

## Effect of Fym, Urea and *Azotobacter* on Growth, Yield and Quality of Strawberry Cv. Chandler

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### Abstract

The present investigation was carried out in the Research orchard of Division of Fruit Science, Faculty of Agriculture, SKUAST-J, Udhewwala, Jammu during 2005-06 and 2006-07 to study the effect of organics FYM integrated with urea and *Azotobacter* on growth, yield and quality of strawberry cv. Chandler. The strawberry plants attained the height of 21.24cm with 28.16cm plant spread, 74.95cm<sup>2</sup> leaf area and fruit size (37.62 x 28.01mm) and fruit weight (15.87g) with the application of 25 per cent nitrogen through FYM augmented with *Azotobacter* and was at par with the plants supplied with cent per cent nitrogen in the form of urea in combination with *Azotobacter*. The fruit quality viz. total soluble solids, total sugars, ascorbic acid and anthocyanin content was highest in fruits obtained from plants supplied with 25 per cent nitrogen through FYM + 75 per cent nitrogen in the form of urea + *Azotobacter* recording 6.81 oBrix, 4.73 per cent, 73.71mg/100g fresh berries and 0.191 OD respectively. Maximum yield of 372.89g per plant was obtained with the application of cent per cent nitrogen in the form of urea along with *Azotobacter* whereas 358.43g fruits per plant were recorded with the application of 25 per cent nitrogen in the form of FYM + 75 per cent through urea + *Azotobacter* and were at par with each other.

**Keywords:** FYM, *Azotobacter*, urea, strawberry, yield

### Introduction

Strawberry (*Fragaria x ananassa* Duch.) is one of the most important soft fruit of the world after grapes. It gives quickest returns in shortest possible time, as its fruit is the first of the season's home-grown supplies to reach the market. Among the various factors which contribute in growth and yield of strawberry, nutrition is one of the most important aspects of crop production and accounts for about one third of the total cost of production (Bhat, 1999; Nazir, 2005). At present, chemical fertilizers contribute a lot in fulfilling the nutrient requirement but their regular, excessive and unbalanced use may lead to health and ecological hazards, depletion of physico-chemical properties of the soil and ultimately poor yields. Hence application of organic manures like FYM to soil not only improve soil physical properties, pH, water holding capacity but also add important nutrients to the soil, thus increase the nutrient availability and its ultimate absorption by plant. Biofertilizers like *Azotobacter* fix atmospheric nitrogen and enhances the production of various field crops. Keeping this in view, a study was conducted to analyse the effect of FYM, urea and *Azotobacter* alone and in combination on growth, yield and fruit quality of strawberry cv. Chandler.

### Materials and methods

The present investigations were conducted on strawberry cv. Chandler at Research Orchard of Division of Fruit Science, Faculty of Agriculture, SKUAST-J, Udhewwala, Jammu during 2005-06 and 2006-07. Required quantity of FYM (@150kg nitrogen per hectare) was applied 20 days before transplanting strawberry runners in the respective plots. The urea was applied in two split doses, viz. first half dose of urea was mixed into soil prior to planting and the second half was applied before flowering. Phosphorus (@ 80 kg P<sub>2</sub>O<sub>5</sub>/ha) and potassium (45 kg K<sub>2</sub>O/ha) was worked out after subtracting the quantity of each of these nutrients supplied by FYM and remaining full quantity was applied through single super phosphate (SSP) and murate of potash (MOP) before planting. The roots of the strawberry runners were thoroughly dipped in the slurry of *Azotobacter* culture and after two months of planting, the soil was also inoculated with *Azotobacter* at the rate of 2 kg per hectare. The experiment was laid out in Randomized Block Design with twelve treatment combinations. The data on vegetative growth parameters like plant height, spread and leaf area were recorded. TSS, titraTab, acidity, total sugars and ascorbic acid content were estimated as per AOAC (1) methods. Total anthocyanin was estimated according to the method given by Ranganna, (16). Data was pooled and subjected to statistical scrutiny as prescribed by Panse and Sukhatme (11).

Tab. 1. Effect of FYM, urea and *Azotobacter* on growth of strawberry cv. Chandler

Treatment	Plant growth		
	Plant height (cm)	Plant spread (cm)	Leaf area (cm <sup>2</sup> )
T1- 100% of N ha-1 through FYM	15.19	24.11	59.14
T2- 75% of N ha-1 through FYM +25% of N ha-1 through urea	18.08	25.30	63.23
T3- 50% of N ha-1 through FYM + 50% of N ha-1 through urea	18.70	26.49	64.90
T4- 25% of N ha-1 through FYM +75% of N ha-1 through urea	19.34	27.49	67.79
T5- 100% of N ha-1 through urea	19.51	27.77	68.55
T6- <i>Azotobacter</i>	12.67	19.58	33.86
T7- <i>Azotobacter</i> + (T1)	17.70	25.17	64.60
T8- <i>Azotobacter</i> + (T2)	18.79	26.32	66.21
T9- <i>Azotobacter</i> + (T3)	19.34	27.50	69.29
T10- <i>Azotobacter</i> + (T4)	21.24	28.16	74.95
T11- <i>Azotobacter</i> + (T5)	21.50	28.67	75.31
T12- Absolute control	10.39	17.22	29.32
S.Em. (±)	0.603	0.342	1.33
CD (5%)	1.25	0.71	2.76

## Results and discussion

### *Effect on plant growth*

The plant growth was significantly influenced by the application of FYM, urea and *Azotobacter* alone as well as

in combination (Tab. 1). The maximum increase in plant height (21.50), spread (28.67 cm) and leaf area (75.31 cm<sup>2</sup>) was recorded by the application of cent per cent nitrogen was applied in the form of urea along with *Azotobacter* (T11) followed by treatment comprising of 25 per cent of nitrogen applied in the form of FYM + 75 per cent

Tab. 2. Effect of FYM, urea and *Azotobacter* on yield parameters of strawberry cv. Chandler

Treatment	Yield parameters		
	Fruit weight (g)	No. of achenes	Yield (q/ha)
T1- 100% of N ha-1 through FYM	13.27	326.11	218.95
T2- 75% of N ha-1 through FYM +25% of N ha-1 through urea	12.97	334.69	239.82
T3- 50% of N ha-1 through FYM + 50% of N ha-1 through urea	13.96	347.94	276.10
T4- 25% of N ha-1 through FYM +75% of N ha-1 through urea	15.51	351.75	322.48
T5- 100% of N ha-1 through urea	15.79	352.31	338.31
T6- <i>Azotobacter</i>	12.77	319.68	190.02
T7- <i>Azotobacter</i> + (T1)	13.27	335.49	249.33
T8- <i>Azotobacter</i> + (T2)	13.42	345.38	265.40
T9- <i>Azotobacter</i> + (T3)	14.26	350.91	309.51
T10- <i>Azotobacter</i> + (T4)	15.87	362.67	358.43
T11- <i>Azotobacter</i> + (T5)	16.49	363.13	372.89
T12- Absolute control	12.08	296.20	151.46
S.Em. (±)	0.561	1.355	11.96
CD (5%)	1.13	2.73	24.10

Tab. 3. Effect of FYM, urea and *Azotobacter* on fruit quality of strawberry cv. Chandler

Treatment	Fruit size		TSS (0Brix)	TitraTab. acidity (%)	Total sugars (%)	Ascorbic acid (mg/100g of fresh berries)	Anthocyanin content (OD at 535nm)
	Length of fruit (mm)	Diameter of fruit (mm)					
T1	32.99	24.44	6.74	0.74	4.59	67.84	0.171
T2	34.39	24.81	6.72	0.74	4.57	68.56	0.174
T3	35.55	25.15	6.72	0.74	4.56	70.40	0.178
T4	36.42	27.28	6.75	0.75	4.62	72.45	0.183
T5	37.03	27.47	6.68	0.76	4.49	72.48	0.184
T6	32.62	24.99	6.57	0.74	4.11	65.90	0.166
T7	34.34	24.81	6.81	0.75	4.70	68.51	0.177
T8	36.00	26.39	6.80	0.75	4.67	69.97	0.184
T9	36.33	27.01	6.79	0.76	4.62	70.98	0.184
T10	37.62	28.01	6.81	0.76	4.73	73.71	0.191
T11	37.83	28.23	6.74	0.77	4.53	73.11	0.188
T12	30.83	23.45	6.44	0.70	3.95	62.24	0.160
S.Em. (±)	0.651	0.437	2.015		0.012	0.960	0.002
CD (5%)	1.35	0.88	0.021	NS	0.024	1.991	0.005

through urea + *Azotobacter* (T10) where plants attained height of 21.24 cm, spread (28.16 cm) and leaf area (74.95 cm<sup>2</sup>). T10 was found to be statistically at par with T11. The maximum increase in vegetative growth characters of strawberry cv. Chandler under these treatment combinations is supported by the fact that nitrogen through urea is readily available to the plant, which increased vegetative growth abruptly contrary to other treatments where nitrogen was released slowly. Secondly, increased nitrogen availability is affected by higher percentage of nitrogen through urea in association with nitrogen fixing culture has been documented by Bambal *et al.* (1998) whereas production of growth regulators by the *Azotobacter* in the root zone which gets absorbed by the plant roots has been reported by Rana and Chandel (2003). Saraf and Tiwari (2004) found that phytohormones extracted from FYM help the plant to grow more luxuriously even with reduced doses of chemical fertilizers.

#### Effect on yield

The data on fruit weight (g), achene number and yield (q/ha) has been presented in Tab. 2. The results reveal that the application of cent per cent nitrogen was applied in the form of urea along with *Azotobacter* (T11) resulted in maximum fruit weight (16.49g), number of achenes (363.13) and yield (372.89q/ha). The results were, however, statistically at par with those obtained when 25 per cent of nitrogen was applied in the form of FYM + 75 per cent through urea + *Azotobacter* (T10). The increased weight of berries with nutrient application might have first improved the internal nutritive condition of plant leading to increased growth and vigour associated with photosynthesis and translocation of assimilates in the fruits. Such assumption gains support from the findings of several workers like Magge (1963) in apples and Hansen (1969) in strawberry who reported increased rate of translocat-

tion of photosynthetic products from leaves to developing fruits increased fruit weight. The increase in fruit weight was also reported by Neuweiler *et al.* (1996) with the increasing nitrogen application in strawberry. Increase in achene number is in line with findings of Rana (2001). The results in the present study on yield due to integration of 25 per cent nitrogen through FYM+75 per cent nitrogen through urea + *Azotobacter* and also with application of cent per cent nitrogen through urea+ *Azotobacter* are similar to observations of Sharma and Gupta (1998) and Pathak *et al.* (2002) who found integration of 75 per cent nutrient supply through chemical fertilizers and 25 per cent through organic source in Maize-wheat cropping system gave yield equal to as obtained by application of cent per cent nitrogen, phosphorus and potassium. The existence of favourable nutritional environment under the influence of bio-fertilizers, FYM and inorganic fertilizers had a positive influence on vegetative and reproductive growth, which ultimately led to realization of higher yield.

#### *Effect on fruit quality*

In the present investigation the total soluble solids were recorded highest on applying cent per cent nitrogen through FYM + *Azotobacter* (T7) or with 25 per cent nitrogen through FYM +75 per cent nitrogen through urea + *Azotobacter* (T10) recording total soluble solids of 6.810 Brix in both the treatments (Tab. 3). Total sugars were also higher in these treatments. In the present investigation nitrogen from different sources might have increased the vigour of strawberry plants including increased leaf area with higher synthesis of assimilates due to enhanced rate of photosynthesis. Such effects have been attributed to increased rate of translocation of photosynthetic products from leaves bearing developing fruits (Magge, 1963), thereby increasing total sugars. Improved TSS with applied organic manure (FYM) is in line with reports of Pereira and Mitra (1999) in guava.

The acidity of the strawberry was not affected with the various treatments tried in the present study however it increased with increase in concentration of urea as source of nitrogen. Highest acidity (0.77 per cent) was under treatment with cent per cent nitrogen applied through urea + *Azotobacter* (T11). The present findings are in line with Ahlawat and Yamdagni (1988) who reported increase in acidity of grapes with nitrogen application. The increase in acidity might be due to synthesis of more organic acids as a result of improved foliage which might have kept the berry temperature lower by shading them and thus resulting in lower loss of acids in respiration.

Ascorbic acid and anthocyanin content was found maximum (73.71mg/100g of fresh berries and 0.191OD) respectively, in fruits harvested from plants receiving 25 per cent nitrogen through FYM + 75 per cent nitrogen through urea + *Azotobacter* (T10). This is in agreement

with the finding of Antipchuk *et al.* (1982) who reported that inoculation of different *Azotobacter* strains to soil resulted in higher vitamin C in tomato. Increase in nitrogen application has also been found to increase the ascorbic acid content in strawberry by Kopanaski and Kawecki (1994) whereas FYM levels have also been reported to increase vitamin C in strawberry (Bhat, 1999). The increase in anthocyanin pigment with the application of nitrogen and *Azotobacter* is in consonance with findings of Rana (2001) who observed increase in red pigment of strawberry cv. Chandler with the combined application of nitrogen and biofertilizers.

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