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Bioefficacy, phytotoxicity and safety of Virtako 1.5 Gr a premixed commercial insecticide against thrips, black cutworm and natural enemies in onion

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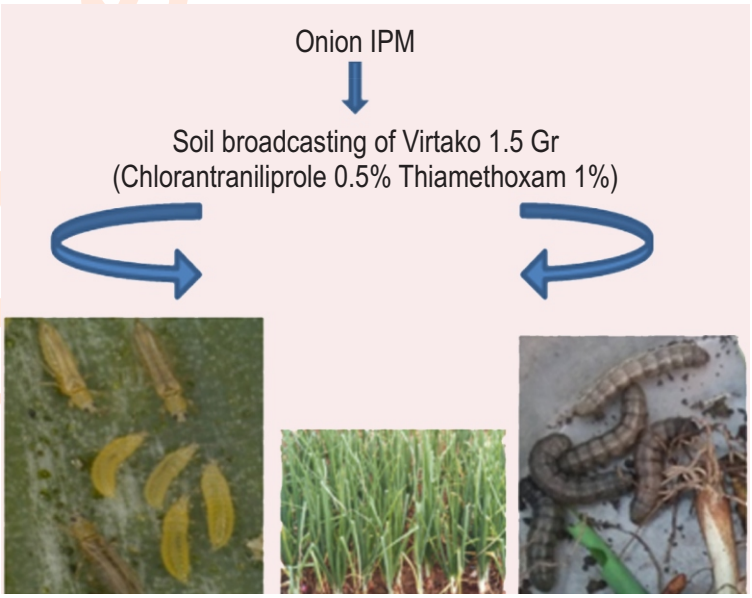
Abstract

Aim: This study aimed to evaluate the relative field-efficacy, natural enemies safety and phytotoxicity of premixed soil insecticide formulation Virtako 1.5 Gr (Chlorantraniliprole 0.5% + Thiamethoxam 1%) against onion thrips (*Thrips tabaci*) and black cutworm (*Agrotis ipsilon*) infesting onion.

Methodology: Two field experiments were conducted in successive years (2017-18 & 2018-19) to evaluate the bio-efficacy of Virtako 1.5® Gr against thrips, cutworms and natural enemies in onion. The desired dosage of Virtako 1.5® Gr was applied as soil broadcasting after 10 days of transplanting. Thrips population, cutworm damage, natural enemies and phytotoxicity observation were made using standard procedures.



Results: The results revealed that Virtako® 1.5 Gr applied @ 105 and 90 g a.i ha^{-1} recorded the lowest mean thrips population, 18.03 and 19.50 thrips per plant, respectively. Similarly, Virtako 1.5 Gr at 105 a.i. ha^{-1} reduced cutworm damage by 88.5%, followed by Virtako 1.5 Gr at 90 g a.i. ha^{-1} (85.5%). Although no natural enemies' activity (Coccinellids, *Orius* spp, and Spiders) was found in the early phase of onion growth, they were recorded in all treatments at later crop growth stages. All doses of Virtako 1.5 Gr had no noticeable phytotoxicity effects on onion plants.

Interpretation: Application of Virtako 1.5 Gr effectively minimized thrips population and cutworm damage in onions. Further, it did not show any significant harmful impact on the activity to above-ground natural enemies. Therefore, Virtako 1.5 Gr at a lower effective dose 90 g a.i ha^{-1} can be recommended for onion against thrips and black cutworm.

Key words: Cutworm, Onion thrips, Premixed insecticide, Phytotoxicty, Virtako 1.5 Gr

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Introduction

Onion is one of the important bulb vegetables grown in India and other parts of the world. India ranks first in cultivation area and second in production, with 1.43 million hectares and 22.40 mt production (FAOSTAT, 2020). The major producing states are Maharashtra, Karnataka, Gujarat, Bihar, Madhya Pradesh, Rajasthan, Andhra Pradesh and Tamil Nadu, with Maharashtra alone accounting for 33% of the national production. Like any other crop, onion is attacked by several insect pests at various crop growth stages, and it is one of the significant constraints for yield reduction. Among these, onion thrips *Thrips tabaci* Lindeman (Thysanoptera: Thripidae) is a major pest of national significance (Gupta *et al.,* 1991) and black cutworm, *Agrotis ipsilon* Hufnagel (Lepidoptera: Noctuidae) being a pest of regional importance in India (Satyagopal *et al.,* 2014). The estimated yield losses due to insect pests and disease in onion are up to 10-15% (Gupta *et al.,* 1994) Thrips causes curling and blistering white patches on the leaves, leads to reduced photosynthesis, ultimately resulting in the formation of undersized bulbs (Hussein *et al.,* 2015) and also aggravates fungal disease such as purple blotch and act as a vector of Irish Yellow Spot Virus (IYSV) in onion (Arantha, 1980; Pozzer *et al.,* 1999). Black cutworm, *A. ipsilon* is a defoliator pest attacking onion, and the early instar larva damages the tender foliage of young seedlings whereas the late instar completely cuts through the stalks causing plant death (Capinera, 2001).

Insecticides have been used widely to control onion thrips and other important onion pests for onion production worldwide. Moreover, insecticides remain an ultimate tool in the onion integrated pest management (IPM) system because of their rapid action, efficiency, cost-effectiveness, ease of application and lack of adequate alternative strategies (Reitz, 2014). Worldwide, insecticides belonging to organophosphate, carbamates, pyrethroid, phenylpyrazole, neonicotinoids, avermectins, and diamide groups have proven effective against onion pests. The majority of these insecticides are selective in their action and to certain pests making them less effective against a broad range of pest species. The occurrence of multiple arthropod (insect and mite) pest species, including thrips and cutworms, is an issue that has been encountered simultaneously in onion (Soumia *et al.,* 2017). Many insecticides recommended for onion thrips may not be effective against *A. ipsilon*. This situation compelled farmers to use more sprays when there was a diversity of pests and resulted in increased control cost, development of insecticide resistance and ecological harm from overuse of the pesticide.

The use of premixed insecticide formulations in pest management provides many benefits, including synergistic effects and other desirable properties such as application flexibility and lower labour costs (Roy *et al.,* 2017). The use of premixing insecticides with different properties such as contact and systemic actions can simultaneously control the chewing and sucking pests. Insecticide combinations having a dual mode of action are the best alternative to manage the multiple pests economically. Mixtures may enhance the overall target spectra, enabling the control of a wide range of pests and can be a potential candidate for thrips and cutworms that infest onion. Therefore, the present study aimed to evaluate the potential of premixed insecticide formulation, Virtako 1.5 Gr, against onion pests and its safety to natural enemies under open field conditions.

Materials and Methods

Two field experiments were carried out for two successive years (2017-18 and 2018-19) in rabi season to evaluate the bio-efficacy of commercial grade granular insecticide Virtako® 1.5 Gr obtained from Syngenta India Ltd., as soil broadcasting against onion thrips and black cutworm in transplanted onion variety Bhima Kiran. Experiments were undertaken from December to May month at ICAR-Directorate of Onion and Garlic Research (DOGR), Pune, India. The crop was transplanted during mid-December and harvested in early-May. The soil of experimental plots was sandy loam in texture with 32-35% clay, 40% sand, and 20% silt with 7.9 pH. The average temperature and relative humidity during the study period was 22.6°C and 62.9%, respectively. The recommended dose of potassium, phosphorus, and sulfur and half dose of nitrogen was applied at the time of transplanting, and the remaining nitrogen was applied in splits doses at 30, 45, and 60 days after transplanting (DAT).

Recommended agronomic practices, including raised beds, hand weeding were performed to combat weeds and recommended fungicide was sprayed against diseases. Irrigation was carried out drip every week. Virtako 1.5 Gr @ different doses as soil broadcasting and other treatments were applied after 10 days of transplanting. All the treatments were replicated three times with a plot size of 50 m^2. The treatments included: T_1 – Check (Untreated), T_2 – Virtako 1.5 Gr at 75 g a.i. ha^{-1}, T_3 – Virtako 1.5 Gr at 90 g a.i. ha^{-1}, T_4 – Virtako 1.5 Gr at 105 g a.i. ha^{-1}, T_5 – Chlorantraniliprole 0.4 Gr at 35 g a.i. ha^{-1}, T_6 – Thiamethoxam 75 SG at 70 g a.i. ha^{-1}, T_7 – Fipronil 80% SG at 60 g a.i. ha^{-1} and T_8– Dimethoate at 200 g a.i. ha^{-1}. The observation of onion thrips, *T. tabaci* (nymphs and adults) population was made from the top five leaves of each onion plant. In each replication, ten plants were counted.

The pre and post-treatment counts were made at 7, 14, 21, 28, 35 and 42 days after treatments. The cutworm damage was documented by recording the total number of cutworm damaged and undamaged plants in each treatment before and after treatment, *i.e.,* at 7, 14, 21, 28, 35 and 42 days. Safety of Virtako 1.5 Gr was evaluated on the natural fauna of (spiders, coccinellids and Orius spp) onion ecosystem. Treatment wise data were pooled and were subjected to normalization using square root transformation and analyzed in a randomized block design (RBD) using SPSS v.16.0 software for tests of least significant difference (Critical difference). The phytotoxicity effect of Virtako 1.5 Gr at different doses was observed. Symptoms of phytotoxicity *viz.,* leaf injury, wilting, vein clearing, necrosis, yellowing, stunting, epinasty and hyponasty were observed at 1, 3, 5, 7, 10 and 15 days after application. The leaf injury was assessed by visual rating on a 0-10 scale (CIB, 1989). Onion bulb yield per plot was recorded from each replication and pooled to arrive at total yield. Finally, it was computed to tonnes ha^{-1}.

Treatment wise bulb yield were subjected to analysis of variance and Tukey's honest significance test for mean yield comparisons.

Results and Discussion

The thrips population before soil application of Virtako 1.5 Gr at 75, 90 and 105 g a.i. ha^{-1} and other treatments ranged from 1.4 to 2.1 thrips per plant. No statistically significant difference was observed among the treatments with regard to thrips population before treatment (Table 1). Virtako 1.5 Gr at 105 g a.i. ha^{-1} recorded the lowest mean population of thrips at 7, 14, 21, 28, 25 and 42 days after treatment and it was on par with Fipronil 80% SG at 7 days after treatment. The mean population at 7, 14, 21, 28, 25 and 42 was 7.68, 11.76,16.13, 22.16, 24.36 and 26.10 thrips per plant whereas the mean population in untreated plots was 14.56, 21.25, 37.53, 49.26, 49.16 and 68.53 thrips per plant at 7, 14, 21, 28, 35 and 42 days after treatment, respectively. At 7 days after treatment, the mean population of thrips in Fipronil treated plots was 6.60, which was on par with T_4- Virtako 1.5 Gr at 105 a.i. ha^{-1}. Further, Virtako 1.5 Gr at 105 g a.i. ha^{-1} was on par with treatment Virtako 1.5 Gr at 90 g a.i. ha^{-1} regardless of observation dates. A significant difference in mean thrips population was observed among the various treatments, and this difference was consistent irrespective of date of observation. A steady growing trend in thrips population was recorded from 7 day to 42 days after treatment. However, the mean population was less than 20.0 thrips per plant with treatment T_3 and T_4 till 21 days after treatment, whereas less than 30.0 thrips (22.1 to 27.9 thrips per plant) was recorded at 28 DAT and 42 DAT. The pooled mean of all six observations dates (7,14, 21, 28, 35 and 42 DAT) among different treatments were 40.06, 25.83, 19.50, 18.03, 29.66, 27.86, 28.60 and 37.96 thrips per plant in T_1– Untreated Check, T_2– Virtako 1.5 Gr at 75 g a.i. ha^{-1}, T_3 –Virtako 1.5 Gr at 90 g a.i. ha^{-1}, T_4 – Virtako 1.5 Gr at 105 g a.i. ha^{-1}, T_5 – Chlorantraniliprole 0.4 Gr at 35 g a.i. ha^{-1}, T_6 – Thiamethoxam 75 SG at 70 g a.i. ha^{-1}, T_7 – Fipronil 80% SG at 60 g a.i. ha^{-1} and T_8–Dimethoate at 200 g a.i. ha^{-1}. The data on percent reduction over untreated control revealed that T_4 –Virtako at 105 g a.i. ha^{-1} (54.99%) most effective in reducing thrips population, followed by T_3 –Virtako at 90 g a.i. ha^{-1} (51.32%), and T_2–Virtako at 75 g a.i. ha^{-1} (35.52%).

The percent reduction over control in the treatments T_5 – Chlorantraniliprole 0.4 Gr at 35 g a.i. ha^{-1}, T_6 – Thiamethoxam 75 SG at 70 g a.i. ha^{-1}, T_7 – Fipronil 80% SG at 60 g a.i. ha^{-1} and T_8– Dimethoate at 200 g a.i. ha^{-1} was 25.96, 30.45, 28.61 and 5.21 per cent, respectively. The order of relative efficacy based on percent reduction over untreated control after a single application of Virtako 1.5 Gr was T4> T3>T2>T6>T7>T8>T1. There was no cutworm damage prior to application, *i.e.,* till 10 days of transplanting. However, the damage noticed at 28 DAT onwards. At 28, 35 and 42 days after treatment, the percentage of plant damage ranged from 1.33- 9.56, 1.36- 9.76, and 1.36-11.56, respectively. The mean damage ranged from 1.36-10.30 percent. The plots treated with Virtako 1.5 Gr at 105 g a.i. ha^{-1} and Virtako 1.5 Gr at 90 g a.i. ha^{-1} had the least cutworm damage and were on par followed by Chlorantraniliprole 0.4% Gr. The order of percent reduction over control was Virtako 1.5 Gr at 105 g a.i. ha^{-1} (86.8%)

Table 1: Field efficacy of Virtako 1.5 Gr against onion thrips (*T. tabaci*) during 2017-18 and 2018-19

Treaentstm	Avg. no. of Thrips/plant							Mean	PRC
	PTC	7 DAT	14 DAT	21 DAT	28 DAT	35 DAT	42 DAT		
Untreated check	2.1	14.56 (3.81)	21.25 (4.60)	37.53 (6.12)	49.26 (7.01)	49.16 (7.01)	68.53 (8.27)	40.06 (6.32)^{g}	–
Virtako 1.5 GR @ 75 g a.i ha^{-1}	1.9	12.33 (3.51)	16.51 (4.06)	24.36 (4.93)	33.13 (5.75)	36.83 (6.06)	31.70 (5.62)	25.83 (5.08)^{c}	35.52
Virtako 1.5 @ 90 g a.i ha^{-1}	1.4	8.43 (2.90)	12.51 (3.53)	17.26 (4.15)	23.13 (4.80)	27.93 (5.28)	27.93 (5.28)	19.50 (4.41)^{b}	51.32
Virtako 1.5 GR @ 105 g a.i ha^{-1}	1.6	7.68 (2.77)	11.76 (3.42)	16.13 (4.01)	22.16 (4.70)	24.36 (4.93)	26.10 (5.10)	18.03 (4.24)^{a}	54.99
Chlorantraniliprole 0.4% Gr.	1.7	11.36 (3.37)	17.78 (4.21)	27.56 (5.24)	33.80 (5.81)	44.76 (6.68)	42.76 (6.53)	29.66 (5.44)^{e}	25.96
Thiamethoxam 75% SG	1.9	10.70 (3.27)	16.53 (4.06)	26.00 (5.09)	39.70 (6.29)	34.66 (5.88)	39.70 (6.29)	27.86 (5.27)^{d}	30.45
Fipronil 80% WG	1.9	6.60 (2.56)	15.45 (3.93)	26.56 (5.15)	33.56 (5.79)	41.83 (6.46)	47.60 (6.89)	28.60 (5.34)^{de}	28.61
Dimethoate 30% EC	1.8	9.66 (3.10)	18.28 (4.27)	36.80 (6.06)	45.23 (6.72)	53.50 (7.31)	64.20 (8.01)	37.96 (6.16)^{f}	5.21
C.D. (0.05)	NS	0.786	1.079	2.352	3.358	3.62	2.82	1.076	
SE(m)		0.257	0.352	0.768	1.096	1.182	0.921	0.351	
SE(d)		0.363	0.498	1.086	1.551	1.672	1.302	0.497	

PTC-Pre-treatment count; DAT-Date after transplanting; PRC-Percent reduction over control; Values in parentheses are square root transformed; Values in the same column followed by same letters are not significantly different at p = 0.05

Table 2: Field efficacy of Virtako 1.5 Gr against cutworm (*Agrotis ipsilon*) in onion during 2017-18 and 2018-19

Treatments	Percent damage of onion plants				Mean	PRC
	PTD	28 DAT	35 DAT	42 DAT		
Untreated check	0	9.56 (3.08)	9.76 (3.12)	11.56 (3.39)	10.30 (3.20)^{d}	–
Virtako 1.5 GR @ 75 g a.i ha^{-1}	0	3.96 (1.98)	5.03 (2.24)	3.36 (1.82)	4.13 (2.03)^{bc}	59.9
Virtako 1.5 GR @ 90 g a.i ha^{-1}	0	1.90 (1.36)	1.56 (1.24)	1.76 (1.32)	1.73 (1.31)^{a}	83.2
Virtako 1.5 GR @ 105 g a.i ha^{-1}	0	1.33 (1.15)	1.36 (1.16)	1.36 (1.16)	1.36 (1.16)^{a}	86.8
Chlorantraniliprole 0.4% Gr.	0	3.06 (1.75)	3.86 (1.95)	2.70 (1.60)	3.23 (1.79)^{b}	68.6
Thiamethoxam 75% SG	0	5.46 (2.33)	6.26 (2.49)	5.03 (2.23)	5.60 (2.36)^{c}	45.6
Fipronil 80% WG	0	5.00 (2.22)	4.20 (2.04)	3.83 (1.95)	4.33 (2.08)^{bc}	58.0
Dimethoate 30% EC	0	4.66 (2.13)	4.63 (2.14)	4.36 (4.36)	4.56 (2.13)^{bc}	55.7
C.D. (0.05)		1.70	1.45	1.12	0.97	
SE(m)		0.55	0.47	0.37	0.32	
SE(d)		0.77	0.67	0.52	0.44	

PTD-Pre-treatment damage; DAT-Date after transplanting; PRC-Percent reduction over control; Values in parentheses are square root transformed; Values in the same column followed by same letters are not significantly different at p = 0.05

> Virtako 1.5 Gr at 90 g a.i. ha^{-1} (83.2%) > Chlorantraniliprole 0.4% Gr (68.6%) > Virtako 1.5 Gr at 75 g a.i. ha^{-1} (59.9%) > Fipronil 80% WG (58.0%) > Dimethoate 30% EC (55.7%) and Thiamethoxam 75% SG (45.6%) (Table 2). All the insecticides treatments produced significantly higher yield (28.1-35.6 tha^{-1}) than the untreated control (16.9 t ha^{-1}) (Fig. 1). The highest yield of 35.6 tha^{-1} was recorded in Virtako 1.5 Gr at 105 g a.i. ha^{-1} treatment followed by Virtako 1.5 Gr at 90 g a.i. ha^{-1} (34.1 tha^{-1}), Fipronil 80% WG (32.0 tha^{-1}), Chlorantraniliprole 0.4% Gr (31.9 tha^{-1}), Virtako 1.5 Gr at 70 g a.i. ha^{-1} (31.2 tha^{-1}), Thiamethoxam 75% SG (30.2 tha^{-1}) and Dimethoate 35% EC (28.1 tha^{-1}). Chen *et al.* (2016) reported that Virtako at a higher rate showed long-lasting effect, produced 65.8% plant hopper control 28 days after application, and rice leaf folder control was 1.75 fold more than chlorantraniliprole treatment after 28 days. Muralibaskaran *et al.* (2013) reported that Virtako 1.5 G was effective in controlling rice pests such as brown planthopper, leaf folder and stem borer while also produced significantly higher yields than the control.

The current results are consistent with the previous findings by Muralibaskaran *et al*. (2013) and Chen *et al.* (2016). An insecticides mixture having two different mode of action may be more effective in controlling insect pests than the usage of single insecticide effective specific to particular insect family. Thiamethoxam is an effective insecticide for controlling the sucking pests such as whiteflies, aphids, thrips and some other microlepidoptera (Sharma and Lal, 2002). Thiamethoxam as soil drench considerably reduced thrips population in onion (Shweta *et al.,* 2019). Likewise, Chlorantraniliprole 20% SC is the most effective insecticide against *A. ipsilon* larvae at relatively low rates (Abd-El-Azi *et al.,* 2020) and effective against third instar larvae of *A. ipsilon* (He *et al.,* 2019). The results of current study are in accordance with the earlier studies reported against thrips and cutworm. Mixtures reduce the amount of pesticides used to target insects and it is also a key strategy to suppress development of insecticide resistance. It broadens the spectrum of activity when more than one pest is present and targets more than one life stage of the pests (Chaubey and Maurya, 2022). Chlorantraniliprole 10%+ Thiamethoxam 20% SC showed better control of bean aphid with long lasing action and safer to prevailing predatory fauna of cow pea (Roy *et al.,* 2017).

Virtako a new generation granular insecticide mixture has dual mode of action for a wide range of pests including sucking and chewing insects. It is a highly effective insecticide for controlling sucking pest of rice, particularly for hoppers that developed resistance to Thiamethoxam and Chlorantraniliprole and is highly toxic to lepidopteran, coleopteran and dipteran pest (Chen *et al.*, 2013). The natural enemies, including spiders, coccinellids and *Orius* spp. populations, were reported in all insecticides treated plots, including Virtako 1.5 Gr treated at higher dose (@ 105 a.i. ha^{-1}) and no natural enemy activity was observed in pre-treatment count. The mean population of spiders, coccinellids and *Orius* spp was 0.52-1.08, 0.86-1.36 and 0.73-1.23 numbers sq m^{-1}, respectively. The populations of spiders and

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Table 3: Field efficacy of Virtako 1.5 Gr against natural enemies (spiders, coccinellids and *Orius* spp) in onion during 2017-18 and 2018-19

Treatments	Spiders					Coccinellids						Orius spp			
	PTC	14 DAT	21 DAT	28 DAT	Mean	PTC	21 DAT	28 DAT	35 DAT	42 DAT	Mean	PTC	28 DAT	35 DAT	42 DAT	Mean
Untreated check	0	1.08 (1.03)	1.25 (1.07)	0.91 (0.95)	1.08 (1.03)	0	0.83 (0.87)	1.33 (1.14)	1.43 (1.18)	1.43 (1.34)	1.36 (1.16)	0	0.58 (0.74)	0.58 (0.71)	1.50 (1.17)	0.90 (0.93)
Virtako 1.5 Gr@ 75 g a.i ha^{-1}	0	1.08 (1.03)	1.41 (1.13)	0.58 (0.70)	1.02 (0.99)	0	0.83 (0.87)	1.00 (0.97)	1.40 (1.18)	1.50 (1.17)	1.20 (1.08)	0	0.75 (0.82)	1.08 (0.98)	1.83 (1.17)	1.23 (1.07)
Virtako 1.5 @ 90 g a.i ha^{-1}	0	0.91 (0.95)	1.25 (1.11)	0.58 (0.74)	0.91 (0.95)	0	0.83 (0.87)	1.33 (1.11)	1.10 (1.02)	1.00 (0.94)	1.10 (1.04)	0	0.58 (0.74)	1.08 (0.95)	1.83 (1.26)	1.16 (1.07)
Virtako 1.5 GR @ 105 g a.i ha^{-1}	0	0.58 (0.74)	1.41 (1.16)	0.58 (0.70)	0.86 (0.91)	0	0.83 (0.87)	1.16 (1.05)	1.26 (1.11)	1.33 (1.14)	1.16 (1.07)	0	0.75 (0.77)	0.75 (0.82)	1.83 (1.34)	1.13 (1.04)
Chlorantraniliprole 0.4% Gr.	0	0.25 (0.50)	0.91 (0.89)	0.75 (0.86)	0.64 (0.78)	0	0.50 (0.87)	0.50 (0.70)	1.26 (1.11)	1.66 (1.05)	0.86 (0.92)	0	0.58 (0.74)	0.58 (0.74)	1.16 (0.99)	0.76 (0.85)
Thiamethoxam 75% SG	0	0.41 (0.62)	0.58 (0.74)	0.58 (0.74)	0.52 (0.72)	0	0.83 (0.87)	1.00 (0.97)	1.10 (1.02)	1.16 (0.99)	1.03 (1.00)	0	0.41 (0.62)	0.58 (0.74)	1.16 (1.05)	0.73 (0.84)
Fipronil 80% WG	0	0.58 (0.70)	1.25 (1.03)	0.58 (0.74)	0.80 (0.88)	0	0.50 (0.71)	1.16 (1.05)	1.10 (1.03)	0.83 (0.87)	0.90 (0.94)	0	0.41 (0.62)	0.58 (0.70)	1.50 (1.22)	0.86 (0.92)
Dimethoate 30% EC	0	0.58 (0.74)	1.25 (1.10)	0.58 (0.74)	0.80 (0.88)	0	0.50 (0.71)	0.83 (0.90)	1.10 (1.00)	1.16 (1.07)	0.90 (1.07)	0	0.58 (0.74)	0.91 (0.91)	2.16 (1.44)	1.20 (1.07)
C.D. (0.05)		NS	NS	NS	NS		NS	NS	NS	NS	NS		NS	NS	NS	NS

PTC-Pre-treatment count; DAT-Date after transplanting; PRC-Percent reduction over control; Values in parentheses are square root transformed; NS- Non-significant

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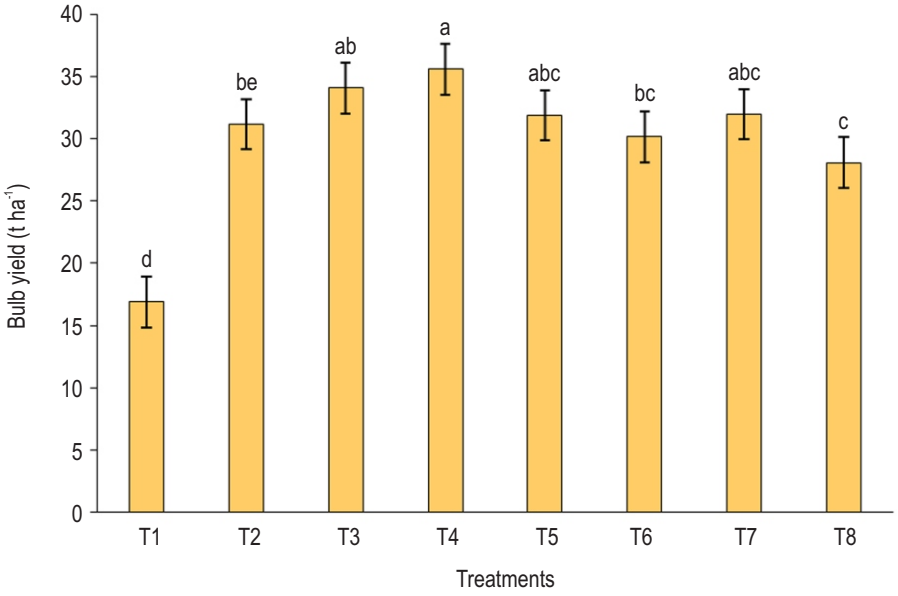

Fig. 1: Onion bulb yield in different Virtako 1.5 Gr treatments. T_1_Untreated Check; T_2_Virtako 1.5 Gr at 70 g a.i. ha^{-1}; T_3_Virtako 1.5 Gr at 90 g a.i. ha^{-1} T_4_Virtako 1.5 Gr at 105 g a.i. ha^{-1}; T_5_ Chlorantraniliprole 0.4% Gr; T_6_Thiamethoxam 75% SG; T_7_ Fipronil 80% WG; T_8_Dimethoate 35% EC.

coccinellids were higher in the untreated check compared to all doses of Virtako 1.5 Gr. However, there was no statistically significant difference between the treatments, including the untreated control. The *Orius* spp. population was higher in all dosages of Virtako 1.5 Gr treated plots, compared to untreated control, but statistically there was no significant difference. This demonstrates that applying Virtako 1.5 Gr at 10 days after transplantation of onion had no substantial impact on the population of natural enemies in the onion ecosystem. Thiamethoxam has been used as foliar/soil insecticide as well as seed treatment in most agricultural crops around the world. Low use rates, flexible application methods, excellent efficacy, long-lasting residual activity and favorable safety profile of this new insecticide well-suited for modern integrated pest control programmes in many cropping systems (Mainfeish *et al.,* 2001).

The premixed insecticide made out of newer insecticides are safer to natural enemies, more effective in minimizing the pest damage and cost effective (Roy *et al.,* 2017; Sen *et al.,* 2017; Reddy and Paul, 2019). Esquivel *et al.* (2020) demonstrated that, a systemic application of thiamethoxam can be compatible with convergent lady beetles and flower bugs, if the time of predator release does not coincide with Thiamethoxam activity. Andorno *et al.* (2019) studied the susceptibility of *O. insidiosus* to some common pesticides including diamide insecticides such as Flubendiamide and Cyantraniliprole in the laboratory and categorized that Flubendiamide as harmless, while Cyantraniliprole was slightly harmful to *O. insidiosus* and it had an impact on the fecundity of predatory bug. Chen *et al.* (2016) demonstrated that single application of Virtako was significantly safer to the predator population in rice ecosystem. It is attributed to cause a short-term reduction in predator population when applied weekly interval and no impact on predator population when applied 21 days interval. Likewise, Chlorantraniliprole showed good safety profile to spider population (Patel *et al.,* 2016) and mirid population in the paddy field reported by Muralibaskaran *et al.* (2013). However, Virtako application at a higher rate (double application) in rice fields lowered the pest control efficiency compared to single application, attributed to higher predator mortality due to the double application (Lee *et al.,* 1993).

This study concludes that soil application of premixed commercial insecticide, Virtako 1.5 Gr, ten days after transplanting, effectively suppresses thrips infestation and cutworm damage in onions without harming the natural enemies. Therefore, Virtako 1.5 Gr 90 g a.i. ha^{-1} application is advised for thrips and cutworms management in onions.

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