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RESEARCH ARTICLE

Effect of inorganic and bio-fertilizers on growth and yield of strawberry [*Fragaria x ananassa* L. Duch.] cv. CHANDLER in Central Uttar Pradesh

■ **SHASHANK VERMA, SANJAY KUMAR, SUTANU MAJI, KAMAL RAM MEENA AND RAKESH KUMAR MEENA**

SUMMARY

A field experiment was conducted during 2014-15 to study the performance of different levels of inorganic fertilizers with combination of bio-fertilizers at Babasaheb Bhimrao Ambedkar University, Lucknow. It comprised application of different level of inorganic and bio-fertilizers in Randomized Block Design with thirteen treatments *i.e.* T_1- Control (No inorganic and no bio-fertilizer),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). It was observed that overall minimum plant height was obtained (14.18 cm) at 90 days after transplanting in T_1 - Control and maximum plant height (18.67 cm) in T_2 - (100 kg N ha^{-1}+ *Azotobacter*). The maximum number of leaves was recorded highest (18.67) in T_2 - (100 kg N ha^{-1}+ *Azotobacter*) with followed by (17.67) in T_4 - (75 kg N ha^{-1} + Azotobacter). The minimum spreading of plant in North- South direction (15.63 cm) was recorded in case of control. The highest yield per plant observed in T_2 (173.42g). Among the thirteen treatments T_2 - (100 Kg N ha^{-1}+ *Azotobacter*) showed best performance in terms of maximum fruit yield of strawberry.

Key Words : Bio-fertilizers, Inorganic fertilizer, Growth, Yield

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Strawberry belongs to the family Rosaceae, is an important fruit crop whose cultivation has ample scope near the cities. The commercial varieties of strawberry (*Fragaria x ananassa* L. Duch.) has cultivated in about 75 countries. Strawberry (*Fragaria* × *ananassa* L. Duch) is one the most popular soft fruits cultivated in plains as well as in the hills up to an elevation of 3000 m in humid or dry regions (Anonymous, 1956; Mitra *et al.*, 1991 and Singh, 1992). Fruits are mostly

eaten fresh and are not consumed for the food value but it may be used the flavour. Besides desert purposes, strawberries are processed into various value added products *viz.*, canned strawberry, jam, jelly and ice-cream, (Hughes *et al*., 1969). For good quality strawberry, its cultivation is affected by many factors *i.e*. soil, climate, irrigation, nutrition, mulching, growth regulators etc. Soil is an important factor for good quality fruits. This crops plants may be successfully grown on sandy-loam, well-drained soil and perform better and produce healthy and good quality fruits (Chindler *et al.*, 1995). Strawberry is an herbaceous perennial and a widely relished fruit owing to its flavor, deliciousness, softness and rich source of mineral and nutrients. The crop is in great demand for fresh fruits as well as in the processing industries, particularly for flavour purposes. Maharashtra, Punjab, Haryana, Himachal Pradesh and Uttrakhand are the major states for its cultivation. In Jammu and Kashmir, the crop has assumed economic importance mainly due to the high returns per unit area (El- Hamid *et al*., 2006 and Gupta and Tripathi, 2012).

This has been attributed to the production of berries within a few months of planting due to small plant size and establishment of more plots within uniform soils. Although strawberry cultivation is becoming popular in Jammu and Kashmir but the farmers are continuing to grow them as a subsidiary crop. Due to lack of proper attention, farmers usually harvest smaller fruits and poor yields. In order to harvest higher yields and quality fruits, use of chemical fertilizers has contributed significantly (Shiow and Shin, 2002 and Singh *et al*., 2015). However, continuous and indiscriminate use of chemical fertilizers has caused serious damage to the soil ecosystem and Physico-chemical characteristics. Although, many organic options are available but high yield and better quality fruits cannot be expected from the sole application of organic manures or biological products. Therefore, a judicious combination of inorganic and organic fertilizers or bio-fertilizers may be helpful in increasing the fruit production in strawberry. Moreover, such efforts shall be helpful to maintain sustainable productivity and soil health. Amongst various available organic options, bio-fertilizers are agriculturally important beneficial micro-organisms which have ability to mobilize the nutritionally important elements. Moreover, they are cost effective and renewable. Bio-fertilizers are known to increase the yield of strawberry (Mohammed *et al*., 2015 and Kumar *et al*., 2014). Bio-fertilizers effects on quality, growth and yield of strawberry with combination of N, P, K and Ca are important mineral elements in strawberry growing (Kessel, 2003). In view of above facts, the present experiment entitled "Effect of Inorganic and Bio-fertilizers on Growth and Yield of Strawberry (*Fragaria x ananassa* L. Duch.) cv. CHANDLER in Central Uttar Pradesh" was carried out with the objective to find out the effect of inorganic and bio-fertilizers on vegetative growth and fruit yield of Strawberry.

MATERIAL AND METHODS

The field experiment was conducted on strawberry cv. CHANDLER at Horticulture Research Farm, Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University situated at Vidya - Vihar, Rea Bareli Road, Lucknow during the year 2014-15. The planting materials *i.e*. runners of strawberry were brought out from Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan (H.P.). The experiment was laid out in Randomized Block Design with 13 treatments *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). Observations of vegetative parameters *i.e.* height of the plant (cm), spread of the plant (cm), number of leaves/plant, leaf length (cm), leaf width (cm), number of runners/plant and yield characters *i.e*. number of fruits/plant, fruit width (cm), fruit length (cm), fruit weight (g), fruit yield/plant (g), fruit yield/plot (kg) and yield/ha (t) were taken. The height of plant, spreading of plant in north-south and east-west direction, leaf length and width were taken with help of measuring scale in centimeter. The yield of fruits under different treatments was determined on the basis of average weight of fruit harvested from plants from each treatment yield per plant and total yield per hectare was calculated. The data analysis done with Randomized Block Design wit suitable ANOVA and the treatment mean was compared at 5 per cent level of significance.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized

under following heads :

Vegetative growth parameters :

The data given in tables showed that the vegetative growth parameters were significantly influenced by different treatments. The maximum plant height was find out in treatment T_2 (18.67cm) (Table 1) significantly superior than others followed by treatment T_6 (16.60cm) which was also reported by Singh *et al.* (2015) who showed that application of Vermicompost + *Azotobacter* + PSB + VAM produced maximum plant height (20.26 cm), plant spread (25.64 cm), number of leaves (54.30) and leaf area (97.87 cm^2) $plant^{-1}$, whereas all the growth characters were found minimum in control. The minimum plant height observed at 90 days after planting in treatment T_1 (14.18cm). The maximum number of leaves (Table 2) was recorded in treatment T_2 (18.67) which statistically at par others followed by treatment T_4 (17.67) with minimum number in treatment T_1 (14.33). Similar results was also observed by Gupta and Tripathi (2012) who observed that the data of both the years of experiment were analyzed which clearly shows that combined application of *Azotobacter* at 7 kg/ha + vermicompost at 30 tonnes/ha significantly increased the

Table 1 : Effect of inorganic and bio-fertilizers on plant height of strawberry

Treatments	Plant height (cm)				
	30 DAP	45 DAP	60 DAP	75 DAP	90 DAP
T_1 Control (No Inorganic and no Bio-fertilizers)	4.05	6.23	8.20	10.20	14.18
T_2 (100 kg N ha^{-1}+ *Azotobacter*)	5.18	8.53	11.67	14.60	18.67
T_3 (100 kg N ha^{-1} + PSB)	4.47	7.32	9.87	11.82	14.73
T_4 (75 kg N ha^{-1} + *Azotobacter*)	4.85	7.74	10.07	12.08	16.14
T_5 (75 kg N ha^{-1}+ PSB)	4.32	7.35	10.00	12.02	16.04
T_6 (60 kg P ha^{-1} + *Azotobacter*)	4.38	7.44	10.40	12.52	16.60
T_7 (60 kg P ha^{-1}+ PSB)	4.22	7.20	9.75	11.75	15.78
T_8 (45 kg P ha^{-1} + *Azotobacter*)	4.14	7.15	9.63	11.60	15.80
T_9 (45 kg P ha^{-1} + PSB)	4.11	7.08	9.59	11.53	15.77
T_{10} (60 kg K ha^{-1} + *Azotobacter*)	4.27	7.24	9.73	11.73	15.82
T_{11} (60 kg K ha^{-1} + PSB)	4.18	7.17	9.70	11.63	15.72
T_{12} (45 kg K ha^{-1} + *Azotobacter*)	4.12	7.10	9.47	11.45	15.53
T_{13} (45 kg Kha^{-1} + PSB)	4.07	7.03	9.30	11.37	15.42
S.E. ±	0.043	0.057	0.103	0.047	0.061
C.D. (P=0.05)	0.128	0.167	0.302	0.137	0.178

Table 2 : Effect of inorganic and bio-fertilizers on number of leaves per plant of strawberry

Treatments	Number of leaves per plant				
	30DAP	45DAP	60DAP	75DAP	90DAP
T_1 Control (No inorganic and no bio-fertilizers)	2.67	5.33	8.33	11.33	14.33
T_2 (100 kg N ha^{-1}+ *Azotobacter*)	5.67	8.67	12.33	15.67	18.67
T_3 (100 kg N ha^{-1} + PSB)	5.00	7.67	10.67	13.67	15.67
T_4 (75 kg N ha^{-1} + *Azotobacter*)	5.33	8.33	11.33	14.67	17.67
T_5 (75 kg N ha^{-1}+ PSB)	4.00	7.33	10.33	13.34	15.34
T_6 (60 kg P ha-^{1} + *Azotobacter*)	4.67	7.33	10.00	12.67	14.67
T_7 (60 kg P ha^{-1}+ PSB)	3.67	7.00	9.67	12.34	14.33
T_8 (45 kg P ha^{-1} + *Azotobacter*)	3.33	6.67	9.34	12.33	13.67
T_9 (45 kg P ha^{-1} + PSB)	3.00	6.33	9.00	12.00	14.00
T_{10} (60 kg K ha^{-1} + *Azotobacter*)	4.33	7.33	10.66	13.66	15.66
T_{11} (60 kg K ha^{-1} + PSB)	3.33	6.66	9.33	12.66	15.33
T_{12} (45 kg K ha^{-1} + *Azotobacter*)	3.00	6.00	9.00	12.33	14.66
T_{13} (45 kg Kha^{-1} + PSB)	3.33	6.33	8.67	12.00	14.33
S.E. ±	0.360	0.360	0.340	0.512	0.326
C.D. (P=0.05)	1.057	1.057	0.997	1.063	0.957

height of plant (19.45 and 17.65 cm, respectively) and number of leaves (63.60 and 59.60, respectively).

The maximum spreading in North-south (Table 3) direction was found in treatment T_2 (26.73cm) which was superior than others followed by treatment T_4 (21.78cm) which reported by Verma and Rao (2013) who conducted an experiment to see the effect of integrated nutrient management on growth, yield of strawberry cv. CHANDLER. Treatment receiving *Azotobacter* + PSB + Vermi-compost + 50% recommended dose of NPK recorded highest plant height, plant spread, leaf area per plant. Plant supplied with *Azotobacter* + PSB + Vermi-compost + 50% RDF registered earliest in flowering and fruit maturity and highest number of flowers per plant and flowering duration. The minimum spreading in North-south and

Table 3 : Effect of inorganic and bio-fertilizers on spread of plant North - South (cm) and East-West (cm) direction

Treatments	Spread of plant N-S (cm), E-W(cm)									
	30DAP N-S	30DAP E-W	45DAP N-S	45DAP E-W	60DAP N-S	60DAP E-W	75DAP N-S	75DAP E-W	90DAP N-S	90DAP E-W
T_1 Control (No inorganic and no bio-fertilizers)	3.33	2.17	5.73	4.22	8.77	7.27	11.76	10.25	15.63	12.27
T_2 (100 kg N ha^{-1}+ *Azotobacter*)	7.67	4.78	11.80	6.78	16.80	10.82	21.63	13.83	26.73	14.83
T_3 (100 kg N ha^{-1} + PSB)	6.07	3.87	9.10	5.83	12.30	8.83	16.30	11.83	20.33	13.83
T_4 (75 kg N ha^{-1} + *Azotobacter*)	6.84	4.72	9.80	6.72	13.80	9.71	17.77	12.76	21.78	14.77
T_5 (75 kg N ha^{-1}+ PSB)	4.87	3.77	7.77	5.77	11.67	8.76	15.72	11.75	19.77	13.75
T_6 (60 kg P ha^{-1} + *Azotobacter*)	5.63	3.82	8.73	5.82	12.67	8.81	16.74	11.82	20.73	13.78
T_7 (60 kg P ha^{-1}+ PSB)	4.70	3.62	7.67	5.63	11.77	8.63	15.75	11.72	19.78	13.73
T_8 (45 kg P ha^{-1} + *Azotobacter*)	3.73	2.73	6.73	4.72	10.80	7.73	14.83	10.74	18.83	12.73
T_9 (45 kg P ha^{-1} + PSB)	3.61	2.67	6.57	4.67	10.67	7.67	14.75	10.67	18.78	12.67
T_{10} (60 kg K ha^{-1} + *Azotobacter*)	4.80	3.72	7.66	5.72	11.73	8.75	15.72	11.77	19.73	13.77
T_{11} (60 kg K ha^{-1} + PSB)	4.60	2.92	7.57	4.92	11.65	7.87	15.63	10.87	19.63	12.85
T_{12} (45 kg K ha^{-1} + *Azotobacter*)	3.87	2.80	6.87	4.80	10.82	7.77	14.78	10.73	18.76	12.72
T_{13} (45 kg Kha^{-1} + PSB)	3.43	2.52	6.47	4.52	10.28	7.55	14.37	10.53	18.37	12.53
S.E. ±	0.089	0.278	0.072	0.031	0.045	0.030	0.044	0.022	0.028	0.042
C.D. (P=0.05)	0.261	0.816	0.210	0.091	0.132	0.089	0.131	0.065	0.082	0.122

Table 4 : Effect of inorganic and bio-fertilizers on leaf length (cm) and leaf width (cm) of strawberry

Treatments	Leaf length (cm) and Leaf width (cm)									
	30DAP Length	30DAP Width	45DAP Length	45DAP Width	60DAP Length	60DAP Width	75DAP Length	75DAP Width	90DAP Length	90DAP Width
T_1 Control (No Inorganic and no Bio-fertilizers)	3.53	3.41	4.55	4.42	5.56	5.42	6.56	6.43	6.87	7.02
T_2 (100 kg N ha^{-1}+ *Azotobacter*)	6.86	5.82	7.84	6.83	8.82	8.85	9.81	9.87	9.94	10.14
T_3 (100 kg N ha^{-1} + PSB)	6.60	5.71	7.62	6.71	8.62	8.71	9.65	9.72	9.86	10.06
T_4 (75 kg N ha^{-1} + *Azotobacter*)	5.70	5.40	6.70	6.41	7.71	7.43	8.72	8.44	8.83	9.05
T_5 (75 kg N ha^{-1}+ PSB)	5.53	5.31	6.54	6.33	7.54	7.34	8.55	8.34	8.76	8.93
T_6 (60 kg P ha^{-1} + *Azotobacter*)	5.50	5.11	6.51	6.11	7.50	7.13	8.51	8.12	8.75	8.56
T_7 (60 kg P ha^{-1}+ PSB)	4.83	4.12	5.85	5.13	6.83	6.14	7.85	7.15	7.95	7.54
T_8 (45 kg P ha^{-1} + *Azotobacter*)	4.60	4.21	5.62	5.22	6.62	6.23	7.62	7.23	7.84	7.76
T_9 (45 kg P ha^{-1} + PSB)	4.36	4.32	5.35	5.33	6.33	6.33	7.34	7.33	7.56	7.63
T_{10} (60 kg K ha^{-1} + *Azotobacter*)	4.80	4.52	5.81	5.53	6.80	6.56	7.81	7.57	7.94	7.94
T_{11} (60 kg K ha^{-1} + PSB)	4.23	4.03	5.24	5.05	6.23	6.07	7.24	7.07	7.47	7.32
T_{12} (45 kg K ha^{-1} + *Azotobacter*)	4.50	4.14	5.52	5.15	6.52	6.15	7.56	7.16	7.87	7.23
T_{13} (45 kg Kha^{-1} + PSB)	3.86	3.72	4.86	4.75	5.85	5.94	6.85	6.96	6.97	7.14
S.E. ±	0.050	0.010	0.011	0.277	0.009	0.010	0.005	0.008	0.008	0.011
C.D. (P=0.05)	0.147	0.029	0.032	0.814	0.026	0.029	0.016	0.023	0.024	0.033

East-west direction (Table 3) were recorded in treatment T_1 (15.63cm) and (12.27cm), respectively which studied by Yadav *et al.* (2009) who suggest from his work that the majority of plant growth parameters of strawberry like number of flowers, number of fruits, number of runners and fruit yield were recorded maximum in *Azotobacter* inoculated treatments with 50 per cent nitrogen substitution by Vermi-compost and remaining 50 per cent through inorganic fertilizers. Leaf length and width (Table 4) was also maximum in treatment T_2 (9.94cm and 10.14cm, respectively) with following T_3 (9.86cm and 10.06cm), respectively. Tripathi and Babu (2008) also observed that application of *Azotobacter* at 6 kg per ha significantly increased the height of plant, number of leaves, crown, runners, number of flowers and fruits per plant.

Yield parameters :

The yield parameters also influenced by various doses of fertilizers. The length and width (Table 6) of fruit observed, respectively maximum in treatment T_2 5.51cm and 4.47cm which was superior than others and minimum in treatment T_1 3.95 cm and T_{13} 3.44 cm which was similar as studied by Chelpinski *et al.* (2010) who

Table 5 : Effect of inorganic and bio-fertilizers on number of fruits per plant of strawberry

Treatments	Number of fruits per plant		
	67 DAP (First picking)	74 DAP (Second picking)	81 DAP (Third picking)
T_1 Control (No inorganic and no bio-fertilizers)	1.33	3.66	6.33
T_2 (100 kg N ha^{-1}+ Azotobacter)	1.33	4.33	6.66
T_3 (100 kg N ha^{-1} + PSB)	2.66	5.33	8.33
T_4 (75 kg N ha^{-1} + Azotobacter)	2.33	4.33	7.33
T_5 (75 kg N ha^{-1}+ PSB)	2.00	4.66	7.66
T_6 (60 kg P ha-^{1} + Azotobacter)	2.33	4.33	7.33
T_7 (60 kg P ha^{-1}+ PSB)	2.66	4.66	6.33
T_8 (45 kg P ha^{-1} + Azotobacter)	2.33	5.33	7.33
T_9 (45 kg P ha^{-1} + PSB)	3.33	6.33	8.66
T_{10} (60 kg K ha^{-1} + Azotobacter)	2.33	4.33	7.66
T_{11} (60 kg K ha^{-1} + PSB)	4.33	7.66	10.33
T_{12} (45 kg K ha^{-1} + Azotobacter)	4.66	8.66	10.66
T_{13} (45 kg Kha^{-1} + PSB)	4.33	7.66	10.33
S.E. ±	0.324	0.327	0.401
C.D. (P=0.05)	0.950	0.960	1.178

Table 6 : Effect of inorganic and bio-fertilizers on length of fruit (cm), width of fruit (cm) and weight of fruit (g) of strawberry

Treatments	Length of fruit (cm)	Width of fruit (cm)	Weight of fruit (g)
T_1 Control (No inorganic and no bio-fertilizers)	3.95	3.60	12.08
T_2 (100 kg N ha^{-1}+ Azotobacter)	5.51	4.47	26.04
T_3 (100 kg N ha^{-1} + PSB)	5.37	4.37	19.11
T_4 (75 kg N ha^{-1} + Azotobacter)	5.42	4.42	22.11
T_5 (75 kg N ha^{-1}+ PSB)	5.30	4.22	21.10
T_6 (60 kg P ha-^{1} + Azotobacter)	5.34	4.32	19.02
T_7 (60 kg P ha^{-1}+ PSB)	4.93	3.96	19.65
T_8 (45 kg P ha^{-1} + Azotobacter)	5.29	4.23	20.00
T_9 (45 kg P ha^{-1} + PSB)	4.76	3.95	13.05
T_{10} (60 kg K ha^{-1} + Azotobacter)	4.62	3.86	14.28
T_{11} (60 kg K ha^{-1} + PSB)	4.52	3.73	9.38
T_{12} (45 kg K ha^{-1} + Azotobacter)	4.83	3.81	11.01
T_{13} (45 kg Kha^{-1} + PSB)	4.45	3.44	9.80
S.E. ±	0.013	0.020	0.608
C.D. (P=0.05)	0.038	0.060	1.687

Table 7 : Effect of inorganic and bio-fertilizers on fruit yield per plant (g), fruit yield per plot (kg), fruit yield per ha (t) and no. of runners / plant of strawberry

Treatments	Fruit yield per plant (g)	Fruit yield per plot (kg)	Fruit yield per ha (t)	No. of runners / plant
T_1 Control (No inorganic and no bio-fertilizers)	76.46	1.83	16.92	3.33
T_2 (100 kg N ha^{-1}+ *Azotobacter*)	173.42	4.16	38.51	6.66
T_3 (100 kg N ha^{-1} + PSB)	159.18	3.82	35.37	6.33
T_4 (75 kg N ha^{-1} + *Azotobacter*)	162.06	3.89	36.01	6.33
T_5 (75 kg N ha^{-1}+ PSB)	161.62	3.87	35.83	5.66
T_6 (60 kg P ha-^{1} + *Azotobacter*)	139.41	3.34	30.92	6.00
T_7 (60 kg P ha^{-1}+ PSB)	124.38	2.98	27.59	5.33
T_8 (45 kg P ha^{-1} + *Azotobacter*)	146.60	3.51	32.50	5.00
T_9 (45 kg P ha^{-1} + PSB)	113.01	2.71	25.09	5.66
T_{10} (60 kg K ha^{-1} + *Azotobacter*)	109.38	2.62	24.25	4.66
T_{11} (60 kg K ha^{-1} + PSB)	96.89	2.32	21.48	4.33
T_{12} (45 kg K ha^{-1} + *Azotobacter*)	117.36	2.82	26.01	4.33
T_{13} (45 kg Kha^{-1} + PSB)	101.23	2.42	22.40	4.00
S.E. ±	0.628	0.047	0.313	0.395
C.D. (P=0.05)	1.691	0.208	0.826	1.160

showed that only fruit length was significantly affected by fertilizer type, where as growing year had no significant effect on morph metric traits studied. Two years study on effect of bio- and chemical fertilizers revealed a stimulating effect of bio-fertilizers particularly PGPRs, on soluble solids, total Acidity, total Sugars and reducing Sugar, which in all probability was owing to highly intensive mineralizing processes in soil and increased activity of plant root and its physiological functions. In the present experiment, it was observed that the weight of fruit (Table 6) was the highest in treatment T_2 (26.00 g) followed by treatment T_4 (22.00 g) which was also observed by Ghaderi and Talaie, 2008. They showed that application of manure along with urea had a significant effect on total fruit yield and prevention of weight, fruit decay as well as leaf specific mass. Fruit quality is a combination of appearance, flavour, texture and nutritional value.

In case of number of fruits was maximum (Table 5) in treatment T_{12} (10.66) followed by treatment T_{11} (10.33). Afroz *et al.* (2016) also reported that the highest concentration of N, P, K and S were found in shoot and fruit of strawberry when N, P, K and S fertilizers were used 140, 60, 135 and 35 kg ha^{-1}, respectively. The highest values of plant height (25.60 cm), number of leaves (21.66), flowers (125.33), fruits (12.35),destroyed fruits (11), fruit weight (215.10 g) $plant^{-1}$ and fruit length (4.16 cm), fruit diameter (3.41cm), individual fruit weight (17.85 g) and fruit yield (11.50 t ha^{-1}) were found in treatment of 115,40,110 kg/ha. The yield in terms of per plant highest (Table 7) in treatment T_2 (173.42g) followed by treatment T_4 (162.06g). Yield per plot (Table 7) also highest in treatment T_2 (4.16kg) followed by treatment T_4 (3.89kg) and similarly per hectare (Table 7) highest in treatment T_2 (38.51t) followed by treatment T_4 (36.01t). In another experiment, Atif (2009) concluded that application of NPK-fertilizer in combination with organic fertilizer tended to increase fruit yield in comparison with the application of each of them alone. The highest strawberry yield (27.62 t/ha) was obtained by the application of 40 tons of organic fertilizer with 60 kg NPK-fertilizer/ha while the lowest strawberry yield (21.76 ton/ha) was obtained in untreated plot. The number of runners (Table 7) also highest in treatment T_2 (6.66 per plant). Nam *et al.* (2006) observed that plant height, number of flowers and number of runners were influenced by N, P, K and Ca.

Conclusion :

The above experiment finding that the maximum yield in terms of per hectare (38.51t) was found by T_2 - (100 kg N ha^{-1}+ *Azotobacter*), same result in runner production (6.66 per plant) under Lucknow condition.

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