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Effect of Integrated Nutrient Management on Soil Nutrient Status, and Leaf Nutrient Status of Strawberry (*Fragaria* × *ananassa* Duch.) C. V. "Sabrina" under Polyhouse

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ABSTRACT

A field experiment was conducted to study the influence of integrated nutrient management on soil nutrient status and nutrient uptake by plant of strawberry (Fragaria × ananassa Duch.) C. V."Sabrina" under polyhouse condition at College of Horticulture, UHS Campus, GKVK Post, Bengaluru during 2016-2017. The experiment was laid out in Randomized Block Design with nine treatments replicated three times. The results revealed that significantly maximum leaf nutrient contents such as N (2.74%), P (0.51%), K (2.99%), Zinc (59.00 ppm) and Boron (76.67 ppm) were also maximum in the plants treated with 100% RDF + VAM @10 kg/ha + 0.4% Boron spray + 0.5% $ZnSO_4$ spray than the control. The highest residual available nitrogen (375.66 kg/ha^{-1}), potassium (164.52 kg/ha^{-1}) and phosphorus (24.36kg/ha^{-1}) in the soil were recorded in 100% NPK through FYM which was on par with 75% RDF + 25 % NPK through vermicompost. Whereas, Control recorded the lowest residual available NPK in the soil.

Key words: *Strawberry, Nutrient, Soil, Leaf, Nutrient Status, Sabrina*

INTRODUCTION

Strawberry (*Fragaria* × *ananassa* Duch.) is one of the most delicious fruit of the world which attained a prime position in the world fruit market as fresh fruit as well as in the processing industries. All the cultivated varieties of strawberry are octaploid (2n=56) in nature and belongs to the family Rosaceae. It is a short day plant, originated in France and the two American diploids *Fragaria* × *chiloensis* and *Fragaria* × *virginiana* are considered as its progenitors. Initially strawberry was growing in temperate zone of the country. However, it can also be cultivated under subtropical climate, even at higher altitudes of tropical climate and it is propagated through one year old runners. Therefore, it is imperative that chemical fertilizers in combination with organic manures are utilized properly and not only for the source of nutrient but also for increasing nutrient use efficiency without adversely distributing the soil health.

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The basic concept underlying the principle of integrated nutrient management (INM) is the maintenance and possibly improvement of soil fertility for sustaining crop productivity. This may be achieved through combined use of all possible sources of nutrients. Integrated nutrient management is not a new concept but an age-old practice. It has now assumed great significance, mainly because of two reasons first; to supply the nutrient for continued increase in agricultural production, present level of fertilizers production in India is not enough to meet the total plant nutrient requirement. Second results of large number of experiments on manures and fertilizers conducted in India and other countries revealed that neither the chemical fertilizers achieve production sustainability under highly intensive cropping. The interactive advantages of combining organic and inorganic sources of nutrients in INM have proved superior to use of its each component separately. Organic manures contain plant nutrients; they have direct effect on plant growth. The complementary use of fertilizer and organic manure referred to integrated nutrient management (INM) is an ideal approach to supply nutrient need of plants and solve the problem of nutrient mining and it plays an important role in sustaining soil health. Accordingly the present study was undertaken with a view to study the influence of INM on soil nutrient status and leaf nutrient status of strawberry cv. Sabrina 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

Uptake of nutrients by plant

Total Nitrogen (%)

The plant nitrogen content was significantly influenced by the various treatment combinations. The per cent nitrogen content of strawberry leaves (2.74%) was maximum in the plants received 100% RDF + VAM @10 kg/ha + 0.4% Boron spray + 0.5% $ZnSO_4$ spray (T_4) which was closely followed by application of 100% RDF + VAM @10 kg/ha + 0.4% Boron spray (2.71%) (T_2) and 100% RDF + VAM @10 kg/ha + 0.5% $ZnSO_4$ spray (2.70%) (T_3). Whereas, minimum nitrogen content was found in 100% NPK through FYM (T_8). Similar results were also obtained by Singh[8] in strawberry, Athani *et al*.[2] in Guava, Rashmi *et al*.[7] in mulberry. The increased plant nitrogen content of strawberry

leaves might be due to the application of nitrogenous fertilizers and VAM which increase root growth and development and production of enzyme complex, which thereby increase more nitrogen uptake from larger area[5].

Total Phosphorus (%)

Higher phosphorus content of strawberry leaves (0.51%) was observed in 100% RDF + VAM @10 kg/ha + 0.4% Boron spray + 0.5% $ZnSO_4$ spray (T_4) which was closely followed by application of 100% RDF + VAM @10 kg/ha + 0.4% Boron spray (0.50 %) (T_2) and 100% RDF + VAM @10 kg/ha + 0.5% $ZnSO_4$ spray (0.50 %) (T_3). This increase may be attributed to organic acids production by plants and bacteria in the rhizosphere, which in turn stimulated the availability of P, Fe and Zn. These findings are in close conformity with the results of Singh *et al*.[9] in strawberry, Emine *et al*.[3] in raspberry, Rashmi *et al*.[7] in mulberry. Phosphorus is an essential nutrient for plant growth and development and is one of the most important elements in crop production

Total Potassium (%)

Higher potassium content in strawberry leaves (2.99 %) was discovered with application of 100% RDF + VAM @10 kg/ha + 0.4% Boron spray + 0.5% $ZnSO_4$ spray (T_4) which was closely followed by application of 100% RDF + VAM @10 kg/ha + 0.4% Boron spray (2.90 %) (T_2) and 100% RDF + VAM @10 kg/ha + 0.5% $ZnSO_4$ spray (2.88 %) (T_3). This findings are in close conformity with the results of Ahmet *et al*.(2010) in strawberry, Emine *et al*. (2006) in raspberry, Athani *et al*.[2] in Guava, Rashmi *et al*.[7] in mulberry. Accumulation of any nutrient in leaf depends considerably on the uptake of that particular nutrient from the soil. Weinbaum *et al*.[11] reported that nitrate uptake in pruned trees depend on the presence of leaf and discussed this phenomenon in the context of leaf carbohydrate supply. The present findings are in consonance with the report of Mahmoud and Mahmoud[6]. Nutrients uptake, in general, follows somewhat similar pattern and is usually affected by the quantity applied, quantity liquefied, the root exudates and bacterial activity which facilitates movement of nutrients.

Total Boron (%)

In the present investigation the plants in the plants treated with 100% RDF + VAM @10 kg/ha + 0.4% Boron spray + 0.5% $ZnSO_4$ spray (T_4) increased the Boron status of strawberry leaves and exhibited maximum Boron content (76.67ppm) which was followed by application of 100% RDF + VAM @10 kg/ha + 0.4% Boron spray (74.00 ppm) (T_2). Similar results were reported by Khorsandi and Hasani in pomegranate. The increased plant boron content of strawberry leaves may be due to its readily available nutrients and maximum absorption from nutrient source and less translocation to the other parts of the plant.

Total Zinc (%)

Zinc content in strawberry leaves was increased with application of 100% RDF + VAM @10 kg/ha + 0.4% Boron spray + 0.5% $ZnSO_4$ spray (T_4) and exhibited maximum Zinc content (59.00ppm) which was followed by application of 100% RDF + VAM @10 kg/ha + 0.5% $ZnSO_4$ spray (56.00ppm) (T_3). Similar results were reported by Khorsandi and Hasani in pomegranate. The increased plant zinc content of strawberry leaves may be due to its readily available nutrients and maximum absorption from nutrient source and less translocation to the other parts of the plant.

Residual nutrient status in soil

The application of different sources of integrated nutrient management did not show any significant effects on residual status of available NPK in the soil (Table 2). However, highest residual available nitrogen (375.66 kg/ha^{-1}), potassium (164.52 kg/ha^{-1}) and phosphorus (24.36kg/ha^{-1}) in the soil were recorded in T_8 - 100% NPK through FYM which was on par with T_9- 75% RDF + 25 % NPK through vermicompost. Whereas, T_1 (Control) recorded the lowest residual available NPK in soil. The organic carbon status of soil at initial level was 0.28 per cent. The study showed no marked effect on organic carbon content as the results were found non-significant. But, it is clear from the present study that the organic carbon level of the soil can be increased gradually to a reasonable extent by addition of organic manure[4,10].

Table 1: Effect of integrated nutrient management (INM) on total leaf nutrients content of strawberry cv. Sabrina

Treatments	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Boron (ppm)	Zinc (ppm)
T_1 -	2.64	0.48	2.85	58.00	44.67
T_2 -	2.71	0.50	2.90	74.00	45.00
T_3 -	2.70	0.50	2.88	62.67	56.00
T_4 -	2.74	0.51	2.99	76.67	59.00
T_5 -	2.55	0.40	2.35	68.00	43.33
T_6 -	2.58	0.41	2.38	56.00	50.33
T_7 -	2.67	0.42	2.38	71.33	52.00
T_8 -	2.52	0.39	2.52	54.33	42.00
T_9-	2.54	0.44	2.58	59.67	41.00
S.Em±	0.07	0.03	0.09	1.58	1.79
CD @ 5%	0.20	0.08	0.26	4.73	5.38

Table 2: Effect of integrated nutrient management (INM) on soil residual nutrient levels of strawberry cv. Sabrina

Treatments	Available nitrogen (kg ha^{-1})	Available phosphorus (kg ha^{-1})	Available potassium (kg ha^{-1})
T_1 -	309.33	21.00	118.07
T_2 -	318.20	22.50	138.00
T_3 -	321.78	22.27	144.10
T_4 -	315.66	23.36	131.52
T_5 -	309.52	22.97	128.00
T_6 -	319.60	23.25	128.15
T_7 -	330.60	23.10	156.00
T_8 -	375.66	24.36	164.52
T_9-	355.76	24.00	161.00
S.Em±	**5.83**	**1.26**	**3.18**
CD @ 5%	**NS**	**NS**	**NS**

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