (@ 0.75ml/l); T₃=Diamethoate 30% EC @ 2 ml/l; T₄=Cyanopyrafen 30% EC @ 0.5ml/l; T₅=Azadirachtin 1% EC @ 1ml/l; T₆= Control (water spray); T₇= Absolute control.

*Significant at 0.05; DAS: Days after spray of the chemical; NS: Non significant; Numbers superscript with same alphabets are statistically on pa

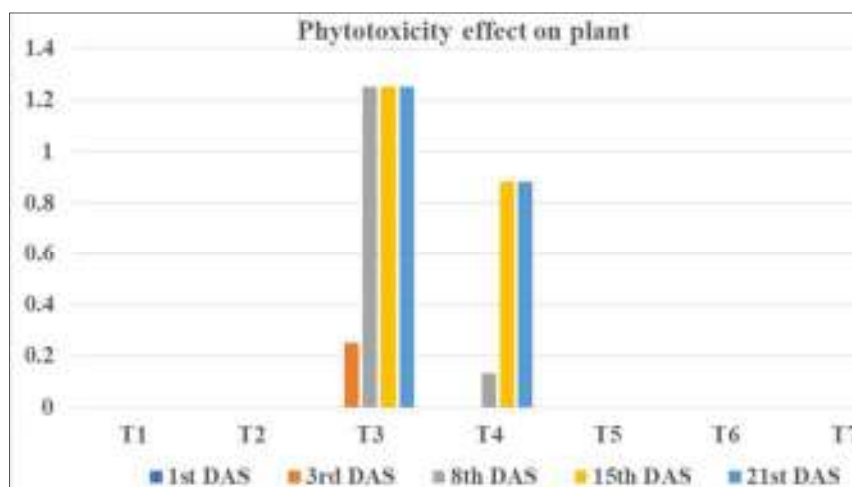


Fig 2: Graphical representation of phytotoxicity effect of selected pesticides on mulberry at different days after spray

Irrespective of the season of spray, diamethoate 30% EC (@ 2 ml/l) and cyenopyrafen 30% EC (@ 0.5ml/l) showed necrosis (0.00, 0.25 on 1st, 3rd DAS; 1.25 on 8,15 and 21st DAS of dimethoate 30% EC and 0.00 on 1, 3 DAS; 0.13 on 8 DAS and 0.88 on 15, 21st DAS of cyenopyrafen 30% EC) (Table 3).

An ideal pesticide is the one which produces no or negligible phytotoxicity symptoms on the plant when sprayed at a specific concentration but should effectively control the pest against which it is used. Kalpana (2022) [8] reported that abamectin 1.9% EC (@ 0.75 ml/l) and diafenthiuron 50% WP (@ 1 g/l) were did not showing any phototoxicity at 15 and 21 DAS, which was used in current

study. Aravind *et al.* (2017) [2] did not observe any phytotoxic symptoms (Necrosis, epinasty and hyponasty) on cardamom at 1, 3, 7, 10, 14 and 20 DAS of diafenthiuron 50% WP. Yeshika *et al.* (2020) [22] reported that among different chemicals used to control mealy bugs in mulberry, flonicamid 50% WG (0.15 and 0.3 g/l) exhibited phytotoxicity symptoms at 7 and 15 DAS.

3.2 Population of coccinellid predators/plant at different days after spray of selected chemicals in mulberry ecosystem

Coccinellids are very effective as predators on thrips and mite pests. Different species of coccinellids were observed

on the mulberry plant (Figure 4). The population count of different coccinellids was recorded separately per plant counted before (Pre) and after (Post) spray of chemicals and the observations are compared across the treatments.

The pre-treatment count of coccinellid population was recorded at a day before spray of the chemicals (4.07 and 5.18 coccinellid predators/plant during Jan-Feb, 2023 and March-April, 2023, respectively). The number of coccinellid predators observed per plant varied significantly across the treatments. Highest number of coccinellids were observed on absolute control (4.75, 4.50, 4.75, 5.00 and 4.50 predators/plant, respectively on 1, 3, 8, 15 and 21st DAS during Jan-Feb, 2023 and 4.50, 4.25, 5.75, 6.25 predators/plant 6.50 respectively on 1, 3, 8, 15 and 21st DAS during Mar-April, 2023) and water spray (4.25, 4.00, 4.25, 4.50 and 4.25 predators/plant respectively on 1, 3, 8, 15 and 21st DAS during Jan-Feb, 2023 and 3.50, 3.00, 5.50, 5.50, 6.25 predators/plant, respectively on 1, 3, 8, 15 and 21st DAS during Mar-April 2023) where the plants were not sprayed with any chemicals (Table 4, Figure 3).

Among different chemicals used in the form of spray solution, azadirachtin 10000 ppm (@ 1 ml/l) recorded least population of coccinellid predators (0.75, 1.50, 1.25, 1.75 and 0.75 predators/plant, respectively on 1, 3, 8, 15 and 21st

DAS during Jan-Feb, 2023 and 1.25, 1.50, 1.25, 1.50 and 1.25 predators/plant, respectively on 1, 3, 8, 15 and 21st DAS during Mar-April, 2023) and diamethoate 30% EC sprayed @ 2 ml/l (2.00, 1.25, 0.75 1.00 and 1.75 predators/plant, respectively on 1, 3, 8, 15 and 21st DAS during Jan-Feb, 2023 and 0.75, 1.25, 1.50, 1.25 and 1.50 predators/plant, respectively on 1, 3, 8, 15 and 21st DAS during Mar-April, 2023) followed by cyenopyrafen 30% EC sprayed @ 0.5 ml/l (1.00, 1.75, 2.50, 2.00 and 1.50 predators/plant, respectively on 1, 3, 8, 15 and 21st DAS during Jan - Feb, 2023 and 1.00, 0.75, 3.25, 3.00 and 3.25 predators/plant, respectively on 1, 3, 8, 15 and 21st DAS during Mar-April, 2023). On contrary to this, the natural enemy population was significantly higher upon spraying abamectin 1.9% EC @ 0.75 ml/l (4.75, 3.25, 3.75, 4.00 and 4.50 predators/plant during Jan-Feb, 2023 and 3.25, 3.25, 4.75, 5.25 and 4.25 predators/plant, during Mar-April, 2023 on 1, 3, 8, 15 and 21st DAS, respectively) that was on par with diafenthiuron 50% WP spray @ 1 g/l (4.50, 3.75, 4.50, 3.50 and 3.25 predators/plant during Jan - Feb, 2023 and 2.25, 3.50, 5.50, 4.50 and 4.25 predators/plant during Mar-April, 2023 on 1, 3, 8, 15 and 21st DAS, respectively) (Table 4).

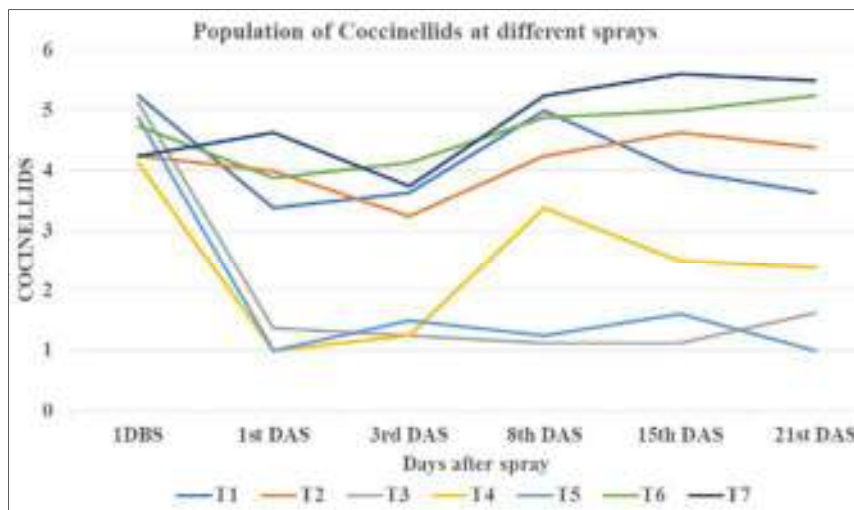


Fig 3: Graphical representation of coccinellid predators/plant population at different days after spray



Fig 4: Natural enemies associated with mulberry ecosystem

The chemicals present in pesticides and acaricides possess repellent and anti-feeding property that might influence the insects including natural enemies and other beneficial organisms along with the targeted pests (Khan *et al.*, 2014) [9]. The repellent action of chemical molecules might affect

the population of coccinellids (Yeshika *et al.*, 2019) [21]. Hence spraying of plain water like rain, irrigation and water jetting might conserve the natural enemies like coccinellid predators while reduce the population of minute sucking pests like thrips and mites, which is evidenced in the present

study. Sakthivel *et al.* (2011) ^[41] reported that the predatory coccinellids were also killed significantly along with the major sucking pests when chemical control was followed in mulberry while water jetting recorded no deleterious effect. Abamectin and diafenthiuron were found safer to natural

enemies in various crops (Singh *et al.*, 2017) ^[17].

Kalpna (2022) ^[8] studied that among six selected chemical molecule abamectin 1.9% EC (@ 0.75 ml/l) and diafenthiuron 50% WP (@ 1 g/l) found safer to natural enemies of mulberry ecosystem.

Table 4: Population of coccinellid predators (No. /plant) at different days after spray of selected chemicals in mulberry ecosystem

Treatments	Period of treatment												Average					
	Jan - Feb, 2023						March- April, 2023											
	1 DBS	1 DAS	3 DAS	8 DAS	15 DAS	21 DAS	1 DBS	1 DAS	3 DAS	8 DAS	15 DAS	21 DAS	1 DBS	1 DAS	3 DAS	8 DAS	15 DAS	21 DAS
T ₁	4.75	4.5 ^a	3.75 ^{ab}	4.50 ^a	3.50 ^{abcd}	3.25 ^{ab}	5.75	2.25 ^{bcd}	3.50 ^{ab}	5.50 ^a	4.50 ^{ab}	4.00 ^{abc}	5.25	3.38 ^{abc}	3.63 ^a	5.00 ^a	4.00 ^{ab}	3.63 ^{abc}
T ₂	3.25	4.75 ^a	3.25 ^{ab}	3.75 ^{ab}	4.00 ^{abc}	4.50 ^a	5.25	3.25 ^{abc}	3.25 ^{abc}	4.75 ^{ab}	5.25 ^a	4.25 ^{ab}	4.25	4.00 ^a	3.25 ^{ab}	4.25 ^a	4.63 ^a	4.38 ^{ab}
T ₃	4.25	2.00 ^b	1.25 ^c	0.75 ^c	1.00 ^d	1.75 ^{bc}	6.00	0.75 ^d	1.25 ^{cd}	1.50 ^b	1.25 ^b	1.50 ^{bc}	5.13	1.38 ^{bc}	1.25 ^b	1.13 ^b	1.125 ^c	1.63 ^{cd}
T ₄	3.25	1.00 ^b	1.75 ^{bc}	2.50 ^{abc}	2.00 ^{bcd}	1.50 ^{bc}	5.00	1.00 ^d	0.75 ^d	3.25 ^{ab}	3.00 ^{ab}	3.25 ^{bc}	4.13	1.00 ^c	1.25 ^b	3.38 ^{ab}	2.50 ^{bc}	2.38 ^{bcd}
T ₅	3.75	0.75 ^b	1.50 ^c	1.25 ^{bc}	1.75 ^{cd}	0.75 ^c	6.00	1.25 ^{cd}	1.50 ^{bcd}	1.25 ^b	1.50 ^b	1.25 ^c	4.88	1.00 ^c	1.5 ^b	1.25 ^b	1.625 ^c	1.00 ^d
T ₆	5.25	4.25 ^a	4.00 ^a	4.25 ^a	4.5 ^{ab}	4.25 ^a	4.25	3.50 ^{ab}	3.00 ^{abc}	5.50 ^{ab}	5.50 ^a	6.25 ^a	4.75	3.88 ^{ab}	4.13 ^a	4.88 ^a	5.00 ^a	5.25 ^a
T ₇	4.00	4.75 ^a	4.50 ^a	4.75 ^a	5.00 ^a	4.50 ^a	4.00	4.50 ^a	4.25 ^a	5.75 ^a	6.25 ^a	6.50 ^a	4.25	4.63 ^a	3.75 ^a	5.25 ^a	5.625 ^a	5.50 ^a
F-test	NS	*	*	*	*	*	NS	*	*	*	*	*	NS	*	*	*	*	*
S. Em ±	-	1.318	1.365	0.868	0.795	0.589	-	1.002	1.757	1.126	1.095	1.141	-	0.809	0.975	0.710	0.521	0.760
CD _{0.05}	-	2.281	1.723	2.598	2.381	1.764	-	1.130	1.820	3.371	3.278	1.751	-	2.421	2.370	2.136	1.548	2.26
CV	-	8.890	5.547	6.272	7.241	8.331	-	5.010	4.566	5.920	9.481	5.482	-	8.803	7.780	9.750	9.541	4.501

T₁= Diafenthiuron 50% WP (@ 1 g/l); T₂= Abamectin 1.9% EC (@ 0.75ml/l); T₃=Diamethoate 30% EC @ 2 ml/l; T₄=Cyanopyrafen 30% EC @ 0.5ml/l; T₅=Azadirachtin 1% EC @ 1ml/l; T₆= Control (Water spray); T₇= Absolute control.

DBS = Day before Spray, DAS: Days after Spray of the chemical; *Significant at 0.05; Numbers superscript with same alphabets are statistically on par.

3.3 Effect of application of selected chemicals on leaf yield (kg/ ha/year) in mulberry at 60 DAP

The mulberry leaf yield estimated on 60th DAP recorded significant difference among different chemicals sprayed on mulberry for management of thrips and mites (Table 5). The estimated leaf yield (kg/ha/year) was significantly highest in abamectin 1.9% EC (@ 0.75 ml/l) followed by diafenthiuron 50% WP (@ 1 g/l) and cyanopyrafen 30% EC (@ 0.5 ml/l) (58244.11, 56757.62 and 56616.24 kg/ha/year, respectively) while the least was reported in azadirachtin (52242.12 kg/ha/year) (Table 5, Figure 5).

The pesticides can produce negative effects on physiological processes, especially the photosynthesis of crop plants

leading to substantial reduction in both growth and productivity (Gimenez-Moolhuyzen *et al.*, 2020) ^[4]. The negative effects of various pesticides on photosynthesis have been reported in different crops viz., lettuce (Toscano *et al.*, 1982; Johnson *et al.*, 1983 and Haile *et al.*, 2000) ^[20, 6, 5], alfalfa (Haile *et al.*, 2000) ^[5], cotton (Youngman *et al.*, 1990) ^[23], citrus (Jones *et al.*, 1983) ^[7] and soybean (Abdel-Reheem *et al.*, 1991) ^[1]. However, the right time and dosage might be advantageous as reported by Chung *et al.* 2000 ^[3] who obtained high yields with low damage to the egg fruit by the use of molecule, abamectin 1.8% EC as a spray in the eggplant.

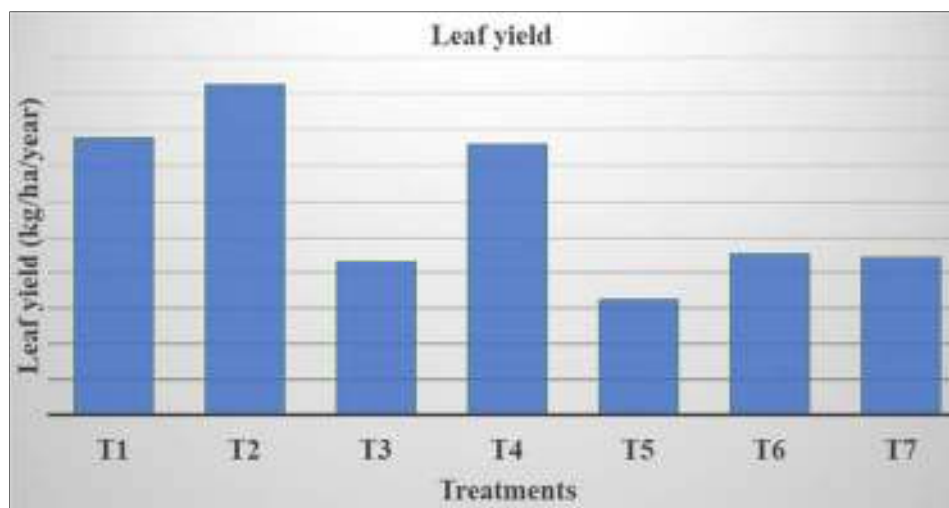


Fig 5: Graphical representation of leaf yield (kg/ ha/year) in mulberry at 60 DAP among different treatments

Table 5: Effect of application of selected chemicals on mulberry leaf yield (kg/ha/year) at 60 DAP

Treatments	Leaf yield (kg/ha/year)
T ₁	56757.62 ^{ab}
T ₂	58244.11 ^a
T ₃	53309.24 ^b
T ₄	56616.24 ^{ab}
T ₅	52242.12 ^b
T ₆	53548.49 ^b
T ₇	53440.02 ^b
F-test	*
S. Em ±	1,149.74
CD _{0.05}	3,442.51
CV	4.191

T₁= Diafenthiuron 50% WP (@ 1 g/l); T₂= Abamectin 1.9% EC (@ 0.75ml/l); T₃=Diamethoate 30% EC @ 2 ml/l; T₄=Cyanopyrafen 30% EC @ 0.5ml/l; T₅=Azadirachtin 1% EC @ 1ml/l; T₆= Control (water spray); T₇= Absolute control.

*Significant at 0.05; DAS: Days after Spray of the chemical; Numbers superscript with same alphabets are statistically on par.

4. Summary

Safety of chemical pesticides to the natural enemies on mulberry was assessed during both Jan-Feb, 2023 and Mar-April 2023 in mulberry. Among the pesticides sprayed on mulberry, and abamectin 1.9% EC (@ 0.75 ml/l) and diafenthiuron 50% WP (@ 1 g/l) recorded highest flourishing coccinellid population (4.00, 3.25, 4.25, 4.63, 4.38 and 3.38, 3.63, 5.00, 4.00, 3.63) on par with the control (4.63, 3.75, 5.25, 5.62, 5.50) on 1, 3, 8, 15 and 21 DAS, respectively. The leaf yield recorded maximum of 58244.11 kg/ha/year in abamectin 1.9% EC (@ 0.75 ml/l) and 56757.62 kg/ha/year in diafenthiuron 50% WP (@ 1 g/l) reflecting that the use of these two molecules has yield advantage in mulberry apart from effective management of thrips and mites.

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