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Research Article

NITROGEN USE EFFICIENCY OF MEDICINAL *COLEUS* IN RELATION TO APPLICATION OF NUTRIENTS

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ABSTRACT
A two years field experiment was carried at Omalur, on sandy loam soil having 212 kg/ha available nitrogen, to study productivity, nutrient uptake and nitrogen use efficiency of medicinal coleus (*Coleus forskohlii*) as affected by sources of nutrients. The treatments on sources of nutrients included 40:60:50 kg NPK/ha + 10t FYM/ha, Urban compost, poultry manure, vermicompost, urban compost + poultry manure + vermicompost and control. Results indicated that application of 40:60:50 kg NPK/ha + 10t FYM/ha or application of poultry manures @ 3t/ha is liable in producing higher yield, nutrients uptake and nitrogen use efficiency.

Keywords: *Medicinal Coleus, N Use Efficiency, Yield*

INTRODUCTION
Medicinal coleus (*coleus forskohlii*) is an important medicinal crop credited with many medicinal properties. It contains diterpene forskolin and possesses activities such as positive enotropic, antihypertensive, branch opasmolytic, antithrombatic, platelet aggregation inhibition etc (Ammon and Muller, 1985). As it possesses multifaceted activities, its cultivation is gaining importance in the rapidly expanding world trade of plant based drugs. As the plant has gained commercial importance and to sustain the productivity, mere application of inorganic fertilizers alone is not sufficient and a major component of profitable production is by adequate and balanced nutrition. Nitrogen is the most essential nutrient, which needs to be supplied in proper time and quantities. Among the most nutrients, the application of N was found to increase the yield (Venugopalan *et al.*, 2012). As far as application of organic manures, equating the quantity of manures based on the quantity of N is essential to boost the yield and improve the nitrogen use efficiency. With this background in view, the present investigation was planned to determine the effect of sources of nutrients on nitrogen use efficiency of medicinal coleus.

MATERIALS AND METHODS
The field experiments were carried out in the farmer`s field located at Danishpet village, Omalur Taluk. The soil of the experimental field was sandy loam in texture with pH - 7.1, EC - 0.42 dS/m, available nitrogen - 212 kg/ha, available phosphorus - 11 kg/ha and available potassium - 290 kg/ha. The experiment was laid out in Randomised block design with four replications with six fertility treatments in *viz.*, Recommended dose of fertilizer (40:60:50 kg NPK/ha + 10 t FYM/ha), Urban compost (6 t/ha), Poultry manure (3 t/ha), Vermicompost (3 t/ha), Urban compost (2 t/ha) + Poultry manure (1 t/ha) + Vermicompost (1 t/ha) and control. Organic manures such as farm yard manure, vermicompost, poultry manure and urban waste compost were applied on equal N basis. The size of each plot was 6x4.5 m. Terminal cuttings of 10-12 cm long with 3-4 pairs of leaves from six months old crop were used for planting in ridges and furrows. FYM contained 0.50: 0.20: 0.50% NPK, urban compost contained 1.50: 0.50: 0.50% NPK, poultry manure contained 3.03: 2.60: 1.40% NPK and vermicompost contained 3.00: 1.00: 1.50% NPK on dry weight basis. The required quantities of organic manures were applied as per the treatments one week before planting. Nitrogen, phosphorus and potassium were applied as per the treatment through urea, single superphosphate and muriate of potash. Fifty per cent nitrogen and entire quantity of single superphosphate and muriate of potash were applied at the time of planting. Remaining 50 per cent nitrogen was top dressed at 30 days after planting in the plot with recommended doses of

fertilizer alone. All the recommended cultural practices were practiced as adopted in the crop production guide of Tamil Nadu Agricultural University. Plants were harvested by pulling out the plants. Growth attributes like plant height, laterals/plant and plant spread were recorded in five tagged plants of each plot. Yield attributes like number of tubers per plant, tuber length and tuber girth was recorded. Harvesting was done after six months of planting. Fresh tuber yield was recorded at the time of harvest and dry tuber yield was recorded after sun drying of tubers for three to four days to attain moisture content of 12%. The nutrient uptake of crops was obtained as product of nutrient concentration and yield. The soil samples from each plot were taken after harvesting medicinal coleus and analysed for available nitrogen, phosphorous and potassium.

Nitrogen use efficiencies were computed as followswiththe formulae given by Choudhary and Behera (2013). Agronomic N – use efficiency (kg yield increase/kg N applied): $[(Y_t-Y_0)/N_a]$ and Physiological N-use efficiency (kg yield increase/kg N uptake increase): $[Y_t-Y_0)/(U_t-U_0)]$, where Y_t: yield in test treatment (kg/ha), Y_0: yield in control plot; N_a: units of N applied in the test treatment (kg/ha); U_t: uptake of N in the test treatment (kg/ha) and U_0: uptake of N in the control plot (kg/ha). The data on various parameters recorded from experimental plot were statistically analysed as suggested by Panse and Sukhatme (1995) by using the randomised block design. Whenever results were found significant the critical difference (CD) values at 5% level of probability were worked out.

RESULTS AND DISCUSSION

Yield

Tuber yield (fresh and dry) of medicinal coleus vary significantly due to different panting pattern (Table 1). The data revealed that the treatment receiving 40:60:50 kg NPK/ha + 10 t FYM/ha recorded higher tuber yield followed by the application of poultry manure and application of vermicompost. However, the harvest index was not significant with system of planting but different nutrient management treatments had influence on harvest index. The increase in tuber yield might be due to increased availability of essential nutrients and accumulation of more sugars in the vegetative parts for translocation of the tubers. This corroborates with the findings of Yamger *et al.*, (2001) in turmeric.

Table 1: Effect of nutrients yield, nutrient uptake and nitrogen use efficiency of *Coleus forskohlii* (Mean data)

Treatment	Fresh tuber yield (t/ha)	Dry tuber yield (t/ha)	Harvest Index	Nutrient uptake (kg/ha) N	P	K	Agronomic N – Use efficiency (kg yield increase/kg N applied)	Physiological N-use efficiency (kg yield increase/kg N uptake)
40:60:50 kg NPK/ha + 10 t FYM/ha	17.3	1.71	0.256	113.2	19.3	116.7	8.11	15.11
Urban compost	12.0	1.01	0.233	62.3	8.8	64.7	3.33	16.21
Poultry manure	15.8	1.51	0.238	101.8	16.2	103.7	5.89	14.83
Vermicompost	14.5	1.25	0.235	84.4	12.8	85.9	3.02	14.81
Urban compost + Poultry manure + Vermicompost	12.9	1.07	0.234	67.9	10.2	71.3	1.06	14.87
Control	8.6	0.98	0.201	52.6	6.5	52.8	-	-
CD (P=0.05)	0.30	0.05	0.006	6.3	1.4	7.4	0.92	1.81

Nutrient Uptake and Balance

The nutrients (N, P and K) uptake by *Coleus forskohlii* was highest with the application of 40:60:50 kg NPK/ha + 10 t FYM/ha followed by the application of poultry manure and application of vermicompost. With the promotion of root growth due to the application of organic manures along with the inorganic fertilzers, the availability of nutrients might have increased and resulted in increased uptake of nutrients. Further, higher uptake of nutrients might be favoured due to the synergistic effect of nutrient interaction (Srividhya, 2002).

Agronomic and Physiological N- use Efficiency

Application of 40:60:50 kg NPK/ha +FYM 10t /ha recorded significantly higher agronomic N use efficiency followed by application of poultry manure @ 3t/ha. This might be due to supplementation of nitrogen at the required time of crop and also due to minimum loss of nutrients from the soil. However, application of urban compost and combination of urban compost, poultry manure and vermicompost resulted in higher physiological N use efficiency. Less uptake of nitrogen might have resulted in higher physiological nitrogen use efficiency in those treatments. This is in accordance with the findings of Giri e*t al.*, (2014).

Based on the above study, it is concluded that application of 40:60:50 kg NPK/ha + 10 t FYM/ha or application of poultry manure @ 3 t/ha is viable in producing higher yield, nutrient uptake and nitogen use efficiency of medicinal coleus.

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