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Effect of Integrated Nutrient Management on Growth and Yield of Senna (*Cassia angustifolia* Vahl)

Sachinbhai D. Dhoti*, M. M. Patel, Jyoti Uppar and B. M. Tandel

Department of Plantation, Spices, Medicinal and Aromatic Crops, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari - 396 450, Gujarat.

*Corresponding Author E-mail: sachinghoti849@gmail.com

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ABSTRACT

The present investigation was carried out at Instructional Farm, ACHF, NAU, Navsari, Gujarat, India. The experiment was laid out in Randomized Block Design with factorial concept and repeated thrice with ten treatment combinations, consisting two level of bio-fertilizer viz., Without bio-fertilizer (B_0), With bio-fertilizer (B_1) and five level integrated nutrient sources viz., 80:40:40 NPK kg ha^{-1} (F_1), 75 % RDN + 25 % N through FYM (F_2), 75 % RDN + 25 % N through vermicompost (F_3), 50 % RDN + 50 % N through FYM (F_4), 50 % RDN + 50 % N through vermicompost (F_5).

The individually application of bio-fertilizer (B_1) and 50 % RDN + 50 % N through FYM (F_4) in senna significantly influenced vegetative, and yield parameters as compared to other treatments which registered the maximum plant height and more number of branches per plant. The yield parameters like maximum fresh weight of leaves, dry weight of leaves, maximum number of pods per plant, maximum fresh weight of pods and dry weight of pods were also recorded under the application of both the treatment individually. So it can be concluded that the individual application of bio-fertilizer and 50 % RDN + 50 % N through FYM found better for growth as well as yield of senna.

Keywords: *Senna, INM, NPK, Bio-fertilizer, FYM and Vermin compost.*

INTRODUCTION

Cassia is a large genus of around 500 species of flowering plants in the family Leguminosae (Lodha et al., 2010). Medicinally, *Cassia angustifolia* Vahl. is an important plant. There is a great scope for commercial cultivation of senna in India. Commercial scale cultivation of senna is taken up in the states of Tamil Nadu, Maharshtra, Gujarat and Rajasthan.

Nutrient management is one of the key factor to increase productivity of medicinal crops. The modern and intensive agriculture calls for the heavy dependence of fertilizers and chemicals, which are not only costly but also cause soil and water pollution. Therefore, it is necessary to supply the plant nutrition in an integrated way.

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The basic concept of INM system is the maintenance and improvement of soil health, sustaining crop productivity and also to minimize the use of chemicals but maximize the fertilizer use efficiency. It improve the farmer's profitability through the judicious and efficient use of different sources of plant nutrients such as mineral fertilizers, organic manures, micronutrients *etc*. in an integrated manner for securing optimum economic yield from a specific cropping system (Pasricha et al., 1996). The basic principle of INM is the maintenance of soil fertility, sustainable agricultural productivity and improving farmers profitability through judicious and efficient use of chemical fertilizers, organic manure and bio-fertilizers (Bhalerao et al., 2009). Therefore, the present investigation was carried out with objectives to find out the effect of integrated nutrient management on growth and yield of senna.

MATERIALS AND METHODS

The present investigation was carried out at Instructional Farm, ACHF, NAU, Navsari, Gujarat, India. The experiment was laid out in Randomized Block Design with factorial concept and three replications with ten treatment combinations, consisting two levels of bio-fertilizer *viz.,* Without bio-fertilizer (B_0), With bio-fertilizer (B_1) and five levels integrated nutrient sources *viz.,* 80:40:40 NPK kg ha^{-1} (F_1), 75 % RDN + 25 % N through FYM (F_2), 75 % RDN + 25 % N through vermin compost (F_3), 50 % RDN + 50 % N through FYM (F_4) and 50 % RDN + 50 % N through vermin compost (F_5). For seed treatment *Jaggery* (25 g) was boiled in 400 ml of water for 15 minutes and allowed to cool. After that 50 g of the bio inoculant *Azospirillum* was added and mixed thoroughly along with the seeds and dried under shade for 30 minutes. Seeds of Gujarat Anand Senna - 1 variety of senna were sown at 45 cm × 30 cm spacing in the field. Nitrogen (80 kg ha^{-1}) was applied in two equal splits in the form of urea (containing 46 % N), FYM (containing 0.50 % N) and vermin compost (containing 1.35 % N) as per treatment. Half dose of nitrogen was applied as basal and the remaining half dose of 'N' was applied at 40 DAS. Phosphorus (40 kg ha^{-1}) and potash (40 kg ha^{-1}) were applied as single basal dose to the all respective plots. 'P' and 'K' applied in the form of, single super phosphate and muriate of potash fertilizers, respectively. All the standard package of practices were followed as per requirement of senna. All the vegetative parameters were taken at 120 DAS and yield parameters at the time of harvesting. The data collected for all the characters were subjected to the statistical analysis by adopting 'Analysis of Variance' technique as described by Panse and Sukhatme (1985) for Randomized Block Design.

RESULTS

Effect on growth parameters

It is perceptible from the data as presented in Table-1 that, the among different combinations of INM studied, plant treated with (B_1) bio-fertilizer recorded significantly maximum plant height (107.97 cm) and more number of branches (10.69). Whereas, minimum plant height (98.49 cm) and number of branches (9.31) was recorded in treatment B_0 (without bio-fertilizer). Increase in growth parameters might be due to the fact that bio-fertilizer plays an important role in fixing the atmospheric nitrogen and making them available to the plants, which is a major nutrient for vegetative growth (Boquet et al., 1994). Also might be due to *Azospirillum*, apart from its higher nitrogen fixing potential, it also produced phytohormones (Tien et al., 1979). The increase in activity of plant growth substance like gibberellic acid, indole acetic acid and dehydrozeatin in *Azospirillum* inoculated plants as noticed by Gunasekaran and Viassak (1986) might have responsible for increased vegetative growth in the plants inoculated with *Azospirillum*. The results of present investigation are in confirmation with findings of Arumugam et al. (2001) and Lakshmanan et al. (2005) in senna; Khanna et al. (2006) and Sajjan et al. (2014) in ashwagandha and Karthikeyan et al. (2009) in periwinkle.

In case of application of different nutrients sources, plant treated with (F_4) 50 %

RDN + 50 % N through FYM attained significantly maximum plant height (110.97 cm) and more number of branches (10.93) and it was statistically remained at par with treatment F_5 (50 % RDN + 50 % N through vermi compost). The increase in plant height and number of branches under this treatment (F_4) might be due to the fact that nitrogen is constituent of protein which is essential for formation of protoplasm thus affecting the cell division and cell enlargement and ultimately better vegetative growth. Availability of nitrogen at early stage and availability of macro and micro nutrient from organic source throughout the crop growth period along with the improvement in soil physical and chemical properties resulted in increasing vegetative growth. Whereas, minimum plant height (97.82 cm) was observed in treatment F_3 (75 % RDN + 25 % N through vermi compost) and lowest number of branches were noted in treatment F_1 (80:40:40 NPK kg ha^{-1}). It is assured that other factors, such as the presence of beneficial microorganisms or biologically active plant growth influencing substances such as phytohormones are released by beneficial microorganisms present in the organic manure (Tomati & Galli, 1995 & Edwards, 1998). Root initiation, increased root biomass, enhanced plant growth and development and sometimes, alterations in plant morphology are among the most frequently claimed effects of organic manures (Tomati et al., 1998). Moreover, application of FYM improved soil environment which encourages the proliferous root growth, resulting in better absorption of moisture, nutrients and thus producing higher growth (Pratibha et al., 2010). These findings are confirmatory with the findings by Ramamoorthy et al. (2003), Kharbade and Gaikwad (2008) and Singaravel et al. (2016) in senna; Smitha et al. (2010) in Phyllanthus amarus and Vijaya et al. (2013) and Patil et al. (2014) in ashwagandha.

The data regarding vegetative parameters as influenced by interaction of bio-fertilizer and integrated nutrient sources was found non-significant.

Effect on yield parameters

It is clear from Table 1 that among different combinations of INM, significantly, maximum fresh weight of leaves per plant and per hectare (173.04 g and 9716.05 kg ha^{-1}) and maximum dry weight of leaves per plant and per hectare (59.04 g and 3232.31 kg ha^{-1}), higher number of pods per plant (31.04), maximum fresh weight of pods per plant and per hectare (14.26 g and 778.04 kg ha^{-1}) and maximum dry weight of pods per plant and per hectare (2.93 g and 152.84 kg ha^{-1}) were found in plants treated with bio-fertilizer (B_1). The yield attributes of senna is closely associated with growth components. It is assured that other factors, such as the improvement of biological activities of soil and mineral element absorption caused more biomass production. Zaady et al. (1993) reported that *Azospirillum* increased, above ground dry weight of plants. The beneficial effect of *Azospirillum* on plants attributed mainly due to an improvement in root development, an increase in the rate of water and mineral uptake by roots, displacement of fungi and plant pathogenic bacteria and to a lesser extent, biological nitrogen fixation (Okon & Itzigshohn, 1994).

Whereas, minimum fresh weight of leaves per plant and per hectare (158.33 g and 8932.30 kg ha^{-1}) and minimum dry weight of leaves per plant and per hectare (53.29 g and 2984.90 kg ha^{-1}), lowest number of pods per plant (26.87), minimum fresh weight of pods per plant and per hectare (11.67 g and 649.02 kg ha^{-1}) and minimum dry weight of pods per plant and per hectare (2.64 g and 133.35 kg ha^{-1}) were noted in treatment B_0 (without bio-fertilizer).

Regarding application of different nutrient sources, plant treated with (F_4) 50 % RDN + 50 % N through FYM found significantly, maximum fresh weight of leaves per plant and per hectare (181.12 g and 10236.11 kg ha^{-1}) and maximum dry weight of leaves per plant and per hectare (62.15 g and 3381.73 kg ha^{-1}), higher number of pods per plant (33.17), maximum fresh weight of pods per plant and per hectare (15.07 g and 824.37

kg ha^{-1}) and maximum dry weight of pods per plant and per hectare (3.08 g and 162.62 kg ha^{-1}) at the time of harvesting. This all parameters were statistically at par with F_5 (50 % RDN + 50 % N through vermi compost). Higher fresh and dry weight of leaves due to better vegetative growth in terms of plant height, inclusive of whole canopy which was reflected through fresh weight and dry matter contents. Rapid elongation of cells because of adequate N seems to be the favourable influence of N on plant growth resulting in the marked increased in plant growth, that ultimately resulting in higher fresh and dry weight of leaves. Improvement in fresh weight might be due to improved vegetative growth of plant under optimum level of nitrogen which caused more storage of carbohydrates and thus improved fresh and dry weight. Higher dry matter production might be due to increased number of leaf, thereby increased photosynthetic efficiency and higher carbohydrate assimilation (Rao, 2003). And also due to the application of both organic and inorganic nutrients resulted in higher number of leaves per plant which represents photosynthetic efficiency in plants, rapid synthesis, translocation and accumulation of photo synthates from source to sink which might have ultimately contributed to increased number of pods and fresh and dry weight of pods. The balanced proportions of plant nutrients supplied to the crop as per need during the growth period resulting in favourable increase in yield attributing characters.

Such positive response of nitrogen fertilization and combine application of organic fertilizer with inorganic fertilizer in increasing growth and yield was reported by Gupta et al. (1977), Kalyansundaram et al. (1981), Ilangovan et al. (1990), Mali (1994), Pareek et al. (1989), Ramamoorthy et al. (2003), Brajeshwar et al. (2007), Kharbade and Gaikwad (2008), Pratibha et al. (2010), Kayina et al. (2012) and Singaravel et al. (2016) in senna. The data regarding number of pods per plant, fresh weight of pods per plant and per hectare and dry weight of pods per plant and per hectare as influenced by interaction of bio-fertilizer and integrated nutrient sources was found non-significant at time of harvesting. The data regarding yield parameters as influenced by interaction of bio-fertilizer and integrated nutrient sources was found non-significant.

Table 1: Effect of integrated nutrient management on growth and yield of senna

	Plant height at120 DAS	No. of branches at 120 DAS	No. of pods	Fresh weight of leaves per plant (g)	Fresh weight of leaves per ha (kg)	Dry weight of leaves per plant (g)	Dry weight of leaves per ha (kg)	Fresh weight of pods per plant (g)	Fresh weight of pods per ha (kg)	Dry weight of pods per plant (g)	Dry weight of pods per ha (kg)
Factor - A											
B_0	98.49	9.31	26.87	158.33	8932.30	53.29	2984.90	11.67	649.02	2.64	133.35
B_1	107.97	10.69	31.04	173.04	9716.05	59.04	3232.31	14.26	778.04	2.93	152.84
S.Em. ±	2.20	0.21	1.13	4.42	242.71	1.39	73.49	0.48	23.78	0.07	3.62
C.D. at 5 %	6.55	0.62	3.35	13.14	721.16	4.13	218.34	1.42	70.65	0.19	10.76
Factor - B											
F_1	97.83	9.30	25.87	151.45	8443.93	51.69	2885.88	11.72	644.16	2.63	130.94
F_2	100.37	9.87	27.33	159.21	9002.06	54.80	2958.86	12.28	680.93	2.67	137.71
F_3	97.82	9.63	26.77	156.85	8834.36	52.87	2944.70	11.85	661.38	2.65	135.31
F_4	110.97	10.93	33.17	181.12	10236.11	62.15	3381.73	15.07	824.37	3.08	162.62
F_5	109.17	10.27	31.63	179.82	10104.42	59.31	3371.87	13.90	756.80	2.90	148.88
S.Em. ±	3.49	0.33	1.78	6.99	383.76	2.20	116.19	0.75	37.60	0.10	5.72
C.D. at 5 %	10.35	0.97	5.30	20.77	1140.25	6.52	345.23	2.24	111.71	0.31	17.01
Interaction B*F											
S.Em. ±	4.93	0.46	2.52	9.89	542.72	3.10	164.32	1.07	53.17	0.15	8.09
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %	8.27	8.02	15.09	10.33	10.08	9.57	9.16	14.25	12.19	9.05	9.80

CONCLUSION

On the basis of results obtained in present investigation, it can be concluded that the application of 50 % RDN + 50 % N through FYM along with bio-fertilizer enhanced vegetative growth and yield parameters of senna.

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