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## Effect of Integrated Nutrient Management on growth, yield and quality traits of strawberry (*Fragaria x ananassa* Duch.) cv. Chandler

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### Abstract

An experiment was conducted at the research farm, Department of Horticulture, Sam Higginbottom Institute of Agriculture Technology and Science, Allahabad during winter (Nov.- Mar.) of 2013-2014 to study the effect of Integrated Nutrient Management on growth, yield and quality traits of strawberry. Experiment was laid out in randomized block design with 11 treatments replicated thrice. Treatments comprising recommended dose of fertilizer (N:P:K- 150:75:100 kg ha<sup>-1</sup>), Vermicompost (5t ha<sup>-1</sup>), Poultry manure (5t ha<sup>-1</sup>), Farmyard manure (10t ha<sup>-1</sup>), Azotobacter (5kg ha<sup>-1</sup>), PSB (5kg ha<sup>-1</sup>) alone or in combination with different reducing levels of recommended dose of fertilizer. The results revealed that maximum plant height (19.53cm), number of leaves (17.93) and petiole length (10.07cm) were recorded in T<sub>5</sub> (75% RDF + 25% Vermicompost + Azotobacter @ 5kg ha<sup>-1</sup> + PSB@ 5kg ha<sup>-1</sup>) followed by T<sub>7</sub> (75% RDF + 25% Poultry manure + Azotobacter @ 5kg ha<sup>-1</sup> + PSB@ 5kg ha<sup>-1</sup>). The minimum days taken to first flower appearance (58.43), maximum number of flowers (28.13), and yield (276.36 g/plant) were obtained by T<sub>5</sub> followed by T<sub>8</sub> (50% RDF + 50% Vermicompost + Azotobacter @ 5kg ha<sup>-1</sup> + PSB@ 5kg ha<sup>-1</sup>). The maximum TSS (9.62<sup>0</sup>Brix), Specific gravity (1.69), Acidity (0.81%), Total sugar (8.13%), Juice content % (84.99) and minimum pH (3.24) were recorded in T<sub>5</sub> followed by T<sub>8</sub>. The least values were recorded in the control.

**Keywords:** Strawberry, RDF, Organic manure, Biofertilizer, Growth, Yield and Quality

### Introduction

Strawberry (*Fragaria x ananassa* Duch.) is one of the attractive, delicious, tasty and nutritious fruit and distinct and pleasant flavor. It has a unique place among cultivated berry fruit. *Fragaria* species belong to family Rosaceae with basic chromosome number  $x = 7$ . The cultivated species *Fragaria x ananassa* has chromosome  $(2n) = 56$ . It is monoecious and octaploid hybrid of two species. It is assumed the hybridization between *Fragaria chiloensis* and *Fragaria virginiana* had taken place spontaneously in Europe in early 17<sup>th</sup> century when female plant of *Fragaria chiloensis* of Chilean origin were grown in proximity to female *Fragaria* plant of North American origin (Galletta and Bringhurst, 1990). Strawberry is an herbaceous, perennial, short day plant and shallow rooted plant. It has short stem known as crown. The crown produces leaves at very close interval along the stem axis and flowers at terminal position on stem axis. The edible portion of strawberry includes the ripened receptacle and achenes (true fruit and seed). Strawberry is usually propagated through runners. Strawberry is rich source of vitamins and minerals and coupled with delicate flavour. The red colour of the fruit is mainly due to the presence of the anthocyanin, pelargonidin, 3 – monoglucoside and traces of cyaniding (Pathak and Singh, 1971). The most important aroma compounds are ethyl hexanoate, ethyl heptanoate, ethyl butanoate, furanone and linalool. Essential oils can be extracted from leaves. The major constituents of oil are linalool and nonanal (Khanizadeh and Belanger, 1993). In India commercially and widely cultivated in Himachal Pradesh, Uttarakhand, Maharashtra, West Bengal, Nilgiri hills, Delhi, Haryana, Jammu and Kashmir Punjab and Rajasthan (Baba, 2010). The use of organic source of plant nutrients restores soil health. Fertilizers are not only short in supply but costly too and produced at the cost of irreparable loss of non-renewable energy. Biofertilizers are able to fix atmospheric nitrogen in the range of 20-200 kg/ha/year, solubilize P in the range of 30-50 kg/ha. Wang *et al.*, (1997) reported that there is an increase in number of fruits per plant, total weight of fruits and average fruit weight in strawberry as compared to the control by the application of *Azotobacter* and P-solubilizing bacteria. Integrated Nutrient Management involves the judicious use of organic, inorganic and microbial sources in such ways that it sustains optimum

yield, improves and maintains the soil physical, chemical and biological properties. Integrated Nutrient Management system can bring about an equilibrium between degenerative and restorative activities in the soil environment. The major components of INM supply involve organic manures (FYM, Vermicompost, Poultry Manure etc.), Bio-fertilizers (Bacteria, fungi, algae) and chemical fertilizers.

### Materials and Methods

A field experiment entitled "Effect of Integrated Nutrient Management on growth, yield and quality traits of strawberry (*Fragaria x ananassa* Duch.) Cv. Chandler" will be carried out under Allahabad agro climatic conditions at the experimental field of the Department of Horticulture,

Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Deemed to-be University, (Formerly known as Allahabad Agriculture Institute AAI-DU).

The experimental site is situated at a latitude of 20° and 15° north and longitude of 60° 3' East and at an altitude of 98 meters above mean sea level (MSL).

The maximum temperature of the location reaches up to 46°C-48°C and seldom falls as low as 4°C- 5°C. The relative humidity ranged between 20 to 94 percent. The average rainfall in this area is around 1013.4 mm annually. The soil of experimental area had sand 60%, Silt 26%, Clay 14%, pH 7.2, Soil EC. (dSm<sup>-1</sup>) at 25°C is 0.28, Organic carbon 0.35%.

### Treatment combination

T <sub>0</sub>	Control
T <sub>1</sub>	100 % RDF (150 : 75 : 100 Kg/ hac.)
T <sub>2</sub>	Vermicompost @ 5 tonnes/hac. + Azotobacter @ 5 kg/ha + PSB@ 5 kg/ha
T <sub>3</sub>	Farm Yard Manure @ 10 tonnes/ hac. + Azotobacter @ 5 kg/ha + PSB@ 5 kg/ha
T <sub>4</sub>	Poultry Manure @ 5 tonnes / hac. + Azotobacter @ 5 kg/ha + PSB@ 5 kg/ha
T <sub>5</sub>	75 % RDF + 25 % Vermicompost + Azotobacter @ 5 kg/ha + PSB@ 5 kg/ha
T <sub>6</sub>	75 % RDF + 25 % Farm Yard Manure + Azotobacter @ 5 kg/ha + PSB@ 5 kg/ha
T <sub>7</sub>	75 % RDF + 25 % Poultry Manure + Azotobacter @ 5 kg/ha + PSB@ 5 kg/ha
T <sub>8</sub>	50 % RDF + 50 % Vermicompost + Azotobacter @ 5 kg/ha + PSB@ 5 kg/ha
T <sub>9</sub>	50 % RDF + 50 % Farm Yard Manure + Azotobacter @ 5 kg/ha + PSB@ 5 kg/ha
T <sub>10</sub>	50 % RDF + 50 % Poultry Manure + Azotobacter @ 5 kg/ha + PSB@ 5 kg/ha

### Result and Discussion

Studies showed that significant effect was increasing on average maximum plant height (19.53) in 120 Days, Rana and Chandel (2003), number of leaves (17.93) in 120 days Lata *et al.* (2013), plant spread (26.89cm<sup>2</sup>) in 120 days Kirad *et al.* (2007) and petiole length (10.07cm) in 120 days Lata *et al.* (2013), days taken to first flowers appearance (58.43 DAT), number of flower per plant (28.13) in 130 days Yusuf *et al.* (2003), number of fruits per plant (19.92) in 145 days Kirad *et al.* (2007), cumulative yield (276.36 g/plant) Ahmad and Jouki (2012), fruit yield (24.87 t ha<sup>-1</sup>) Rana and Chandel (2003), fruits index (1.55), specific gravity of fruits (1.69) Umar *et al.* (2010), T.S.S. (9.62%) Rana and Chandel (2003); Yusuf *et al.* (2003), Vitamin-C content of fruits (52.67 mg / 100g) Yusuf *et al.* (2003), pH of fruit juice (3.24) Badiyala

and Bhutani (1990), juice content (84.99%) Umar *et al.* (2010) and total acidity (0.81%) Umar *et al.*, (2010). Cost of cultivation (5,00,120 Rs/ha), Gross return (24,87,000 Rs/ha), Net return (19,86,880Rs/ha) and Cost of benefit ratio (4.97) was recorded in treatment T<sub>5</sub> (75% RDF + 25% Vermicompost + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha)

### Conclusion

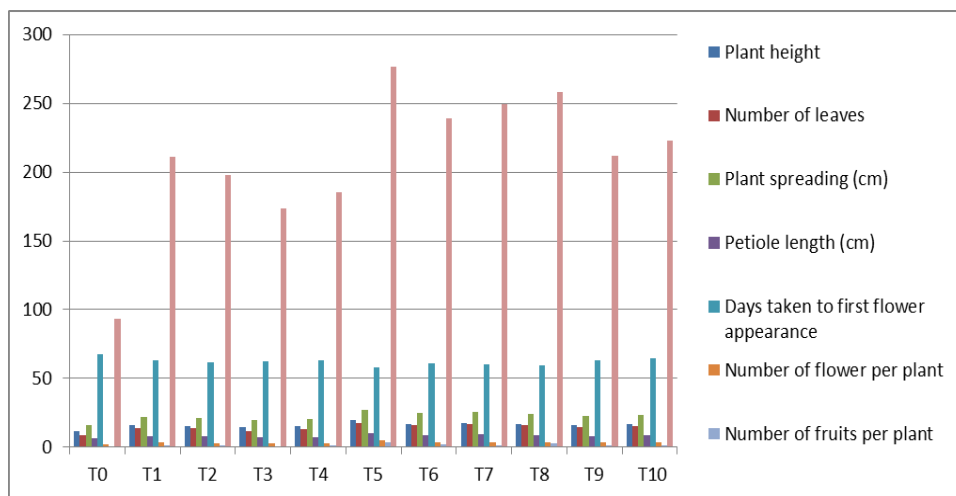
On the basis of results obtained, It is concluded that the treatment T<sub>5</sub> (75% RDF + 25% Vermicompost + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha) was found beneficial in terms of maximum yield (24.87 t/ha) and quality of strawberry with net return of 19,86,880 Rs/ha. = 19.86 Lakh/ha and maximum benefit cost ratio (1: 4.97).

**Table 1:** Growth, flowering and fruiting observation to be recorded

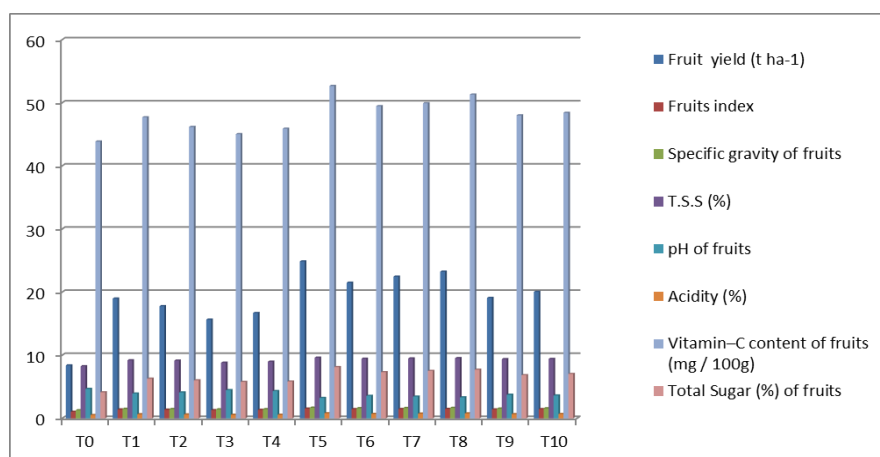
Character Treatment	Plant height (cm) 120 DAT	Number of leaves 120 DAT	Plant spreading (cm) 120 DAT	Petiole length (cm) 120 DAT	Days taken to first flower appearance (DAT)	Number of flower per plant 130 DAT	Number of fruits per plant 145 DAT	cumulative yield /plant (g)
T <sub>0</sub>	12.03	9.00	15.85	6.42	67.71	1.87	0.93	93.33
T <sub>1</sub>	15.77	14.07	21.95	8.35	63.43	3.40	1.33	210.90
T <sub>2</sub>	15.59	13.80	21.35	8.02	62.08	3.07	1.20	197.55
T <sub>3</sub>	14.56	11.87	19.78	7.51	62.35	3.00	1.00	173.87
T <sub>4</sub>	15.30	13.07	20.44	7.61	63.32	3.00	1.13	185.53
T <sub>5</sub>	19.53	17.93	26.89	10.07	58.43	4.93	3.27	276.36
T <sub>6</sub>	16.98	16.20	25.12	9.05	60.78	3.80	2.07	238.80
T <sub>7</sub>	17.42	16.87	25.55	9.22	60.63	3.80	1.53	249.51
T <sub>8</sub>	16.97	15.93	24.03	8.98	59.90	3.93	2.60	258.36
T <sub>9</sub>	16.32	14.47	22.78	8.37	63.28	3.53	1.40	212.13
T <sub>10</sub>	16.69	15.33	23.31	8.65	64.40	3.67	1.47	222.80
CD.(0.5%)	1.25	0.83	1.84	1.15	4.34	1.08	0.31	10.68

**Table 2:** Yield and quality observation to be recorded

Character Treatment	Fruit yield (t ha <sup>-1</sup> )	Fruits index	Specific gravity of fruits	T.S.S (%) of fruits	pH of fruits	Acidity (%) of fruits juice	Vitamin-C content of fruits (mg / 100g)	Total Sugar (%) of fruits	Juice content (%) of fruits
T <sub>0</sub>	8.39	1.04	1.29	8.26	4.67	0.53	43.86	4.12	75.67
T <sub>1</sub>	18.98	1.41	1.51	9.20	3.93	0.65	47.70	6.29	80.29
T <sub>2</sub>	17.77	1.38	1.48	9.15	4.11	0.62	46.17	6.02	79.92
T <sub>3</sub>	15.64	1.30	1.43	8.82	4.47	0.57	45.03	5.78	78.08
T <sub>4</sub>	16.69	1.35	1.46	8.98	4.32	0.58	45.90	5.83	79.50
T <sub>5</sub>	<b>24.87</b>	<b>1.55</b>	<b>1.69</b>	<b>9.62</b>	<b>3.24</b>	<b>0.81</b>	<b>52.67</b>	<b>8.13</b>	<b>84.99</b>
T <sub>6</sub>	21.49	1.47	1.61	9.45	3.57	0.71	49.47	7.32	82.84
T <sub>7</sub>	22.45	1.48	1.65	9.50	3.45	0.75	49.93	7.52	83.07
T <sub>8</sub>	23.25	1.50	1.67	9.54	3.33	0.78	51.30	7.72	83.54
T <sub>9</sub>	19.09	1.42	1.54	9.38	3.74	0.67	48.01	6.84	81.58
T <sub>10</sub>	20.05	1.47	1.59	9.41	3.63	0.69	48.40	7.04	81.96
<b>CD.(0.5%)</b>	0.84	0.05	0.07	0.75	0.51	0.04	1.79	0.16	2.43

**Fig 1:** Growth, flowering and fruiting observation to be recorded**Table 3:** Economics of treatment

Character Treatment	Cost of cultivation (Rs ha <sup>-1</sup> )	Gross return (Rs ha <sup>-1</sup> )	Net return (Rs ha <sup>-1</sup> )	Benefit cost ratio
T <sub>0</sub>	4,83,924	8,39,000	355076	1.73
T <sub>1</sub>	4,95,776	18,98,000	14,02,224	3.82
T <sub>2</sub>	5,10,909	17,77,000	12,66,091	3.47
T <sub>3</sub>	5,05,659	15,64,000	10,58,341	3.09
T <sub>4</sub>	5,05,659	16,69,000	11,63,341	3.30
T <sub>5</sub>	5,00,120	24,87,000	19,86,880	4.97
T <sub>6</sub>	4,98,807	21,49,000	16,50,193	4.30
T <sub>7</sub>	4,98,807	22,45,000	17,46,193	4.50
T <sub>8</sub>	5,03,710	23,25,000	18,21,290	4.61
T <sub>9</sub>	5,01,085	19,09,000	14,07,915	3.80
T <sub>10</sub>	5,01,085	20,05,000	15,03,915	4.00

**Fig 2:** Yield and quality observation to be recorded

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