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INFLUENCE OF MICROBIAL, ORGANIC AND INORGANIC SOURCES OF NUTRIENTS ON GROWTH PARAMETERS OF STRAWBERRY

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ABSTRACT: An experiment was conducted to study the influence of microbial sources of nutrients along with organic and inorganic sources on the vegetative growth parameters of strawberry cv. Chandler. The data observed at different days after transplanting (30, 45, 60, 75, 90 and 105 days) clearly indicate that the application of integrated sources of nutrients significantly affect the vegetative growth of the plant. The maximum growth in terms of height of the plant (5.83 cm, 8.31 cm, 12.61 cm, 14.83 cm, 17.44 cm and 19.25 cm), number of leaves per plant (5.81, 10.27, 13.66, 16.86, 18.04 and 18.80), length of leaves (6.34cm, 6.96cm, 7.32 cm, 8.00 cm 8.32 cm and 8.80 cm) and width of leaves (5.16cm, 6.58cm, 7.86 cm, 8.93 cm, 10.20 cm and 10.94cm) were recorded in the treatment T_{12} - *Azotobactor* (50%) + *Azospirillum* (50%) + NPK (50%) + FYM at 30, 45, 60, 75, 90 and 105 DAT respectively in each respective parameters which was statistically significant over control (T_1) where recommended dose of fertilizer was applied.

Keywords : *Strawberry, integrated nutrient management, Azotobactor, Azospirillum, vegetative growth.*

Strawberry (*Fragaria ananassa* Duch.) has attained a premier position in the world fruit market as fresh fruit as well as in the processing industries (Sharma and Sharma, 4). Initially grown in temperate zone of the country but its cultivation has now become possible in the sub-tropical zones as well with the introduction of day neutral cultivar viz., Chandler (Asrey and Singh, 1). Among the various factors which contribute towards the growth and yield of strawberry, nutrition is the important aspect of crop production (Umar *et al*., 8). Integrated nutrient management includes the use of inorganic, organic and microbial sources of nutrients which ensure balanced nutrient proportion by enhancing nutrient response efficiency and maximizing crop productivity of desired quality. It also helps in minimizing the existing gap between the nutrient removal through continuous use of chemical fertilizers and supply through slow release of fertilizers. It is well reported that the extensive use of chemical fertilizers adversely affect the soil health and results in decreased crop productivity and quality (Macit *et al.,* 2). Thus, in this experiment an attempt has been made to assess the influence of microbial sources of nutrients along with organic and inorganic on the vegetative growth parameters of strawberry cv. Chandler under sub-tropical conditions of Lucknow.

MATERIALS AND METHODS

The present study was conducted at the Horticultural Research Farm of Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow (U.P.) during 2009-10 and 2010 – 11. Runners of strawberry cv. Chandler and biofertilizers (*Azotobactor* and *Azospirillum*) were procured from Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, (Solan), H.P. and Pant Bio Lab, Pantnagar (Uttarakhand), respectively. The strawberry runners of uniform size were transplanted on ridges at a spacing of 15 x 30 cm in first week of November during both the year of experimentation. Strawberry was fertilized with recommended (100%) and half of the recommended doses (50%) of integrated sources of nutrients viz., NPK @ 90, 75 and 60 Kg/ha, FYM @ 50 tonnes/ha and biofertilizers (*Azotobactor* and *Azospirillum*) @ 50ml in 20 litres of water according to the treatment combination. The design of the experiment was Randomized Block

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Design with three replications and twelve treatment combinations viz., T_1 – Control (recommended doze of NPK), T_2 - *Azotobactor* (100%), T_3 - *Azospirillum* (100%), T_4 - FYM, T_5 - *Azotobactor* (50%) + *Azospirillum* (50%), T_6 - *Azotobactor* (100%) + NPK (50%), T_7 - *Azospirillum* (100%) + NPK (50%), T_8 - *Azotobactor* (50%) + *Azospirillum* (50%) + NPK (50%), T_9 - *Azotobactor* (100%) + FYM, T_{10} - *Azospirillum* (100%) + FYM, T_{11} - *Azotobactor* (50%) + *Azospirillum* (50%) + FYM, T_{12} - *Azotobactor* (50%) + *Azospirillum* (50%) + NPK (50%) + FYM. The required quantity of farm yard manure (FYM) as per treatment combination was applied at the time of land preparation. Urea was applied in two split doses before planting and flowering stages while the full dose of phosphorus and potash was given before planting. *Azotobactor, Azospirillum* and *Azotobactor* + *Azospirillum* solution were made by dissolving 50ml in 20 litres of water. The roots of the strawberry runners were thoroughly dipped in the solution for about 30 min. and then planting were done. Yellow polythene of 200 gauge was used as mulch material (Singh and Dwivedi, 6). Other cultural practices like weeding, hoeing, irrigation, insect pest and disease management were done as and when required.

Observations on vegetative growth parameters were recorded at 15 days interval whereas numbers of runners per plant was recorded one month after final harvesting of the fruits. The data recorded on different vegetative parameters during both the years of investigation were analysed statistically.

RESULTS AND DISCUSSION

The data regarding the different growth parameters (Table 1 and 2) observed at different days after transplanting clearly indicate that the application of integrated sources of nutrients significantly affect the vegetative growth of the plant. The data also showed a continuous fast increase in vegetative growth upto 60 DAT and after that the vegetative growth increased slowly as the reproductive phase of the plant starts. The maximum height of the plant (5.83 cm, 8.31 cm, 12.61 cm, 14.83 cm, 17.44 and 19.25 cm), number of leaves per plant (5.81, 10.27, 13.66, 16.86, 18.04 and 18.80), length of leaves (6.34 cm, 6.96 cm, 7.32 cm, 8.00cm 8.32 cm and 8.80 cm) and width of leaves (5.16 cm, 6.58 cm, 7.86 cm, 8.93cm, 10.20 cm and 10.94 cm) were recorded in the treatment T_{12} - *Azotobactor* (50%) + *Azospirillum* (50%) + NPK (50%) + FYM at 30, 45, 60, 75, 90 and 105 DAT, respectively which was statistically significant over control (T_1) while the minimum height of the plant (3.09cm, 4.92cm, 7.34cm, 8.70 cm, 10.67 cm and 11.75 cm), number of leaves per plant (3.60, 6.32, 9.65, 12.38, 14.29 and 15.61), leaf length (4.05 cm, 5.67 cm, 6.16 cm, 6.73 cm, 7.09cm and 7.53 cm) and leaf width (4.10 cm, 5.30 cm, 6.21 cm, 7.63 cm, 8.33 cm and 9.02 cm) were recorded in treatment T_4 – FYM only at 30, 45, 60, 75, 90 and 105 DAT, respectively. The maximum leaf area 30.45 cm^2 was recorded in the treatment T_{12} - *Azotobactor*–50%) + *Azospirillum*–50%) + NPK 50%) + FYM followed by 28.08cm^2 in treatment T_8 (*Azotobactor*–50%) + *Azospirillum*–50%) + NPK (50%) while the minimum (16.97cm^2) was recorded in treatment T_4 with recommended dose of FYM. The increase in these vegetative growth parameters may be due to integrated nutrient management i.e. inorganic, organic and biological (*Azotobacter* and *Azospirillum*) sources of nutrients. The addition, biofertilizers might have helped in N-fixation and its quick release for plants absorption. The increase in the plant height and number of leaves might be due to the production of more chlorophyll content with inoculation of nitrogen fixers. The other reason for increased vegetative growth may be due to the production of plant growth regulators by biofertilizers in the rhizosphere which are absorbed by the roots. Better development of root system and the possibly synthesis of plant growth hormones like IAA, GA and cytokinins and direct influence of biofertilizers might have caused increased in plant's vegetative growth parameters. These results are in conformity to that of Yadav *et al.* (9) in strawberry. Higher number of leaves, leaf length, leaf width and leaf area may be due to

Table 1: Effect of integrated nutrient management on plant height (cm), number of leaves/plant and leaf area (cm^2) of strawberry cv. Chandler (pooled data of 2 years)

Treat-ments	Plant Height (cm)						Number of leaves/plant						Leaf Area (cm^2)
	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	105 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	105 DAT	
T_1	3.87	5.48	8.08	9.96	12.23	13.49	4.28	7.25	10.28	13.16	14.30	15.75	18.28
T_2	4.36	6.25	8.88	10.98	12.88	14.05	4.74	8.37	11.91	15.33	16.55	17.27	22.72
T_3	3.95	6.93	9.71	12.10	13.66	13.84	3.82	7.20	11.13	13.81	15.04	16.13	19.68
T_4	3.09	4.92	7.34	8.70	10.67	11.75	3.60	6.32	9.65	12.38	14.29	15.61	16.97
T_5	4.80	7.29	10.08	12.74	14.16	15.70	5.15	8.93	13.28	15.03	16.31	17.36	26.00
T_6	4.98	7.57	9.95	12.60	13.95	15.17	5.39	8.09	12.66	14.98	16.43	17.35	25.30
T_7	4.41	6.85	9.75	11.58	13.39	14.79	5.18	8.81	12.52	14.00	16.22	17.57	24.74
T_8	4.85	7.92	12.26	14.12	16.26	18.32	5.63	9.00	13.31	15.28	17.43	18.51	28.08
T_9	3.97	6.84	9.73	11.56	13.38	14.69	4.90	8.44	12.17	14.43	16.25	17.41	24.39
T_{10}	4.77	7.09	9.57	11.65	13.11	14.54	4.72	8.57	11.94	15.11	15.98	17.13	23.14
T_{11}	5.57	7.81	11.35	13.43	15.04	17.18	5.28	9.94	13.98	15.78	17.49	18.33	26.81
T_{12}	5.83	8.31	12.61	14.83	17.44	19.25	5.81	10.27	13.66	16.86	18.04	18.80	30.45
CD (P=0.05)	0.247	0.410	0.597	0.777	1.060	1.181	0.097	0.097	0.013	0.013	0.013	0.013	1.336

*DAT – Days After Transplanting

Table 2: Effect of integrated nutrient management on leaf length (cm), leaf width (cm) and number of runners/plant of strawberry cv. Chandler (pooled data of 2 years)

Treat-ments	Leaf Length (cm)						Leaf Width (cm)						Number of Runners / Plant
	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	105 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	105 DAT	
T_1	4.11	5.69	6.37	6.80	7.36	7.70	4.15	5.41	6.42	7.68	8.43	9.22	4.54
T_2	5.53	6.11	6.57	7.13	7.54	7.90	4.26	5.52	6.63	8.06	8.75	9.53	5.31
T_3	4.59	5.76	6.68	6.98	7.38	7.66	4.18	5.41	7.13	8.29	9.04	9.39	4.84
T_4	4.05	5.67	6.16	6.73	7.09	7.53	4.10	5.30	6.21	7.63	8.33	9.02	4.06
T_5	5.24	6.40	7.01	7.50	7.68	7.97	4.40	5.91	6.64	8.24	9.30	9.94	5.93
T_6	5.56	6.10	6.95	7.53	7.70	8.00	4.41	5.83	6.56	8.23	9.23	9.87	5.59
T_7	5.27	6.11	6.87	7.54	7.75	8.05	4.33	5.75	7.02	8.72	9.48	9.74	5.45
T_8	6.22	6.65	7.15	7.68	7.97	8.56	5.07	6.42	7.75	8.82	9.65	10.39	6.19
T_9	5.55	6.08	6.77	7.47	7.65	8.00	4.35	5.73	7.01	8.74	9.53	9.66	5.38
T_{10}	5.53	6.06	6.65	7.25	7.52	7.87	4.27	5.54	6.62	8.10	8.82	9.63	5.49
T_{11}	5.61	6.61	7.06	7.65	7.95	8.45	4.98	6.09	7.51	8.80	9.65	10.31	7.51
T_{12}	6.34	6.96	7.32	8.00	8.32	8.80	5.16	6.58	7.86	8.93	10.20	10.94	7.00
CD (P=0.05)	0.158	0.220	0.227	0.246	0.255	0.263	0.121	0.240	0.149	0.185	0.179	0.221	0.661

*DAT – Days After Transplanting

the cell division caused by cytokinins (Singh and Singh, 5).

The maximum (7.00) number of runners/ plant (Table 2) was recorded in the treatment T_{12} - *Azotobactor* (50%) + *Azospirillum* (50%) + NPK (50%) + FYM which was statistically significant over control (T_1) while the minimum (4.06) was recorded in treatment-T_4. Increased number of runners per plant might be due to the increased growth of plant in the form of height, number of leaves and leaf area, which accumulated more photosynthates and thereby increased runners per plant. The results are in conformity with Nazir *et al.* (3), Singh *et al.* (7) and Umar *et al*. (8) where they observed that the integrated nutrient management was better than the single application of nutrients.

According to the vegetative growth results obtained in this study, it is concluded that the combined application of nutrients from different sources was better than their alone application. Treatment (T_{12}) - *Azotobactor* (50%) + *Azospirillum* (50%) + NPK (50%) + FYM performed better than other treatments in respect of plant growth which was followed by the treatment T_8 (*Azotobactor* (50%) + *Azospirillum* (50%) + NPK (50%) and thus, these combination of treatments are beneficial for strawberry growth under subtropical conditions of Lucknow.

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