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EFFECT OF VERMICOMPOST AND BIOFERTILIZERS ON STRAWBERRY: CHLOROPHYLL AND NUTRIENTS CONCENTRATION IN LEAVES

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ABSTRACT

Field experiment was conducted during 2012-13 and 2013-14 at the Horticulture Research Farm, Department of Horticulture, Banaras Hindu University, Varanasi (U.P.) to study the effect of vermicompost and biofertilizers chlorophyll and nutrients concentration in strawberry. The experiment was laid out in randomized block design with twelve treatments and three replications. Chlorophyll (53.36 SPAD reading), nitrogen (3.09%) and phosphorus (1.36%) contents were recorded maximum in vermicompost + Azotobacter + PSB + AM treatment, whereas potassium (3.38%) and boron (44.74 mg kg^{-1}) contents were maximum in vermicompost + PSB + AM treated plants. Calcium (2.50%) and magnesium (0.21%) contute were highest in vermicompost + PSB and Vermicompost + Azotobacter, respectively. The contents of iron (24.65 mg kg^{-1}) and zinc (34.49 mg kg^{-1}) were recorded highest in vermicompost + Azotobacter + AM. The lowest values of these nutrients were recorded in control.

KEYWORDS: Vermicompost, biofertilizers, chlorophyll, leaf nutrient, strawberry

INTRODUCTION

Strawberry is an attractive, luscious, tasty and nutritious fruit with a distinct and pleasant aroma and delicate flavour. It has a unique place among cultivated berry fruits. Rich in vitamin C and iron, it is mainly consumed as fresh. Jam and syrup are also prepared from strawberry. It is cultivated in tropical and sub-tropical areas round the year. It is cultivated commercially in the Himanchal Pradesh, Uttar Pradesh, Maharashtra, West Bengal, Nilgiri hills, Delhi, Haryana, Punjab and Rajasthan. Owing to wide climatic and soil adaptation and high returns, it has tremendous potential in India. Its cultivation can be extended to the suitable areas having assured irrigation and transport facilities. All the cultivated varieties of strawberry are octaploid (2n = 8x = 56) in nature. The yield of strawberry is very low due to inadequate and imbalanced nutrition of the crop. Results on status of nutrients in soil have been documented (Sharma and Bhandari, 1995). However, current and comprehensive information on nutrient status of strawberry on leaf analysis is lacking.Vermicompost is a product of biodegradation and stabilization of organic materials by interaction between earthworms and micro-organisms. Vermicompost exhibits similar effects on growth and yield of plants as shown by soil applied inorganic fertilizers or plant growth regulators or hormones in strawberry crop.Biofertilizers are one of the best modern tools for agriculture and are used to improve the fertility and quality of the soil. It offers an economically attractive and ecologically sound route foraugmenting nutrient supply. The integrated nutrient supply including the use of chemical fertilizers with organic manures like vermicompost and biofertilizers help not only in bridging the existing wide gap between the nutrient removal and supply but also insuring balanced nutrient proportion, by enhancing nutrient response efficiency and maximizing crop productivity of desired quality in strawberry. The objectives of the present study were to investigate the combined effect of vermicompost and biofertilizers on nutrient contents in strawberry leaves.

MATERIALS AND METHODS

The experiment was conducted at the Horticulture Research Farm near central office, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (U.P.), India during two subsequent years i.e. 2012-13 and 2013-14. Treatment consisted of T_0: control, T_1: Vermicompost (10 t ha^{-1}), T_2: *Azotobacter* (7 kg ha^{-1}), T_3: PSB (6 kg ha^{-1}), T_4: Arbuscular Mycorrhiza (5 kg ha^{-1}), T_5: Vermicompost + *Azotobacter*, T_6: Vermicompost + PSB, T_7: Vermicompost + AM, T_8: Vermicompost + *Azotobacter* + PSB, T_9: Vermicompost + *Azotobacter* + AM, T_{10}: Vermicompost + PSB + AM, T_{11}: Vermicompost + *Azotobacter* + PSB + AM were tested in randomized block design with three replications.In strawberry plant youngest fully expanded matured leaves without petiole (Bhargava and Raghupati, 1993) were selected for leaf nutrient analysis. The leaf samples were digested with di-acid (HNO_3: $HClO_4$) mixture. In this digest, potassium was determined by flame photo meter, phosphorus by vandophosphormolybdo yellow

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colour method, calcium and magnesium by EDTA titration and iron and zinc with the help of atomic absorption spectrophotometer. Nitrogen was determined by Kjeldahl method (Jackson 1973). Boron in di-acid digest was determined by carmine metod (Hatcher and Wilcox 1950). Total chlorophyll content was measured by chlorophyll meter and value was read as SPAD reading.

RESULTS AND DISCUSSION

The plant nutrient contents were influenced significantly by the various treatment combinations of vermicompost and biofertilizers. Pooled data (Table 1) revealed that the nitrogen content in leaf samples varied from 2.21% to 3.31%. The maximum nitrogen (3.31%) was reported in vermicompost + *Azotobacter* treated plants. Magnesium (0.21%) content was reported maximum in vermicompost + *Azotobacter* fertilized plants, whereas minimum in control (0.175%). Calcium content was maximum (2.50%) in vermicompost + PSB which was statistically at par to vermicompost + PSB + AM (2.40%) and minimum in control (1.95%). Similar results were also reported by Ranjit and Bandyopadhyay (2014) in tomato, Singh and Singh (2009) in strawberry and Rashmi *et al.* (2010) in mulberry. Increased plant nutrient content might be due to the biological nitrogen fixation and production of enzyme complex, which solubilize the unavailable form of nutrient element and render them available (Marwaha, 1995).

Table1. Effect of vermicompost and biofertilizers on macro nutrient contents (%) in strawberry leaf (mean of two years)

Treatment	Nitrogen	Phosphorus	Potassium	Calcium	Magnesium
Control	2.21	0.91	2.38	1.95	0.175
VC	2.60	1.03	2.48	2.13	0.18
Azotobacter	2.54	1.1	2.18	2.05	0.20
PSB	2.64	1.15	2.43	2.25	0.198
Arbuscular Mycorrhiza AM	2.70	1.24	2.52	2.22	0.202
VC + *Azotobacter*	3.31	1.2	2.50	2.31	0.21
VC + PSB	2.93	1.25	3.08	2.5	0.208
VC + AM	2.77	1.19	2.78	2.25	0.197
VC + *Azotobacter* + PSB	2.86	1.23	3.00	2.3	0.205
VC +*Azotobacter*+ AM	3.07	1.28	3.15	2.32	0.192
VC + PSB + AM	2.99	1.3	3.38	2.4	0.205
V+*Azotobacter*+PSB+AM	3.09	1.36	3.23	2.35	0.202
SEm±	0.11	0.08	0.12	0.17	0.012
CD (P 0.05)	0.32	NS	0.36	NS	NS

In addition, vermicompost contains all the nutrients and the application of vermicompost increased the amounts of available nutrients in soil. Phosphorus content in strawberry leaves ranged from 0.91 to 1.36% and higher phosphorus content (1.36%) was reported in vermicompost + *Azotobacter* + PSB + AM treated plants followed by vermicompost + *Azotobacter* + PSB + AM (1.30%) treatment, whereas minimum phosphorus content was found in control (0.91%). This increase may also be explained by organic acids production by plants and bacteria in the rhizosphere, which in turn stimulates the availability of P, Fe and Zn. The findings obtained in this study were supported by Sundra *et al.* (2002) and Shen *et al.* (2004). Increase in phosphorus content with the increase in application of nitrogen has been reported by Yadav (2006) and Yadav (2010) in peach. Further, *Azotobacter*and PSB also increased leaf phosphorus content which indicated that the biofertilizers might have created certain microbial environment in the roof rhizosphere zone for better absorption of phosphorus.

Higher contents of potassium (3.38%) and boron (44.76 mg kg^{-1}) in strawberry leaf were reported in vermicompost + PSB + AM treated plants which was statistically at par to vermicompost + *Azotobacter* + PSB + AM treatment. Pooled data (Table 2) clearly revealed that maximum iron (24.65 mg kg^{-1}) and zinc (34.49 mg kg^{-1}) content was reported in vermicompost + *Azotobacter* + AM applied plantswhich was statistically at par to vermicompost + AM and minimum in control. This finding was also supported by Baba *et al.*(2010), Ahmet *et al.* (2010) in strawberry, Shashi *et al.* (2011) in aonla. Accumulation of any nutrient in the leaves depends considerably on the uptake of that nutrient from the soil. The present findings are in consonance with the report of Mahmoud and Mahmoud (1998). Nutrients contents, in general, follow a somewhat similar pattern and is usually affected by the quantity applied, quantity liquefied, the root exudates and bacterial activity which facilitates movement of such nutrients.

Table2: Effect of vermicompost and biofertilizers on chlorophyll concentration and micro nutrient (mg kg^{-1}) in strawberry leaf (mean of two years)

Treatment	Chlorophyll (SPAD reading)	Iron	Zinc	Boron
Control	43.22	15.47	20.2	33.91
VC	34.93	16.1	21.66	37.69
Azotobacter	44.22	18.94	22.8	38.82
PSB	45.45	19.24	24.85	40.6
Arbuscular Mycorrhiza AM	43.48	19.8	25.59	41.65
VC + *Azotobacter*	47.32	22.72	24.07	41.82
VC + PSB	49.5	20.85	25.07	43.21
VC + AM	48.71	23.74	32.72	42.04
VC + *Azotobacter* + PSB	50.61	21.64	30.18	41.41
VC + *Azotobacter* + AM	51.72	24.65	34.49	43.35
VC + PSB + AM	50.01	21.89	31.11	44.74
V+*Azotobacter* + PSB + AM	53.36	22.6	31.68	43.66
SEm±	1.83	1.04	1.04	0.7
CD (P 0.05)	5.39	3.07	3.07	2.05

Chlorophyll concentration (53.36 SPAD reading) was recorded maximum in vermicompost + *Azotobacter* + PSB + AM which was statistically at par to vermicompost + *Azotobacter* + AM (51.72 SPAD reading) and minimum was found in control (43.22 SPAD reading). The similar result was also reported by Singh and Singh (2009) in strawberry. Increased chlorophyll (plant growth) may be attributed to the increased biological nitro-fixation, better organic nitrogen utilization, better development of root system and the possible synthesis of plant growth regulators like IAA, GA_3 and cytokinins (Martinez *et al.*, 2001). Awasthi *et al.* (1998) reported that increase in chlorophyll may be related to general role of biofertilizers in stimulating nutrient uptake especially nitrogen which has role in the assimilation of numerous amino acids that are subsequently incorporated in proteins and nucleic acid, which provides frame work for chloroplast, mitochondria and other structure in which the most of the biochemical reactions occurs.

On the basis of present investigation, it can be concluded that contents of chlorophyll, nitrogen and phosphorus were found maximum in vermicompost + *Azotobacter* + PSB + AM treated plants, whereas potassium and boron contents were maximum in vermicompost + PSB + AM treatment. Calcium and magnesium contents were highest in vermicompost + PSB, vermicompost + *Azotobacter* treated plants respectively and iron and zinc were recorded highest in vermicompost + *Azotobacter* + AM treated plants.

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