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Effect of organic manure and inorganic fertilizer on growth, yield and physiological parameter of chilli (*Capsicum annum* L.)

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Abstract

The effect of organic and inorganic fertilizer on growth, yield and biochemical parameters of Chili were studied under 10 different treatment of T₀ Control, T₁ 100% RDF of Inorganic, T₂ 100% FYM, T₃ 100% Poultry Manure, T₄ 100% Vermicompost, T₅ 25% RDF Inorganic + 75% FYM, T₆ 25% RDF Inorganic + 75% poultry manure, T₇ 25% RDF Inorganic + 75% Vermicompost, T₈ 33% FYM + 33% PM + 33% Vermicompost, T₉, 25% RDF Inorganic + 25% FYM+ 25% poultry manure + 25% Vermicompost. The results showed significantly higher growth in plant height, number of leaves, number of branches, number of flower, number of fruit, fresh weight and dry weight per plant in treatment T₆ (NPK+ poultry manure) in comparison to other treatments. The biochemical parameters like the Chlorophyll a, and b, Carotenoid, protein and Capsaicin were recorded maximum in T₆ (NPK+ poultry manure). The level of NPK in soil has showed significantly higher results in T₆ (inorganic fertilizer + organic manure).

Keywords: Chili, flower, inorganic fertilizer, organic manure (FYM, Poultry Manure, Vermicompost)

Introduction

Chili is famous for its pleasant aromatic flavour, pungency and high colouring substance. Among the spices, dry Chili contributes the major share in India (Revanappa *et al.*, 1998) Chili (*Capsicum annum* L.) belongs to the family solanaceae. It is one of the most valuable commercial annual spice crop grown in India. It is rich source of vitamin A and C. Chili fruits having deep red colour, without pungency are used as paprika colour is the principal criterion for assessing its quality. Chili is one of the most important nutritious and its green fruits. It is difficult to obtain higher yields of good quality fruits throughout the year under open conditions in most parts of India. The cultivation of Chili is possible even during the off season under greenhouse condition. Fertilizer application has a pronounced influence on plant development, growth and marketable yield of many vegetable crops production of chilies. (Peter 1999).

Inorganic and organic fertilizer: Inorganic fertilizer or fertilizer is any material of natural or synthetic origin (other than liming materials) that is applied to soils or to plant tissues (usually leaves) to supply one or more plant nutrients essential to the growth of plants. This also depends on its soil fertility as well as organic things such as humic acid, seaweed and worm castings.

Farm Yard Manure (FYM) refers to decomposed mixture of dung and urine of farm animals along with the litter (bedding material) and left over material from roughages or fodder fed to the cattle. On an average, well rotted FYM contains 0.73 per cent N, 0.18 per cent P₂O₅ and 0.71 per cent K₂O, 100 per cent dose of FYM is 9 t/ha (Ghosh *et al.*, 2004) ^[15].

Poultry manure Poultry litter or broiler litter is a mixture of poultry excreta, spilled feed, feathers, and material used as bedding in poultry operations. This term is also used to refer to unused bedding materials. Poultry litter is used in confinement buildings used for raising broilers, turkeys and other birds. Common bedding materials include wood shavings, sawdust, peanut hulls, shredded sugar cane, straw, and other dry, absorbent, low-cost organic materials. Poultry manure contains 2.14 per cent N, 1.09 per cent P₂O₅ and 1.23 per cent K₂O (Ghosh *et al.*, 2004) ^[15].

Vermicompost is the product or process of composting using various worms, usually red wigglers, white worms, and other earthworms to create a heterogeneous mixture of decomposing vegetable or food waste, bedding materials, and vermin cast.

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Vermicast, also called worm castings, worm humus or worm manure, is the end-product of the breakdown of organic matter by an earthworm. These castings have been shown to contain reduced levels of contaminants and a higher saturation of nutrients than do organic materials before vermicomposting. Vermicompost contains 1.6 per cent N, 1.8 per cent P_2O_5 and 0.75 per cent K_2O (Rao *et al.*, 2015) ^[19].

Material and Methods

The study was conducted at Department of Biological Sciences, SHUATS, Allahabad (U.P.), to evaluate the response of organic manure and inorganic fertilizer in case on Chilli plantation. The doses were switched from Inorganic to Organic in a fix ratio on the Chilli. The experiments consist of 10 treatments and three replications with LSD design *viz.* According to the treatment the organic manure and inorganic fertilizer are applied before transplanting and 10: 40 days after transplanting.

Table 1: Treatment details

Treatments	Details
T ₀	Control
T ₁	100% RDF of Inorganic
T ₂	100% FYM
T ₃	100% PM
T ₄	100% Vermicompost
T ₅	25% RDF Inorganic + 75% FYM.
T ₆	25% RDF Inorganic + 75% PM
T ₇	25% RDF Inorganic + 75% Vermicompost
T ₈	33% FYM + 33% PM + 33% Vermicompost
T ₉	25% RDF Inorganic + 25% FYM + 25% P.M. + 25% Vermicompost

*RDF - Recommended Dose of Fertilizer

*FYM- Farm yard manure

*PM-Poultry manure

*Vermi- Vermicompost

Results and Discussion

1. Observation on growth parameters

The results of the experiments are presented At 30 DAT maximum plant height was found in T₆ (16.33cm) and minimum was found in T₀ (8.33cm). At 60 DAT maximum average plant height per plant was found in T₆ (23.33cm) and minimum was recorded in T₀ (12.67cm.) and maximum average plant height per plant at 90 DAT was recorded in T₆ (27.33cm) and minimum was recorded in T₀ (17.67cm). The same result has been shown by (Alabi 2006) ^[3].

At 30 DAT, maximum number of leaves was found in T₆ (14.67) and minimum was found in T₀ (8.44). At 60 DAT maximum number of leaves was found in T₆ (42.00) and minimum was recorded in T₀ (21.00) and maximum number of leaves at 90 DAT was recorded in T₆ (53.00) and minimum was recorded in T₀ (27.00). (Sundaravelu *et al.*, 1993) assessed the effect of seed treatment with Azospirillum and gibberellic acid on the growth and yield of radish. Application of Azospirillum in combination with GA3 induced the vegetative growth at a faster rate growth of leaves.

At 30 DAT, maximum number of branches was found in T₆ (3.00) and minimum was found in T₀ (0.33). At 60 DAT maximum number of branches was found in T₆ (8.67). and minimum was recorded in T₀ (3.33) and maximum number of branches at 90 DAT was recorded in T₆ (17.00) and minimum was recorded in T₀ (6.67). N, P, K + Poultry manure increasing the soil biomass and helping the growth and development and enzymatic and hormonal activities of plants. The same results have been shown by (Alabi 2006) ^[3].

Leaf area index the poultry droppings increased the leaf area index. The data on leaf area index as influenced by different treatments are presented in the maximum leaf area index per plant was found in T₆ (2.94 cm²) followed by T₇ (2.89 cm²) and followed by T₉ (2.49 cm²) and minimum was found in control T₀ (1.33 cm²) N, P, K + poultry

Manure increasing the soil biomass and helping the growth and development and enzymatic and hormonal activities of plants. The same results has been shown by (Alabi 2006) ^[3].

Number of flowering At 60 DAT there was significant difference in average number of flower per plant the treatments, maximum flower per plant was found in T₆ (36.00) followed by T₇ (33.33) and minimum was found in control T₀ (12.67). Days to flower initiation and 50 per cent flowering were differed significantly due to soil application with NPK+ poultry manure. This might be due to enhanced production of growth promoting substances like gibberellic acid, Indole acetic acid and plant growth substances. N, P, K + poultry manure increasing the soil biomass and helping the growth and development and enzymatic and hormonal activities of plants. The same results has been shown by (Bindiya *et al.*, 2006).

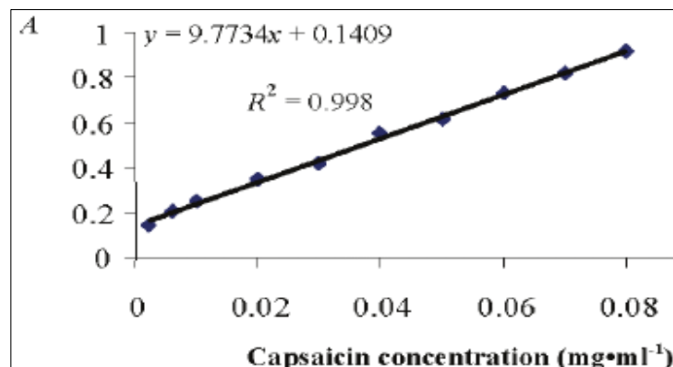
2. Observation on yield parameters

Number of fruits at 120 DAT there was significant difference in average number of fruits per plant the treatments maximum fruits per plant was found in T₆ (35.00) followed by T₇ (32.00) and minimum was found in T₀ (11.67). Application of NPK + poultry manure might have helped to the slow release of nutrients from organic manures when supplemented with inorganic fertilizers. further micro-organisms might have helped in faster decomposition of organic manures there by increasing the availability of nutrients, specially protein synthesis further it was suggested that increase in fruit weight might have accelerated the mobility of photosynthesis from source to the sink which was influenced the growth hormones which released from poultry manure in combination with chemical fertilizers on the yield and nutrient uptake by chilli in the hill valley (Rahman 2014) ^[18].

3. Biochemical Parameters

At 90 DAT maximum Chlorophyll a (mg/g) content was recorded in T₆ (0.50 mg/g) followed by treatment T₇ (0.48mg/g) and minimum chlorophyll a was recorded in T₀ (0.41 mg/g). The same result has been reported by (Saha *et al.*, 2003). The maximum Chlorophyll b (mg/g) content was recorded in T₆ (0.86 mg/g) followed by T₇ (0.84 mg/g) and the minimum chlorophyll b was recorded in T₀ (0.74mg/g). The same result has been reported by (Balasubramani 1988) ^[7].

And the maximum Carotenoid (mg/g) content was recorded in T₆ (0.30 mg/g) and T₇ (0.28mg/g) followed by treatment T₉ (0.27 mg/g) and minimum was recorded in T₀ (0.22 mg/g). Organic and inorganic fertilizers contain NPK and other micro nutrients in required amount which increase the biomass of soil and helps in growth and development of plants and increasing the chlorophyll contents. The same result has been shown by (Ramanathan and Subbaiah, 1982). The maximum Capsaicin content was recorded in T₆ (1194.20 µg/g) and followed by T₇ (1036.90 µg/g) and minimum was recorded in T₀ (531.50 µg/g). Organic and inorganic fertilizers increasing the hormonal activities of plants like ethylene which helps in repining of fruits and capsaicin formation. The same result has been shown by (Balasubramani, 1988) ^[7].



The maximum protein content recorded in T6 (0.28mg/g) and

T₇ (0.26mg/g) followed by treatment T₉ (0.25 mg/g) and minimum was recorded in T₀ (0.16 mg/g). The statistical analysis reveals that significant. Application of NPK + poultry manure might have helped to the slow release of nutrients from organic manures when supplemented with inorganic fertilizers. Further, micro-organisms might have helped in faster decomposition of organic manures there by increasing the availability of nutrients, specially protein synthesis further it was suggested that increase in fruit weight might have accelerated the mobility of photosynthesis from source to the sink which was influenced the growth hormones which released from poultry manure in combination with chemical fertilizers on the yield and nutrient uptake by chilli in the hill valley (Rahman 2014) [18].

Table 2: The effect of organic and inorganic on growth parameters on plant height (cm), number of leaves and number of branches chili (*Capsicum annum* L.)

Treatment	plant height (cm)	number of leaves	number of branches	Leaf area index (cm ²)
T0	12.89	18.81	3.44	1.33
T1	16.56	23.45	7.00	2.31
T2	16.33	25.00	5.22	1.86
T3	17.33	25.78	6.11	1.88
T4	17.44	26.67	7.45	1.75
T5	17.44	26.67	7.33	1.57
T6	22.33	36.56	9.56	2.94
T7	20.00	34.11	8.44	2.89
T8	15.33	23.11	5.22	1.58
T9	18.45	30.44	7.67	2.49
F- test	S	s	S	s
S. Ed. (±)	2.957	8.266	3.345	0.064
C. D. (% 0.05)	8.723	24.384	9.868	0.188

Table 3: The effect of organic and inorganic on yield parameters number of fruit, weight of fruit, Fresh weight of per plant (g) Dry weight of per plant (g) chili (*Capsicum annum* L.)

Treatment	No. of flower	No. of fruit	Weight (g) of fruit/ plant	Fresh weight (g) of plant	Dry weight (g) of plant
T0	12.67	11.67	14.77	20.50	3.19
T1	27.00	26.67	21.50	22.63	5.60
T2	20.33	18.33	19.03	21.67	4.27
T3	21.67	20.67	19.53	21.63	4.70
T4	22.33	19.67	22.33	21.67	4.57
T5	25.67	24.67	23.17	22.73	4.43
T6	36.00	35.00	32.20	28.27	7.60
T7	33.33	32.00	27.00	27.40	6.30
T8	23.33	21.67	21.33	21.40	4.53
T9	31.33	31.33	23.47	22.77	5.73
F- test	S	S	S	S	s
S. Ed. (±)	1.434	1.468	0.889	0.105	0.167
C. D. (P = 0.05)	4.229	4.331	2.622	0.311	0.491

Table 4: The effect of organic and inorganic on yield parameters Chlorophyll a, Chlorophyll b Carotenoid, capsaicin, Protein, chilli (*Capsicum annum* L.)

Treatment	Chlorophyll a	Chlorophyll b	Carotenoid	Capsaicin	Protein
T0	0.41	0.74	0.22	531.50	0.16
T1	0.44	0.81	0.26	730.30	0.23
T2	0.43	0.76	0.25	663.13	0.21
T3	0.46	0.81	0.26	675.23	0.22
T4	0.46	0.78	0.26	732.93	0.21
T5	0.45	0.79	0.25	845.57	0.20
T6	0.50	0.86	0.30	1194.20	0.28
T7	0.48	0.84	0.28	1036.90	0.26
T8	0.44	0.77	0.24	748.47	0.23
T9	0.47	0.82	0.27	948.40	0.25
F- test	s	s	S	S	s
S. Ed. (±)	0.007	0.016	0.008	7.430	0.009
C. D. (P = 0.05)	0.021	0.047	0.024	21.918	0.027

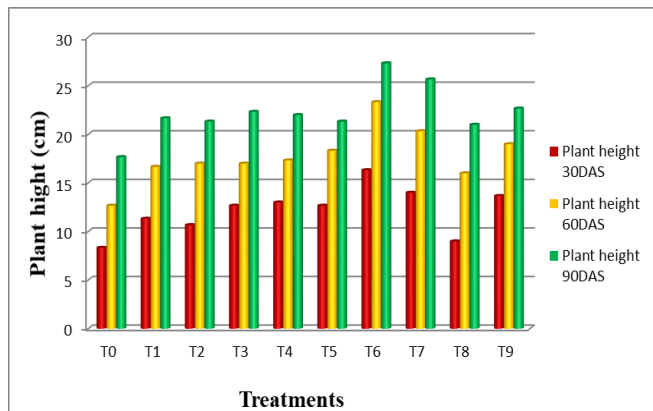


Fig 1: Effect of organic and inorganic fertilizer on plant height (cm) under different days in chilli (*Capsicum annum* L.)

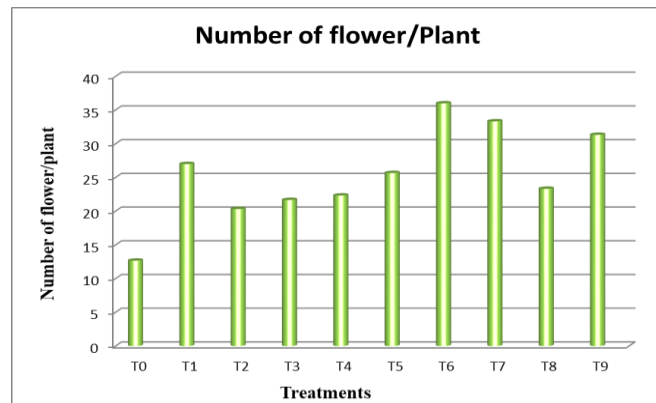


Fig 5: Effect of organic and inorganic fertilizer on number of flower under different treatments in chilli (*Capsicum annum* L.)

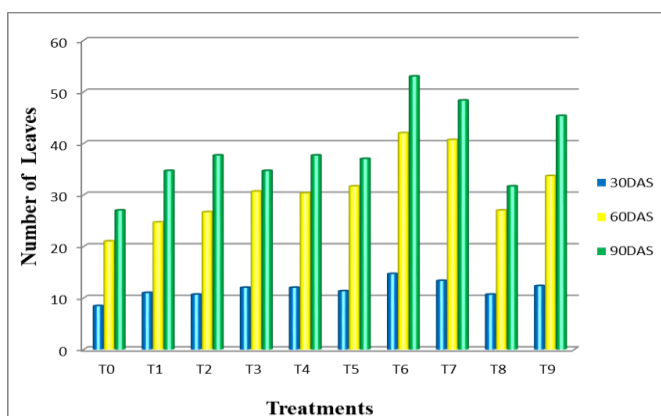


Fig 2: Effect of organic and inorganic fertilizer on number of leaves under different days in chilli (*Capsicum annum* L.)

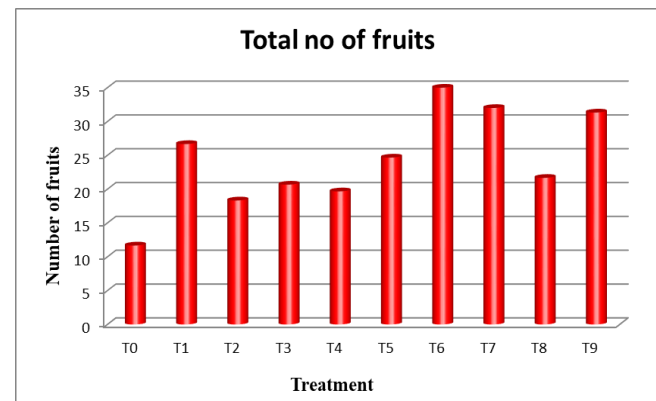


Fig 6: Effect of organic and inorganic fertilizer on Total number of fruit per plant under different treatment in chilli (*Capsicum annum* L.)

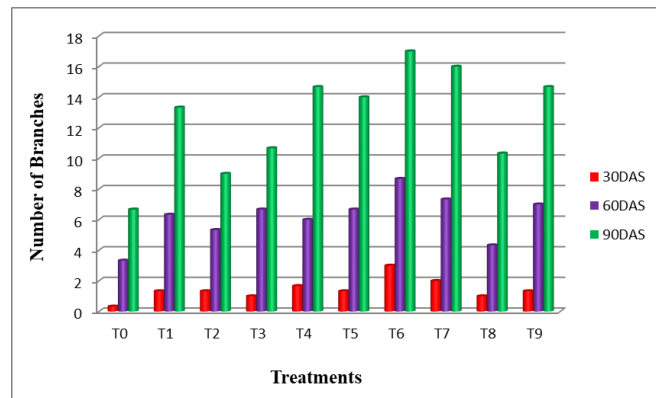


Fig 3: Effect of organic and inorganic fertilizer on number of branches under different days in chilli (*Capsicum annum* L.)

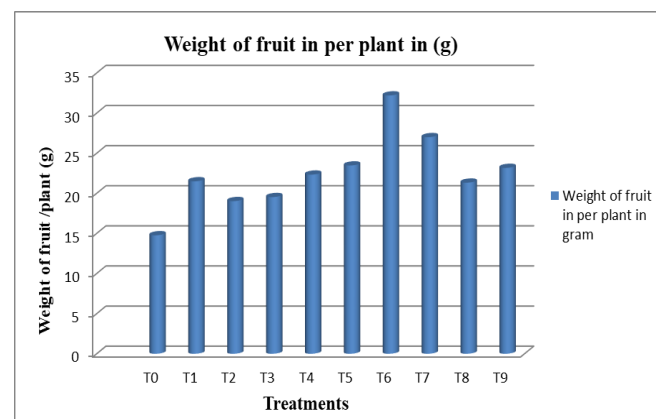


Fig 7: Effect of organic and inorganic fertilizer on weight of fruit in per plant (g) under different treatments in chilli (*Capsicum annum* L.)

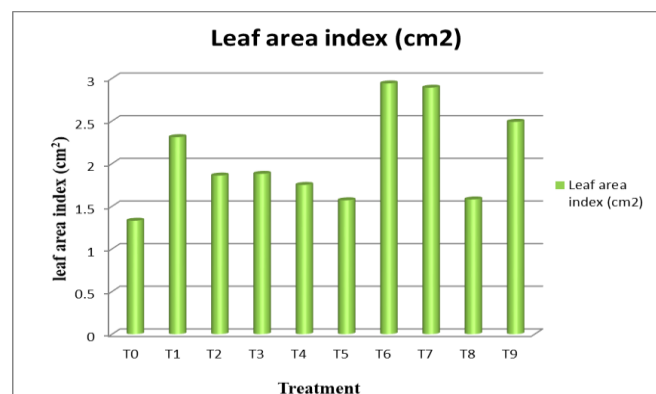


Fig 4: Effect of organic and inorganic fertilizer on Leaf area index (cm²) in chilli (*Capsicum annum* L.)

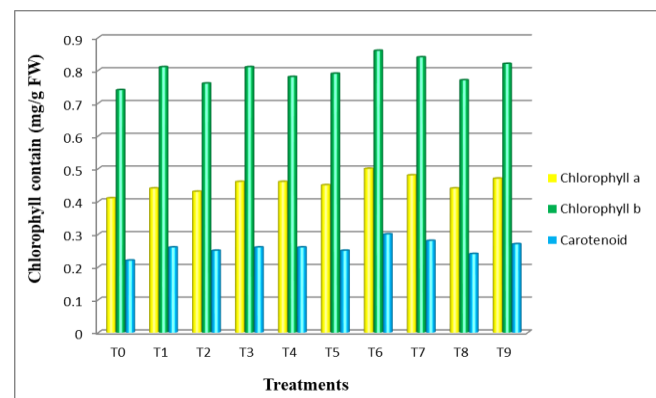


Fig 8: Effect of organic and inorganic fertilizer on Total chlorophyll "a", chlorophyll "b", Carotenoid (mg/g FW) of leaves under different treatment in chilli (*Capsicum annum* L.)

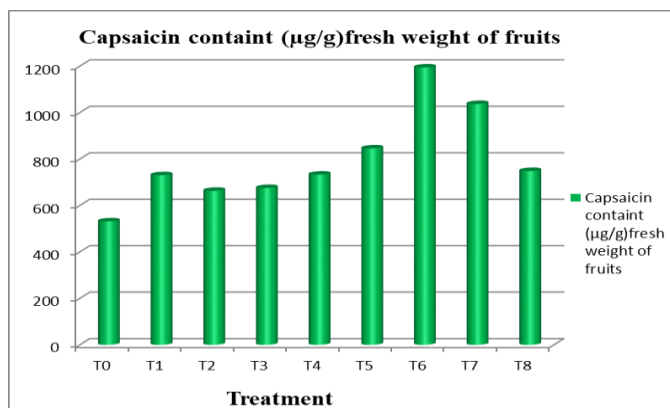


Fig 9: Effect of organic and inorganic fertilizer on Total Capsaicin contain (µg/g) fresh weight of leaves under different treatment in chili (*Capsicum annum* L.)

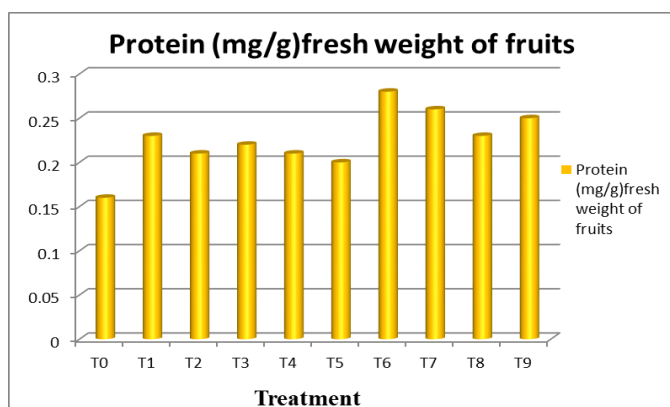


Fig 10: Effect of organic and inorganic fertilizer on Total Protein (mg/g) fresh weight of leaves under different treatment in chili (*Capsicum annum* L.)

Conclusion

The present investigation would be concluded that, the application of NPK+ poultry manure has recorded highest in all parameters as compare to all the treatments. The level of NPK has shown significantly higher results in T₆ (inorganic fertilizer + organic manure) soil sample. Application of organic manure also increased over time. Soil properties indicate changes in soil carbon, nitrogen mineralization and plant feeding nematodes due to different organic amendments improved soil quality.

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