www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
TPI 2024; 13(3): 362-367

www.thepharmajournal.com
Received: 14-12-2023
Accepted: 18-02-2024

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Multiplex yield enhancer and its effect on growth, yield, pest, and disease incidence on chili

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Abstract
Chili is the most used vegetable in India, which requires balanced nutrition for optimal growth. Various multiplex yield enhancers were tested against a standard recommended dose of fertilizer to check their effect on growth, yield, and pests. The study found that treatments with Samruddhi at 30 Days After Planting (DAP) and with Mahapal and Biojodi at 60 DAP resulted in increased growth parameters like plant height (22.93cm, 61.13cm, and 100.80cm, respectively). Meanwhile, treatments with Mahapal and Navajeevan G at 30, 60, and 90 DAP resulted in an increased number of branches per plant (4.93, 8.73, and 16.26, respectively). The highest number of leaves per plant (39.33) was observed when Annapurna + Samruddhi, Organic Magic, High Zinc, and Navjeevan G were applied at 30 DAP. Treatment T_{10}, which involved the application of RDF + Annapurna (240 kg/ac), + Samruddhi (50 kg/ac) + High zinc (10 kg/ac) + Navajeevan G (10 kg/ac), resulted in the highest fruit yield per plant and hectare, with 94 kg and 58.29 t/ha, respectively. Furthermore, the treatment with essential nutrients along with *Bacillus* and *Pseudomonas* species (Bio Jodi) reduced the incidence of pests and diseases. Therefore, various multiplex yield enhancers were found to be effective at different stages of the chili crop and significantly superior to the control. To produce healthy chili plants with full fruits, it is important to provide them with optimal nutrition. Therefore, a combination of organic and inorganic fertilizers would be the best option for producing quality chili.

Keywords: Multiplex yield enhancer, chilli, *Bacillus, Pseudomonas,* growth parameters and fruit yield

Introduction
Chilli, also known as chilli pepper (*Capsicum annum* L.), is widely used in India in various forms such as green, dried or in powder form (Naik *et al*., 2012) [9]. India is the largest producer and cultivator of chilies, accounting for 43% of the global area and 33% of the global production. Chilli is commercially important due to its red color, which is attributed to capsanthin, and its unique taste, which is due to capsaicin. Proper fertilizer management is essential for the growth and development of chilli crops. If not done correctly, it can lead to a significant reduction not only in yield but also in the color and quality of the produce. To address the increasing demand for chillies, high-yielding varieties have been introduced, which require higher doses of nutrients that are often met with chemical fertilizers. Recently, studies have shown that chemical fertilizers have caused severe ecological damage, leading to soil and water pollution, which in turn contributes to climate change (Khaitov *et al*., 2019) [7].
However, organic farming is a viable solution to mitigate the adverse effects of chemical fertilizers and climate change. The use of organic manures, bio-fertilizers, bio-stimulants, vermicompost, and deoiled cakes can help to restore soil health and improve the quality of produce. For instance, it has been found that the capsaicin content in chili, which is a prime factor in determining the quality of the edible fruit, can be increased with the use of organic farming techniques (Wang, W J *et al*., 2010) [13].
Organic manures are known to provide essential macro and micronutrients, as well as secrete phytohormones by microbe load, as stated by Khaitov *et al*. (2019) [7]. Among the various factors that contribute to the low production of chili, nutrition is of prime importance. Chemical fertilizers are not only unfriendly to the environment but also costly. Being an inorganic fertilizer, it poses various problems concerning the environment and human health, as mentioned by K.K. Bade *et al.* (2017) [2]. Therefore, it has become necessary to adopt a strategy that includes organic manures, green manures, biofertilizers, vermicompost, etc.
The present study aims to evaluate the effect of the combined use of organic and inorganic fertilizers on plant growth, yield, and pest incidence.

Materials and Methods

The experiment was conducted in open field conditions at the College of Horticulture, UHS, Bengaluru. It was laid out in a randomized complete block design (RCBD), with a total of 16 treatments (Table 1), and replicated thrice. Observations were recorded on 30, 60, and 90 DAP (Days after planting) for growth parameters such as plant height, number of leaves per plant, and number of branches per plant. Yield parameters such as total number of fruits per plant, fruit yielded per plant, and fruit yield were also recorded.

$$\text{Fruit yield} = \frac{\text{Fruit yield per plot}}{\text{Net plot area } (m^2)} \text{X } 10{,}000$$

Disease and Pest incidence was checked at every 15 day interval

For fungal disease - Percent disease index (PDI) was calculated using the formula.

$$(\text{PDI}) = \frac{\text{Sum of the individual disease ratings}}{\text{Number of fruits/ leaves observe}} \text{X} \frac{100}{\text{Maximum disease grade}}$$

For bacterial disease The percentage incidence was calculated using the formula

$$\text{Percent incidence} = \frac{\text{Number of plants infected}}{\text{Total number of plants}} \text{ x } 100$$

The incidence of insects was recorded at 15-day intervals.

Analysis and result

All the parameters were analyzed using the statistical tool SPSS. ANOVA was done for all the experiments using CD at 5% using LSD.

Table 1: Treatment details

Sl. No.	Treatment	Method of application
T_1	RDF (N:P: K) + (FYM)	Basal dose
T_2	RDF + Annapurna @ 150 kg/ac	Basal dose
T_3	RDF + Annapurna @ 240 kg/ac	Basal dose
T_4	RDF + Annapurna @ 450 kg/ac	Basal dose
T_5	RDF + Organic magic @ 10 kg/ac	Basal dose
T_6	RDF + Samruddhi @ 50 kg/ac	50% each as basal + Earthing up
T_7	RDF + Zinc high @ 10 kg/ac	50% each as Basal + Earthing up
T_8	RDF + Navjeevan G @ 10 kg/ac	50% each as Basal + Earthing up
T_9	RDF + Jivras @ 3 ml/L	After planting and before flowering during vegetative phase
T_{10}	RDF + Annapurna (240 kg/ac) + Samruddhi (50 kg/ac) + Zinc high (10 kg/ac) + Navjeevan G (10 kg/ac)	Basal dose + Earthing up
T_{11}	RDF + Mahapal @ 3 ml/L + Bio jodi @ 5 g/L	3 Foliar sprays during the vegetative phase, flowering to fruit setting and fruit development stage. (Except Kranti -2 sprays)
T_{12}	RDF + Sambrama @ 5 g/15l + Bio jodi @ 5 g/L	
T_{13}	RDF + Samras @ 3 ml/L + Bio jodi @ 5 g/L	
T_{14}	RDF + Kranti @ 2 ml/L + Bio jodi @ 5 g/L	
T_{15}	RDF + Foliar spray (Mahapal + samras + sambrama + Bio jodi)	
T_{16}	RDF + (Annapurna (120 kg/ac) + Samruddhi (25 kg/ac) + organic magic (5 kg/ac) + Zinc high (5 kg/ac) + Navajeevan G (5 kg/ac)	Basal dose + Earthing up

Note: RDF-Recommended Dose of Fertilizer, DAP- Days after planting, FYM – Farmyard manure, NS- non-significant, Annapurna- Decomposed organic matter fortified with vermicompost, Neem Cake, Castor Cake, Coir pith & enriched with millions of beneficial Microorganism, Organic magic: Phosphate solubilizing fungal Bio-Fertilizer along with PGPR bacterial consortium, Samruddhi: Contains secondary nutrients such as Calcium, Magnesium and Sulphur, Zinc high: Contains high percentage of Zinc, Magnesium apart from other secondary and micronutrients like calcium, manganese, molybdenum, boron and sulphur in easily available form, Navajeevan G: Contains Sea-weed, humic acid and a mixture of amino acid and triacontanol, Jivras: Contains Humic acid 12.0% w/w, Mahapal: A combination product of bio-organics and traces of micronutrients in balanced quantity in chelated form, Sambrama: This contains all essential plant nutrients like major nutrients, secondary and micronutrients in chelated form, Biojodi: *Bacillus spp. & Pseudomonas spp.*, Samras: Contains a mixture of 18 natural amino acids, extracted from plant source, Kranti: This contains all essential plant nutrients like major nutrients, secondary and micronutrients in chelated form

Results and Discussion

Growth parameters

Plant height

Plant height was observed to be significantly different in all intervals (Table 2). The highest plant height of 22.93 cm was recorded in T_6 at the 30 day after planting (DAP). Samruddhi in this treatment contains secondary nutrients like Ca, Mg, and S which are known to contribute to plant height (Kurubetta *et al*., 2018) [8]. When applied as a soil treatment, it enhances the early growth rate of chili. On the other hand, T_{11} recorded the highest plant height of 61.13 cm and 100.80 cm at 60 and 90 DAP, respectively. The presence of chelated micronutrients and organic chelates like amino acids has been shown to increase crop growth, resulting in increased plant height. Comparatively, lower plant height was recorded in T_1, with the application of only RDF at all intervals. This finding is in line with Altaf, M.A *et al*.'s findings in 2019.

Table 2: Impact of multiplex yield enhancers on plant height of chili

Sl. No.	Treatment	Plant height (cm)		
		30 DAP	60 DAP	90 DAP
T_1	RDF (N:P: K) + (FYM)	9.80	30.13	36.93
T_2	RDF + Annapurna @ 150 kg/ac	13.06	30.13	44.43
T_3	RDF + Annapurna @ 240 kg/ac	14.53	36.13	57.73
T_4	RDF + Annapurna @ 450 kg/ac	15.93	36.40	59.06
T_5	RDF + Organic magic @ 10 kg/ac	11.20	34.26	57.33
T_6	RDF + Samruddhi @ 50 kg/ac	22.93	29.93	52.53
T_7	RDF + Zinc high @ 10 kg/ac	15.60	31.33	47.06
T_8	RDF + Navjeevan G @ 10 kg/ac	13.53	39.13	64.73
T_9	RDF + Jivras @ 3 ml/L	20.26	33.73	57.66
T_{10}	RDF + Annapurna (240 kg/ac) + Samruddhi (50 kg/ac) + Zinc high (10 kg/ac) + Navjeevan G (10 kg/ac)	18.60	39.00	59.40
T_{11}	RDF + Mahapal @ 3 ml/L + Bio jodi @ 5 g/L	21.46	61.13	100.80
T_{12}	RDF + Sambrama @ 5 g/15l + Bio jodi @ 5 g/L	11.60	30.86	50.18
T_{13}	RDF + Samras @ 3 ml/L + Bio jodi @ 5 g/L	15.80	42.33	68.86
T_{14}	RDF + Kranti @ 2 ml/L + Bio jodi @ 5 g/L	22.00	32.93	43.86
T_{15}	RDF + Foliar spray (Mahapal + samras + sambrama + Bio jodi)	15.40	33.86	52.33
T_{16}	RDF + (Annapurna (120 kg/ac) + Samruddhi (25 kg/ac) + organic magic (5 kg/ac) + Zinc high (5 kg/ac) + Navajeevan G (5 kg/ac)	22.86	39.53	56.20
S.Em +		1.60	3.89	7.93
C.D @ 5%		4.63	11.30	23.03
C.V @ 5%		16.81	18.40	24.19

Note: RDF-Recommended Dose of Fertilizer, DAP- Days after planting, FYM – Farmyard manure, NS- non-significant

Number of branches/plant

T_{11} had the highest number of branches at 30DAP because When macro and micronutrients were given in combination which is a balanced nutrient required for higher growth, growth parameters like the number of branches per plant increased (Baloch *et al.*, 2008) [3]. Similarly, T_8 recorded the highest number of branches per plant at 60 and 90 DAP (Table 3). This might be due to the contribution of amino acids and natural chelators in the absorption of micro-nutrients. Additionally, they might have served as a source of nitrogen for further increase in growth-contributing characters (Datir, R. B *et al*., 2012) [4].

Table 3: Impact of multiplex yield enhancers on number of branches in tomato

Sl. No.	Treatment	Mean plant height (cm) per plant		
		30 DAP	60 DAP	90 DAP
T_1	RDF (N:P: K) + (FYM)	0.53	5.53	9.06
T_2	RDF + Annapurna @ 150 kg/ac	0.66	6.20	9.60
T_3	RDF + Annapurna @ 240 kg/ac	1.33	6.80	11.20
T_4	RDF + Annapurna @ 450 kg/ac	2.80	7.00	12.66
T_5	RDF + Organic magic @ 10 kg/ac	0.40	7.53	14.66
T_6	RDF + Samruddhi @ 50 kg/ac	0.13	6.86	9.33
T_7	RDF + Zinc high @ 10 kg/ac	0.53	6.93	13.33
T_8	RDF + Navjeevan G @ 10 kg/ac	1.20	8.73	16.26
T_9	RDF + Jivras @ 3 ml/L	4.66	5.93	11.73
T_{10}	RDF + Annapurna (240 kg/ac) + Samruddhi (50 kg/ac) + Zinc high (10 kg/ac) + Navjeevan G (10 kg/ac)	2.80	7.06	11.33
T_{11}	RDF + Mahapal @ 3 ml/L + Bio jodi @ 5 g/L	4.93	7.13	9.33
T_{12}	RDF + Sambrama @ 5 g/15l + Bio jodi @ 5 g/L	3.60	8.53	16.53
T_{13}	RDF + Samras @ 3 ml/L + Bio jodi @ 5 g/L	1.60	7.00	12.40
T_{14}	RDF + Kranti @ 2 ml/L + Bio jodi @ 5 g/L	2.40	5.86	11.46
T_{15}	RDF + Foliar spray (Mahapal + samras + sambrama + Bio jodi)	2.40	6.86	10.40
T_{16}	RDF + (Annapurna (120 kg/ac) + Samruddhi (25 kg/ac) + organic magic (5 kg/ac) + Zinc high (5 kg/ac) + Navajeevan G (5 kg/ac)	2.53	7.46	12.40
S.Em +		0.91	0.41	1.03
C.D @ 5%		2.64	1.19	2.99
C.V @ 5%		77.93	10.27	14.82

Note: RDF-Recommended Dose of Fertilizer: DAP- Days after planting, FYM – Farmyard manure, NS- non-significant

Number of leaves

The highest number of leaves (39.33) was recorded in T_{16} at 30 DAP similarly, 104.40 leaves in T_4 and 241.66 leaves in T_8 were recorded at 60 and 90 DAP respectively (Table 4). These results show that the use of organic manure along with essential nutrients and biostimulants can improve growth. Organic manure is a natural source of Nitrogen and also contains NPK and micronutrients. Amino acids in organic manure help in the effective absorption of these nutrients, leading to an increase in the number of leaves per plant (Wang *et al.*, 2010) [13]. The lowest number of leaves was observed in T_1 at all the intervals.

Table 4: Impact of multiplex yield enhancers on the number of leaves of chili

Sl. No.	Treatment	Mean plant height (cm) per plant		
		30 DAP	60 DAP	90 DAP
T_1	RDF (N:P: K) + (FYM)	9.73	73.20	133.46
T_2	RDF + Annapurna @ 150 kg/ac	16.00	81.49	133.46
T_3	RDF + Annapurna @ 240 kg/ac	22.93	90.93	165.86
T_4	RDF + Annapurna @ 450 kg/ac	29.20	104.40	176.26
T_5	RDF + Organic magic @ 10 kg/ac	10.67	73.20	146.46
T_6	RDF + Samruddhi @ 50 kg/ac	31.67	89.06	146.46
T_7	RDF + Zinc high @ 10 kg/ac	12.46	80.60	148.73
T_8	RDF + Navjeevan G @ 10 kg/ac	15.46	96.93	241.66
T_9	RDF + Jivras @ 3 ml/L	33.53	91.60	179.80
T_{10}	RDF + Annapurna (240 kg/ac) + Samruddhi (50 kg/ac) + Zinc high (10 kg/ac) + Navjeevan G (10 kg/ac)	28.60	96.93	153.86
T_{11}	RDF + Mahapal @ 3 ml/L + Bio jodi @ 5 g/L	23.66	87.33	151.00
T_{12}	RDF + Sambrama @ 5 g/15l + Bio jodi @ 5 g/L	11.53	94.86	178.20
T_{13}	RDF + Samras @ 3 ml/L + Bio jodi @ 5 g/L	24.93	90.20	172.13
T_{14}	RDF + Kranti @ 2 ml/L + Bio jodi @ 5 g/L	24.93	88.20	151.46
T_{15}	RDF + Foliar spray (Mahapal + samras + sambrama + Bio jodi)	14.73	84.13	153.53
T_{16}	RDF + (Annapurna (120 kg/ac) + Samruddhi (25 kg/ac) + organic magic (5 kg/ac) + Zinc high (5 kg/ac) + Navajeevan G (5 kg/ac)	39.33	81.46	136.73
S.Em +		4.30	7.67	5.68
C.D @ 5%		12.42	-	15.91
C.V @ 5%		34.17	15.19	17.98

Note: RDF-Recommended Dose of Fertilizer, DAP- Days after planting, FYM – Farmyard manure, NS- non-significant

Yield attributes

Number of fruits

The highest number of fruits per plant was recorded in T_7 of 315.33 (Table 5). Calcium and Boron are essential for an increased number of flower and fruit set (Salim *et al.*, 2019) [10] When there is a balance of nutrients along with the supply of Ca and boron gives the increased fruit set which is in line with our findings. (Harris *et al*., 2018) [6]. Comparatively lowest number of fruits per plant was recorded inT_1 (RDF)of 128.33.

Table 5: Impact of multiplex yield enhancers on yield of chilli

	Treatment	Number of fruits/plants	Fruit yield/plant (kg)	Yield/ha (tons)
T_1	RDF (N:P: K) + (FYM)	128.33	1.01	30.14
T_2	RDF + Annapurna @ 150 kg/ac	256.67	1.46	43.86
T_3	RDF + Annapurna @ 240 kg/ac	272.00	1.48	44.32
T_4	RDF + Annapurna @ 450 kg/ac	272.00	1.76	52.94
T_5	RDF + Organic magic @ 10 kg/ac	238.66	1.20	35.94
T_6	RDF + Samruddhi @ 50 kg/ac	237.33	1.21	36.34
T_7	RDF + Zinc high @ 10 kg/ac	315.33	1.84	55.02
T_8	RDF + Navjeevan G @ 10 kg/ac	167.33	1.03	31.03
T_9	RDF + Jivras @ 3 ml/L	206.33	1.26	37.90
T_{10}	RDF + Annapurna (240 kg/ac) + Samruddhi (50 kg/ac) + Zinc high (10 kg/ac) + Navjeevan G (10 kg/ac)	268.33	1.94	58.29
T_{11}	RDF + Mahapal @ 3 ml/L + Bio jodi @ 5 g/L	190.33	1.35	40.42
T_{12}	RDF + Sambrama @ 5 g/15l + Bio jodi @ 5 g/L	204.33	1.48	44.32
T_{13}	RDF + Samras @ 3 ml/L + Bio jodi @ 5 g/L	210.00	1.06	31.74
T_{14}	RDF + Kranti @ 2 ml/L + Bio jodi @ 5 g/L	204.33	1.02	30.73
T_{15}	RDF + Foliar spray (Mahapal + samras + sambrama + Bio jodi)	233.00	1.18	35.37
T_{16}	RDF + (Annapurna (120 kg/ac) + Samruddhi (25 kg/ac) + organic magic (5 kg/ac) + Zinc high (5 kg/ac) + Navajeevan G (5 kg/ac)	182.33	1.43	42.89
S.Em +		33.01	0.13	0.27
C.D @ 5%		95.82	0.38	0.80
C.V @ 5%		25.51	17.15	13.99

Note: RDF-Recommended Dose of Fertilizer, DAP- Days after planting, FYM – Farmyard manure, NS- non-significant

Fruit yield

The experimental plot produced ten pickings of ripe green chilies. Treatment T_{10}, which involved the application of RDF + Annapurna (240 kg/ac), + Samruddhi (50 kg/ac) + High zinc (10 kg/ac) + Navajeevan G (10 kg/ac), resulted in the highest fruit yield per plant and per hectare, with 94 kg and 58.29 t/ha respectively (Table 5). When enriched organic manure is applied to soil, the root system is activated, enhancing the absorption of nutrients such as Ca, K, Na, P, and N, which ultimately results in higher yield attributes (Khaitov *et al*., 2019) [7]. The application of secondary nutrients (Samruddi) and micro-nutrients is crucial for fruit yield and quality attributes (Gupta and Gupta 2014) [5]. The natural chelating agents, Humic acids, and amino acids present in Navajjevan G, make all the nutrients applied with it readily available. Therefore, when all these yield enhancers are applied in combination, they work wonders in enhancing the fruit yield and quality. The fruit yield per plant and yield per hectare was lowest, 1.01 kg, and 30.14 t/ha, respectively, in treatment T_1, which involved the application of only RDF. The application of different yield enhancers significantly increased fruit yield in all chilli treatments over the control (T_1).

Disease incidence

In the given table, the incidence of various diseases has been recorded (Table 6). T_{13} had a percent disease index (PDI) of 6.78 for cercospora leaf spot. Both T_{12} and T_{13} had a chili leaf curl incidence of 1.33. Among all the treatments, T_1 showed a higher incidence of cercospora leaf spot (19.50). T_{12} had the least percentage of anthracnose infection on fruits with only 1.15% of the fruits being affected. According to Wang *et al*. (2014) [14], amino acid fertilizers are better than chemical fertilizers as they improve soil physicochemical properties, contain a wide spectrum of bioactive chemicals, and improve vegetable crop nutrient usage efficiency. This leads to improved yield and quality while cutting pesticide costs and conserving the environment. When applied with balanced nutrients or amino acids, *Bacillus* and *Pseudomonas* species, which are well-known biopesticides, resulted in reduced disease incidence in chili.

Table 6: Impact of multiplex yield enhancers on disease incidence in chili

Treatment		Cercospora leaf spot (PDI)	Percent incidence of chilli leaf curl	Percent anthracnose infection on fruits
T_1	RDF (N:P: K) + (FYM)	19.50 (26.21)	16.00 (23.58)	9.03 (17.49)
T_2	RDF + Annapurna @ 150 kg/ac	9.04 (17.50)	13.33 (21.41)	8.55 (17.00)
T_3	RDF + Annapurna @ 240 kg/ac	8.60 (17.05)	4.00 (11.54)	7.66 (16.07)
T_4	RDF + Annapurna @ 450 kg/ac	7.25 (15.62)	2.67 (9.40)	5.29 (13.30)
T_5	RDF + Organic magic @ 10 kg/ac	6.81 (15.13)	8.00 (16.43)	5.74 (13.86)
T_6	RDF + Samruddhi @ 50 kg/ac	9.68 (18.13)	12.00 (20.67)	4.27 (11.93)
T_7	RDF + Zinc high @ 10 kg/ac	11.72 (20.02)	2.66 (9.39)	3.66 (11.03)
T_8	RDF + Navjeevan G @ 10 kg/ac	11.02 (19.39)	6.66 (14.96)	5.37 (13.40)
T_9	RDF + Jivras @ 3 ml/L	12.63 (20.82)	8.00 (16.43)	5.41 (13.45)
T_{10}	RDF + Annapurna (240 kg/ac) + Samruddhi (50 kg/ac) + Zinc high (10 kg/ac) + Navjeevan G (10 kg/ac)	6.83 (15.16)	5.33 (13.35)	7.17 (15.53)
T_{11}	RDF + Mahapal @ 3 ml/L + Bio jodi @ 5 g/L	16.44 (23.92)	5.33 (13.35)	2.41 (8.93)
T_{12}	RDF + Sambrama @ 5 g/15l + Bio jodi @ 5 g/L	9.05 (17.51)	1.33 (6.62)	1.15 (6.16)
T_{13}	RDF + Samras @ 3 ml/L + Bio jodi @ 5 g/L	6.78 (15.09)	1.33 (6.62)	8.37 (16.82)
T_{14}	RDF + Kranti @ 2 ml/L + Bio jodi @ 5 g/L	12.27 (20.50)	6.66 (14.96)	7.25 (15.62)
T_{15}	RDF + Foliar spray (Mahapal + samras + sambrama + Bio jodi)	7.53 (15.93)	2.66 (9.39)	5.47 (13.53)
T_{16}	RDF + (Annapurna (120 kg/ac) + Samruddhi (25 kg/ac) + organic magic (5 kg/ac) + Zinc high (5 kg/ac) + Navajeevan G (5 kg/ac)	9.17 (17.63)	2.66 (9.39)	3.17 (10.26)
S.Em +		1.92	3.00	2.10
C.D @ 5%		5.55	8.71	N/A
C.V @ 5%		32.36	84.29	64.79

Note: RDF-Recommended Dose of Fertilizer:DAP- Days after planting; FYM – Farmyard manure: NS- non-significant

Pest infestation

During the cropping period, the major pest infestations observed were whiteflies and thrips, and the results are presented in Table 7. The lowest percentage of whitefly infestation of 0.33% was observed in T_4, T_7, T_{12}, T_{13}, and T_6 followed by 1% in T_{11}, and 0.66% in T_{15}, T_{14}, T_{10}, and T_3. The percentage of thrips infestation was 0.00 in T_4, T_7, T_8, T_{10}, T_{11}, T_{13} and T_{16} followed by 0.33% in T_{14}, T_9, T_3 and T_{15}. In comparison to all other treatments, whitefly and thrips infestation were severely noticed in T_1 in the case of sucking pests. The results show that many multiplex yield enhancers are effective in reducing the whitefly and thrips population compared to the control. When the plant is given all essential nutrients, its capacity for induced resistance will increase (Tripathi *et al*., 2022) [12], because balanced nutrition acts as the first line of defense. The combined application of amino acids, biofertilizers, and biopesticides will enhance pest resistance. Seaweed in the treatment is also known to reduce the pest population (Sugandhika *et al*., 2021) [11].

Table 7: Impact of multiplex yield enhancers on insect infestation in chilli

Treatment		Number of whitefly per leaf	Thrips per leaf
T_1	RDF (N:P: K) + (FYM)	2.00	1.66
T_2	RDF + Annapurna @ 150 kg/ac	0.66	0.66
T_3	RDF + Annapurna @ 240 kg/ac	1.66	0.33
T_4	RDF + Annapurna @ 450 kg/ac	0.33	0.00
T_5	RDF + Organic magic @ 10 kg/ac	1.00	0.66
T_6	RDF + Samruddhi @ 50 kg/ac	1.66	1.00
T_7	RDF + Zinc high @ 10 kg/ac	0.33	0.00
T_8	RDF + Navjeevan G @ 10 kg/ac	1.33	0.00
T_9	RDF + Jivras @ 3 ml/L	1.33	0.33
T_{10}	RDF + Annapurna (240 kg/ac) + Samruddhi (50 kg/ac) + Zinc high (10 kg/ac) + Navjeevan G (10 kg/ac)	0.66	0.00
T_{11}	RDF + Mahapal @ 3 ml/L + Bio jodi @ 5 g/L	1.00	0.00
T_{12}	RDF + Sambrama @ 5 g/15l + Bio jodi @ 5 g/L	0.33	0.66
T_{13}	RDF + Samras @ 3 ml/L + Bio jodi @ 5 g/L	0.33	0.00
T_{14}	RDF + Kranti @ 2 ml/L + Bio jodi @ 5 g/L	0.66	0.33
T_{15}	RDF + Foliar spray (Mahapal + samras + sambrama + Bio jodi)	0.66	0.33
T_{16}	RDF + (Annapurna (120 kg/ac) + Samruddhi (25 kg/ac) + organic magic (5 kg/ac) + Zinc high (5 kg/ac) + Navajeevan G (5 kg/ac)	0.33	0.00
S.Em +		0.38	0.41
C.D @ 5%		1.11	N/A
C.V @ 5%		74.88	84.29

Note: RDF-Recommended Dose of Fertilizer: DAP- Days after planting: FYM – Farmyard manure: NS- non-significant

Conclusion

Based on our experiment, it has been discovered that the implementation of multiplex yield enhancers can greatly enhance the growth and yield of chili crops. Chili plants require a high level of nutrients, which are often supplied through chemical fertilizers. However, our observations indicate that when these fertilizers are combined with organic manure, biopesticides, biostimulants, and biofertilizers, the yield can be significantly improved while maintaining quality. Some treatments even demonstrated resistance to disease and pest infestation when *Bacillus* and *Pseudomonas* sps were combined with fertilizers. As such, using the Multiplex yield enhancer in conjunction with RDF can have a positive impact on chili production.

Acknowledgment

The authors wish to express their gratitude to the College of Horticulture, UHS, Bgalkot for providing the necessary experimental facilities. Furthermore, we would like to extend our sincere appreciation to the Multiplex Group of Companies for their unwavering support and encouragement.

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