

Original Research Article

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Effect of Nutrient Concentration on Vegetative Growth of Strawberry (*Fragaria x ananassa*)

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ABSTRACT

Keywords

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An experiment on effect of nutrient concentration on vegetative growth of Strawberry (*Fragaria x ananassa*) was carried out during winter season of the year 2016-2017 at Agriculture research farm, Department of Soil Science, Lovely Professional University. This trial was operated based on a Randomized Complete Block Design (RCBD) with nine treatments including different ratios of farmyard manure, vermicompost and recommended dose of fertilizer. The measured traits included Plant height (cm), plant girth (mm), number of leaves/plant and Leaf area (cm²). The results revealed that T9 significantly increase growth attributing characters like plant height (6.9 cm), stem girth (0.27mm), number of leaves/plant (14.33) at 90days while maximum leaf area (42.73 cm²) find at 60 days.

Introduction

Strawberry (*Fragaria x ananassa*) is the popular soft fruit and mainly grows in sub-tropical and hills at elevation of 3000 meter. It cultivated mainly in protected structure and produce best quality and production of fruits. In sub-tropic region strawberry require 20°-25°temperature maximum in day time and minimum 7° to 13° temperature in night time. As compare to all berries it gives early fruits in short time. The strawberry rich in nutrients content like protein, Ca, P and K with Vitamin-A, B1, B2, C and niacin. In last few decades the strawberry production and

demand is increase in international market. The U.S.A is the largest producer of strawberry in the world. About 28% world production of strawberry is given by U.S.A. as per the food and agriculture organization of united nation. And Spain is produced 8% followed by the Russia, Korea, Japan and Poland. In India, strawberry is cultivated in hilly area like Himachal Pradesh, Uttaranchal, parts of Uttar Pradesh and Kashmir valley. But now a day it is also cultivated in north plain zone of India like Punjab, Haryana, Delhi and some part of Rajasthan. According

to national horticulture board of India the production of strawberry in 2014-15 is 8000MT and under 2015-16 it is 5000 MT.

Materials and Methods

Location of research

It is carried out at Experimental Farm of School of Agriculture, Lovely Professional University, Phagwara, Punjab. The experiment shall be laid out on pot with three replications. The package of practices for raising the crop shall be followed as per latest PAU guidelines and check the Nitrogen, Phosphorus, Potassium and organic carbon of soil.

Experimental details

Period of work: Mid November to march 2017

Treatments: 9

Replications: 3

Total number of pots: $9 \times 3 = 27$

Design: RCBD on pots

Variety: Chandler

Seed rate: seedling plants

Observation details

For the determination of the plants growth selected various parameters viz., Plant height (cm), plant girth (mm), number of leaves/plant and Leaf area (cm²).

Statistical analysis

The data collected during the course of investigation were subjected to statistical analysis by adopting appropriate method of analysis of variance as described by Fisher. The critical difference for the treatment comparison was worked out, wherever the SPSS 16 is used to analysis the data.

Results and Discussion

Plant height in different pot is observed at different days like 15 days, 30 days, 45 days, 60 days, 75 days and 90 days. And the variation is observed in different treatments in the plant height at different time period. In between the 15 days observation the plant height increase 29.62%. In 30 days observation shows that 33.03% increase in between all treatments and according to this at 45 days data shows that the 30.30% increase in plant height; however the variation in treatment T₈, T₉ (50% RDF+ 50% FYM, 25% RDF +75% FYM) are from 3.80-5.40 cm and 4.06-5.93 cm respectively (Table 1).

And it also depends on the different condition of the growing strawberry in poly house (Tripathi *et al.*, 2015). In plant height at 30 days observation shows the 10.62% increase at 15 days; however the variation in treatments from 4.06-5.93 cm and T₉ (25% RDF + 75% FYM) shows the best plant height. Due to the application FYM and vermicompost, fertilizer increase the yield and growth 37% and also increase the activity of the microorganism due to this it effect on the uptake of water is more (Arancon *et al.*, 2006).

But in these experiment the FYM and RDF (Recommended dose of fertilizer) shows the best plant height. Phosphorus with the organic manure increases the water retention capacity of soil it leads to the more plant height (Arancon *et al.*, 2006). At 45 days observation shows that 13.17% increase as compared to the 30 days; however the variation from 4.76 to 6.83 cm and the T₉ (25% RDF + 75% FYM) shows the best impact on plant height. And after the vegetative growth of plant, the plant height was not increase. The plant height after the 45 days is not increase due to the stop of cell division after flowering (Morgan *et al.*, 2006).

Table.1 The effect of nutrient concentration on strawberry plant height (cm) at 15, 30, 45, 60, 75 and 90 days. The mean follows by different letters are significant different at $p < 0.05$, according to DMRT (Duncan's Range Test) for separation of means

T	PH 15 Days	PH 30 Days	PH 45Days	PH 60Days	PH 75Days	PH 90Days
T1	4.36ab±0.42	4.56ab±0.41	5.13cd ±0.37	5.16bc±0.40	5.16cd ±0.40	5.16cd±0.40
T2	5.16ab±0.27	5.26ab±0.27	5.60bcd ±0.25	5.73abc±0.24	5.73bcd ±0.26	5.73bcd±0.26
T3	4.83ab ±0.63	4.93ab ±0.57	5.26bcd ±0.52	5.33bc ±0.46	5.33cd ±0.46	5.33cd ±0.46
T4	3.80b ±0.33	4.06b ±0.40	4.76d ±0.35	4.96c ±0.35	4.96d ±0.35	4.96d ±0.35
T5	5.13ab ±0.73	5.30ab ±0.72	5.86abcd±0.61	5.93abc±0.61	5.93abcd±0.61	5.93abcd±0.6
T6	5.13ab ±0.24	5.30ab ±0.30	5.73abcd±0.31	5.93abc±0.31	5.93abcd±0.31	5.93abcd±0.31
T7	4.83ab ±0.24	5.16ab ±0.14	6.06abc ±0.14	6.3ab ±0.08	6.33abc ±0.08	6.33abc ±0.08
T8	5.40a ±0.34	5.66a ±0.31	6.46ab ±0.23	6.56a ±0.27	6.56ab ±0.21	6.56ab ±0.21
T9	5.30ab ±0.51	5.93a ±0.49	6.83a ±0.20	6.90a ±0.23	6.90a ±0.23	6.90a ±0.23

T= Treatment, PH= Plant Height

Table.2 Data on the effect of nutrient concentration on strawberry stem girth (mm) at 15, 30, 45, 60, 75 and 90 days. The mean followed by different letters are significant different at $p < 0.05$, according to DMRT (Duncan's Range Test) for separation of means

T	SG 15 Days	SG 30Days	SG 45Days	SG 60Days	SG 75Days	SG 90Days
T1	0.14a±0.01	0.17a±0.02	0.17ab±0.01	0.19a±0.03	0.21ab±0.02	0.23abc±0.02
T2	0.14a±0.01	0.15a±0.01	0.17ab±0.01	0.19a±0.01	0.20ab±0.01	0.23abc±0.01
T3	0.13a±0.01	0.14a±0.01	0.15ab±0.01	0.19a±0.01	0.21b±0.01	0.22bc±0.01
T4	0.13a±0.02	0.15a±0.02	0.16ab±0.01	0.18a±0.02	0.19b±0.02	0.21c±0.01
T5	0.12a±0.01	0.14a±0.01	0.15ab±0.01	0.17a±0.01	0.19b±0.01	0.21c±0.01
T6	0.11a±0.01	0.13a±0.01	0.14b±0.01	0.15a±0.01	0.19b±0.01	0.21c±0.01
T7	0.14a±0.01	0.16a±0.01	0.17ab±0.01	0.19a±0.01	0.21ab±0.01	0.23abc±0.01
T8	0.18a±0.02	0.17a±0.02	0.18ab±0.03	0.20a±0.03	0.22ab±0.02	0.26ab±0.01
T9	0.17a±0.03	0.19a±0.02	0.20a±0.02	0.21a±0.02	0.25a±0.01	0.27a±0.02

T= Treatment, SG= Stem Girth

Table.3 Data on the effect of nutrient concentration on strawberry number of leaves/Plant at 15, 30, 45, 60, 75 and 90 days. The mean followed by different letters are significant different at $p < 0.05$, according to DMRT (Duncan's Range Test) for separation of means

T	LP15Days	LP 30Days	LP 45Days	LP 60Days	LP 75Days	LP 90Days
T1	3.33a±0.88	8.00a±0.00	9.66a±0.33	10.00ab±0.00	12.00b±1.15	12.00b ±1.15
T2	4.00a ±1	6.00a±0.57	7.66ab±0.33	9.33b ±0.66	10.66b±0.60	10.66b ±0.60
T3	4.00a ±1	5.66a ±1.2	7.00b ±0.57	9.00b ±0.57	12.00ab±0.77	12.00ab±0.77
T4	3.33a ±0.3	6.33a±0.33	8.33ab±0.33	10.66ab±0.66	12.33ab±0.33	12.33ab±0.33
T5	5.33a± 1.4	6.66a±1.20	8.00ab±1.0	10.33ab±0.88	11.66ab ±1.2	11.66ab ±1.2
T6	4.66a±0.88	7.00a±1.00	8.00ab±0.57	10.00ab±0.00	10.66b ±0.66	10.66b ±0.66
T7	3.33a±0.88	5.66a±0.66	8.00ab±0.00	11.33ab±0.66	13.00ab±0.57	13.00ab±0.57
T8	5.66a ±1.4	6.00a±1.15	8.00ab±1.15	11.66ab±1.85	12.66ab±1.33	12.66ab±1.33
T9	4.00a ±1	5.66a±0.66	8.00ab±0.57	12.66a ±0.66	14.33a ±0.33	14.33a ±0.33

T= Treatment, LP= Leaf/plant

Table.4 Data on the effect of nutrient concentration on strawberry leaf area (cm²) at 15, 30, 45, 60, 75 and 90 days. The mean followed by different letters are significant different at $p < 0.05$, according to DMRT (Duncan's Range Test) for separation of means

T	LA 15 Days	LA 30Days	LA 45 Days	LA 60 Days	LA 75Days	LA 90 Days
T1	11.13b±1.67	18.00ab±3.05	13.10a ±2.82	15.80b ±3.36	18.80ab±6.32	12.73cd ±4.13
T2	17.66ab±0.88	19.33ab±4.33	13.70a ±4.27	18.80b ±9.61	13.70b ±1.93	11.43d ±1.37
T3	21.20ab±3.74	15.37b ±3.90	14.40a ±3.30	16.83b ±1.37	19.33b ±6.56	14.46bcd ±4.82
T4	13.23b ±3.01	28.70a ±0.90	27.76a ±4.73	14.96b ±2.28	14.70b ±2.30	10.37d ±0.87
T5	23.50ab±5.23	13.86b ±2.54	16.75a ±1.75	17.20b ±4.61	15.40b ±3.11	12.70cd ±0.30
T6	19.60ab±5.16	20.13ab±0.46	29.36a ±6.71	24.20b ±2.34	14.40b ±3.21	25.33abc ±7.42
T7	29.00a ±7.23	24.16ab±4.84	36.33a ±3.71	30.40ab±8.33	21.66b ±5.23	18.33abcd±1.32
T8	22.63ab±2.36	19.10ab±3.80	27.70a ±7.72	19.53b ±3.01	23.00ab±4.58	29.33a ±5.36
T9	22.76ab±2.36	21.50ab±3.37	28.86a ±4.96	42.73a ±2.96	31.03a±3.61	26.40ab ±2.66

T= Treatment, LA=Leaf Area

Details of Treatment

T ₁ = Control
T ₂ = 100% Recommended dose of fertilizer (RDF)
T ₃ = 75% RDF + 25% Vermicompost
T ₄ = 50% RDF + 50% Vermicompost
T ₅ = 25% RDF + 75% Vermicompost
T ₆ = 100% Vermicompost
T ₇ = 100% Farm yard manure (FYM)
T ₈ = 50% RDF + 50% FYM
T ₉ = 25% RDF + 75% FYM

In between the treatment at 45 days, the stem girth is increase 30%; At 75 days stem girth increase 24%; At 90 days, stem girth increase 22.22%. At 45 days stem girth observation shows that the 5% increase as compared to the 30 days; however variation is from 0.14-0.20 mm and T₉ (25% RDF + 75% FYM) shows the best impact on stem girth. At 75 days the stem girth observation 16% increase as compared to the 60 days; however the variation is from 0.19-0.25 mm and T₉(25%RDF + 75%FYM) shows the best impact on the stem girth. At 90 days stem girth observation shows that the 7.40% increase as compared to the 75 days observation; however the variation in treatment are from 0.21-0.27 mm and T₉ (25%RDF + 75%FYM) shows the best impact on stem girth. This impact is may be due the microorganism and FYM. (Arancon *et al.*, 2006) tell about the 37% increase in the shoot biomass due to organic fertilizer (Table 2).

Number of leaves/plant increase till the flowering period because the division of cell is stop after flowering (Morgan *et al.*, 2006). In between the 45 days observation of all treatment the leaf/plant increase 27.53%; at 60 days shows that 28.90% increase in leaf/plant. At 45 days observation shows that the 19.14% increase of leaf/plant as compared to the 30 days; however the variation in treatment is from 7-9.66 leaves and T₁ control shows best impact on leaf/plant. At 60 days

observation shows that the 22.22% increase as compared to the 45 days; however the variation in treatment are from 9-12.66 leafs and T₉ (25%RDF +75% FYM) shows best impact on the leaf/plant (Table 3). At 75 days results shows that 16.66% increase as compared to the 90 days; however the variation in treatment are from 10.66-14.33 leafs and T₉ (25%RDF +75%FYM) shows that best impact on leaf/plant. But the vermicompost change the biological activity (Cristina and Jorge *et al.*, 2011) and the availability of the different nutrient change in the soil due to the vermicompost and if increase the number of leaves per plant (Mamta *et al.*, 2012). At 15 days, leaf area increase 61.62% in between all treatment; 51.70% increase in 30 days; 63.94% increase in 60days; 64.98 % increase in 75 days; and 27.13 % increase in 90days. At 45 days leaf area observation shows that 53.90% increase as compared to the 30 days; The variation in treatment are from 13.86-28.70 cm² and T₄ (50% RDF + 50% vermicompost) shows the best impact on the leaf area. Due to the application of vermicompost helpful for increase the leaf area (10.1- 18.9%) (Papadopoulos *et al.*, 1987). At 60 days the result shows the 32.45% as compare to 45 days; however the variation in treatment are from 14.96-42.76 cm² and T₉ (25%RDF + 75%FYM) shows best impact on leaf area. At 75 days leaf area observation shows the 15.95% increase as compared to the 60 days;

the variation in treatment are in between 13.70-18.80 cm² and T₁ (control) shows the best impact on the leaf area (Table 4). In soil sample the phosphorus is more and the fruits plant is more uptakes of the phosphorus nutrient it impact on the leaf area. At 90 days leaf area of plants show that the 21.58% increase as compared to the 75 days; however the variation in treatment are from 10.37-29.33 cm² and T₈ (50% RDF + 50% FYM) gives good result on leaf area. But the vermicompost increases the macro and micro pore in soil which effect on air water retention it increase the plant growth (Nagavallemma *et al.*, 2004).

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