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Influence of Integrated Nutrient Management on Vegetative Growth and Reproductive Parameters of Strawberry (*Fragaria* × *ananassa* Duch.) C. V. "Sabrina" under Polyhouse

Esmatullah Ahmadi*, Honnabyraiah, M. K., Ashok S. Alur., J. Dinakara Adiga and Venkat Rao

Department of Fruit Science, College of Horticulture, UHS Campus, GKVK Post, Bengaluru,Karnataka, India

*Corresponding Author E-mail: ahmadiesmat40@gmail.com

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ABSTRACT

An experiment was conducted to study the impact of integrated nutrient management on vegetative growth and reproductive parameters of strawberry (Fragaria × ananassa Duch.) Cv."Sabrina" under polyhouse condition at College of Horticulture, UHS Campus, GKVK Post, Bengaluru during 2016-2017. The design followed was Randomized Block Design with nine treatments replicated three times. The significantly maximum plant height (24.50 cm), number of leaves/plant (23.13), leaf length (9.63 cm), leaf breadth (8.57 cm), plant spread (30.53 cm and 25.83 cm in north-south and east-west directions, respectively), number of runners/plant (5.13), leaf area (105.41 cm^2), earliest in flowering (76.53 days), maximum number of flowers/plant (25.07), number of days taken for fruit maturity (30.40 days) and per cent of fruit setting (76.23%) were recorded in the plants supplied with 100% RDF + VAM @10 kg/ha + 0.4% Boron + 0.5% $ZnSO_4$ spray. Whereas, the lowest result was recorded in the plants treated with 100% NPK through FYM only.

Key words: *Strawberry, Vegetative, Reproductive Growth, Sabrina*

INTRODUCTION

Strawberry (*Fragaria* x *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[10]. It belongs to family Rosaceae and the most of cultivated varieties are octaploid (2n= 56). The fruits are rich in bioactive phyto-chemicals especially phenolic compounds with high antioxidant capacity and also contain vitamins and minerals and, as a part of daily diet could be beneficial to human health. Strawberry can be successfully grown in plains as well as in hills up to an elevation of 3000 meters above mean sea level in humid or dry regions. In India, it is cultivated on commercial scale in Maharashtra, Punjab, Haryana, Delhi, hills of Himachal Pradesh, Jammu & Kashmir, Uttrakhand, Uttar Pradesh, Rajasthan and West Bengal[8].

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Initially grown in temperate zone of the country but its cultivation has now become possible in the sub-tropical zones as well with the introduction of day neutral cultivar *viz*., Chandler[1].

Among the various factors which contribute towards the growth and yield of strawberry, nutrition is the important aspect of crop production[13]. 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[5]. Thus, an attempt has been made to assess the impact of integrated nutrient management on performance of strawberry under poly house.

MATERIAL AND METHODS

Field experiment on strawberry was conducted under polyhouse condition at College of Horticulture, Bengaluru, Karnataka, India during 2016-2017. The soil of the experimental site was medium sandy loam soil. The forest soil having good physical and chemical properties with the pH of 5.79 was mixed with native soil in polyhouse in order to increase the fertility. The uniform tissue culture planting materials were procured from Kf bioplants, Pune, Maharastra.

This experiment was undertaken to find out the best nutrient sources to obtain good growth, yield and yield attributes in strawberry. The design followed was RBD (Randomized Block Design) with nine treatments and three replications having plot size 1.0× 2.0 m^2 accommodating twelve plants in each plot at a spacing of 30 cm x 60 cm. The nine treatments consisted of T_1 - Control (100% RDF), T_2 - 100% RDF + VAM @10 kg/ha + 0.4% Boron spray, T_3 - 100% RDF + VAM @10 kg/ha + 0.5% $ZnSO_4$ spray, T_4 - 100% RDF + VAM @10 kg/ha + 0.4% Boron spray + 0.5% $ZnSO_4$ spray, T_5 - 75% RDF + VAM @ 15 kg/ha + 0.4% Boron spray, T_6 - 75% RDF + VAM @15 kg/ha + 0.5% $ZnSO_4$ spray, T_7 - 75% RDF + VAM @15 kg/ha + 0.4% Boron spray + 0.5% $ZnSO_4$ spray, T_8 - 100% NPK through FYM and T_9- 75% RDF + 25 % NPK through vermicompost. The nitrogen, phosphorus and potassium were supplied through urea, single super phosphate and sulphate of potash, respectively. Full dose of phosphorus and potassium were applied as basal dose while nitrogen was applied in three splits *viz*., 50 per cent as basal, 25 per cent at 45 days after planting and 25 per cent at 70 days after planting. Therefore, bio-fertilizer was applied through basal dose one week before planting as well as micronutrients were applied through foliar spray at 45 and 70 and 90 days after planting.

RESULTS AND DISCUSSION

Growth parameters

Growth attributes were differed significantly by different treatments (Table 1). The perusal of result indicated that strawberry plants fertilized with the application of - 100% RDF + VAM @10 kg/ha + 0.4% Boron spray + 0.5% $ZnSO_4$ spray (T_4) recorded significantly maximum plant height (24.50 cm), number of leaves/plant (23.13), leaf length (9.63 cm), leaf breadth (8.57 cm), plant spread (30.53 cm and 25.83 cm in north-south and east-west directions, respectively), number of runners/plant (5.13) and leaf area (105.41 cm^2) followed by the treatment comprising 100% RDF + VAM @10 kg/ha + 0.4% Boron spray. The increase in tallness may be due to the availability of nutrients that might have coincided with plant need. The increase in number of leaves might be due to the release of instantaneous micro nutrients from well decomposed FYM, Boron and Zinc, and optimum supply of nitrogen and phosphorus that would have promoted protein synthesis from reserved carbohydrate source leading to enhanced production of leaves. These findings are in close agreement with the result of Rubee *et al.*[9], Khalid *et al.*[3] and Yadav *et al.*[17] in strawberry. The shortest plant height (14.63

cm) and least number of leaves (13) at 120 days after planting was recorded in the strawberry plants provided with 100% NPK through FYM.

The increase in length and breadth of leaves may be due addition of biofertilizer might have helped by transporting slowly mobile nutrient especially P, Mn, Zn, Fe and Cu from bulk of soil beyond the depletion zone surrounding active roots. Biofertilizers produces the plant growth regulators in rhizosphere which are absorbed by the roots[11]. Better development of root system and the possible synthesis of plant growth hormones like IAA, GA and cytokinins and direct influence of biofertilizer might have caused increased length and breadth of leaves. These results are in conformity with that of Yadav *et al*.[17] and Rubee *et al.*[9] in strawberry. The minimum length and breadth of leaves and plant spread in both North – South and East – West directions was noticed with application of 100% NPK through FYM. This might be due to slow rate of mineralization of FYM. The increase in number of runners per plant maybe due to the increased growth of plant in the form of height, number of leaves and leaf area, which has accumulated more photosynthates and thereby increased number of runners per plant. These findings are in close conformity with results of Umar *et al.*[13], Rubee *et al.*[9] and Mohamed *et al*.[7] in strawberry. The minimum runners per plant (2.33) were produced with 100% NPK through FYM (T_8).

The increase in leaf area might be due to addition of biofertilizer like VAM resulted in higher uptake of phosphorus, zinc and copper, the most important elements whose uptake is enhanced by AM fungi in plants. This in turn ensures photosynthetic efficiency causing greater synthesis, translocation and accumulation of carbohydrates. Biofertilizers release certain growth hormones like IAA, GA_3 and cytokinin in the rhizosphere which could have caused greater cell division and cell expansion resulted in increased of leaf area[11]. These results are in conformity with the findings of Khalid *et al*.[3], Rubee *et al.*[9] and Verma and Rao[15] in strawberry. The minimum leaf area (43.04 and 61.86 cm^2) at 60 and 90 days after planting, respectively was recorded with 100% NPK through FYM (T_8) and at 120 days after planting (84.60 cm^2) was observed in 75% RDF + 25 % NPK through vermicompost T_9. This might be due to slow rate of mineralization of vermicompost.

Reproductive parameters

Various treatments significantly altered most of reproductive parameters (Table 2). Significant results were obtained with respect to number of days taken for first flowering due to integrated nutrient management. The minimum number of days taken for first flowering (76.53) was recorded in the plants supplied with 100% RDF + VAM @10 kg/ha + 0.4% Boron spray + 0.5% $ZnSO_4$ spray (T_4). The maximum number of days taken for first flowering (88.93) was observed in 100% NPK through FYM (T_8). Earlier flowering in T_4 may also be due to the application of Boron which plays a vital role in the hormone movement, activated salt absorption and fruiting process, pollen germination, physiological process such as cell maturation, cell elongation, cell division, cell proliferation, sugar transport, hormone metabolism and cytokinin synthesis[16]. These findings are in close conformity with results of Ayesha *et al.*[2], Verma and Rao[15] Mohamed *et al*.[7] in strawberry.

The number of flowers per plant differed significantly among the treatments. The maximum number of flowers per plant (25.07) was recorded in plants supplied with 100% RDF + VAM @10 kg/ha + 0.4% Boron spray + 0.5% $ZnSO_4$ spray (T_4) which was on par with the application of 100% RDF + VAM @10 kg/ha + 0.4% Boron spray(23.40) (T_2). The increased in number of flowers in treatment T_4 might be due to supply of optimum level of nutrients as N, P and K nutrients and hormones provided by biofertilizers played a significant role in increasing gibberlic acid in roots thus, breaking bud dormancy and increasing flowering buds and fruiting sites[14]. These results are in conformity with the findings of Mehraj *et al.*[6], Kazemi[4] , Singh *et al.*[12] in

strawberry. The minimum number of flowers per plant was recorded with application of 100% NPK through FYM (18.27) T_8. The present study indicates the positive response of combined application of inorganic fertilizers, organic manures and biofertilizers for increasing the growth, and flowering parameters of strawberry. The results showed that, the highest values for vegetative growth and flowering parameters were obtained with microbial inoculated treatment, application of 100% recommended dose of fertilizers and foliar application of Boron and Zinc.

Table 1: Influence of integrated nutrient management (INM) on plant height (cm), plant spread (cm) in (N-S) and (E-W) direction and number of leaves per plant of strawberry cv. Sabrina

Treatments	Plant height (cm)	plant spread (cm) (N-S) direction	plant spread (cm) (E-W) direction	Number of leaves/plant
T_1 -	18.90	25.60	22.63	17.27
T_2 -	20.30	27.97	24.47	19.60
T_3 -	19.53	26.73	23.93	15.67
T_4 -	24.50	30.53	25.83	23.13
T_5 -	17.87	24.23	21.53	15.60
T_6 -	16.90	23.57	20.83	15.00
T_7 -	18.20	25.10	21.57	15.87
T_8 -	14.63	20.73	20.40	13.00
T_9-	16.50	22.53	20.77	14.00
S.Em±	0.54	0.73	0.74	0.45
CD @ 5%	1.63	2.19	2.13	1.36

Table 2: Influence of INM on leaf parameters and number of runners of strawberry cv. Sabrina

Treatments	Leaf length (cm)	Leaf breadth (cm)	Leaf area (cm^2)	No. of runners per plant
T_1 -	8.07	7.10	93.80	3.47
T_2 -	9.17	8.00	99.08	4.60
T_3 -	8.53	7.43	98.00	4.07
T_4 -	9.63	8.57	105.41	5.13
T_5 -	7.50	6.77	89.62	2.87
T_6 -	7.50	6.72	88.59	2.73
T_7 -	7.83	7.00	90.90	3.27
T_8 -	7.17	6.33	84.73	2.33
T_9-	7.43	6.39	84.60	2.53
S.Em±	0.21	0.24	2.45	0.11
CD @ 5%	0.63	0.71	7.34	0.34

Table 3: Influence of (INM) on reproductive parameters of strawberry cv. Sabrina

Treatments	Days to first flowering	No of flowers per plant	Days to fruit maturity	Per cent fruit set
T_1 -	80.87	22.07	27.67	71.02
T_2 -	78.47	23.40	29.47	73.24
T_3 -	79.60	22.80	28.47	71.72
T_4 -	76.53	25.07	30.40	76.23
T_5 -	82.67	20.93	26.87	68.47
T_6 -	82.80	20.60	26.47	67.61
T_7 -	81.60	21.33	27.20	70.23
T_8 -	88.93	18.27	25.27	70.69
T_9-	84.40	19.93	25.80	68.33
S.Em±	2.16	0.66	0.97	NS
CD @ 5%	6.48	1.98	2.90	NS

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