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Effect of organic and inorganic plant nutrition alone and in combination on onion thrips (*Thrips tabaci*)

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Abstract

The experiment entitled qualitative and quantitative estimation of insect pests and their natural enemies on onion crop in *Malwa* region of Madhya Pradesh conducted during Rabi 2018- 2019 and 2019 - 2020 in the department of Entomology of School of agriculture at Dr. B.R. Ambedkar University of social science Mhow Indore (M.P.).

It is used as vegetable in the form of salad and in the preparation of recipes of various curries besides being used as a medicinal plant. It is an essential item of every kitchen because of this reason popularly referred as "Queen of Kitchen. It is considered to be an oldest source of food. Onion is enjoyed for its flavor and pungency which is due to the presence of a volatile oil i.e. allyl propyl disulphide, an organic compound rich in sulphur. Onions are low in calorie but high in vitamins, mineral, fibers and vitamin C. besides vitamin B, folate (B9) pyridoxins (B6) which play a key role in metabolism, RBC (Red Blood Cells) production and nerve function. it also contain sufficient amount of potassium which is essential for normal cellular function, fluid balance, nerve transmission, kidney and muscles function. It has been found to lower the triglycerides and cholesterol level. The presence of Quercetin flavonides in onion is considered to lower the risk of heart disease, blood pressure and inflammation. As it contains sufficient quantity of vitamin-C, minerals and flavonoid quercetin. Onion has been credited with anticarcinogenic, anti-inflammatory, and antidiabetic properties (Jillion kubala 2018). The chemical composition of onion indicate the presence of carbohydrates 7%, protein 2%, fat 0.5%, vitamin C 12% and minerals 3.21% (Anil kumar 2016).

Keywords: Fibers flavonoid quercetin, metabolism, cellular

Introduction

Onion crop is the second most important vegetable crop cultivated globally after tomato. It is a biennial plant but cultivated as annual crop in temperate climate. It is a semi perishable vegetable and can be transported to a long distance without much injury." Cultivation of Onion crop is done in an area of 3971.51 lakh hectare in the world with a production and productivity of 19.1 MT/ha, respectively (Anonymous 2010-11). In India the crops occupy 19.90 lakh hectare area and the production is 15118 MT and productivity is 14.21 t/ha. Cultivation of this crop in Madhya Pradesh is being done in an approximately 10.02 lakh ha with an average productivity of 17.5t/ha. The major belt of this crop in the state are Khandwa and Khargone district.

The productivity of the crop in Madhya Pradesh actually is higher than national level but still lagging behind than other states like Maharashtra Perhaps, reasons for the low productivity of the crop in Madhya Pradesh are mainly due to losses from the biotic stress (pests and diseases) and nutritional status of soil.

The trend of onion cultivation at national and state level indicate the dependency on chemical fertilizer and pesticides which in true sense is an undesirable approach for sustainable and quality production of the crop. However, the desirable approach emphasis on the indigenous use of nutrients and pesticides for the higher productivity of quality onion having long shelf life and good taste. Nutrient management is the main aspect for healthy growth and good yield of the crop besides soil health maintenance. As the fertilizer and pesticides are the major issue with regard to the production cost and needs to be adjusted in such a way through nutritional management that higher yield without soil and environmental hazard could be achieved. In the developing countries like India, the higher prices of fertilizers and pesticides are badly hitting the small and marginal farmers. As a result there of the productivity and cultivation of

the crop also is being affected adversely irrespective of being cash crop.

Effect of different organic and inorganic plant nutrition, alone and in combination, against *T. tabaci* on onion crop

The study was carried out during the Rabi 2018-2019 and 2019 – 2020 by using the different source of inorganic and organic plant nutrients. The computed quantity of Farm yard manure (FYM) and Vermicompost were applied basally at the time of main field preparation similarly; Inorganic fertilizers like single super phosphate, muriate of potash and micronutrient mixture pentagon were applied at recommended doses at the time of main field preparation. While nitrogenous fertilizer urea was given in split doses. The NPK was given by using the different fertilizers viz. Urea, DAP, and MOP. Urea

was used @ 54kg/ha (62g/plot), DAP 87 kg/ha (100 g/plot) and MOP 100 kg/ha (115g/plot) Sulfur 15 kg/ha (17.28 g/plot) and Pentagon 12 kg/ha (14g/plot) as per recommended dose. The Organic manure FYM @ 15 tons/ha (17.28 kg/plot) and Vermicompost @ 7.5 tons/ha (8.64 kg/plot). Total quantity of NPK, Single super phosphate and muriate of potash were applied as a basal dose. Thrips count was made from 21 to 84 DAT (Days After Transplanting) at 7 days interval on 20 randomly selected plants from each treatments. The plant height, bulb size, maturity period and yield per plot were also recorded. The data was analyzed as per the statistical design to test the significant at 5% level.

Experimental detail

Table 1: Treatments

S. No.	Particulars	Season one 2018-19	Season two 2019- 20
1	Experimental design	Randomized block design (RBD)	Randomized block design (RBD)
2	Replication	Three	Three
3	Treatments	9	9
4	Plant spacing	10 cm	10 cm
5	Row to row distance	15 cm	15 cm
6	Plot size	3.60m x 3.20m	3.60m x 3.20m
7	Date of sowing	06 December	08 December
8	Date of transplanting	I st First February	III rd February
9	Date of harvesting	23 May	24 May

Treatments

T 0 = Control, T1 = NPK, T2 = NPK + Sulfur, T3 = Vermicompost, T4 = Pentagon + Sulfur, T5 = FYM alone, T6 = Vermicompost + Pentagon, T7 = FYM + Pentagon, T8 = FYM + NPK, T9 = Vermicompost + FYM + NPK + Sulfur (S = Sulfur).

Result

Effect of different organic and inorganic plant nutrition, alone and in combination, against *T. tabaci* on onion crop

The finding related to effect of organic and inorganic nutrients, alone and in combination, against *T. tabaci* on onion crop is presented. (Table 2 & graph 1).

Effect on the incidence of *T. tabaci*

The incidence of *T. tabaci* on the crop was observed 21 days after transplanting. That the population of the pest at this stage varied from 1.40 to 2.47 thrips/plant in different treatments. The highest population of 2.47 thrips/plant was observed in the treatment of vermicompost + FYM + NPK + S.

Incidence of *T. tabaci*; 28 days after transplanting

The incidence of the pest 28 days after transplanting indicated thrips population between 3.06 to 4.88 thrips/plant in different treatments. The highest population of 4.88 thrips/plant was observed in Vermicompost + Pentagon.

Effect on the incidence 35 days after transplanting

Incidence of *T. tabaci* after 35 days of transplanting indicated the range of population from 3.67 to 5.35 thrips/plant in different treatments. The highest population of 5.35 thrips/plant was observed in the treatment of FYM + NPK.

Effect on the incidence; 42 days after transplanting

It is visual from the table 2. That after 42 days, the population of the pest started declining and population was found between 2.58 to 3.53 thrips/plant in different treatments. The highest population of 3.53 thrips/plant was observed in the treatment FYM + NPK (T8).

Effect on the incidence after 49 days of transplanting

It is conspicuous from the table 2. That after 49 days of Transplanting thrips population ranged from 3.15 thrips/plant to 5.53 thrips/plant in different treatments.

Effect on the incidence, 56 days after transplant

It is visual from the table 3. That after 56 days of transplanting, the population varied from 3.55 thrips/plant to 4.75 thrips/plant in different treatments. The highest population of 4.75 thrips/plant was observed in the FYM + NPK (T8) treated plot.

Effect on incidence after 63 days of transplanting

Table 3. Indicate that 63 days after the population of the pest varied from 2.45 to 3.02 thrips/plant in different treatments. The highest population of 3.02 thrips/plant was observed in the treatment of FYM + Pentagon.

Effect on the incidence, 70 days after transplanting

70 days after transplanting there was *flow* in thrips population showing population between 3.02 to 3.77 thrips/plant in different treatments. The highest number i.e. 3.77 thrips/plant was shown by NPK + Sulfur (T2) treatment but differed non-significantly with other treatments.

Effect on the incidence 77 days after transplanting

The table 3 divulged an increase in population of the pest which varied from 3.03 to 3.77 thrips/plant in different treatments. Maximum population of 3.88 thrips/plant was observed in NPK recommended dose.

Effect on the incidence 84 days after transplanting

At this stage again a surge in thrips population was noted and the recorded population was in range of 1.95 to 2.75

thrips/plant in different treatments. The highest number i.e. NPK + Sulfur.
2.75 thrips/plant was observed in Vermicompost + FYM +

Table 2: Effect of different organic and inorganic nutrients on the incidence of *T. tabaci* in onion crop during Rabi 2018-19 (Ist season)

Sr. No.	Treatment	Name of the treatment	Average population of <i>T. tabaci</i> /plant at different interval (Days after transplant)							Mean population/plant	
			7	14	21	28	35	42	49		Total
1	T0	Control	0.00	0.00	2.08	4.83	5.03	3.18	3.35	18.48	3.70
					(1.74)	(2.42)	(2.46)	(2.01)	(1.96)	10.59	2.12
2	T1	NPK (Re. dose)	0.00	0.00	1.62	4.53	3.67	3.13	3.98	16.93	3.39
					(1.61)	(2.35)	(2.16)	(1.98)	(2.12)	10.22	2.04
3	T2	NPK + Sulfur (S)	0.00	0.00	1.80	3.52	4.15	3.28	4.84	17.59	3.52
					(1.68)	(2.12)	(2.27)	(2.06)	(2.31)	10.40	2.08
4	T3	Vermicompost	0.00	0.00	1.42	4.67	4.42	3.20	4.43	18.14	3.63
					(1.55)	(2.37)	(2.32)	(2.00)	(2.22)	10.47	2.09
5	T4	FYM	0.00	0.00	1.65	4.58	5.33	2.58	3.15	17.30	3.46
					(1.62)	(2.36)	(2.51)	(1.86)	(1.91)	10.27	2.05
6	T5	NPK + Peantagon	0.00	0.00	1.88	4.35	5.18	2.73	3.90	18.05	3.61
					(1.69)	(2.31)	(2.49)	(1.90)	(2.09)	10.48	2.10
7	T6	Vermicompost + Pentagon	0.00	0.00	1.85	4.88	4.77	3.28	4.08	18.86	3.77
					(1.68)	(2.42)	(2.40)	(2.04)	(2.14)	10.68	2.14
8	T7	FYM + Pentagon	0.00	0.00	1.50	3.77	4.98	3.13	4.28	17.67	3.53
					(1.58)	(2.18)	(2.44)	(1.99)	(2.19)	10.38	2.08
9	T8	FYM + NPK	0.00	0.00	2.03	3.06	5.35	3.53	4.72	18.69	3.74
					(1.73)	(2.01)	(2.52)	(2.08)	(2.28)	10.63	2.13
10	T9	Vermicompost + FYM + NPK + S	0.00	0.00	2.47	4.03	5.12	3.32	5.53	20.46	4.09
				(1.85)	(2.24)	(2.47)	(2.04)	(2.46)	11.06	2.21	
		SE (m)			0.05	0.07	0.03	0.04	0.19		
		CD			0.14	0.22	0.09	0.14	0.56		
		CV			10.69	7.42	5.44	20.49	7.74		

Note: Figures in parenthesis are square root transformed values i.e. $\sqrt{x} + 0.5$

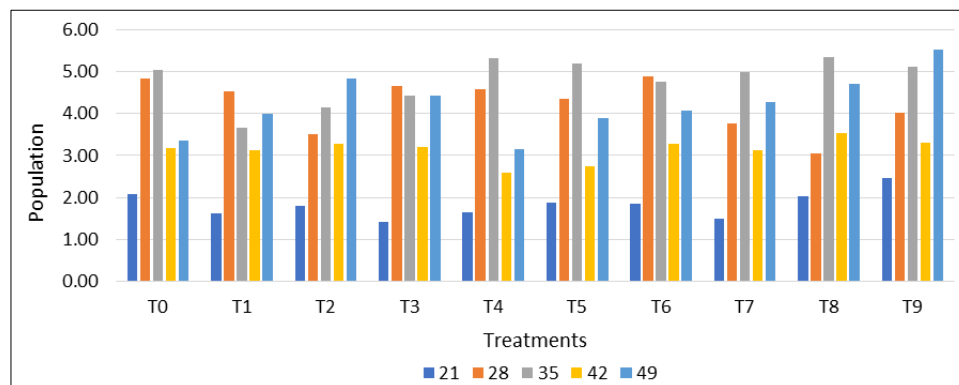


Fig 1: Effect of different organic and inorganic nutrients on the incidence of *T. tabaci* on onion crop in Rabi 2018-19 Ist season

Table 3: Effect of different organic and inorganic nutrients on the incidence of *T. tabaci* in onion crop during Rabi 2018-19 (Ist season)

Sr. No.	Treatments	Name of the treatment	Average population of <i>T. tabaci</i> /plant at different interval (Days after transplant)								Mean population/plant	
			56	63	70	77	84	91	98	105		Total
1	T0	Control	4.00	2.48	3.73	3.53	2.30	0.00	0.00	0.00	16.05	3.21
			(2.23)	(1.84)	(2.16)	(2.12)	(1.80)				(10.17)	(2.03)
2	T1	NPK (Re. dose)	3.55	2.82	3.55	3.88	2.03	0.00	0.00	0.00	15.83	3.17
			(2.12)	(1.94)	(2.13)	(2.20)	(1.70)				(10.11)	(2.02)
3	T2	NPK + Sulfur (S)	4.03	2.62	3.77	3.48	2.08	0.00	0.00	0.00	15.98	3.20
			(2.23)	(1.89)	(2.17)	(2.10)	(1.73)				(10.14)	(2.02)
4	T3	Vermicompost	3.98	2.45	3.35	3.08	1.95	0.00	0.00	0.00	14.82	2.96
			(2.22)	(1.84)	(2.06)	(2.00)	(1.69)				(9.83)	(1.97)
5	T4	FYM	3.78	2.67	3.02	3.03	2.05	0.00	0.00	0.00	14.55	2.91
			(2.18)	(1.89)	(1.99)	(2.00)	(1.72)				(9.80)	(1.96)
6	T5	NPK + Peantagon	3.95	2.67	3.15	3.63	2.35	0.00	0.00	0.00	15.75	3.15
			(2.22)	(1.89)	(2.02)	(2.14)	(1.80)				(10.08)	(2.01)
7	T6	Vermicompost + Pentagon	3.87	2.65	3.62	3.72	2.38	0.00	0.00	0.00	16.23	3.25
			(2.21)	(1.90)	(2.14)	(2.15)	(1.82)				(10.22)	(2.04)
8	T7	FYM + Pentagon	3.80	3.02	3.18	3.45	2.22	0.00	0.00	0.00	15.67	3.13
			(2.19)	(1.99)	(2.03)	(2.10)	(1.76)				(10.08)	(2.01)
9	T8	FYM + NPK	4.75	3.00	3.48	3.77	2.53	0.00	0.00	0.00	17.53	3.51
			(2.39)	(1.99)	(2.10)	(2.16)	(1.84)				(10.49)	(2.09)

10	T9	Vermicompost + FYM + NPK + S	4.28	2.90	3.73	3.65	2.75	0.00	0.00	0.00	17.32	3.46
			(2.29)	(1.95)	(2.17)	(2.14)	(1.90)				(10.46)	(2.09)
		SeM	0.06	0.08	0.06	0.05	0.05					
		CD	0.16	0.24	0.17	0.14	0.15					
		CV	6.33	12.25	11.28	10.54	17.60					

Note: Figures in parenthesis are square root transformed values i.e. $\sqrt{x} + 0.5$.

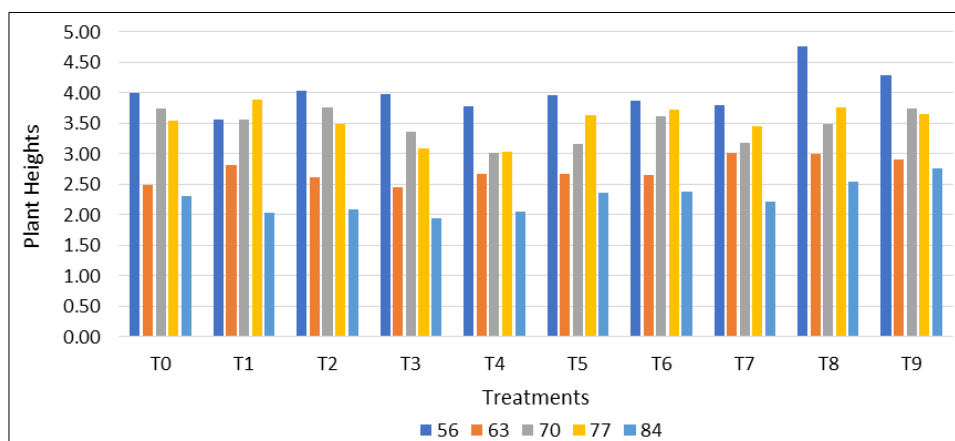


Fig 2: Effect of different organic and inorganic nutrients on the incidence of *T. tabaci* on onion crop in Rabi 2018-19 Ist season

Effect of different nutrients on the plant height of onion (Season one)

The effect of plant nutrients on the onion plant heights was observed at 7 days interval beginning from 7 days old crop and ending with on 105 days old crop. The result is presented (Table & Graph 4).

Effect of nutrients on 7th day old crop, the plant height was found in between 10-14 to 12.75 cm in different treatments. The minimum average plant height of 10.14 cm was observed in untreated control whereas maximum 12.75 cm in the combination treatment i.e. NPK + Sulphur (S).

Effect of nutrients on plant height after 14 days

The plant height at this stage varied from 11.00 cm to 13.50 cm. Minimum average plant height (11.00 cm) was observed in untreated control whereas maximum 13.37 cm in the combination treatment i.e. Vermicompost + FYM + NPK + S. Effect of nutrients on plant height after 21 days: At this stage, height of the crop was measured between 11.70 cm to 13.50 cm. The minimum average plant height (11.70 cm) was observed in untreated control whereas maximum (13.50 cm) in combination treatment i.e. Vermicompost + FYM + NPK + S.

Effect of nutrients on the plant height after 28 days

The plant height at this stage of crop varied from 12.08 cm to 17.46 cm. The minimum average plant height of 12.08 cm was observed in untreated control while maximum 17.46 cm in the combination treatment i.e. Vermicompost + FYM + NPK + S.

Effect of nutrients on the plant height after 35 days

At this stage of crop plant height varied from 13.18 cm to 20.78 cm. In different treatments. The minimum average plant height i.e. 13.18 cm was observed in untreated control whereas maximum 20.78 cm in combination treatment; FYM + NPK.

Effect of nutrients on plant height after 42 days

Different plant heights in various treatments were noted between 14.09 cm to 22.56 cm. The minimum plant height (14.09 cm) was observed in untreated control and maximum (22.56 cm) in FYM + NPK Treatment.

Effect of nutrients on the plant height after 49 days

Plant heights varied from 15.14 cm to 23.45 cm at this stage of the crop and a significant effect was observed among the treatments. Average plant height was lowest in untreated control i.e. 15.14 cm and highest in the combination treatment i.e. Vermicompost + FYM + NPK + S (23.45 cm).

Effect of nutrients on the plant height after 56 day

At this stage, crop height varied from 16.41 cm to 25.04 cm in different treatments. The minimum, average plant height (16.41 cm) was observed in untreated control whereas maximum (25.04 cm) was noted in treatment of Vermicompost + FYM + NPK + S.

Effect of nutrients on the plant height after 63 days

It is obvious from table that plant height varied from 17.42 cm to 28.50 cm. at this stage of crop. The minimum (17.42 cm) plant height was observed in untreated control and maximum (25.04 cm) [treatment T9 (Vermicompost + FYM + NPK + S.).

Effect of nutrients on the plant height after 70 days

A prominent effect of plant nutrition from different sources has indicated a significant effect on plant height. Retarded plant growth was noted in untreated control where plant height measured as 18.08 cm and the treatment Vermicompost + FYM + NPK + S.

Effect of nutrients on the plant height after 77 days

Plant heights varied from 19.12 cm to 36.46 cm at this stage of crop in various treatments. The minimum average plant height (19.12 cm) was observed in untreated control. Whereas maximum (36.46 cm) in treatment of Vermicompost + FYM + NPK + S.

Effect of nutrients on the plant height after 84 day

Heights of the plant varied from 20.60 cm to 38.08 cm. after 84 days of transplanting in different treatments. The plant height of 20.60 cm was observed in untreated control whereas the maximum (38.08 cm) was noted in the treatment of Vermicompost + FYM + NPK + S.

Effect of nutrients on the plant height after 91 days

At this stage of crop plant heights varied from 23.25 cm to 41.11 cm. Minimum average plant height (23.25 cm) was recorded in untreated control and maximum (41.11 cm) in the Vermicompost + FYM + NPK + S treatment.

Effect of nutrient on the plant height after 98 days

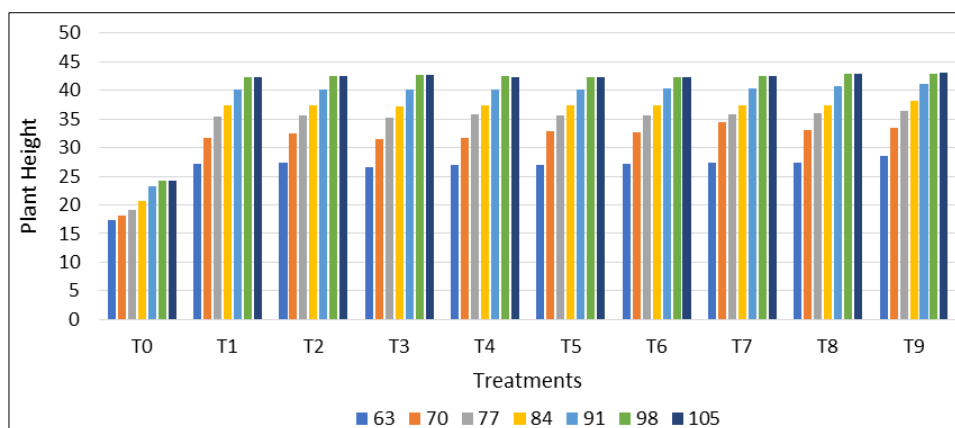
Plant heights in different treatments varied from 24.18 cm to 42.96 cm. The minimum plant height (24.18 cm) was observed in untreated control whereas the maximum (42.96 cm) in the combination treatment i.e. Vermicompost + FYM + NPK + S.

Effect of nutrients on the plant height after 105 days

At this stage of crop, different plant heights was observed which varied from 24.18 cm to 43.09 cm. the minimum average plant height (24.18 cm) was observed in untreated control whereas the maximum (43.09 cm) was noted in the combination treatment i.e. Vermicompost + FYM + NPK + S. Effect of nutrients on the percent increase in the plant height: on the basis of overall the increase in plant height at the end of the crop has shown the variation in plant height which varied from 58.92 cm to 65.17 cm. The highest increase of 65.17 percent was notice in the Vermicompost + FYM + NPK + S.

Table 4: Effect of organic and inorganic nutrients on the plant height of onion crop; Rabi 2018-19 (Ist season)

Sr. No.	Treatment	Name of the treatment	Plant height of onion plants at different interval								Total	Mean (cm)	Over all mean (cm)	% Increase in plant height over control
			Average plant height (cm) Days after transplanting (DAT)											
			7	14	21	28	35	42	49	56				
1	T0	Control	10.14	11.00	11.70	12.08	13.18	14.09	15.14	16.41	103.75	12.97	16.97	-
2	T1	NPK (Re. dose)	11.71	12.55	12.30	15.50	19.53	20.77	22.09	24.20	138.67	17.33	26.97	58.92
3	T2	NPK + Sulfur (S)	12.11	12.72	13.08	17.27	20.21	20.73	22.14	24.18	142.46	17.80	27.33	61.04
4	T3	Vermicompost	12.41	12.63	13.03	15.98	19.96	21.01	22.59	24.08	141.73	17.71	27.15	59.98
5	T4	FYM	11.95	12.52	12.37	16.86	19.75	21.53	22.29	24.28	141.56	17.69	27.21	60.34
6	T5	NPK + Peantagon	11.83	12.35	13.30	15.80	19.95	20.82	22.55	24.41	141.02	17.62	27.22	60.40
7	T6	Vermicompost + Pentagon	12.9	12.42	12.55	17.21	19.7	20.86	22.70	24.41	142.75	17.84	27.32	60.98
8	T7	FYM + Pentagon	12.41	12.60	13.06	16.98	19.26	20.84	22.51	24.54	141.22	17.65	27.40	61.46
9	T8	FYM + NPK	12.16	12.52	12.93	17.01	20.78	22.56	23.01	24.89	144.76	18.09	27.65	62.93
10	T9	Vermicompost + FYM + NPK + S	12.75	13.37	13.50	17.46	20.12	21.90	23.45	25.04	147.26	18.40	28.03	65.17
		SEm	0.27	0.29	0.15	0.09	0.06	0.32	0.27	0.18				
		CD	0.81	0.86	0.46	0.28	0.19	0.97	0.82	0.54				
		CV	3.89	3.99	2.09	1.01	0.58	2.72	2.16	1.33				

**Fig 3:** Effect of organic and inorganic nutrients on the plant height of onion crop; Rabi 2018-19**Second season (Rabi 2019-2020)**

The finding related to effect of organic and inorganic nutrients, alone and in combination, against *T. tabaci* on onion crop during 2019-20 is presented in the table 11a & 11b. Which indicate that the incidence of thrips began 56 days after transplant and completely ended after-84 days and onward. The data recorded on 56 days after transplant showed a population of 2.68 to 3.28 thrips/plant in different treatments. The highest population of 3.28 thrips/plant was noted in NPK + Pentagon (T5) treatment followed by T9 (Vermicompost + FYM + NPK + S) with a record of 3.13 thrips/plant and a significant effect of different nutrients on the intensity of the pest.

Effect on the incidence 63 days after transplanting

(Table 11b) 63 days after transplanting a population surge in different treatments was registered with a record of 7.58 to 9.18 thrips/plant. The highest number i.e. 9.18 thrips/plant was observed in FYM + Pentagon (T7) treatment followed by the T7 (FYM + Pentagon, 9.18 thrips/plant) T8 (FYM + NPK; 8.97 thrips/plant), T4 (FYM; 8.33 thrips/plant). Minimum, 8.18 thrips/plant was counted in untreated control.

Effect on the incidence 70 days after transplanting

The incidence of the pest 70 days after transplanting, thrips population was found between 12.78 to 14.62 thrips/plant in different treatments. The highest population of 14.62 thrips/plant was observed in FYM + NPK (T8) treatment followed by untreated control (T0) with a record of 13.87 thrips/plant.

Effect on incidence 77 days after transplanting

The incidence of the pest 77 days after transplanting indicated the population between 4.05 to 5.78 thrips/plant in different treatments. The highest population of 5.78 thrips/plant was observed in NPK + Pentagon (T5) treatment followed by NPK + Sulphur (T2) with a record of 5.43 thrips/plant.

Effect on incidence, 84 days after transplanting

The incidence of the thrips; 84 days after transplanting; indicated its population between 1.57 to 2.92 thrips/plant in

different treatments. The highest population of 2.92 thrips/plant was observed in Vermicompost + FYM + NPK + S (T9) treatment followed by FYM + Pentagon (T7; 2.70 thrips/plant), FYM + NPK (T8; 2.28 thrips/plant), NPK recommended dose (T1; 2.13 thrips/plant) and Vermicompost + Pentagon (T6) with 2.00 thrips/plant and the difference between them were non-significant.

The population of thrips in all treatments became null beyond 91 days after transplanting.

Table 5: Effect of different organic and inorganic nutrients on the incidence of *T. tabaci* on onion crop in Rabi 2019-20 (IInd season)

Sr. No.	Treatment	Name of the treatment	Average population of <i>T. tabaci</i> /plant at different interval								Total	Mean population/plant
			56	63	70	77	84	91	98	105		
1	T0	Control	3.12	8.18	13.87	5.40	1.80	0.00	0.00	0.00	32.37	6.47
			*(2.03)	(3.03)	(3.86)	(2.53)	(1.67)					
2	T1	NPK (Re. dose)	2.75	8.95	13.28	4.90	2.13	0.00	0.00	0.00	32.02	6.40
			(1.93)	(3.15)	(3.78)	(2.43)	(1.77)					
3	T2	NPK + Sulfur (S)	3.03	8.28	13.35	5.43	1.85	0.00	0.00	0.00	31.95	6.39
			(2.00)	(3.04)	(3.78)	(2.53)	(1.68)					
4	T3	Vermicompost	2.87	8.88	13.22	5.40	1.57	0.00	0.00	0.00	31.93	6.39
			(1.97)	(3.14)	(3.76)	(2.53)	(1.60)					
5	T4	FYM	2.82	8.33	13.78	5.17	1.63	0.00	0.00	0.00	31.73	6.35
			(1.95)	(3.06)	(3.84)	(2.48)	(1.62)					
6	T5	NPK + Pentagon	3.28	7.58	12.78	5.78	1.97	0.00	0.00	0.00	31.40	6.28
			(2.070)	(2.93)	(3.71)	(2.60)	(1.72)					
7	T6	Vermicompost + Pentagon	2.95	7.75	13.84	4.52	2.00	0.00	0.00	0.00	31.06	6.21
			(1.98)	(2.95)	(3.84)	(2.34)	(1.73)					
8	T7	FYM + Pentagon	2.68	9.18	13.65	4.05	2.92	0.00	0.00	0.00	32.48	6.50
			(1.91)	(3.19)	(3.82)	(2.24)	(1.97)					
9	T8	FYM + NPK	2.90	8.97	14.62	5.10	2.28	0.00	0.00	0.00	33.87	6.77
			(1.97)	(3.15)	(3.95)	(2.47)	(1.81)					
10	T9	Vermicompost + FYM + NPK + S	3.13	8.62	13.42	5.17	2.70	0.00	0.00	0.00	33.03	6.61
			(2.03)	(3.10)	(3.79)	(2.48)	(1.92)					
		SEm	0.02	0.013	0.04	0.02	1.92					
		CD	0.07	0.03	0.12	0.06	0.09					
		CV	3.19	2.83	3.36	4.41	7.67					

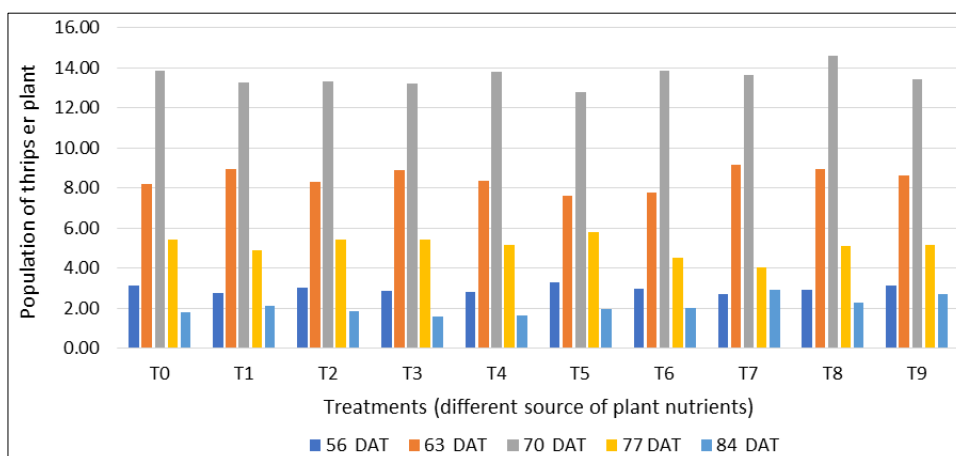


Fig 4: Effect of different nutrients (Organic and Inorganic) on the incidence of *T. tabaci* on onion crop during Rabi 2019-20 (IInd season)

Effect of nutrients on the onion plant heights (Second season i.e. 2019-20)

The effect of plant nutrients on plant height of onion crop was observed regularly at 7 days interval beginning from transplanting to 105 days old crop.

Effect of nutrients on the plant height after 7 days

At this stage of the crop plant heights varied from 10.02 cm to 12.55 cm in different treatments. The minimum average plant

height (10.02 cm) was observed in untreated control Whereas the maximum 12.55 cm in combination treatment i.e. Vermicompost + FYM + NPK + S. (Table 12a).

Effect of source of nutrients after 14 days on the plant height

At this stage of the crop plant heights was recorded from 10.82 cm to 13.62 cm in different treatments. The lesser average plant height of 10.82 cm was observed in untreated

control and the higher 13.62 cm in Vermicompost + FYM + NPK + S treatment.

Effect of the nutrient after 21 days on the plant height

At this stage of the crop, plant height reached between 11.33 cm to 13.73 cm. in different treatments. Plant height was found lowest on an average 11.33 cm in untreated control while tall plants of 13.73 cm in the treatment of Vermicompost + FYM + NPK + S.

Effect of source nutrients after 28 days on the plant height

Variable plant height in different treatments was observed. The minimum plant height of 12.15 cm was recorded in untreated control whereas maximum 17.65 cm in the combination treatment i.e. Vermicompost + FYM + NPK + S.

Effect of nutrient on the plant height after 35 days

This stage of the crop indicated different plant heights which varied from 14.22 cm to 20.52 cm. The minimum plant height (14.22 cm) was observed in untreated control whereas the maximum 20.52 cm in the treatment of Vermicompost + FYM + NPK + S.

Effect of source of nutrients after 42 days on the plant height

The plant height after 42 days varied from 15.03 cm to 20.99 cm with minimum plant height (15.03 cm) in untreated control and maximum 20.99 cm in the combination treatment i.e. Vermicompost + FYM + NPK + S. However, the treatment T8, T7, T6, T5, T4, T3, T2, and T1 were at par with each other.

Effect of source nutrients on the plant height after 49 days

At this stage of crop indicated deferent height which varied from 15.59 cm to 22.52 cm. The minimum plant height of 15.59 cm was observed in untreated control whereas the maximum 22.52 cm in the combination treatment i.e. Vermicompost + FYM + NPK + S. The treatment T8, T7, T6, T5, T4, T3, T2, and T1 were found at par with each other.

Effect of source of nutrients, after 56 days, on the plant height

At this stage of the crop plant height varied from 16.40 cm to 26.57 cm. in the different treatments. The average plant height 16.40 cm was observed minimum in the untreated control whereas the 26.75 cm was the maximum plant height was recorded in the combination treatment of Vermicompost + FYM + NPK + S.

Effect of source of nutrients, after 63 days, on the plant height

This stage of the crop indicated plant heights varied from 18.48 cm to 27.35 cm. in different treatments. Minimum plant height of 18.48 cm was observed in control whereas the maximum 27.35 cm was noted in Vermicompost + FYM + NPK + S treatment.

Effect of source of nutrients, after 70 days, on the plant height

70 days old crop indicated plant height between 20.16 cm to 28.82 cm. in different treatments. The minimum plant height (20.16 cm) was observed in untreated control whereas maximum; 28.82 cm in the combination treatment of Vermicompost + FYM + NPK + S.

Effect of source nutrients after 77 days on the plant height

Varied from 23.16 cm to 33.65 cm. The minimum average plant height 23.16 cm was observed in untreated control whereas maximum 33.65 cm in the combination treatment i.e. Vermicompost + FYM + NPK + S. The treatments T8, T7, T6, T5, T4, T3, T2 and T1 were at par with each other.

Effect of source of nutrients, after 84 days, on the plant height

84 days old crop of onion under the influence of different source of nutrients had indicated plant heights from 25.42 cm to 37.17 cm. The minimum plant height of 25.42 cm was observed in untreated control whereas maximum 37.17 cm in the combination treatment i.e. Vermicompost + FYM + NPK + S.

Effect of source nutrients after 91 days on the plant height

at this stage of crop indicated deferent heights which varied from 26.24 cm to 41.98 cm the minimum average plant height 26.24 cm was observed in untreated control whereas maximum 41.98 was noted in the combination treatment of Vermicompost + FYM + NPK + S. The treatment T8, T7, T6, T5, T4, T3, T2 and T1 were found at par with each other.

Effect of source of nutrients, after 98 days, on the plant height

Plant height varied form 27.37 cm to 44.53 cm at this stage. The minimum average plant height (27.37 cm) was observed in untreated control whereas the maximum (44.53 cm) was noted in the combination treatment of Vermicompost + FYM + NPK + S.

Effect of source of nutrients, after 105 days, on the plant height

At this stage of crop plant heights varied from 27.36 cm to 44. cm. The minimum plant height 27.36 cm was observed in untreated control whereas the maximum 44.34 cm in the treatment of Vermicompost + FYM + NPK + S. The treatment T8, T6, T3 were at par with each other (Table 12b). Effect of source of nutrients on the percent increase in the plant height: on the basis of overall effect of source of nutrients; the increase in plant height at the end of the crop, has shown the increase in plant height over untreated control in a range between.16 cm to 48.73 cm in various treatments. The highest increase of 48.73 percent was notice in the Vermicompost + FYM + NPK + S.

Table 6: Effect of organic and inorganic nutrients on the plant height of onion crop; Rabi 2019-20. (IInd season)

Sr. No.	Treatment	Name of the treatment	Plant height of onion plants at different interval								Total	Mean (cm)	Over all Mean (cm)	% increase in plant height over control
			Average plant height cm day after transplanting (DAT)											
			7	14	21	28	35	42	49	56				
1	T0	control	10.02	10.82	11.33	12.15	14.22	15.03	15.59	16.40	105.58	13.20	18.61	-
2	T1	NPK (Re. dose)	11.65	12.55	12.30	15.40	19.30	20.07	22.20	25.07	138.53	17.32	26.27	41.16
3	T2	NPK + Sulfur (S)	12.13	12.88	13.22	17.38	20.15	20.72	22.32	25.75	144.55	18.07	27.04	45.29

4	T3	Vermicompost	11.77	12.70	12.77	15.88	19.58	20.03	22.22	25.25	140.20	17.53	26.44	42.07
5	T4	FYM	11.75	12.47	11.83	16.75	19.67	20.27	22.08	25.58	140.40	17.55	26.54	42.61
6	T5	NPK + Pentagon	11.80	12.38	13.33	15.68	19.98	20.48	22.38	26.08	142.13	17.77	26.72	43.57
7	T6	Vermicompost + Pentagon	12.50	12.48	12.28	17.10	19.55	20.28	22.17	25.62	141.98	17.75	26.70	43.47
8	T7	FYM + Pentagon	11.92	12.13	12.30	16.87	19.00	19.78	21.95	25.43	139.39	17.42	26.73	43.63
9	T8	FYM + NPK	12.12	12.03	12.03	17.03	20.09	20.43	22.17	25.57	141.47	17.69	26.52	42.50
10	T9	Vermicompost + FYM + NPK + S	12.55	13.62	13.73	17.65	20.52	20.99	22.52	26.57	148.14	18.52	27.68	48.73
		SEm	0.26	0.28	0.23	0.13	0.24	0.26	0.20	0.19				
		CD	0.76	0.85	0.68	0.38	0.71	0.79	0.59	0.57				
		CV	3.74	3.94	3.15	1.36	2.15	2.29	1.59	1.33				

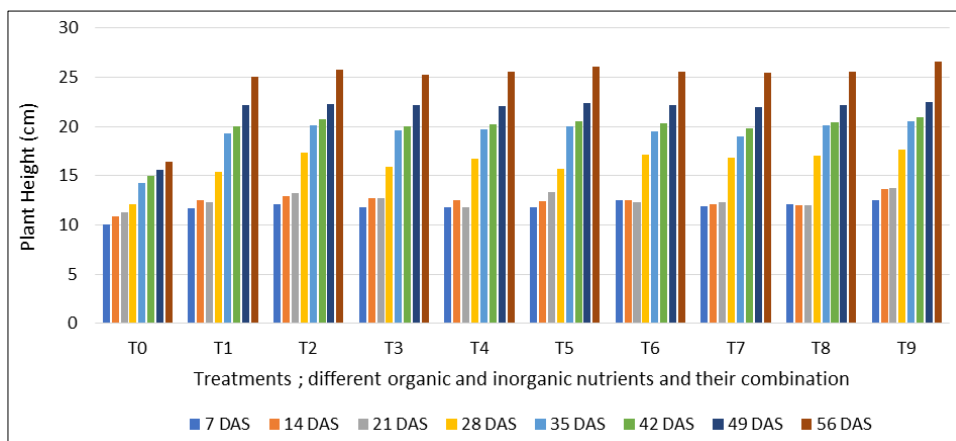


Fig 5: Effect of organic and inorganic nutrients on the plant height of onion crop; Rabi 2018-19

Table 7: Effect of organic and inorganic nutrients on the plant height of onion crop; Rabi 2019-20 (IInd season)

Sr. No.	Treatment	Name of the treatment	Plant height of onion plants at different interval							Total	Mean (cm)	Over all mean (cm)	% increase in plant height over control	
			Average plant height cm day after transplanting (DAT)											
			63	70	77	84	91	98	105					
1	T0	control	18.48	20.16	23.16	25.42	26.24	27.37	27.36	168.20	24.03	18.61	-	
2	T1	NPK (Re. dose)	26.72	28.30	30.77	35.72	40.47	42.03	42.55	246.55	35.22	26.27	41.16	
3	T2	NPK + Sulfur (S)	27.27	28.53	33.22	36.83	40.69	42.92	42.60	252.06	36.00	27.04	45.29	
4	T3	Vermicompost	26.88	28.22	31.35	35.78	40.20	42.98	42.04	247.45	35.35	26.44	42.07	
5	T4	FYM	26.92	28.02	31.75	35.83	40.10	43.95	42.19	248.75	35.54	26.54	42.61	
6	T5	NPK + Pentagon	27.30	28.35	32.45	36.77	39.45	42.75	42.65	249.71	35.67	26.72	43.57	
7	T6	Vermicompost + Pentagon	26.85	28.63	32.94	36.28	39.65	42.67	42.6	249.62	35.66	26.70	43.47	
8	T7	FYM + Pentagon	26.85	28.4	33.23	36.27	40.45	43.53	43.52	252.25	36.04	26.73	43.63	
9	T8	FYM + NPK	26.92	28.37	32.38	35.92	39.83	41.93	42.13	247.48	35.35	26.52	42.50	
10	T9	Vermicompost + FYM + NPK + S	27.35	28.82	33.65	37.17	41.98	44.53	44.34	257.85	36.84	27.68	48.73	
		SEm	0.36	0.22	0.33	0.25	0.14	0.22	0.11	0.36				
		CD	1.07	0.67	0.99	0.74	0.41	0.67	0.32	1.07				
		CV	2.36	1.40	1.82	1.22	0.61	0.93	0.44	2.36				

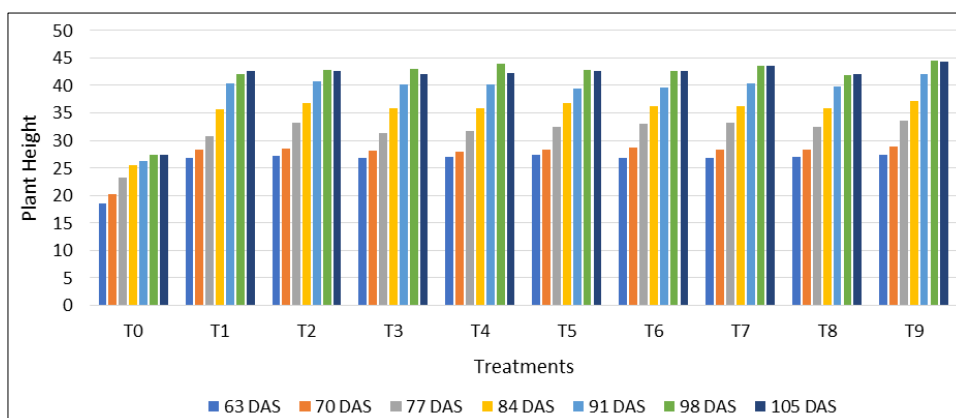


Fig 6: Effect of organic and inorganic nutrients on the plant height of onion crop; Rabi 2019-20

Discussion

On the basis of two year study the onion plant height of onion due to different kind plant nutrients had shown a variation in height between 17.48 to 27.24 cm. in different treatments. The maximum plant height of 27.24 cm was noted in the treatment of Vermicompost + FYM + NPK + S (T9) and minimum 17.48 cm in the Untreated control (T0). Where no extra plant nutrients were added. Of course, higher plant height was noted from the combination treatment i.e. Vermicompost + NPK (recommended dose) + FYM + Sulfur treatments. Gererufael *et al.* (2020) [1] also reported the effect of nutrients both inorganic and organic (N, FYM) as well as their interactions significantly ($P < 0.05$) influenced the plant height. Saima *et al.* (2014) [2] and Yohannes *et al.* (2017) [3] have also reported the increase in plant height in onion as well as other crops by combination of inorganic and organic plant nutrition. These findings do relate with the present findings.

Effect of plant nutrients on onion bulb size (Pooled data, Rabi 2018-2020)

The comprehensive data of two season study clearly indicated that plant nutrients had influenced bulb size of onion which measured between 4.23 to 7.28 cm. in different treatments (Table 7). The bigger size onion was obtained from Vermicompost + FYM + NPK + S (7.28 cm) treatment while small sizes (4.23 cm) from Untreated control (T0). This clearly indicated that addition of zero [plant nutrients had greatly affected the bulb size and addition of Vermicompost, NPK in recommended dose along with FYM and Sulfur in soil had definitely increased the bulb size. Similar finding on onion has been reported by, Gererufael (2020) [1], Saima sultana *et al.* (2014) [2]. Who have mentioned the higher bulb size of onion due to inorganic and inorganic nutrients. So bigger size bulb obtained from the combination treatment of organic and inorganic sources gets support from these studies. Perhaps the this combination treatment not only added the extra nitrogen to the crop but also provided the soil condition and improved the plant health favorable for increased bulb size. Kaswan *et al.* (2017) also reported that application of FYM @ 40 t/ha significantly increased number of leaves per plant, moisture content of bulb, neck thickness, diameter of bulb and volume of bulb.

Yield Kg/plot

On the basis data based on two year study the overall average yield under different condition of nutrients it was varied between 24.18 to 32.34 kg/plot (209.50 to 280.50 q/ha). The highest average yield of 32.34 kg/plot (280.50 q/ha) was obtained from the. Vermicompost + FYM + NPK + S (T9) treatment and the lowest 24.18 kg/plot (209.50 q/ha) from Untreated control (T0). This clearly indicated that higher yield of onion was possible due to incorporation of Vermicompost, NPK (recommended dose) along with FYM and Sulfur in soil. Bandi *et al.* 2012 [5] also mentioned the higher bulb yield of 19.50 t/ha was obtained from the plots where, recommended dose of inorganic nutrients along with farm yard manure, biofertilizers and neem cake was applied. Aisha (2007) [4], Bagali (2012) [6], Ebtisam (2015) [7] and Yohannes (2017) [3] are also of the opinion that high production potential of onion is related to higher organic nitrogen rate (4 tons/fed.) and the highest natural P and K levels (100:100 of each per fed.).

Conclusion

As regard to the effect of nutrients on the incidence of thrips and yield was concerned findings indicated the variation in incidence, intensity of the pest in different nutritional treatments. Higher population of 2.47 thrips/plant was observed in Vermicompost + FYM + NPK + S followed by FYM + NPK (2.03 thrips/plant). And minimum 2.08 thrips/plant in untreated control. A variable number of the pest in different nutritional

treatments was recorded at different interval of transplanting i.e. 28, 35, 42, 49, 56, 63, 70, 77, 84, 91, 98 and 105 days. The observation recorded on 84 days after transplanting has indicated the pest population in between 1.95 to 2.75 thrips per plant in Vermicompost + FYM + NPK + Sulfur treatment during the first season trial while In the second season trial, incidence began 56 days after transplanting with lowest population (2.68 thrips/plant) was recorded in the treatment of FYM + Pentagon. Which clearly indicated the non-consistent effect of plant nutrition on the incidence of the pest on the crop.

- Effect of different nutrients on the plant height of onion, studies divulged, that the minimum average plant height (24.18 cm) was noted in the treatment of Vermicompost + FYM + NPK + S during first season while in second season trial highest plant height (44.34 cm) was recorded in the same treatment.
- Effect of plant nutrients on onion bulb size (Pooled Data): The plant nutrients had influenced the bulb size which indicated a variation between 4.23 to 7.28 cm in different treatments. The bigger size onion (7.28 cm) was obtained from Vermicompost + FYM + NPK + S treatment while small size (4.23 cm) from Untreated control. Addition of vermicompost + NPK at recommended dose + FYM + Sulfur in soil has firmly increased the bulb size of onion.
- Yield of crop kg/plot the yield of crop as effected by various plant nutrition either alone or in combination. A variation in yield was noted in a range of between 24.18 to 32.34 kg/plot (i.e. 209.50 to 280.50 q/ha). The maximum average yield of 32.34 kg/plot (i.e. 280.50 quintal/ha) was obtained from the. Vermicompost + FYM + NPK + S treatment and the lowest 24.18 kg/plot (209.50 q/ha) from the Untreated control. This clearly indicated that higher yield of onion is possible if Vermicompost + recommended NPK dose + FYM + Sulfur is incorporated in soil.

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