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EFFECT OF INORGANIC AND BIO-FERTILIZERS ON PHYSICO-CHEMICAL CHARACTERS AND BENEFIT COST RATIO OF STRAWBERRY [*FRAGARIA X ANANASSA* L. DUCH.] CV. CHANDLER IN CENTRAL UTTAR PRADESH, INDIA

Shashank Verma*, Sanjay Kumar[1], Sutanu Maji[2] and Rakesh Kumar Meena

[1]Supervisor, [2]Co-supervisor

Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow- 226 025 (Uttar Pradesh), India.

Abstract

A field experiment was carried out during 2014-15 at Babasaheb Bhimrao Ambedkar University, Lucknow (U.P.), India to investigate the effect of different levels of inorganic and bio-fertilizers doses *i.e.* T_1 -Control (No Inorganic and no Bio-fertilizers), T_2 -(100 Kg N ha^{-1} + Azotobacter), T_3 - (100 Kg N ha^{-1} + PSB), T_4 - (75 Kg N ha^{-1} + Azotobacter), T_5 - (75 Kg N ha^{-1} + PSB), T_6 - (60 Kg P ha^{-1} + Azotobacter), T_7 - (60 Kg P ha^{-1} + PSB), T_8 - (45 Kg P ha^{-1} + Azotobacter), T_9 - (45 Kg P ha^{-1} + PSB), T_{10} - (60 Kg K ha^{-1} + Azotobacter), T_{11} - (60 Kg K ha^{-1} + PSB), T_{12} - (45 Kg K ha^{-1} + Azotobacter) and T_{13} - (45 Kg K ha^{-1} + PSB) which significantly effect of treatments on Physico chemical – Characters and as well as benefit : cost ratio. Overall minimum T.S.S. find in treatment T_1 (7.85 ^{o} Brix), lowest acidity in treatment T_6 (0.50%), vitamin c and total sugars in treatment T_6 (62.23mg/100g and 7.81%, respectively), which was statistically superior to others. The cost: benefit ratio was also highest in T_2 (1: 4.47). The highest yield per plant observed in T_2 (173.42g) and number of runners was also observed highest in T_2 (6.66).

Key words : Bio-fertilizers, inorganic, bio-fertilizers and quality attributes.

Introduction

The Strawberry is not really a berry, but is a false fruit and consists of many tiny individual fruits embedded in a fleshy scarlet receptacle which belongs to family Rosaceae having 56 chromosomes where as somatic number is 7 due to octaploid in nature. The brownish or whitish specks, commonly considered seeds, are the true fruit known as achene. Strawberries are an excellent source of vitamin c, a good source of folate and potassium and are relatively low in calories. Strawberry is one of the most widely appreciated fruits and it has attained a premier position in the fresh fruit market and processing industries of the world (Sharma and Sharma, 2003). Strawberry offers quicker returns on capital outlay than any other fruit crop since under special methods of cultivation. A crop can be picked as early as the first summer planting. The fruit is the first of the home-grown supplies to reach the market. Strawberry is one of the most important high value cash crops around the world. Strawberry is an attractive, luscious, tasty, nutritious fruit with distinct flavors and aroma. It fetches a good value in world among the fruits which is rich in the vitamin c and iron, the principal demand for cultivated strawberry is from the processing and baking industries around the world and also use in making ice- cream.

Among the various factors like N, P, K which contributes toward the growth, yield and quality of strawberry, nutrition is the most important and it has direct bearing on crop production (Umar *et al*., 2008). Integrated nutrient management includes the use of inorganic and organic sources of nutrients to ensure balanced nutrient proportions by enhancing nutrient response efficiency and maximizing crop productivity of desired quality. It also helps to minimize the exiting gap between nutrient removal through continuous use of chemical fertilizers and supply through slow release of fertilizers. It is widely reported that the extensive use of chemical fertilizers adversely affects soil health and results in decreased crop productivity and quality (Macit *et al*., 2007).

Author for correspondence : E-mail: shashank3978@gmail.com

Bio-fertilizers consist mainly of beneficial micro-organisms that can release nutrients from raw materials and plant residues in the soil and make them available commercially where specific strains are used as biological fertilizers. They become recently, positive alternatives to chemical fertilizers because they help bring down the costs of chemical fertilizers especially N and P and improve soil fertility by maintaining the physical properties of the soil. They may help in improving crop productivity and quality by increasing the biological N fixation, the availability and uptake of nutrients and stimulating the natural hormones. They are safe for humans, animals and environment and using them is accompanied with reducing the pollution occurring in our environment (Walid *et al*., 2014). Azotobacter represents the main group of heterotrophic, non symbiotic, gram negative, free living nitrogen-fixing bacteria. They are capable of fixing an average 20 kg N/ha/year. The genus Azotobacter includes 6 species, with *A. chroococcum* most commonly inhabiting in various soils all over the world (Mahato *et al*., 2009). In view of above facts, the present experiment entitled "Effect of Inorganic and Bio-fertilizers on Physico-chemical Characters and Benefit Cost Ratio of Strawberry (*Fragaria x annanasa* L. Duch.) cv. Chandler in Central Uttar Pradesh" with the objectives to ascertain the effect of inorganic and bio-fertilizers on physico-chemical Characteristics of benefit: cost ratio of strawberry.

Materials and Methods

The present investigation was done at Horticulture Research Farm, Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Vidya - Vihar, Rea Bareli Road, Lucknow during the year 2014-15. Lucknow is characterized by sub-tropical climate with hot, dry summer and cold winter. The soil of experimental farm was saline with soil pH 8.2, Electrical conductivity 4.0 and sodium exchangeable percentage 15.0. During the period of experiment, meteorological observations were recorded from Indian Institute of Sugarcane Research, Lucknow. The planting material was brought from Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan (H.P.), India. The experiment was laid out in Randomized Block Design with 13 treatments *i.e.*, $\mathbf{T_1}$ -Control (No Inorganic and no Bio-fertilizers), $\mathbf{T_2}$ - (100 Kg N ha^{-1}+ Azotobacter), $\mathbf{T_3}$ - (100 Kg N ha^{-1} + PSB), $\mathbf{T_4}$ - (75 Kg N ha^{-1} + Azotobacter), $\mathbf{T_5}$ - (75 Kg N ha^{-1}+ PSB), $\mathbf{T_6}$ - (60 Kg P ha^{-1} + Azotobacter), $\mathbf{T_7}$ - (60 Kg P ha^{-1}+ PSB), $\mathbf{T_8}$ - (45 Kg P ha^{-1} + Azotobacter), $\mathbf{T_9}$ - (45 Kg P ha^{-1} + PSB), $\mathbf{T_{10}}$ - (60 Kg K ha^{-1} + Azotobacter), $\mathbf{T_{11}}$ -(60 Kg K ha^{-1} + PSB), $\mathbf{T_{12}}$ - (45 Kg K ha^{-1} + Azotobacter) and $\mathbf{T_{13}}$ - (45 Kg K ha^{-1} + PSB). Observations were taken on Physico - chemical parameters *i.e.* total soluble solids (^{0}B), acidity (%), vitamin c (ascorbic acid), pigment (anthocyanin), total sugars (%), reducing sugars (%), non- reducing sugars (%) and cost benefit ratio were recorded by A. O. A. C. (1980), Sagar and Samaul (2005) and Saini *et al*. (2001).

Results and Discussion

Physico-chemical characters and benefit cost ratio

Different doses of fertilizers significantly affected on the qualitative characters of strawberry plants. The maximum total soluble solids (table 1) were recorded in the treatment $\mathbf{T_6}$ (9.50 ^{o} Brix), which statistically at par with treatment $\mathbf{T_7}$ (9.35 ^{o} Brix), but significantly superior over other treatments. This was also reported by Andersson *et al*. (2012) that effects on soluble solids and sugars were also previously reported. The glucose, sucrose and malic acid content of the berries were in the same range as previously. There are studies showing that strawberries are better pollinated in organic than in conventional farms and Mishra and Tripathi, 2011 reported that Azotobacter and PSB (each at 6 Kg/ha) produced berries with maximum length (4.63 cm), width (2.64 cm), weight (8.48 g),volume (6.14 cc), total soluble solids (10.30^{0}Brix), total sugars (9.54%), ascorbic acid (57.55 mg/100g edible material) with minimum titratable acidity (0.548%) contents in comparison to untreated plants under plains of Central Uttar Pradesh (India). The maximum acidity (table 1) observed in treatment $\mathbf{T_1}$ (0.76%), which also observed by Badiyala and Bhutani (1990) had recorded that total soluble solids (8.13%) and lowest acidity with the fertilizer schedule consisting of 150kg N, 75kg P and 50kg K per ha in strawberry cv. Tioga in mild hills areas Palampur of Himanchal Pradesh, India.

In case of vitamin C (table 1) was highest in treatment $\mathbf{T_6}$ (62.23mg/100g), which was superior to others. It is also reported by Asami *et al*. (2003) observed that application of Vermi-compost and organic fertilizers increased vitamin- c in strawberry and total sugars also found (table 2)significantly high in $\mathbf{T_6}$ (7.81%), which also observed by Dadashpour and Jouki (2012). This study was conducted during 2008-2009 to investigate the influence of different organic nutrient combinations on yields and quality of strawberry cv. Kurdistan in Iran find the total sugars (7.95%), total soluble solids (TSS) (9.01° Brix), acidity (0.857), TSS: acidity ratio)(11.12) and yields (238.95 g/plant.

The pigment anthocyanin was maximum (table 1) and comes under the treatment $\mathbf{T_{10}}$ (34.66mg/100g),

Table 1 : Effect of inorganic and bio-fertilizers on T.S.S. (°Brix), acidity (%), vitamin C (mg/100g) and pigment (mg/100g) of strawberry.

Treatments	T.S.S. (°Brix)	Acidity (%)	Vitamin-C (Ascorbic acid mg/ 100g)	Pigment (Antho-cyaninmg/100g)
T_1 Control(No Inorganic and no Bio-fertilizers)	7.85	0.76	55.10	20.66
T_2 (100 Kg N ha^{-1}+ Azotobacter)	8.90	0.54	61.92	32.66
T_3 (100 Kg N ha^{-1} + PSB)	8.85	0.56	61.52	32.33
T_4 (75 Kg N ha^{-1} + Azotobacter)	8.70	0.59	60.85	29.66
T_5 (75 Kg N ha^{-1}+ PSB)	8.60	0.62	60.43	28.66
T_6 (60 Kg P ha^{-1} + Azotobacter)	9.50	0.50	62.23	25.33
T_7 (60 Kg P ha^{-1}+ PSB)	9.35	0.52	62.11	23.66
T_8 (45 Kg P ha^{-1} + Azotobacter)	7.95	0.66	58.64	25.33
T_9 (45 Kg P ha^{-1} + PSB)	7.80	0.64	58.43	24.66
T_{10} (60 Kg K ha-^{1} + Azotobacter)	8.85	0.57	61.82	34.66
T_{11} (60 Kg K ha^{-1} + PSB)	8.80	0.58	61.71	33.00
T_{12} (45 Kg K ha^{-1} + Azotobacter)	8.20	0.65	60.23	27.33
T_{13} (45 Kg K ha^{-1} + PSB)	8.15	0.68	60.05	25.66
S Em (±)	0.055	0.017	0.022	0.514
C.D. (P=0.05)	0.163	0.049	0.063	1.509

Table 2 : Effect of inorganic and bio-fertilizers on total sugars (%), reducing sugar (%) and non- reducing sugar (%) strawberry.

Treatments	Total sugars (%)	Reducing sugar (%)	Non- reducing sugar (%)
T_1 Control(No Inorganic and no Bio-fertilizers)	5.65	4.28	1.37
T_2 (100 Kg N ha^{-1}+ Azotobacter)	7.12	5.16	1.96
T_3 (100 Kg N ha^{-1} + PSB)	7.02	5.08	1.94
T_4 (75 Kg N ha^{-1} + Azotobacter)	6.93	4.81	2.12
T_5 (75 Kg N ha^{-1}+ PSB)	6.84	4.75	2.09
T_6 (60 Kg P ha^{-1} + Azotobacter)	7.81	5.58	2.23
T_7 (60 Kg P ha^{-1}+ PSB)	7.62	5.49	2.13
T_8 (45 Kg P ha^{-1} + Azotobacter)	6.05	4.44	1.61
T_9 (45 Kg P ha^{-1} + PSB)	6.02	4.42	1.60
T_{10} (60 Kg K ha-^{1} + Azotobacter)	6.72	4.72	2.00
T_{11} (60 Kg K ha^{-1} + PSB)	6.67	4.69	1.98
T_{12} (45 Kg K ha^{-1} + Azotobacter)	6.40	4.43	1.97
T_{13} (45 Kg K ha^{-1} + PSB)	6.34	4.40	1.94
S Em (±)	0.029	0.055	0.021
C.D. (P=0.05)	0.084	0.162	0.062

minimum in treatment T_1 (20.66mg/100g), similar finding by Nakata and Ohme – Tagaki (2014) anthocyanin are a class of flavonoids and important plant pigments. They attract insects to pollinate flowers, protect plants from UV irradiation and act as antimicrobial agents against herbivores and pathogens. The highest return was (table 3) find in treatment T_2 (1: 4.47) and also investigated by Gupta and Kumar (2015). The experiment consisting 12 treatments with 3 replication was conducted in field plot with Randomized Block Design. The growth parameter *viz*., plant height, plant spread, number of leaf/plant and petiole length, benefit cost ratio etc. was done. The highest yield (table 3) in terms of per plant find in treatment T_2 (173.42g) with higher runner production *i.e.* 6.66 also reported by Nowsheen *et al*. (2015). The experiment comprised of five organic nutrient treatments with different combinations of FYM, *Azotobacter*, PSB, mustard oil cake, poultry manure and wood ash, *Azospirillum* including the recommended doses of N, P and K through chemical fertilizer as control. Observations recorded on different growth parameters depicted that maximum plant height (23.39cm), plant spread (24.21 cm)

Table3 : Effect of inorganic and bio-fertilizers on fruit yield per plant (g), no. of runners/plant and benefit: cost ratio of strawberry.

Treatments	Fruit yield per plant (g)	No. of runners / plant	Benefit: Cost Ratio
T_1 Control(No Inorganic and no Bio-fertilizers)	76.46	3.33	1.41:1
T_2 (100 Kg N ha^{-1}+ Azotobacter)	173.42	6.66	4.47:1
T_3 (100 Kg N ha^{-1} + PSB)	159.18	6.33	4.03:1
T_4 (75 Kg N ha^{-1} + Azotobacter)	162.06	6.33	4.12:1
T_5 (75 Kg N ha^{-1}+ PSB)	161.62	5.66	4.10:1
T_6 (60 Kg P ha^{-1} + Azotobacter)	139.41	6.00	3.35:1
T_7 (60 Kg P ha^{-1}+ PSB)	124.38	5.33	2.88:1
T_8 (45 Kg P ha^{-1} + Azotobacter)	146.60	5.00	3.63:1
T_9 (45 Kg P ha^{-1} + PSB)	113.01	5.66	2.57:1
T_{10} (60 Kg K ha-^{1} + Azotobacter)	109.38	4.66	2.44:1
T_{11} (60 Kg K ha^{-1} + PSB)	96.89	4.33	2.05:1
T_{12} (45 Kg K ha^{-1} + Azotobacter)	117.36	4.33	2.69:1
T_{13} (45 Kg K ha^{-1} + PSB)	101.23	4.00	2.18:1
S Em (±)	0.628	0.395	
C.D. (P=0.05)	1.691	1.160	

and runners/plant (13.03) were in treatment poultry manure + *Azotobacter* + wood ash + phosphorus solublizing bacteria + mustard oil cake along with maximum yield (238.95 g/plant).

Conclusion

The above experiment concluded that the maximum T.S.S. was found in T_6 - (60 Kg P ha^{-1} + Azotobacter) and total sugars was highest in T_6 - (60 Kg P ha^{-1} + Azotobacter) under Lucknow conditions.

References

A. O. A. C. (1980). Official method of analysis. 23th ed., *American Organization of Agricultural Chemist,* Washigton D.C.

Andersson, G. K. S., M. Rundlo and H. G. Smith (2012). Organic farming improves pollination success in strawberries. *PLoS One*, **7** : 1–4.

Asami, D. K., Y. J. Hong, D. M. Barrett and A. E. Mitchel (2003). Comparison of the total phenolic and ascorbic acid content of freeze-dried and air dried marion berry strawberry, using conventional, organic, and sustainable agricultural practices. *Journal of Agricultural and Food Chemistry*, **51** : 1237- 1241.

Badiyala, S. D. and V. P. Bhutani (1990). Effect of planting dates and spacing on the performing of strawberry cv. tioga. *South Indian Horticulture*, **38** : 295-296.

Dadashpour, Ahmad and Mohammad Jouki (2012). Impact of Integrated Organic Nutrient Handling on Fruit Yields and Quality of Strawberry cv. Kurdistan in Iran. *Journal of Ornamental Horticulture Plant*, **2** : 251-256.

Gupta, Pratima and Vidhur Kumar (2016). Effect of organic manures and bio-fertilizers on growth, yield and quality of strawberry *(Fragaria ananassa*). *Research in Environment and Life Sciences*, **9(1)** : 95-96.

Macit, I., A. Koc, S. Guler and I. Deligoz (2007). Yield, quality and nutritional status of organically and conventionally grown strawberry cultivars. *Asian Journal of Plant Sciences*, **6(7)** : 1131-1136.

Mahato, P., A. Badoni and J. S. Chauhan (2009). Effect of *Azotobacter* and nitrogen on seed germination and early seedling growth in tomato. *Researcher*, **1(4)** : 62-66.

Misrha, A. N. and V. K. Tripathi (2011). Influence of different levels of Azotobacter, psb alone and in combination on vegetative growth, flowering, yield and quality of strawberry cv. chandler. *International Journal of Applied Agricultural Research*, **6(3)** : 203.

Nakata, Masura and Masaru Ohme–Takagi (2014). Quantification of anthocyanin content. *Bio-protocol.*, **4(7)** : 1-3.

Nowsheen, Singh, S. R. Aroosa and Shabeena Masart (2006). Yield and Growth of strawberry cv Senga Segana. *Environment and Ecology*, **245(3)** : 651-654.

Sharma, V. P. and R. R. Sharma (2003). The Strawberry. *Indian Council of Agricultural Research*, *New Delhi,* pp. 166.

Saini, R. S., K. D. Sharma, O. P. Dhankar and R. A. Kaushik (2001). *Laboratory Manual of Analytical Techniques in Horticulture*. Agro bios Jodhpur (India).

Sagar, V. R. and D. V. K. Samuel (2005). *Laboratory Manual on Analysis of Fruit and Vegetable products*, I.A.R.I. New Delhi.

Umar, I. Wali, V. K. Kher and R. M. Jamwal (2009). Effect of FYM, Urea and *Azotobacter* on growth, yield and quality of strawberry cv. Chandler. *Notulae Botanica Horticulture*, **37(1)** : 139- 143.

Walid, Fediala, Abd., El-Gleel, Mosa, Lidia, Sas, Paszt, A. Nagwa and Abd EL-Megeed (2014). The role of bio-fertilization in improving fruits productivity : A review. *Advances in Microbiology*, **4** : 1057-1064.