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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH PARAMETERS OF MEDICINAL COLEUS (*COLEUS FORSKOHLII* BRIQ.)

C. Muruganandam*, R. Ezhilnilavu and S. Sivasankar
Department of Horticulture, Faculty of Agriculture, Annamalai University,
Annamalai Nagar – 608 002 (Tamilnadu) India.
*Author for correspondence.

ABSTRACT

Medicinal coleus (*Coleus forskohlii* Briq.) is one of the commercial Indian medicinal herb. It plays an important role in medicinal industry. The demand of tuberous roots is very high, but the productivity is very low. Therefore the integrated nutrient management could help in achieving higher growth in medicinal coleus. Thus, an experiment was conducted to know the "Effect of Integrated nutrient management on growth of medicinal coleus (*Coleus forskohlii* Briq.)" at Sirukalathur village, Ariyalur District - Tamilnadu during the year 2018-2020. A field experiment was consist of different combination of nutrients *viz.*, recommended dose of fertilizers, farmyard manure, neem cake, castor cake and bio-fertilizers (Azospirillum and Azotobacter). The experiment was laid out in randomized block design with 10 treatments and three replications. Among these various treatments tried, plants supplied with T_5 (75 % RDF + FYM @ 15 t ha^{-1} + Castor cake @ 2 t ha^{-1} + Azotobacter @10 kg ha^{-1}) was recorded maximum growth parameters *viz.*, plant height, number of branches $plant^{-1}$, plant spread, number of leaves $plant^{-1}$, leaf area $plant^{-1}$, LAI, fresh and dry weight of leaves and shoots $plant^{-1}$ and dry matter production.

Keywords : Medicinal coleus, organic manures, bio-fertilizers, inorganic manures, growth.

Introduction

Coleus forskohlii Briq. belongs to the family Lamiaceae and it is one of the most significant potential medicinal crop. It is a perennial herb and having fleshy and fibrous roots. The tuberous roots are found to be rich sources of forskolin (Colenol), a diterpenoid ($C_{12}H_{34}O_7$) that is being developed as a drug for hypertension, glaucoma, asthma, congestive heart failures and certain types of cancer. Roots are believed to have blood purifying action. The forskolin content varies from 0.1%- 0.4% in medicinal coleus (Sandya *et al*., 2009). It comes up well in warm, subtropical, and temperate regions of India, Burma, and Thailand. *Coleus forskohlii* Briq. is cultivated in India for use as a condiment. According to the World Health Organization (WHO), the International market of herbal products is estimated to be US $ 62 billion which is poised to grow to US $ 5 trillion by the year 2050. India's share in the global export market of medicinal plants related trade is estimated to be 0.5% (Sathiyaraj, 2017). Continuous application of heavy doses of chemical fertilizers without organic manures or bio-fertilizers has led to a deterioration of soil health in terms of physical and chemical properties of soil, declining soil microbial activities, reduction in soil humus, increased pollution of soil, water and air. Hence, considering the environmental friendliness and maintain better health, used effectively by adopting the integrated nutrient management practices.

Materials and Methods

An experiment was carried out at sirukalathur village, Ariyalur District. The present study was entitled to "Effect of integrated nutrient management on growth, of medicinal Coleus (*Coleus forskohlii* Briq.)" during the year 2018 – 2020. The treatment was consist of organic manures and bio-fertilizers along with inorganic manures. The experiment was laid out in randomized block design with 10 treatments and three replications. The different treatment combinations viz., T_1- 100 % RDF + FYM @ 15 t ha^{-1}, T_2 - 75 % RDF + FYM @ 15 t ha^{-1} + Neem cake @ 1 t ha^{-1} + Azospirillum @ 10 kg ha^{-1}, T_3 - 75 % RDF + FYM @ 15 t ha^{-1} + Neem cake @ 2 t ha^{-1} + Azospirillum @ 10 kg ha^{-1}, T_4 - 75 % RDF + FYM @ 15 t ha^{-1} + Castor cake @ 1 t ha^{-1}+ Azotobacter @ 10 kg ha^{-1}, T_5 - 75 % RDF + FYM @ 15 t ha^{-1} + Castor cake @ 2 t ha^{-1} + Azotobacter @ 10 kg ha^{-1}, T_6 - 50 % RDF + FYM @ 15 t ha^{-1} + Neem cake @ 1 t ha^{-1} + Azospirillum @ 10 kg ha^{-1}, T_7 - 50 % RDF + FYM @ 15 t ha^{-1} + Castor cake @ 1 t ha^{-1} + Azotobacter @ 10 kg ha^{-1}, T_8 - 50 % RDF + FYM @ 15 t ha^{-1} + Neem cake @ 2 t ha^{-1} + Azospirillum @10 kg ha^{-1}, T_9 - 50 % RDF + FYM @ 15 t ha^{-1} + Castor cake @ 2 t ha^{-1} + Azotobacter @10 kg ha^{-1} and T_{10} - Control. The observations were recorded on growth parameters *viz*., plant height, number of branches $plant^{-1}$, number of leaves $plant^{-1}$, leaf area $plant^{-1}$, fresh and dry weight of leaves and shoots $plant^{-1}$ and dry matter production. The observed data was analyzed by using statistical method of Panse and Sukhatme (1985).

Results and Discussion

The results of the present investigation reported that the plants treated with T_5 is 75 % RDF + FYM @ 15 t ha^{-1} + Castor cake @ 2 t ha^{-1} + Azotobacter @ 10 kg ha^{-1} recorded the maximum growth parameters *viz*., the maximum plant height (68.32 cm), number of branches $plant^{-1}$ (86.53),

number of leaves plant^{-1} (574.18), leaf area plant^{-1} (4125.86 cm^2), fresh and dry weight of leaves plant^{-1} (713.79 g plant^{-1} and 58.96 g plant^{-1} respectively), fresh and dry weight of shoots plant^{-1} (800.12 g plant^{-1} and 66.98 g plant^{-1} respectively) and dry matter production (372.21 g plant^{-1}). The lowest values are reported in control (T_{10}).

The plant height increased due to balanced nutrition on account of the application of FYM, castor cake, and biofertilizers along with inorganic fertilizers which helped in better cell division, cell expansion, and enlargement, led to higher plant height of *Coleus forskohlii* Briq at different stages of cop growth (Sadashiv Nadukeri, 2014). These similar findings were reported by Sailaja (2004), Singh *et al*. (2012) and Nageswara Rao (2014) in medicinal coleus, Sanjutha *et al*. (2008) in kalmegh, Vembu *et al*. (2010) in periwinkle, Umesha *et al.* (2011) in medicinal solanum.

The higher values of the branches are the resultant of a better supply of all the major and micronutrients. Particularly, the availability of bio-fertilizers on addition of organic manures to the soil in conjunction with chemical fertilizers which increased the availability in absolute amount during vegetative and reproductive phase. Thus, resulting in more auxin concentration in plant and nitrogen metabolism, increased more number of branches at different growth stages (Atul *et al*., 2018). The similar findings were recorded by vennila and Jayanthi (2014) in medicinal coleus, Law and Remison (2007) in dioscorea, Singh *et al*. (2012) and Tanuja *et al*. (2013), Vishal and Duhan (2014) in ashwagandha.

While, the increased values of leaves characters indicated the benefits of adding organic manures and bio-fertilizers to the soil in conjunction with chemical fertilizers which increased the availability of nutrients due to improvement in physical and biological properties of soil, which in turn resulted in the formation of more number of leaves plant^{-1} and leaf area plant^{-1} (Atul *et al*., 2018). The similar findings were also noticed by Sadashiv nadukeri *et al*. (2014) in medicinal coleus, solanum, Dinesh and Singh (2015) in periwinkle, Egbuchua and Enujeke (2015), Khaliq *et al*. (2016) and Mirawsaf *et al*. (2016) in aloe vera, Divya *et al*. (2017) in kalmegh.

The increased in physiological parameters was due to increase in plant height, number of branches plant^{-1} and number of leaves leading to higher dry matter accumulation in plants and translocation of photosynthates from source to sink which might due to sufficient availability of major and micronutrients from FYM, castor cake, azospirillum used in combination with inorganic fertilizers helped in the uptake of more nutrients (Sadashiv Nadukeri, 2014). The similar findings also recorded by Sathiyaraj *et al*. (2017) in medicinal coleus, Sudhakar (2005) and Padmapriya *et al*. (2010) in gymnema, Umesha *et al*. (2011) in medicinal solanum, Aruw *et al*. (2012) in senna, Sumathi *et al*. (2012) in patchouli, Vajantha *et al*. (2012) in ashwagandha. Hence, that the treatment combination of T_5 (75 % RDF + FYM @ 15 t ha^{-1} + Castor cake @ 2 t ha^{-1} + Azotobacter @10 kg ha^{-1}) is recommended to get better growth with improved quality of coleus tubers in addition to maintain soil health.

Conclusion

Based on the observation recorded throughout the cropping period, it could be concluded that among the various treatments of Integrated nutrient management on medicinal coleus (*Coleus forskohlii* Briq.), the maximum growth characters were observed on the plants treated with T_5 (75 % RDF + FYM @ 15 t ha^{-1} + Castor cake @ 2 t ha^{-1} + Azotobacter @10 kg ha^{-1}) in medicinal coleus. The combined use of organic fertilizers, and bio-fertilizers along with inorganic fertilizers, recorded significantly superior growth characters in medicinal coleus due to increased soil fertility through proper nutrient management.

Table 1 : Effect of integrated nutrient management on plant height (cm), number of branches plant^{-1}, number of leaves plant^{-1} and leaf area plant^{-1} in medicinal coleus (*Coleus forskohlii* Briq.).

TREATMENTS	Plant height (cm) (150 DAP)	Number of branches plant^{-1} 150 DAP)	Number of leaves plant^{-1} (150 DAP)	Leaf area plant^{-1} (cm^2) (150 DAP)
T_1 -100 % RDF + FYM @ 15 t ha^{-1}	52.69	66.47	265.87	2979.14
T_2 - 75 % RDF + FYM @ 15 t ha^{-1} + Neem cake @ 1 t ha^{-1}+ Azospirillum @ 10 kg ha^{-1}	58.65	74.45	383.75	3415.42
T_3 - 75 % RDF + FYM @ 15 t ha^{-1}+ Neem cake @ 2 t ha^{-1}+ Azospirillum @ 10 kg ha^{-1}	61.24	78.11	437.97	3574.52
T_4 -75 % RDF + FYM @ 15 t ha^{-1}+ Castor cake @ 1 t ha^{-1}+ Azotobacter @ 10 kg ha^{-1}	64.88	82.53	503.65	3837.75
T_5 - 75 % RDF + FYM @ 15 t ha^{-1}+ Castor cake @ 2 t ha^{-1}+ Azotobacter @ 10 kg ha^{-1}	68.32	86.53	574.18	4125.86
T_6 - 50 % RDF + FYM @ 15 t ha^{-1}+ Neem cake @ 1 t ha^{-1}+ Azospirillum @ 10 kg ha^{-1}	55.27	69.78	315.65	3125.47
T_7 – 50 % RDF + FYM @ 15 t ha^{-1}+ Castor cake @ 1 t ha^{-1}+ Azotobacter @ 10 kg ha^{-1}	62.23	79.10	451.27	3684.52
T_8 - 50 % RDF + FYM @ 15 t ha^{-1}+ Neem cake @ 2 t ha^{-1}+ Azospirillum @ 10 kg ha^{-1}	57.78	73.56	368.75	3288.46
T_9 -50 % RDF + FYM @ 15 t ha^{-1}+ Castor cake @ 2 t ha^{-1}+ Azotobacter @ 10 kg ha^{-1}	65.64	82.97	518.45	3956.86
T_{10} – Control	50.46	63.12	233.27	2710.12
S. Ed	1.167	1.482	8.886	69.109
CD (P = 0.05)	2.451	3.12	18.67	145.194

Table 2 : Effect of integrated nutrient management on fresh and dry weight of leaves plant^{-1}, fresh and dry weight of shoots plant^{-1} and dry matter production in medicinal coleus (*Coleus forskohlii* Briq.)

TREATMENTS	Fresh weight of leaves (g plant^{-1}) (150 DAP)	Dry weight of leaves (g plant^{-1}) (150 DAP)	Fresh weight of shoots (g plant^{-1}) (150 DAP)	Dry weight of leaves (g plant^{-1}) (150 DAP)	Dry matter production (150 DAP)
T_1 -100 % RDF + FYM @ 15 t ha^{-1}	482.79	40.41	559.26	46.46	236.7
T_2 - 75 % RDF + FYM @ 15 t ha^{-1} + Neem cake @ 1 t ha^{-1}+ Azospirillum @ 10 kg ha^{-1}	572.69	47.4	646.9	54.08	292.21
T_3 - 75 % RDF + FYM @ 15 t ha^{-1}+ Neem cake @ 2 t ha^{-1}+ Azospirillum @ 10 kg ha^{-1}	607.14	49.89	682.13	57.13	312.00
T_4 -75 % RDF + FYM @ 15 t ha^{-1}+ Castor cake @ 1 t ha^{-1}+ Azotobacter @ 10 kg ha^{-1}	661.82	54.18	737.68	61.78	341.33
T_5 - 75 % RDF + FYM @ 15 t ha^{-1}+ Castor cake @ 2 t ha^{-1}+ Azotobacter @ 10 kg ha^{-1}	713.79	58.96	800.12	66.98	372.21
T_6 - 50 % RDF + FYM @ 15 t ha^{-1}+ Neem cake @ 1 t ha^{-1}+ Azospirillum @ 10 kg ha^{-1}	518.69	43.40	591.38	49.41	260.68
T_7 – 50 % RDF + FYM @ 15 t ha^{-1}+ Castor cake @ 1 t ha^{-1}+ Azotobacter @ 10 kg ha^{-1}	626.92	51.64	704.58	58.81	322.23
T_8 - 50 % RDF + FYM @ 15 t ha^{-1}+ Neem cake @ 2 t ha^{-1}+ Azospirillum @ 10 kg ha^{-1}	554.70	45.95	623.03	52.22	283.54
T_9 -50 % RDF + FYM @ 15 t ha^{-1}+ Castor cake @ 2 t ha^{-1}+ Azotobacter @ 10 kg ha^{-1}	680.81	56.00	762.02	63.76	351.32
T_{10} – Control	452.30	37.24	528.15	42.61	220.25
S. Ed	**11.829**	**0.971**	**13.231**	**1.108**	**6.106**
CD (P = 0.05)	**24.853**	**2.04**	**27.798**	**2.328**	**12.829**

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