International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

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Effect of integrated nutrient management on growth of senna (*Cassia angustifolia*Vahl.)

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International Journal of Science and Research Archive, 2022, 07(02), 555–558

Publication history: Received on 16 November 2022; revised on 24 December 2022; accepted on 26 December 2022

Article DOI: https://doi.org/10.30574/ijsra.2022.7.2.0322

Abstract

Senna (*Cassia angustifolia*Vahl.) belongs to the family Fabaceae and is one of the most significant medicinal crops in India. India holds leading position in the production of senna crop and export of its produce to the world market, annually earning nearly 45 million. Almost all the senna leaves produced in India are exported and the major portion is transported to London market. Thus an experiment was conducted on the "Effect of Integrated nutrient Management on Growth of Senna (*Cassia angustifolia*Vahl.)" carried out at ParamathiVelur, Namakkal District, Tamil Nadu during the year 2019 - 2021. The field experiment was consisting of different combination of nutrients viz., recommended dose of fertilizers RDF, farmyard manure FYM, vermicompost VC and biofertilizers (Azospirillum AS and Phosphobacteria PB).The senna plants were planted in a plot with the size of 2.2x2.2 m^2 with 35 plants @ 45 x 30 cm^2 spacing. The experiment was laid out in Randomized Block Design with three replications and twelve treatments. Among the various treatments tried, plants supplied with T10 (75%RDF+FYM@10tha^{-1}+Azospirillum@2.5$kgha^{-1}$ + Phosphobacteria @ 2 kg ha^{-1}) recorded maximum growth parameters such as plant height, number of branches $plant^{-1}$, plant spread and leaf area $plant^{-1}$.

Keywords: Senna; FYM; VC; Biofertilizers; Growth

1. Introduction

India has been a big producer in medicinal and aromatic plants trade across the globe. The global market for the medicinal and aromatic plants was 1.1 billion USD in 1999, 1.8 billion USD in 2009 and 3 billion USD in 2015 (TRAFFIC, 2018). This is further expected to reach 35.4 billion USD by 2020 with a compound annual growth rate of 6.6% from 2015 to 2020 (BCC, 2015). India is the second largest exporter of medicinal plants next to china. India holds leading position in the production of senna crop and export of its produce to the world market, annually earning nearly 45 million. Almost all the senna leaves produced in India are exported and the major portion is transported to London market. The crop is grown in about 10,000 ha, mainly in Southern districts of Tamil Nadu v*iz*., Tirunelveli, Ramanathapuram and Madurai (Kumar, 2018). Senna (*Cassia angustifolia*Vahl.) belongs to the family Fabaceae and isone of the most significant medicinal crops in India. Sennaisalarge genus of flowering plant in the legume family. It consists of 21 genera with 260 to 350 species. Among these, about 50 species of senna is known for cultivation (Marazzi*et al*., 2006). The leaves and pods of senna contain sennosides which are having high medicinal properties (Randell *et al*., 2017). Senna is a legume but produces no nodules for fixing atmospheric nitrogen. The leaves are large, compound and pinnate. The fully grown leaflets are bluish green to pale green in colour. The flowers are borne in racemose inflorescence up to 15 cm long and are brightly yellow in colour. The long-term use of chemical fertilizers leads to the deterioration of physical and chemical properties of soil. Continuous application of heavy doses of chemical fertilizers without using organic manures or bio fertilizers led to decline in soil microbial activities, ground water and

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environmental pollution. Organic manures and bio fertilizers improves the soil texture, allowing it to hold water longer, and increases the microbial activities in the soil. INM is considered as an integral part of any sustainable agricultural system. INM enhances the availability of applied as well as native soil nutrients and it synchronizes the nutrient demand (Mostafa, 2020).

2. Material and methods

2.1. Experiment field

The experiment was conducted at ParamathiVelur which is located at 11.112^0 North latitude, 78.0044^0 East longitude and at an altitude of 170 meters above the mean sea levelin Namakkal District of Tamil Nadu. The weather of the experimental site is moderately warm with hot summer months. The mean maximum temperature is 38.2^0C, while the mean relative humidity is 66.8 percent. The mean hour of bright sunshine is 9.5 and the mean annual rainfall is 1500 mm. The soil type of the experimental field was sandy loam soil with pH - 7.45 and electrical conductivity of 0.40 dsm^{-1}.

2.2. Source of inputs

Seeds of senna are collected from the wild types located at the foothills of Kollimalai. Organic inputs such as farmyard manure and vermicompost were collected from farmer's field in Olappalayam village. Inorganic fertilizers such as NPK (Urea, SSP, MOP) were procured from VelurAgri clinic located at ParamathiVelur. Bio fertilizers such as Azospirillum and phosphobacteria were collected from office of the Assistant Director of Agriculture located at Paramathi.

2.3. Treatment details

The experiment consist of twelve treatments *viz*., T1 - 100 % RDF (80:40:20 kg NPK ha^{-1}), T2 - FYM @ 10 t ha^{-1}, T3 - VC @ 4 t ha^{-1}, T4 - 75 % RDF + FYM @ 10 t ha^{-1},T5-50%RDF+FYM@10tha^{-1},T6-75%RDF+VC@4tha^{-1},T7-50%RDF+VC @ 4 t ha^{-1}, T8 - 75 % RDF + VC @ 4 t ha^{-1} + VC @ 2.5 kg ha^{-1}+ PB @ 2 kg ha $^{-1}$, T9 - 50 % RDF + VC @ 4 t ha^{-1} + VC @ 2.5 kg ha^{-1}+ PB @ 2 kg ha $^{-1}$, T10 - 75 % RDF + FYM@ 10 t ha^{-1} + VC @ 2.5 kg ha^{-1} + PB @ 2 kg ha $^{-1}$, T11 - 50 % RDF + FYM @ 10 t ha^{-1}+ VC@2.5kgha^{-1}+PB@2kgha^{-1}andT12- Control.Theobservationswererecordedon140 days after sowing from the randomly tagged 5 existing plants. The observed data was analysed by using statistical method of Panse and Sukhatme (1985).

2.4. Determination of growth attributes

The observations were recorded on 140 days after sowing from the randomly tagged 5 existing plants and the mean was calculated. The plant height was measured from the ground level to the growing point, similarly the no. of branches were counted manually, the maximum plant spread along East – West and North – South direction was measured, the leaf area was measured by using leaf area meter with the transparent belt conveyor utilizing an electronic digital display. The observed data was analysed by using statistical method of Panse and Sukhatme (1985).

3. Results and discussion

Among the several treatments the maximum plant height (79.86 cm) was observed in T10 was due to the easy availability of nitrogen which on further accompanied by the biofertilizers resulted in increased vegetative growth of the plants. According to Aruw*et al*. (2012), the increase in plant height was due to the increased nitrogen content, which is the chief constituent of protein, essential for the protoplast formation leading to cell division and cell enlargement, further the application of biofertilizers increases the soil microbial activity leading to the enhanced nutrient availability to the plants. This may be due to the balanced nutrition on account of FYM application and biofertilizers along with inorganic fertilizers which helped in higher rate of cell division, rapid elongation and enlargement of cells which leads to the increased plant height in senna at different stages of crop growth. Such positive responses of integrated nutrient treatments in increasing the plant height of senna was also reported by Singaravel*et al*. (2016) and Dhoti *et al*. (2020). Similar findings were reported ni other crops Mayank*et al*. (2017) in ashwagandha, Abhilasha (2017) in kalmegh, Siddalingayya*et al*. (2019) in isabgol and Mahantesh*et al*. (2020) in patchouli.

From the present experiment maximum no. of branches $plant^{-1}$ (16.07) and plant spread (80.36 cm) was recorded by the plants supplied with T10. The plant spread increased with advancement in age of the crop and maximum spread was recorded at harvest. The plant spread was increased due to a greater number of branches and maximum leaf area. Similar findings were reported by Mirawsaf*et al*. (2016) in aloe vera, Pooja *et al*. (2018) in ocimum and Jagadish*et al*. (2020) in safedmusli. Leaf area represents the photosynthetic efficiency of plants. It is evident from the data that the

leaf area plant-1was significantly influenced by the organic manures, biofertilizers and inorganic fertilizers at different stages of crop growth. The plants supplied with T10 recorded the highest leaf area plant^{-1}(136.17 cm^2). An integrated use of nutrients was found to be positive in increasing the leaf area of senna. This was due to the adequate supply of nitrogen both synthetic fertilizers, organic manures and biofertilizers which results in the production of greater number of photosynthetically active leaves for the production of carbohydrates growth promoting substances like auxinandgibberellins. The increased leaf area could be attributed the increased availability of N and K that could have caused cell expansion. Such positive responses of increased leaf area plant^{-1} in senna with integrated nutrient treatments have been reported by Munnu (2011) in patchouli, Umesha*et al*. (2011) in medicinal solanum, Zahida*et al*. (2013) in stevia, Dinesh and Singh (2015) in periwinkle.

Table 1 Influence of integrated nutrient management on growth characters of senna (*Cassia angustifolia*Vahl.)

Treatment	Plant height (cm)	No. of branches	Plant spread (cm)	Leaf area (cm^2)
T1	51.96	9.45	56.08	95.84
T2	45.23	7.71	48.94	84.82
T3	48.83	8.56	52.17	90.20
T4	62.99	11.97	65.77	112.79
T5	56.10	10.27	59.05	101.51
T6	65.77	12.85	69.84	118.37
T7	58.35	11.13	61.82	107.16
T8	73.98	15.28	77.56	130.58
T9	69.14	13.68	72.27	124.05
T10	79.86	16.07	80.36	136.17
T11	73.08	14.81	76.58	127.67
T12	41.88	6.66	45.37	78.83
S.Ed	0.874	0.231	0.791	1.795
CD (p=0.05)	2.228	0.483	1.648	3.961

4. Conclusion

Based on the observation recorded, it could be concluded that among the various treatments of Integrated nutrient management on senna (*Cassia angustifolia*Vahl.), the maximum growth was observed on the plants treated with T10. The combined use of organic fertilizers, and bio-fertilizers along with inorganic fertilizers, recorded significantly maximum growth attributes in senna plant due to increased soil fertility through proper integrated nutrient management.

Compliance with ethical standards

Acknowledgments

The authors would like to thank all the respondents who have participated in the study and the anonymous reviewers for their invaluable help during the revision process.

Disclosure of conflict of interest

All authors declare that there is no conflict of interest in this paper.

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