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Effect of organics on growth, yield and biochemical parameters of chilli (Capsicum annum L.)

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Abstract: *A field experiment was conducted to study the "Effect of organics on growth yield and biochemical parameters in chilli (Capsicum annum L.) cv: Suryamukhi at Sam Higginbottom Institute of Agriculture Technology and Sciences during rabi, 2012-13. The experiment was laid out in RBD with three organic source and their combinations. The RDF kept as control.*

The effect of organics on growth yield and biochemical parameters in chilli having different 7 teatment of FYM, Vermicompost)and Biofertilizers (Azospirillum + PSB) ware applied.The results show that better plant height , number of leaves, number of branches, number of flower, number of fruit, fresh weight and dry weight per plant consisting of treatment FYM (12.5t/ha) + Vermicompost (2.5t/ha) + Biofertilizer (@2.5kg/ha Azospirillum + PSB)

The biochemical parameters like the Chlorophyll a, and b, carotenoid, protein and abscorbic acid were recorded maximum in with organics FYM (12.5t/ha) + Vermicompost (2.5t/ha) + Biofertilizer (@2.5kg/ha Azospirillum + PSB.

Key Words: *Capsicum, FYM , Vermicompost, Biofertilizers, growth, yields.*

I. Introduction

Chillies, green or red fruits of Capsicum annuum L. belong to the family Solanaceae. Chillies are native of Peru and Mexico and Portuguese were the first to introduce chillies in India during 15th century. Its cultivation became popular in the 17th century.

The world's chilli area accounts for 1.5 million hectares and production around seven million tonnes. The largest producer of chilies in the world is India, accounting for 11.53 lakh tonnes in 2005-2006; followed by China, with a production of around four lakh tonnes; Mexico, with around three lakh tonnes; and Pakistan with three lakh tonnes **(Anon, 2008).**

Chilli is rich source of vitamins A, C, E and P. Hundred gram of edible portion of capsicum provides 24 k cal of energy, 1.3 g of protein 4.3 g of carbohydrate and 0.3 g of fat **(Anon. 2001**).

In simple words, organic farming is the cultivation of crops through organic inputs with intensity to minimize the use of chemical fertilizers and pesticides that is hazardous to the environment. Organic materials such as bio-digested slurry, poultry manure, green leaf manures and FYM can substitute for inorganic fertilizers to maintain productivity and environmental quality **(Chaoudhary et al., 2002)**.

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

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.

With the increase in population our compulsion is not only to stabilize agricultural production but also to increase it further in sustainable manner. Excessive use over years of agro-chemicals like pesticides and fertilizers has affected the soil health and lead to declining of crop yields and quality of products. Hence, a natural balance needs to be maintained at all cost for existence of life and property.

Keeping theses things under consideration use of organics in chilli cultivation as target dose of application and to study its effect on growth, yield and biochemical parameters of chilli, the present study was conducted with the aims is to study the effect of individual and combinational application of organics on growth ,yield and biochemical parameters on chilli.

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II. Materials and Methods

The present experiment was conducted in randomized block design 7 treatment with 3 replication in Pot at Experimentation Centre, Department of Biological Sciences, SHIATS Allahabad during rabi, 2012-13. The experimental material used in expriment FYM, Vermicompost and Biofertilizer (Azospirillum + PSB).

Treatment details

Treatment	Dose of application of organics
T0	Control
T_1	FYM(12.5t/ha)
T_2	Vermicompost(2.5t/ha)
T_3	Biofertilizer (@2.5kg/ha Azospirillum+2.5kg/ha PSB)
T_4	FYM(12.5t/ha)+ Vermicompost(2.5t/ha)
T_5	FYM(12.5t/ha)+ Biofertilizer (@2.5kg/ha Azospirillum+2.5kg/ha PSB)
T_6	Vermicompost(2.5t/ha)+ Biofertilizer (@2.5 kg/ha Azospirillum+ 2.5kg/ha PSB)
T_7	FYM (12.5t/ha) + Vermicompost (2.5t/ha) +Biofertilizer(@2.5kg/ha Azospirillum+ 2.5kg/ha PSB)

Observation Recorded

2.1 Growth parameters

2.1.1 Plant height per plant (cm): The plant height was measured from ground level to the terminal growing point of the main stem at 30, 60, and 90 DAT. The average plant height was expressed in centimeter (cm).

2.1.2 Number of leaves per plant: Total number of leaves per plant was counted from plants at 30, 60 and 90 DAT and at harvest and mean was worked out and expressed as number of leaves per plant.

2.1..3 Number of branches per plant: The number of branches arising on the main stem in the plant was recorded at 30, 60 and 90 DAT. The mean number of branches per plant was worked out and expressed in number.

2.1.4 Number of flower per plant: The number of flowers arising from plants in each treatments were counted at 60 DAT and expressed as number of flowers per plant.

2.2 Yield parameters

2.2.1 Number of fruit per plant: The numbers of fruits harvested from plants in each treatment were counted 90 DAT from different pickings and average was worked out and expressed as number of fruits per plant.

2.2.2 Fresh weight of fruit per plant (g): The fruits were picked from plants collected and weighed (g) at 90 DAT it treatment vise.

2.2.3 Dry weight of fruit per plant (g): The fruits were picked, air dried and then kept in oven for 24 hours at 80^oC and their dry weight was determined at harvesting time.

2.3 Biochemical Parameters

2.3.1 Estimation of Chlorophyll a & b:-

Estimation of chlorophyll was done by methods given by **Arnon (1949).**The chlorophyll content in the leaves was estimated by weighing 1 gm of fresh leaves and was grounded with pestle and mortar. The 10 ml of 80% acetone was added to and this much quantity of samples was taken in test tubes and and was kept overnight. Next to that those samples are homogenized at 3000 rpm for 15 minutes. The absorbance of the samples was recorded at 645 nm and 663 nm respectively.

Chlorophyll mg/g fresh weight can be calculated by the formula given below:

Chl a (mg/g) = $[\{(12.7x\ ABS_{663}) – (2.69\ x\ ABS_{645})\}\ x\ V]/\ 1000\ x\ W$

Chl b (mg/g) = $[\{(22.9\ x\ ABS_{645}) – (4.68x\ ABS_{663})\}\ x\ V]/1000\ x\ W$

Where;

ABS_{663} = Absorbance at 663 nm

ABS_{645} = Absorbance at 645 nm

V = Volume of acetone used

W = Weight of sample taken

2.3.2 Estimation of Carotenoids:-

Carotenoid was determine according to method of **Lichtenthaler and Welburn (1983)**. 0.1 gm fresh leaves weigh and crushed in 80% acetone, made the volume to 10ml. with 80% acetone. Then centrifuge at 800 rpm for 5 minutes. The supernant was read under 470 nanometer against 80% acetone blank. The carotenoid content was calculated using the following formula:-

Carotenoid mg/g freash weight=$1000_{(A470)}$ - 3.27 (Chl-a) – 104 (Chl-b) / 227

2.3.3Determination of protein in fruit of chilli: Protein content of the fruit was estimated by **Lowry method (1951).**
Reagent A: 2gm NaOH +500ml. double distilled water + 1gm Sodium carbonate.
Reagent B: 1gm potassium sodium tartrate + 50ml double distilled water +0.25gm $CuSO_4$
Reagent C: 1ml of Reagent B + 50ml of reagent A
Reagent D: 1ml of foline + 1ml double distilled water Phosphate Buffer:
Solution A: 1.36gm potassium dihydrogen orthophosphate + 100ml double distilled water
Solution B: 1.74 gmdipotassium orthophosphate + 100ml double distilled water
Solution C: 39ml of solution of A + 61ml of solution B.
Normal NaOH; 4gm NaOH+100ml double distilled water
0.5 gm fruit weight and crushed in 5 ml of Phosphate buffer and centrifuge at 3000 rpm for 5 minutes. 0.5 ml of the Supernatant was collected in the test tube and 0.5 ml of 1N NaOH, 2.5 ml reagent C and 0.5ml reagent D was added to it after adding the reagent D blue colour was appeared and absorbance was read at 660 nanometers. The protein content was determined by the standard curve prepare out the Bovin Serum Albumin (BSA) protein

2.3.4Ascorbic Acid Content (90 days after transplanting):
Ascorbic acid content was estimated by the following procedure (**Anon, 1975).**

Reagents

1. Oxalic acid 4 per cent solution
2. Dye solution : 42 mg of sodium bicarbonate was dissolved in little amount of distilled water and 52 mg of 2,6-dichlorophenol indophenol was added and volume made up to 200 ml with distilled water.
3. Standard ascorbic acid solution: 100 mg of ascorbic acid dissolved in 4 per cent oxalic acid and made up to 100 ml in a volumetric flask with oxalic acid. 10 ml of stock solution was diluted to 100 ml with oxalic acid to form working standard.

Procedure

Ascorbic acid standard solution (5 ml) was pipette out into a 100 ml conical flask to which 5 ml of oxalic acid (4%) was added. It was titrated against 2, 4-dichlorophenol indophenols dye solution until the appearance of pink colour which persisted for few minutes. The dye factor was determined as the amount of dye consumed is equivalent to the amount of ascorbic acid.

The Ascorbic acid content was estimated by extracting two grams of pulp in oxalic acid (4%), filtered through muslin cloth. The final volume was made up to 25 ml using 4 percent oxalic acid. From this 5 ml of aliquot was taken and 5 ml of 4 per cent oxalic acid was added and titrated against 2, 6 – dichlorophenol indophenols dye to pink end point. The amount of ascorbic acid was calculated by the following formula and expressed as mg/100 g fresh weight.

$$\text{Ascorbic acid content (Mg/100 g fr.wt)} = \frac{\text{Titrate value x Dye factor x volume made up}}{\text{Aliquot taken x Weight of sample}} \times 100 \quad \text{Eq.No 3}$$

2.4Statistical analysis

Data recorded on different aspects of crop, viz; growth, yield attributes and yield were tabulated and subjected to statistical analysis as per **Gomez and Gomez, 1976.** Significance difference between treatment means was tested through 'F' test and the critical difference (CD) was worked out wherever 'F' value was found to be significant for treatment effect.

III. Results and Discussion

3.1Observation on growth parametrs

3.1.1 Plant height (cm)

At 30 DAT, maximum plant height was found in T_7 (20.22cm) and minimum was found in T_0 (16.11 cm). At 60 DAT maximum average plant height per plant was found in T_7 (40.20 cm) and minimum was recorded in T_0 (30.33 cm.) and maximum average plant height per plant at 90 DAT was recorded in T_7 (46.28cm) and minimum was recorded in T_0 (34.28 cm). The increment in plant height with increasing dose (Azospirillum + PSB) application might be better root growth, cell multiplication, elongation and cell expansion in the plant body by higher dose of Azospirillum which ultimately increased the plant height Similar results have been reported by **Amirthalingam (1988)**

3.1.2 Number of leaves

At 30 DAT, maximum number of leaves was found in T_8 (30.72 cm) and minimum was found in T_0 (24.00 cm). At 60 DAT maximum number of leaves was found in T_7 (65.34 cm) and minimum was recorded in T_0 (37.03 cm.) and maximum number of leaves at 90 DAT was recorded in T_7 (96.12 cm) and minimum was recorded in T_0 (53.41 cm). **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

3.1.3 Number of branches

At 30 DAT, maximum average number of branches per plant was found in T_7 (8.52 cm) and minimum was found in T_0 (4.23 cm). At 60 DAT maximum average number of branches per plant was found in T_7 (11.62 cm) and minimum was recorded in T_0 (4.92 cm.) and maximum average number of branches per plant at 90 DAT was recorded in T_7 (14.85 cm) and minimum was recorded in T_0 (5.56 cm). **Amirthalingam (1988)** observed that soil inoculation of Azospirillum along with 50 per cent recommended dose of nitrogen increased the plant height and number of branches in chilli. Plant height, shoot growth and fruit yield of bhendi were significantly improved due to application of Azospirillum inoculum at rate of 2.5 kg per ha**.**

3.1.4Number of flower

At 60 DAT there was significant difference in average number of flower per plant the treatments, maximum flower per plant was found in T_7(26.32) and minimum was found in T_0 (14.08). Days to flower initiation and 50 per cent flowering was differed significantly due to soil application with FYM 50 per cent + vermicompost 50 per cent + biofertilizers. This might be due to enhanced production of growth promoting substances like gibberellic acid, indole acetic acid and plant growth substances. These results are in agreement with the findings of **Bindiya et al. (2006)**

3.2 Observation on yield parameters

3.2.1 Number of fruits

at 90 DAT there was significant difference in average number fruits per plant the treatments maximum fruits per plant was found in T_7 (17.97) and minimum was found in T_0 (10.33). Application of FYM 50 per cent and vermicompost 50 per cent + biofertilizers, 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 photosynthates from source to the sink which was influenced by the growth hormones which released from vermicompost, the organic source **(Sivakumar et al., 1999** in capsicum).

3.2.2fresh weight (g) of fruit

At 90 DAT maximum fresh weight recorded was in T_7(37.86 g) and minimum fresh weight recorded was in T_0 (21.69 g). The statistical analysis shows significant. **Paramaguru et al. (1993)** studied the effect of Azospirillum on growth and yield of chilli. Azospirillum + 56 kg N per ha recorded the highest plant height of 56.13 to 57.86 cm.

3.2.3 Dry weight (g) of fruit

plant at 90 DAT maximum dry weight recorded was in T_7 (18.02g) and minimum dry weight recorded was in T_0 (10.32 g). **Dhanapal et al. (1978)** reported that seed inoculated with Azospirillum increased the vigour index and seedling growth. Inoculation of Azospirillum to seed, soil and seedling increased the number of fruits per plant, fresh and dry weights of pod per plant

3.3 Observation on biochemical parameters

3.3.1 Chlorophyll a (mg/g)

At 90 DAT and maximum Chlorophyll a (mg/g) content at was recorded in T_7 (0.59 mg/g) and minimum was recorded in T_0 (0.38 mg/g). The statistical analysis reveals that significant. The might have resulted in better growth of plants and higher synthesis of chlorophyll a, b which might have led to higher photosynthesis as reported by **Saha et al. (2003)** and **Chandal et al. (2004)** rice.

3.3.2 Chlorophyll b (mg/g)

At 90 DAT maximum Chlorophyll b (mg/g) content at was recorded in T_7(0. 92mg/g) and minimum was recorded in T_0 (0.60 mg/g).The statistical analysis in table shows that there was significantce. The resulted

in better growth of plants and higher synthesis of chlorophyll a, b which might have led to higher photosynthesis as reported by **Saha et al. (2003)** and **Chandal et al. (2004)** rice.

3.3.3Carotenoid (mg/g)

At 90 DAT maximum carotenoid (mg/g) content at was recorded in T_7 (0. 31 mg/g) minimum was recorded in T_0 (0.22 mg/g). Azospirillum and phosphobacteria physiologically influenced the activity of number of enzymes which lead to increased cell metabolism and enzymatic activity which in turn change the biochemical composition of fruit. it might have been reported by **Ramanathan and Subbaiah (1982) i**n amaranthus.

3.3.4 Protein (mg/g)

At 90 DAT maximum protein content recorded was (0.25 mg/g) in T_7 and minimum protein content recorded was (0.14 mg/g) in T_0. The protein content was maximum due to the higher concentration of FYM, Vermicompost and Biofertilizer (Azospirillum + PSB), Application of FYM 50 per cent and vermicompost 50 per cent + biofertilizers it 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 photosynthates from source to the sink which was influenced by the growth hormones which released from vermicompost, the organic source **Sivakumar et al., 1999** in capsicum**.**

3.3.5 Ascorbic acid (mg/g)

At 90 DAT Ascorbic acid content at maximum Ascorbic acid content recorded was in T_7 (1.62 mg/g) and minimum Ascorbic acid recorded was in T_0 (1.14 mg/g). **(Kumarswamy and Madalageri, 1990)** The application of 50 per cent of recommended dose (120:240:120 kg NPK/ha) as basal and another 50 per cent as top dressing along with Azospirillum and Phosphobacteria resulted in higher tuber yield (25.87 t /ha) and ascorbic acid (21.2mg/100 gm) content in onion **.**

Table No.1 The effect of organics on growth parameters on plant height (cm), number of leaves and number of branches chilli (Capsicum annum L.) cv: Suryamukhi.

Treatment	plant height (cm)	number of leaves	number of branches
T_0	34.28	53.41	5.56
T_1	36.24	61.66	6.58
T_2	38.01	64.19	8.73
T_3	38.40	64.99	9.66
T_4	38.92	70.44	10.57
T_5	40.63	76.00	11.14
T_6	44.42	81.66	12.57
T_7	46.28	96.12	14.85
F-test	S	S	S
S.Ed(±)	0.87	1.21	0.72
C.D. at 5%	1.81	2.51	1.50

Table No.2: The effect of organics on yield parameters number of fruit, Fresh weight of fruit per plant (g) Dry weight of fruit per plant (g) chilli (Capsicum annum L.) cv: Suryamukhi.

Treatment	No. of flower	No. of fruit	Fresh weight (g) of fruit	Dry weight (g) of fruit
T_0	14.08	10.33	21.69	10.32
T_1	16.21	13.44	29.56	13.86
T_2	18.37	14.22	30.86	14.69
T_3	19.08	12.32	32.10	15.90
T_4	24.12	17.33	36.39	17.32
T_5	21.80	16.07	34.84	16.59
T_6	22.11	16.67	35.08	16.70
T_7	26.32	17.97	37.86	18.02
F-test	S	S	S	S
S.Ed(±)	1.58	0.64	0.24	0.77
C.D. at 5%	3.28	1.37	0.52	1.56

Table No.3: The effect of organics on yield parameters Chlorophyll a, Chlorophyll b Carotenoid, , Protein, Ascorbic acid chilli (Capsicum annum L.) cv: Suryamukhi.

Treatment	Chlorophyll a	Chlorophyll b	Carotenoid	Protein	Ascorbic acid
T_0	0.38	0.60	0.22	0.14	1.14
T_1	0.42	0.85	0.23	0.17	1.35
T_2	0.49	0.90	0.26	0.18	1.48
T_3	0.41	0.87	0.24	0.16	1.28
T_4	0.58	0.91	0.27	0.22	1.52
T_5	0.55	0.88	0.27	0.19	1.51
T_6	0.57	0.92	0.29	0.27	1.45
T_7	0.59	0.92	0.31	0.25	1.62
F-test	S	S	S	S	S
S.Ed(±)	0.03	0.02	0.01	0.01	0.02
C.D. at 5%	0.06	0.05	0.03	0.03	0.05

IV. Conclusion

On the basis of experiment conducted, it is concluded that the effect of organics on growth, yield and biochemical parameters of chilli (Capsicum annum L.) cv: Suryamukhi FYM @ (12.5t/ha) + Vermicompost @(2.5t/ha) +Biofertilizer (@2.5kg/ha Azospirillum + PSB) showed better results compare to other treatments .

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