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IMPACT OF INTEGRATED NUTRIENT MANAGEMENT ON VEGETATIVE GROWTH AND YIELD OF STRAWBERRY

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ABSTRACT

A field study was conducted at Horticulture Research Farm, Banaras Hindu University, Varanasi, during 2013-14 and 2014-15 to study the impact of integrated nutrient management on vegetative growth and yield of strawberry (Fragaria × ananassa Duch.) cv. Chandler. The runners of strawberry were planted in the last week of October with a spacing of 40×30cm. The experiment was laid out in randomized block design with twelve treatments replicated thrice. Result indicated that there was a steady rise in plant height, spread of plant, and leaves/plant with age of the crop, which continued till 90 days. However, the rate of increase in these characters was quitisl ow at later stages of growth. The maximum height of the plant, spread of the plant and leaves/plant were recorded at all the stage of growth with 100% NPK application followed by 75% NPK + Vermicompost + Azotobacter + PSB and minimum in control. Length (8.3 cm) and width of leaves (11.9 cm) and leaf area (98.0 cm)^2 at 75 to 90 DAP were recorded maximum with 100 % NPK. The maximum runners/plant (7.0) and crowns/plant (5.1) were recorded with 75% NPK + Vermicompost + Azotobacter + PSB treatment. Maximum yield/plant (297.0 g) and yield (177.9 qha^{-1}) was recorded with 75% NPK + Vermicompost + Azotobacter + PSB. The values of these parameters were recorded minimum under control.

Keywords: *Chandler*, growth characters, yield, fertilizers, organic manures and biofertilizers.

INTRODUCTION

Strawberry (*Fragaria* × *ananassa* Duch.) is one of the most delicious fruits of the world which has attained a premier position in the world fruit market as fresh fruit as well as in the processing industries (Sharma and Sharma, 2003). Initially grown in temperate zone of the country but its cultivation has now become possible in the sub-tropical zones as well as with the introduction of day neutral cultivar *viz*., Chandler (Asrey and Singh, 2004). Among the various factors which contribute towards the growth and yield of strawberry, nutrition is the important aspect of crop production (Umar *et al.,* 2008). 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.,* 2007).The integrated nutrient supply including the use of chemical fertilizers with organic manures like FYM, Vermicompost, town-compost, neem-cake, poultry manure and biofertilizers helps not only in bridging the existing wide gap between the nutrient removal and supply but also insuring balanced nutrient proportion, by enhancing nutrient response efficiency and maximizing crop productivity of desired quality. From the stand point of crop yield and quality, nutrient supply from both organic and inorganic sources is important. The INM helps to restore and sustain soil fertility and crop productivity. It may also help to check the emerging deficiency of nutrients other than N, P and K. Thus, in this experiment an attempt has been made to assess the impact of integrated nutrient management practices on the vegetative growth parameters of strawberry *cv.* Chandler.

MATERIALS AND METHODS

The present study was conducted at Horticulture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, during 2013-14 and 2014-15. Runners of strawberry *cv.* Chandler were procured from Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, (Solan), H.P. The climatic condition of Varanasi is sub-tropical with three

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distinct seasons *i.e.,* winter, summer and rainy. During the winter season (December-January) temperature fall, 5^{o}C or even low, while in summer season (May-June) it reaches as high as 45^{o}C. Occasional spell of frost and precipitation may occur during winter. The mean temperature is minimum 15-20 ^{0}C and maximum 18-32 ^{0}C, maximum relative humidity 95% and minimum 55% with annual rainfall of 850-1100 mm. The experimental had pH 7.2, organic matters 4.6g kg^{-1} available N- 200kg ha^{-1}, P_2O_5- 245 kg ha^{-1} and K_2O- 300 kg ha^{-1}. The strawberry runners of uniform size were transplanted on ridges at a spacing of 40×30 cm in last week of October during both the years. The treatments *viz*., T_0 – Control (Untreated), T_1 - 100% NPK, T_2 - 75% NPK + FYM + *Azotobacter* + PSB , T_3 - 75% NPK + Vermicompost + *Azotobacter* + PSB , T_4 - 75% NPK + town-compost + *Azotobacter* + PSB , T_5 - 75% NPK + Neem-cake + *Azotobacter* + PSB, T_6 - 75% NPK + poultry manure + *Azotobacter* + PSB , T_7 - 50% NPK + FYM + *Azotobacter* + PSB , T_8 - 50% NPK + Vermicompost + *Azotobacter* + PSB , T_9 - 50% NPK + town-compost + *Azotobacter* + PSB, T_{10} - 50% NPK + Neem-cake + *Azotobacter* + PSB and T_{11} - 50% NPK + poultry manure + *Azotobacter* + PSB were evaluated in randomized block design with three replications.The required quantity of organic manures as per treatments was applied at the time of land preparation. Urea was applied in two splits before planting and flowering stages while the full dose of phosphorus and potash was given before planting. *Azotobactor*, phosphorus solubilising bacteria solutions were made by dissolving 50 ml 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. Black polythene of 200 gauges was used as mulch material. 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. Yield per plant and per hectare were recorded at physiological maturity.

RESULTS AND DISCUSSION

The data (Table 1) revealed that there was a steady rise in plant height, spread of plant and number of leaves/plant with increase the age of the crop. However rate of increase in these characters was slow at later stages of growth. The maximum height of the plant (8.12, 10.78, 14.28, 14.43, 16.67, 18.15 and 19.76 cm) and spread of the plant (14.4, 16.8, 18.6, 20.4, 21.9, 23.4 and 24.6 cm) were encountered with 100% NPK alone followed by 75% NPK + Vermicompost + *Azotobacter* + PSB at all the stage of growth. The minimum height of plant (3.61, 4.43, 6.66, 7.98, 8.83, 9.52 and 10.60cm) and spread of plant (7.6, 9.6, 10.7, 12.0, 13.8, 15.7 and 16.5 cm) were recorded in control. The data (Table-2) showed that maximum number of leaves/plant (9.8, 12.8, 15.4, 16.3, 16.8, 17.4 and 17.4) were recorded with 100 % NPK and minimum number of leaves/plant (5.5, 8.8, 10.7, 11.3, 12.1, 12.4 and 12.4) was recorded in control at 30, 45, 60, 75, 90, 105 and 120 DAP. The reasons for better growth (plant height, spread of the plant and number of leaves/plant) under fertilizer and organic manures combination may be due to increased availability of nutrients to plants initially through fertilizers and then by organic manures. These organic manures supplying all the essential nutrients and improve physical condition of soil especially under light textured soil. The increase in growth parameters through integrated nutrient management were also reported by Nowsheen *et al.* (2006) and Tripathi *et al.* (2010) in strawberry.

The number of runners/plant and crowns/plant were significantlly affected by various organic sources of nutrients and fertilizers (Table 2). The number of runners/plant varied from 2.93 to 6.83. The corresponding range for crowns/plant was from 2.39 to 5.18. The maximum number of runners/plant (6.83) and crowns/plant (5.18) were recorded with 75% NPK + Vermicompost + *Azotobacter* + PSB treatment and minimize under control. The higher values of runners and crowns/plant may be due to greater availbilty of nutrients in soil, improvement of soil environment resulting in higher number of runners and crowns/plant. Similar results were reported by Tripathi *et al.* (2010) in Strawberry.

Table 1: Effect of INM on plant height/plant and plant spread/plant (cm) of strawberry *cv.* Chandler (mean data of two years)

Treatments	Plant height (cm) at DAP							Plant spread (cm) at DAP						
	30	45	60	75	90	105	120	30	45	60	75	90	105	120
T_0	3.61	4.43	6.66	7.98	8.83	9.52	10.60	7.6	9.6	10.7	12.0	13.8	15.7	16.5
T_1	8.12	10.78	14.28	14.43	16.67	18.15	19.76	14.4	16.8	18.6	20.4	21.9	23.5	24.6
T_2	7.23	9.53	12.23	13.02	14.00	15.81	16.61	12.5	14.9	16.8	19.0	19.9	22.0	23.1
T_3	7.80	9.95	13.13	13.53	15.05	16.63	17.91	13.0	15.8	17.9	19.9	21.1	22.5	23.7
T_4	5.85	8.21	11.44	11.58	13.26	14.15	15.63	11.9	13.7	15.8	17.5	18.7	19.8	20.6
T_5	5.11	7.08	9.97	10.09	12.05	12.11	13.96	10.7	13.2	14.9	16.4	17.3	18.9	19.9
T_6	4.83	6.85	9.42	9.94	11.86	11.92	13.36	10.7	13.0	14.6	16.2	18.3	18.7	19.4
T_7	4.70	7.79	10.74	11.11	12.86	13.85	14.87	11.9	14.6	16.3	17.7	19.1	20.3	21.5
T_8	6.40	9.00	11.85	11.98	13.77	12.29	16.13	12.4	14.7	16.7	18.4	19.6	21.0	22.5
T_9	5.51	7.64	10.43	10.78	12.44	12.97	14.30	11.6	13.6	15.3	16.9	18.5	19.4	20.1
T_{10}	4.54	6.57	9.11	9.82	11.36	11.55	12.60	9.3	12.1	14.0	15.0	16.5	17.6	18.7
T_{11}	4.28	5.93	8.11	8.82	10.37	10.66	11.67	8.8	10.6	12.2	13.8	15.0	16.4	17.6
CD P=0.05	0.335	0.265	0.536	0.245	0.373	0.410	0.698	0.31	0.29	0.26	0.25	0.29	0.32	0.70

Leaf length, leaf width and leaf area were significantly influenced by different treatments (Table 2). Averaged across two years, leaf length ranged from 5.3 to 8.4 cm. The maximum and minimum leaf length of strawberry was recorded with T_0 (Control) and T_1 (100% NPK) treatments, respectively. Most of treatments proved significantly superior to control in respect of leaf length. Among the treatments, leaf width ranged between 7.9 and 11.7 cm for the control and 100% NPK. Almost all the treatments produced significantly wider leaves over control. The difference in leaf area reflected a similar trend with 100% NPK producing higher leaf area. The significantly improvement in these parameters (leaf length, leaf width and leaf area) may be due to better and increased availability of nutrients under integrated nutrient management. Wange *et al.* (1998) and Tripathi *et al.* (2010) also reported similar results.

Table 2: Effect of INM on No. of leaves/plant, No. of Runners/plant, No. of crowns/plant, Leaf length (cm), Leaf width (cm), Leaf area (cm^2), yield/plant, and yield/ha of strawberry *cv*. Chandler (mean data of two years)

Treatments	Number of leaves/plant DAP							Runners /plant	Crowns / plant	Leaf length (cm)	Leaf width (cm)	Leaf area (cm^2)	Yield/ plant (g)	Yield (qha^{-1})
	30	45	60	75	90	105	120							
T_0	5.6	8.8	10.7	11.4	12.1	12.4	12.4	2.93	2.39	5.3	7.9	85.7	144.0	86.1
T_1	9.8	12.8	15.5	16.4	16.8	17.4	17.4	3.76	3.25	8.4	11.7	97.9	150.8	90.3
T_2	8.6	11.8	14.9	15.9	16.3	16.6	16.6	6.01	4.31	8.3	11.5	96.9	289.5	173.5
T_3	8.9	12.5	15.3	16.1	16.5	16.8	16.9	6.83	5.18	8.2	10.9	96.2	297.0	177.9
T_4	7.7	10.5	13.6	14.5	15.1	15.6	15.6	4.94	3.81	7.9	10.6	92.7	270.6	162.0
T_5	6.6	10.0	12.8	13.8	14.2	14.7	14.7	3.71	3.23	7.3	9.1	90.8	198.8	118.9
T_6	6.3	9.6	12.3	13.1	13.6	13.9	14.0	3.58	3.11	6.9	9.0	89.0	187.6	112.3
T_7	7.8	11.0	14.1	15.1	15.5	16.0	16.1	3.96	3.36	7.9	10.1	94.3	229.4	137.5
T_8	8.2	11.5	14.5	15.6	16.0	16.4	16.4	5.46	4.11	8.1	10.7	94.9	259.4	155.4
T_9	6.6	10.1	13.2	14.2	14.7	15.0	15.1	4.26	3.44	7.8	9.5	91.3	221.7	132.8
T_{10}	6.1	9.5	11.9	12.4	13.1	13.3	13.5	3.18	3.01	6.5	8.6	87.5	170.8	102.3
T_{11}	5.8	9.2	11.5	11.9	12.6	12.9	13.0	3.06	2.85	6.3	8.3	86.5	165.9	99.3
CD P=0.05	0.10	0.15	0.11	0.13	0.11	0.17	0.11	0.141	0.072	0.07	0.09	0.88	2.41	1.47

Pooled data analysis revealed that yield/plant and yield/ha responded significantlly to various treatments (Table 2). The yield/plant ranged from 144.0 to 297.0 g. The corresponding range for yield/ha was from 86.1 to 177.9 q. The maximum yield/plant (297.0 g) and yield/ha (177.9 q) were recorded with 75% NPK + Vermicompost + *Azotobacter* + PSB followed by 75% NPK + FYM + *Azotobacter* + PSB. The minimum yield/plant (144.0 g) and yield/ha (86.1 q) were recorded under control. Application of organic sources might have

increased the activities of beneficial micro organisms due to increased organic pool in soil, which resulted in production of growth promoting substances and improved nutrient availability for longer period throughout the crop growth. The beneficial effect of organic sources of nutrient and fertilizers on yield was also reported by Wange *et al.* (1998) and Tripathi *et al.* (2010) in strawberry.

It is concluded from the results that growth parameters responded to 100% NPK through chemical fertilizers. Higher yields were noticed under 75% NPK + vermicompost + Azotobacter + PSB treatment.

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