IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 10, Iss 01, 2021

Effect of integrated nutrient management on plant growth and yield parameter of strawberry (*Fragaria x ananassa* Duch.) Var. Chandlar

Vinay Joseph Silas, Jitendra Kumar, Atul Yadav, K K Mishra, Syed Quatadah, & Ashish Srivastava, Jitendra Ojha
Faculty of Agricultural Sciences and Allied Industries, Rama University, Kanpur 209217

Corresponding Author Email: vinay.fas@ramauniversity.ac.in

Abstract
The experiment was carried out at Agriculture Research Farm of Rama University, Mandhana, Kanpur, U.P, India, during October 2021-2022 to investigate the effect of integrated nutrient management on plant growth, & yield parameter of strawberry (*Fragaria x ananassa* Duch.) var. Chandlar" eight treatments *viz.*, T1(Control), T2(100% RDF N: P: K @ 6:10:6 g/plant), T3(100% RDF + *Azotobacter* @ 2g/plant), T4(100% RDF + *Azospirillum* @ 2g/plant), T5(50% RDF + *Azotobacter* @ 2g/plant + topdressing of 50% each of P and K), T6(50% RDF + *Azospirillum* @ 2g/plant + topdressing of 50% each of P and K), T7(50% RDF + *Azotobacter* @ 2g/plant + PSB @2g/plant + topdressing of 50% K) and T8(50% RDF + *Azospirillum* @ 2g/plant + PSB @2g/plant + topdressing of 50% K) along with their combinations, replicated thrice in a Randomized Block Design. In strawberry use the application of fertilizer with bio-fertilizer like *Azotobacter* and *Azospirillum* hasten early flowering along with the expanded duration of blossoming, harvesting by increasing the growth, yield and quality of strawberry. The integrated nutrient management maximized plant height (cm), number of leaves per plant, plant area (cm^2), number of runners per plant, number of flowers per plant, number of berries per plant, fruit weight (g), fruit length (mm), fruit diameter (mm), fruit yield/plot (kg).

Keywords: *Azotobacter*, *Azospirillum*, *Fragaria x ananassa*

Introduction
Strawberry (*Fragaria* × *ananassa* Duch.) is a high value and low volume crop belonging to the family Rosaceae. The cultivated varieties are octaploid (2n=8x=56) in nature and has been derived from North American species, Fragaria chiloensis and Fragaria verginiana in France in the 17th century. Strawberry is one of the most important temperate fruits, it can also grow in sub-tropical and tropical regions (Sharma and Badiyala, 1980) [12]. Strawberry successfully grown up to 3000 meters, above mean sea level in humid and dry regions. Being a quick growing crop, it is also suitable for kitchen garden. In India Haryana is the leading state in India both in area and production (93.28), (4.26) followed by Maharastra production (3.28), Punjab, Uttar Pradesh is least growing state of India, Jammu and Kashmir, Uttarakhand and

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 10, Iss 01, 2021

lower hills of Himachal Pradesh with a total area of 0.21 thousand ha and production of 1.61 thousand MT (Anon. 2021)[1]. The fruits of strawberry are attractive with distinct aroma and pleasant flavour, proteins and minerals like P, K, Ca and Fe (Joolka, 1983) [5]. Nutritionally, strawberry is a low-calorie carbohydrate fruit but a rich in source of vitamin A (60 IU/100g of edible portion), vitamin C (30-120mg/100g of edible portion), fiber (1.1%) and also has high pectin content (0.55%) available in the form of calcium pectate. Water is a major constituent (90%) of strawberry fruit. Elegiac acid is a naturally occurring plant phenol. It has been found to inhibit the cancer disease and asthma by the regular consumption of its fruits. It is also rich source of Thiamine (0.03 mg/100g), Riboflavin (0.01 mg/100g) and Nicotinic acid (0.2 mg/100g). The beneficial microorganisms present in the biofertilizers not only able to improve the plant growth but also maintained the environmental health and productivity of the soil. Among the various factors which contribute towards the growth, yield and quality of strawberry, nutrition is the most important and it has direct effect on bearing and production (Umar *et al.,* 2009)[15]. The basic principle behind this concept is to supply both the chemical fertilizers with bio-fertilizers for a sustainable crop production in most efficient manner. Adoption of integrated nutrient management practices in strawberry is more essential to realize higher yield, quality and returns.

Materials and Methods

The present investigation on the effect of integrated nutrient management on plant growth, and yield parameter of strawberry (*Fragaria x ananassa* Duch.) var. chandlar was carried out during the October 2021-23 at Agriculture Research Farm of Rama University, Mandhana, Kanpur. For this an experiment was planned using eight treatments *viz.*, T_1 (Control), T_2 (100% RDF N: P: K@6:10:6g/plant),T_3(100% RDF + *Azotobacter* @ 2g/plant), T_4 (100% RDF + *Azospirillum* @ 2g/plant), T_5(50% RDF + *Azotobacter* @ 2g/plant + topdressing of 50% each of P and K), T_6 (50% RDF + *Azospirillum* @ 2g/plant + topdressing of 50% each of P and K), T_7 (50% RDF + *Azotobacter* @ 2g/plant + PSB @2g/plant + topdressing of 50% K) and T_8 (50% RDF + *Azospirillum* @ 2g/plant + PSB @2g/plant + topdressing of 50% K) along with their combinations, replicated thrice in a Randomized Block Design. Other cultural practices including irrigation, insect- pests and disease management were common in all treatments. The observations were recorded from each treatment of all three replication. Five plants of strawberry were selected randomly and tagged under each treatment for recording different vegetative attributes *viz.*, plant height(cm), number of leaves per plant, plant area (cm^2), days taken to first flower, number of runners per plant, number offlowers per plant, number of berries per plant, fruit weight(g), fruit length (mm), fruit diameter (mm), fruit yield/plot (kg).

Results and Discussion

The data on the effect of integrated nutrient management on plant growth, and yield parameter of strawberry (*Fragaria x ananassa* Duch.) var. winter dawn characters *viz.*, vegetative Growth and yield parameter of strawberry.

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 10, Iss 01, 2021

Vegetative growth parameter

The data on effect of integrated nutrient management on vegetative growth parameter *viz.*, plant height (cm), number of leaves per plant, leaf area (cm^2), days taken to first flower, number of runners per plant, number of flowers per plant are presented in Table-1.

The plant height and number of leaves was significant differences among the treatments at 30, 60 and 90 DAT. The maximum plant height (5.85, 9.60 and 15.80cm) and number of leaves (4.40, 12.70 and 18.20) at 30, 60 and 90 DAT per plant were obtained in T_6 (50% RDF + *Azospirillum* @ 2g/plant+ top dressing of 50% each of P and K) treated plants. The minimum plant height (3.80, 6.52 and 11.15cm) and number of leaves (2.40, 10.10 and 14.60) were recorded with T_1 (control). These findings are in agreement with the reports of Marathe and Bharambe (2005) [8] in sweet orange, Now sheen *et al.* (2006) [9] and Tripathi *et al.* (2010) [14] in strawberry.

The effect of integrated nutrient management on maximum leaf area (121.20 cm^2), number of flower (27.20), number of runners per plant (4.90) and minimum days taken to first flower (27.70) were recorded in T_6(50% RDF + *Azospirillum* @ 2g/plant + topdressing of 50% each of P and K). These traits were minimum under T_1 (control) leaf area (102.08cm^2), number of flowers(18.55), number of runners per plant (1.20) and maximum days taken to flowering (40.08). These findings are in complete agreement with Nowsheen *et al.*, (2006) [9] and Umar *et al.*, (2009) [15] in strawberry working with strawberry noted similar results.

The increase in vegetative growth and other parameters might be due to the production of more chlorophyll content with inoculation of nitrogen fixers. The other reason for increased vegetative growth may be the production of plant growth regulators by microorganism in rhizosphere, which are absorbed by the roots. Therefore, increased vegetative growth may be attributed to the increased biological nitrogen fixation. Better development of root system and the possibly synthesis of plant growth hormones like IAA, GA and Cytokinins and direct influence of bio-fertilizers might have caused increase in vegetative growth parameters.

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 10, Iss 01, 2021

Treatments	Plant Height (cm)			Number of leaves			Leaf area (cm^2)	Days taken to first flower	Number of runners/plants	Number of flower/plants
	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP				
T1	3.80	6.52	11.15	2.40	10.10	14.60	102.08	40.08	1.20	18.55
T2	4.07	8.40	12.60	3.60	11.70	15.10	105.12	36.60	2.78	24.25
T3	4.90	8.53	13.50	3.90	11.85	15.48	110.17	35.12	3.10	25.05
T4	5.35	9.30	14.88	4.08	12.20	16.56	112.40	35.39	3.18	25.80
T5	5.65	9.20	14.80	4.20	12.10	17.60	119.21	28.12	4.60	26.30
T6	5.85	9.60	15.80	4.40	12.70	18.20	121.20	27.20	4.90	27.70
T7	4.70	8.72	13.75	3.90	12.08	18.09	112.18	34.68	3.20	23.50
T8	5.21	9.42	14.98	4.10	12.30	17.90	113.06	35.92	3.70	34.95
S.Em(±)	0.054	0.125	0.135	0.080	0.163	0.263	1.421	0.524	0.051	0.409
C.D. (P=0.05)	0.166	0.382	0.413	0.246	0.499	0.805	4.353	1.605	0.155	1.253

Table1: Effect of INM (Integrated nutrient management) on vegetative growth parameter of strawberry (*Fragaria x ananassa* Duch.) var. Chandlar

Yield Parameter

The data on effect of integrated nutrient management on yield parameter *viz.*, number of berries per plant, fruit weight (g), fruit length (mm), fruit diameter (mm) and fruit yield per plot (kg) are presented in Table-2.

The effect of integrated nutrient management on maximum number of berries per plant (22.08) were recorded in T_6(50% RDF + *Azospirillum* @2g/plant + top dressingof 50% each of P and K). These traits were minimum under T_1 (control) number of berries per plant (12.70). These findings are in line with the Gajbhiye *et al.*, (2003)[4]and Shukla *etal.*, (2009)[13] in tomato. The maximum fruit weight (21.64g) and fruit yield per plot (2.94 kg) were recorded in T_6 (50% RDF + *Azospirillum* @ 2g/plant + topdressing of 50% each of P and K). These traits were minimum under T_1 (control) fruit weight (16.50g) and fruit yield per plot (1.92 kg). These findings are in line with the Wange *et al.*, (1998) [16] in strawberry, Kadlag *et al.*, (2007) [6] in tomato and Tripathi *et al.*, (2010) [14] in strawberry.

The increase in fruit size (length 6.92 mm and diameter 4.67mm) during the present investigation might be due to the increased photosynthetic ability of plants fertilized with T_6 (50% RDF + *Azospirillum* @ 2g/plant + topdressing of 50% each of P and K). These traits were minimum under T_1 (control) fruit length 3.58 mm diameter 2.20 mm. Fruit size highly

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 10, Iss 01, 2021

correlated with dry matter content and balance level of hormone and nitrogen fixers are known for accumulation of dry matter and their translocation (Kachot *et al.*, 2001) [7] as well as synthesis of different growth regulators

Table2: Effect of INM (Integrated nutrient management) on yield parameter of strawberry (*Fragaria x ananassa* Duch.) var. Chandlar.

Treatments	Number of berries per plant	Fruit weight (g)	Fruit yield/plot (kg)	Fruit length (mm)	Fruit diameter (mm)
T1	12.70	16.50	1.92	3.58	2.20
T2	18.52	18.85	2.10	4.20	2.85
T3	19.02	19.02	2.10	5.60	3.65
T4	19.79	19.42	2.85	5.40	3.32
T5	21.32	20.82	2.90	6.40	4.30
T6	22.08	21.64	2.94	6.92	4.65
T7	20.10	20.30	2.20	5.80	3.90
T8	19.92	21.05	2.28	6.02	3.92
S.Em(±)	0.218	0.268	0.052	0.110	0.055
C.D. (P=0.05)	0.667	0.819	0.159	0.337	0.169

Conclusion

Based on the results obtained from the present investigation, it is conducted that the highest vegetative growth, yield and quality parameters *viz.*, plant height at 30, 60 and 90 DAT (5.85, 9.60 and 15.80cm),number of leaves per plant at 30, 60 and 90 DAT (4.40, 12.70 and 18.20), leaf area (121.20 cm^2), number of runners per plant found (4.90), number of flower (27.70), number of berries per plants (22.80), fruit weight (21.64g), fruit length (6.92mm), Fruit diameter (4.65 mm), fruit yield/plot (2.94 kg).

Recommendation

From this study it can be recommend that the application of INM at 50% RDF + *Azospirillum* @ 2g/plant + topdressing of 50% each of P and K a can be applied to obtain maximum vegetative growth, yield of Strawberry.

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 10, Iss 01, 2021

References

1. Anon. The Role of Wild Food Plants of Himachal Pradesh in Boosting Immunity to Combat COVID-19. Journal of Scientific Research in Medical and Biological Sciences. 2021;2(2):23-62.
2. Attia MM, Shawky SM. Banana fiber reinforcedconcrete: A review. NY Sci. J. 2021;14:48-55.
3. Baksh H, Yadav R, Dwivedi R. Effect of INM onGrowth, Yield, Yield Attributing Characters and Quality of Guava (P. *guajava* L.) Cv. Sardar.Progressive Agriculture. 2008;8(2):141-144.
4. Gajbhiye RP, Sharmar RR, Tewari RN: Effect of biofertilizers on growth and yield parameters of tomato. Indian Journal of Horticulture. 2003;60(4):368- 371.
5. JoolkaNK, BadiyalaSD .Studies on the comparative performance of strawberry cultivars. Haryana journal of horticultural sciences; 1983.
6. Karlıdag H, Esitken A, Turan M, Sahin F. Effects of root inoculation of plant growth promoting rhizobacteria (PGPR) on yield,growth and nutrient element contents of leaves of apple. Scientia Horticulturae. 2007;114:16-20.
7. Kachot NA, Malavia DD, Solanki RM, Sagarka BK. Integrated nutrient management in rainy-season groundnut (*Arachis hypogaea*). Indian Journal of Agronomy. 2001;46(3):516-522.
8. Marathe RA, Bharambe PR. Micrological population in rizosphere as affected by organic, inorganic and biofertilizer and their influence on soil and leaf nutrient status of sweet orange. PKV Research J. 2007;29(1):20- 23.
9. NowsheenN, SinghSR, AroosaK, MasaratJ, Shabeena M. Yield and growth of strawberry cv. Senga sengana as influenced by integrated organic nutrient management system. Environment and Ecology. 2006;24(3):651-654.
10. RathiDS, BistLD. Inorganic fertilization through the use of organic supplements in low-chill pear cv.Pant Pear- 18.Indian Journal of Horticulture.2004;61(3):223-225.
11. Singh A, Singh JN. Effect of bio-fertilizers and bio- regulators on growth, yield and nutrient status of strawberry cv. sweet Charlie. I. J Hort. 2009;66(2):220- 224.
12. Sharma RL, Badiyala SD. A study on the performance of some strawberry (*Fragaria x ananassa*) cultivars in the mid hill region of North India.Prog.Hort.1980;12(2):17- 23.
13. Shukla YR, Thakur AK, Joshi A. Effect of inorganic and bio-fertilizers on yield and horticultural traits in tomato. Indian Journal of Horticulture. 2009;66(2):285- 287.
14. Tripathi VK, Kumar N, Shukla HS, Mishra AN. Influence of Azotobacter, Azospirillum and PSB on growth, yield and quality of strawberry cv. chandler. Abst: National Symposium on Conservation Hort., Dehradun; 2010. p. 198-199.
15. Umar I, Vinod KW, Ravi K, Mahital J. Effect of FYM, Urea and Azotobacter on growth, yield and quality of strawberry cv. chandler. Not. Bot. Hort. Agrobot. Cluj. 2009;37(1):139-

ISSN PRINT 2319 1775 Online 2320 7876
 UGC CARE Listed (Group -I) Journal Volume 10, Iss 01, 2021

143.

16. Wang SY, Galletta GJ. Foliar application of potassium silicate induces metabolic changes in strawberry plants. Journal of Plant Nutrition. 1998;21(1):157-167.
17. Yadav SK, Khokhar UU, Yadav RP. Integrated nutrient management for strawberry cultivation. I. J of Horticulture. 2010;67(4):445-449