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Effect of Individual and Combined Application of Biofertilizers, Inorganic Fertilizer and Vermicompost on the Biochemical Constituents of Chilli (Ns - 1701)

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Abstract

Organic Agriculture is a holistic way of farming besides production of high quality promoters without any agrochemicals. Biofertilizers (i.e), living organisms used in the fertilization of soil and are useful in supplementing the usual application of chemical nitrogen fertilizers and help in enriching the soil. Vermicompost is blackish–brown humus like coarse granular material having electrically charged particles meant for improved adsorption of plant nutrients in the soil. The organic carbon in vermicompost releases the nutrients slowly and steadily into the system and enables the plant to absorb these nutrients. The present investigation is undertaken to study the effect of individual and combined application of biofertilizers, inorganic fertilizer and vermicompost on the biochemical constituents of chilli (NS- 1701).

Keywords: Chilli; Vermicompost; Biofertilizers; Triple-17; Complex

Introduction

Sustainable agriculture aims at long term maintenance of natural resources and agricultural productivity with minimal adverse impact on the environment. It emphasizes optimal crop production with minimal external inputs, reducing dependence on commercial inputs (fertilizers and pesticides) and substituting them with internal resources [1]. At present, there is a need for developing an efficient nutrient management system with the use of organic manures, inorganic fertilizers and biofertilizers to maintain soil fertility and for better crop production [2]. The high content of both micro and macro nutrients in organic manures along with the slow release of phosphorus could reduce the nutrient deficiency problems and lower the magnitude of phosphorus fixation.

Now a days there is a need to devise alternate ways to collect, process, compost, utilize organic manure as well as biofertlizers like *Azotobacter, Azospirillum, Acetobacter, Rhizobium, Azolla, Blue green algae* and *Phosphate solubilizing bacteria* enrich fertility status of the soil [3]. The chemical fertilizers like N, P and K have played significant role on increasing the yield and quality in plants during early seventies. But in recent years the usage of chemical fertilizers indiscriminately in an unbalanced manner has been shown to result in several problems like loss of fertility, soil health and multiple nutrient deficiencies and loss of microbial activities etc, which ultimately resulting in reduced crop productivity and quality [4].

In respect to this, nitrogen, phosphorus and potash is of paramount importance, nitrogen stimulates vegetative growth and phosphorus helps in early establishment of crop, formation of fibrous and strong root system and thereby helping absorption of nutrients from the soil and finally contributing towards rapid growth in seedling. Potash helps in the biosynthesis of carbohydrates. It also helps in moisture regulation within plant system there by reducing the ill effects of moisture stress at the time of water deficiency [5].

Vermicomposting is a process by which epigeic earthworm species are used for the conversion of organic wastes into vermicompost, excellent organic manure or it is the degradation of organic waste by earthwormic consumption. Vermicomposting is a solid waste management strategy in which organic solid wastes are considered as resources [6]. Composting have agricultural and other biowastes is the most widely adapted process for their recycling into the soil for replenishing with the scavenged nutrients, particularly the organic matter and micronutrients. The trace elements like Zn, Cu, Cr, Mn, Fe etc are essential for plants; they may become injurious for health of plants, animals and human beings. Therefore the concentration of trace elements in compost should not exceed the prescribed limits [7].

Chilli (*Capsicum annum*) is one of the most valuable commercial spice crops grown on 0.95 million hectares of land in India with a total production of 0.82 million tones [8]. Chilli is a rich source of ascorbic acid.The fruit color is due to the presence of capsaicin and capsorubin [9]. Chilli is the only source of capsaicin and has significant physiological action and which is used in pharmaceutical and cosmetic preparations [10].

Hence a study was undertaken to find out the effect of individual and combined application of Biofertilizers, Vermicompost and Inorganic fertilizers on the biochemical constituents of chilli (NS -1701).

Materials and Methods

A pot culture investigation was done to identify the effect of Biofertlizers, Vermicompost and Inorganic fertilizers on the biochemical constituents in chilli (NS–1701). Each pot was filled with 7.5 kg of soil. The soil was mixed with different combinations of biofertilizers

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(*Azospirillum* and *Phosphobacteria)* and inorganic Fertilizer (Triple 17- complex) at the rate of 20gm / kg and vermicompost in the ratio of 1:10 respectively.

The experiment was carried out in randomized block design pots with six treatments consisting of combinations of biofertilizers, vermicompost and inorganic fertilizers with four replications.

T_o - Control
T_1 - Inorganic fertilizer (Triple – 17complex)
T_2 - *Azosprillum* and *Phosphobacteria*
T_3 - Triple 17 complex + *Azospirillum* and *Phosphobacteria*
T_4 – Vermicompost
T_5 - Vermicompost + *Azospirillum* and *Phosphobacteria*
T_6 - Vermicompost + Triple – 17 complexes.

The chilli seeds of variety NS- 1701 (Namdhari seeds – 1701) were used. This premium hybrid variety has very high pungency and high level of tolerance to viruses and at high temperatures.

The chilli seeds were sown on each pot without any treatment. After germination 100% moisture content was maintained. The plants were protected from the attack of insects and pest. All the four replications were subjected to biometric observation and biochemical analysis in chilli leaves and fruits (Table 1) and the results were analyzed statistically for mean and variance.

Parameters	Part of Plant used	Method of Analysis	Reference
Chlorophyll	Fresh leaves	Spectrophotometry	Yasidia et al.,1971
Carotenoid and Lycopene	Fresh leaves	Spectrophotometry	Zarkaria et al.,1979,Adsule &Ambadan,1979
Protein	Fresh leaves and Vegetables	Spectrophotometry	Lowry et al.,1951
Starch	Fresh leaves and Vegetables	Colorimetry	McCready et al.,1950
Ascorbic acid	Vegetables	Spectrophotometry	Roe & Keuther,1953
Reducing sugars	Vegetables	Colorimetry	Somogyi,1952
Total carbohydrates	Vegetables	Colorimetry	Hedge & Hefreiter,1962
Total soluble sugars	Vegetables	Colorimetry	Dubois,1956
Total phenol	Vegetables	Colorimetry	Bray&Thorpe,1954
Calcium	Vegetables	Titrimetry	Raghuramulu et al.,2003
Magnesium	Vegetables	Colorimetry	Raghuramalu et al.,2003

Table 1: Methodology for analysis of Biochemical Parameters in Leaves and Fruits.

Parameters	T_0 T_1 T_2 T_3 T_4 T_5 T_6 SED CD (P<0.05)
Total Number of Fruits Per Plant	19.00 20.00 22.00 21.00 22.67 21.00 30.00 0.89 1.91
Total Number of Leaves	4.33 5.33 7.33 9.00 13.00 11.67 16.00 0.64 1.38
Per Plant Length of Shoot (cm)	20.98 21.52 22.07 25.90 21.99 26.11 28.57 O.68 1.45

SED: Standard Deviation

Table 2: The effect of individual and combined application of biofertilizers, vermicompost and inorganic fertilizers on the biochemical constituents of chilli (NS-1701).

Parameters	T_0 T_1 T_2 T_3 T_4 T_5 T_6 SED CD (P<0.05)
Chlorophyll(mg/g)	1.92 3.23 2.08 1.88 2.21 2.49 2.58 0.15 0.33
Protein(mg/g)	2.53 3.43 3.10 3.40 10.50 5.87 10.83 0.38 0.82
Lycopene(mg%)	0.69 0.86 0.71 0.87 0.83 0.72 0.85 0.04 0.08
Carotenoid(µg/g)	129.67 150.11 131.43 174.52 146.95 148.98 147.32 0.69 1.47
Starch (%)	0.40 0.75 0.82 0.41 1.19 1.16 0.78 0.17 0.36

SED: Standard Deviation

Table 3: The effect of individual and combined application of biofertilizers,vermicompost and inorganic fertilizers on the biochemical constituents of chilli (NS-1701).

Parameters	T_0 T_1 T_2 T_3 T_4 T_5 T_6 SED CD (P<0.05)
Carbohydrates (%)	0.48 3.12 2.71 2.16 2.14 2.26 3.68 0.05 0.11
Reducing sugars (%)	2.44 2.53 4.14 2.42 2.84 2.80 4.56 0.09 0.19
Total soluble sugars (mg %)	160.39 210.66 370.59 194.02 254.56 230.40 450.60 0.64 1.37
Starch (%)	1.54 3.22 1.83 1.70 3.58 3.84 5.40 0.24 0.50
Protein (%)	0.85 1.55 2.11 2.35 2.16 1.22 2.59 0.09 0.26
Ascorbic acid (mg %)	90.49 141.56 184.84 224.27 255.79 210.18 311.04 2.00 4.29
Total phenol (mg %)	151.33 170.42 244.27 161.37 228.65 250.26 260.71 1.98 4.25
Calcium (mg %)	27.82 33.27 32.31 35.17 30.39 31.55 38.41 1.38 2.96
Magnesium (mg %)	250.44 275.36 282.40 269.25 276.51 274.42 288.34 0.90 1.94

SED: Standard Deviation

Table 4: The effect of individual and combined application of biofertilizers, vermicompost and inorganic fertilizers on the biochemical constituents of chilli (NS-1701).

Results and Discussion

Effect on growth and yield parameters

Pooled data on chilli growth and yield presented in Table 2 reveal that the application of vermicompost + triple 17-complex (T_6) recorded significantly higher number of leaves, fruits and maximum shoot length over the control and other treatments.

These observations were also in conformity with those of workers [11] reported that the increased level of phosphorus and potash has increased the growth of the plant. Since phosphorus is the structural component of cell organelles and also it favours the formation of metabolites required for growth similarly potash application enhances the uptake of and N and hence there is an improvement in growth characters. The application of N in combination with P significantly increased the plant height number of leaves and internodes in chrysanthemum [12]. The application of vermicompost improvement in shoot length, number of leaves and fruits in chilli [13].

Effect on biochemical constituents in leaves

The data presented in Table 3 revealed that among different treatments of vermicompost, biofertilizers and inorganic fertilizers the leaf chlorophyll content was found to be significantly superior in the treatment T_1 when compared to other treatments and control. The protein content has significantly (P<0.05) increased in the T_6 (Triple–17 complex + Vermicompost) treatment. The maximum lycopene and carotenoid content of 0.87 mg% and 174. 5 µg/g was recorded in T_3 (Triple 17 complex + *Azospirillum* and *Phosphobacteria*. Vermicompost T_4 and Vermicompost + *Azosprillum* and_Phosphobacteria T_5 significantly increased the starch content by 1.19% and 1.16% respectively.

Effect on biochemical constituents in fruits

The fruits harvested from the chilli plants after 60days were analyzed for various biochemical constituents (Table 4). The biochemical constituents starch, carbohydrates, reducing sugars, starch, protein, total soluble sugars, ascorbic acid, total phenol, calcium and magnesium were recorded significantly maximum in the treatment triple 17 complex + vermicompost (T_6) followed by other treatments and the lowest was found in control (T_0).

Study by [13] had shown that the application of vermicompost had recorded the maximum carbohydrate content. Application of

phosphorus, nitrogen increased the protein content [14]. When recommended dose of fertilizers (N, P and K) were applied, total soluble sugars in acid lime fruit was raised significantly [15]. Ascorbic acid content in strawberry was found to be significantly higher when *Azotobacter* and NPK were supplied in combination [16]. Application of triple 17-complex along with organic monures increases the calcium and magnesium content in sugarcane [17].

The present investigation revealed that the biochemical constituents of the chilli fruits increased in the treatment. This indicates that the application of inorganic fertilizers along with vermicompost or organic manures enhances the nutrient composition in chilli fruit.

Conclusion

NPK are the most primary nutrients which are useful for plant growth; appropriate combination of biofertilizer, chemical fertilizer, FYM, organic manure and vermicompost would be conducive for greater nutrient uptake by the crop and also would improve the soil health and soil fertility status. It is recommended that by using organic manures the yield of chilli was improved and the product and processed and used for pharmeautical preparations (capsaicin and ascorbic acid).

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