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## Effect of organic manures and bio-fertilizers on plant nutrient uptake and post-harvest soil fertility status in senna (*Cassia angustifolia* Vahl.) cv. 'Sona'

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**Abstract**

A field experiment was conducted during late *kharif* 2018-2019 at College of Horticulture, Anantharajupeta to evaluate the effect of different organic manures and bio-fertilizers on plant nutrient uptake and post-harvest soil fertility status in senna cv. 'Sona'. Analysis of plant nutrient uptake by senna has revealed that significantly maximum uptake of nitrogen content (174.87 kg ha<sup>-1</sup>) in the plant sample was observed by application of 100% RDN through urea, whereas, significantly maximum plant nutrient uptake of phosphorous (48.22 kg ha<sup>-1</sup>) and potassium (173.84 kg ha<sup>-1</sup>) contents were observed by application of 100% RDN through vermicompost in combination with bio-fertilizers *viz.*, *Azospirillum* and PSB. However, post-harvest soil fertility analysis of senna has revealed that significantly maximum nitrogen content (168.65 kg ha<sup>-1</sup>) and potassium content (440.51 kg ha<sup>-1</sup>) in the soil was recorded by application of 100% RDN through neem cake, whereas, significantly maximum content of phosphorous fertility in the soil (101.82 kg ha<sup>-1</sup>) was noticed with the application of 100% RDN through vermicompost in combination with bio-fertilizers *viz.*, *Azospirillum* and PSB.

**Keywords:** Bio-fertilizers, nutrient uptake, organic manures, senna and soil fertility

**Introduction**

Senna (*Cassia angustifolia* Vahl.) is a non-nitrogen fixing member of Leguminaceae family. Senna is native of Yemen and South Arabia and is popularly known as 'Swarnapatri'. Though, senna is an introduced crop to India, it leads in the production and export of sennoside in the world trade and commerce by producing an average annual income to the tune of 300 million Indian rupees (Kayina *et al.*, 2012) [4] and thus considered as 'South Indian Dollar Earning Crop'. In India, senna is widely grown in the state of Tamil Nadu and to a smaller extent in the neighboring states of Andhra Pradesh, Telangana and Karnataka in the southern part of India and to certain extent in other states like Rajasthan, Gujarat, Maharashtra, West Bengal and Tripura. At present, senna is cultivated in an area of about 25,000 hectares (Basak and Gajbhiye, 2018) [1]. It is a widely used medicinal herb in ayurveda, unani and also in the allopathic system of medicine. The economic parts of senna are the leaves and pods which mainly contain Sennoside-A and Sennoside-B. Sennoside-A&B are mainly used for their laxative property. Apart from this, senna is also used as a potent cathartic, febrifuge in spleen enlargement, anemia, typhoid, tumors, foul breath, bronchitis and also in curing leprosy. Organic fertilizer management is a key factor in the successful cultivation of medicinal and aromatic plants. Restricted usage of chemical fertilizers and inclusion of organic manures in combination with bio-fertilizers in the soil improves the fertility status and believed to encourage vegetative growth and development of the plant and economic parts of plant. Thus, usage of organics and bio-fertilizers in combination with chemical fertilizers in the form of integrated nutrient management is emphasized especially in the cultivation of medicinal plants because of ever increasing demand for organically produced herbs (Singaravel *et al.*, 2016) [7]. Organic fertilizers will enhance the soil fertility, soil structure, water holding capacity, physical and chemical properties of soil, microbial activity and nutrient availability without any undesirable effect on the environment. They also enhance the vegetative and reproductive growth of the plant. Roots of senna do not form nodules and hence cannot fix nitrogen. So, use of N-fixing micro-organisms like *Azospirillum*, the availability of nitrogen to the plant can be increased, thus increasing the yield.

Dual inoculation of *Azospirillum* and phosphate solubilizing bacteria (PSB) has proved an additional benefit on crop yield and also indicated a synergistic effect on quality (Okon and Gonzalez, 1994) [6]. Bio-fertilizers are harmless, low cost, renewable agricultural inputs which contain active strains of specific micro-organisms which increase the productivity by increasing the availability of nutrients to the host plant. Keeping all these things in view, the present investigation was carried to find out the influence of organic manures and bio-fertilizers on nutrient uptake ability and postharvest soil fertility status in senna cv. 'Sona'.

### Materials and Methods

A field experiment was conducted at College of Horticulture, Dr. Y.S.R. Horticultural University, Anantharajupeta, Kadapa district of Andhra Pradesh to study the influence of different organic manures and bio-fertilizers on plant nutrient uptake and post-harvest soil fertility status in senna. Senna seeds of 'Sona' cultivar were obtained from the Medicinal Plants Research Station of Sri Konda Laxman Telangana State Horticultural University, Rajendranagar, Hyderabad. The seeds were sown directly in the well prepared field with a spacing of 45 x 30 cm under drip irrigation. The field was laid out in a randomized block design with three replications. The treatments included were T1: 100% RDN through FYM (11.25 t ha<sup>-1</sup>); T2: 100% RDN through vermicompost (5 t ha<sup>-1</sup>); T3: 100% RDN through neem cake (1.73 t ha<sup>-1</sup>); T4: 100% RDN through FYM (11.25 t ha<sup>-1</sup>) in combination with Bio-fertilizers (*Azospirillum* + PSB); T5: 100% RDN through vermicompost (5 t ha<sup>-1</sup>) in combination with Bio-fertilizers (*Azospirillum*+PSB); T6: 100% RDN through neem cake (1.73 t ha<sup>-1</sup>) in combination with Bio-fertilizers (*Azospirillum* + PSB); T : 100% RDN through FYM (33% @ 3.75 t ha<sup>-1</sup>) + vermicompost (33% @ 1.66 t ha<sup>-1</sup>) + neem cake (33% @ 0.57 t ha<sup>-1</sup>); T8: 100% RDN through FYM (33% @ 3.75 t ha<sup>-1</sup>) + vermicompost (33% @ 1.66 t ha<sup>-1</sup>) + neem cake (33% @ 0.57 t ha<sup>-1</sup>) + Bio-fertilizers (*Azospirillum*+PSB); T9: 100 % RDN through urea (0.195 t ha<sup>-1</sup>). The biofertilizers viz., *Azospirillum* and PSB were applied at the rate of 2.0 kg per hectare in all the treatment combinations.

### Collection and preparation of soil samples for chemical analysis

Soil samples were collected randomly from plough layer depth with the help of soil sampling auger before sowing and after harvesting the crop from each treatment. The collected samples were mixed thoroughly and dried in air, crushed, sieved through 2 mm sieve. The soil samples so prepared were subjected to chemical analysis for evaluating soil fertility status by following standard procedures. Different methods adopted for chemical analysis of soil samples have been described as below.

### Analysis of available nitrogen (kg ha<sup>-1</sup>) content in plant and soil samples

Determination of uptake and available nitrogen content in plant and soil samples was done by alkaline permanganate method as suggested by Subbiah and Asija (1956) [8].

### Analysis of available phosphorus (kg ha<sup>-1</sup>) content in plant and soil samples

The uptake and available content of phosphorous in both plant and soil samples was determined by using Olsen's method described by Jackson (1967) [7].

### Analysis of available potassium (kg ha<sup>-1</sup>) content in plant and soil samples

The uptake and available amounts of potassium in plant and soil samples was determined by using flame photometer method explained by Muhr *et al.* (1965) [5].

### Uptake of nutrient content by plant

Uptake of nutrients like N, P and K was computed by using the data on nutrient contents of plant and dry matter yields using the following formula and expressed as kg ha<sup>-1</sup>

Macronutrient status of soil was estimated as per the procedures described above just before sowing and the available soil nutrients status was reported to be as N @ 210 (kg ha<sup>-1</sup>), P<sub>2</sub>O<sub>5</sub> @ 15.4 (kg ha<sup>-1</sup>) and K<sub>2</sub>O @ 411 (kg ha<sup>-1</sup>).

### Results and discussion

The data pertaining to plant nutrient uptake in senna cv. 'Sona' was presented in Table 1. The results showed that significantly maximum nitrogen uptake (174.87 kg ha<sup>-1</sup>) by plant was observed by the application of 100% RDN through urea and was found at par with 100% RDN through vermicompost in combination with bio-fertilizers viz., *Azospirillum* and PSB (158.08 kg ha<sup>-1</sup>), whereas, significantly maximum phosphorous and potassium uptake was noticed with the application of 100% RDN through vermicompost in combination with bio-fertilizers viz., *Azospirillum* and PSB. Significantly increased uptake of nitrogen content observed in the plant by the application of 100% RDN through urea might be due to readily available form of nitrogen which was provided in the form of split applications. Significant positive correlation was noticed between the total uptake of N, P and K with yield indicating their contribution in increasing the leaf and pod yields. Similar kind of observation was also recorded by Rao *et al.* (2015) [2]. Further, treatments with bio-fertilizers recorded more plant nutrient uptake than the treatments without bio-fertilizers. This might be due to the fact that, bio-fertilizers enhanced the nutrient uptake in plant by producing some growth promoting substances near the root zone, which further helped in increasing the nutrient uptake in to the plant parts.

The data pertaining to post-harvest soil fertility status in senna cv. 'Sona' was presented in Table 1. The results obtained showed that significantly highest post-harvest soil fertility status of nitrogen (168.65 kg ha<sup>-1</sup>) was observed with the application of 100% RDN through neem cake and was found at par with the application of 100% RDN through FYM (33%) in combination

with vermicompost (33%) and neem cake (33%) as well as 100% RDN through vermicompost and 100% RDN through FYM. Significantly the lowest post-harvest soil fertility status of nitrogen content in the soil (74.97 kg ha<sup>-1</sup>) was observed with the application of 100% RDN through urea.

Application of 100% RDN through vermicompost in combination with bio-fertilizers viz., *Azospirillum* and PSB resulted in significantly highest post-harvest soil fertility status of phosphorous content in the soil (101.82 kg ha<sup>-1</sup>) when compared with all other treatments the reason being presence of more phosphorous content in the vermicompost, while significantly the lowest post-harvest soil fertility status of phosphorous content in the soil (37.22 kg ha<sup>-1</sup>) was noticed with the application of 100% RDN through urea.

Significantly highest postharvest soil fertility status of potassium content in the soil (440.51 kg ha<sup>-1</sup>) was found with the application of 100% RDN through neem cake followed by

application of 100% RDN through FYM (430.40 kg ha<sup>-1</sup>). Significantly lowest postharvest soil fertility status of potassium content in the soil (333.87 kg ha<sup>-1</sup>) was noticed with the application of 100% RDN through vermicompost in combination with bio-fertilizers viz., *Azospirillum* and PSB. The post-harvest soil fertility status of different macronutrients content in the soil was found significantly highest in the treatments without bio-fertilizers than the

treatments with bio-fertilizers. This might be due to the fact that the treatments with bio-fertilizers made the nutrients more available to plants due to production of some growth promoting substances due to the biological action of microbes present in the bio-fertilizers. So that, the uptake of macronutrients content was more in the treatments with bio-fertilizers and this might be the reason for presence of more soil fertility in the treatments without bio-fertilizers.

**Table 1:** Influence of organic manures and bio-fertilizers on nutrient uptake and post-harvest soil fertility status (kg ha<sup>-1</sup>) in senna cv. 'Sona'.

Treatments	Nutrient uptake (kg ha <sup>-1</sup> ) at harvest			Post-harvest soil fertility (kg ha <sup>-1</sup> )		
	N <sub>2</sub>	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	N <sub>2</sub>	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
100 % RDN through FYM (11.25 t ha <sup>-1</sup> )	82.63	28.78	84.72	162.57	62.38	430.4
100 % RDN through vermicompost (5 t ha <sup>-1</sup> )	86.30	29.74	87.46	162.80	82.46	418.77
100 % RDN through neem cake (1.73 t ha <sup>-1</sup> )	85.35	29.45	86.94	168.65	69.28	440.51
100 % RDN through FYM (11.25 t ha <sup>-1</sup> ) + Bio-fertilizers ( <i>Azospirillum</i> + PSB)	103.47	36.54	128.67	142.53	71.06	387.95
100 % RDN through vermicompost (5 t ha <sup>-1</sup> ) + Bio-fertilizers ( <i>Azospirillum</i> + PSB)	158.08	48.22	173.84	91.83	101.82	333.87
100 % RDN through neem cake (1.73 t ha <sup>-1</sup> ) + Bio-fertilizers ( <i>Azospirillum</i> + PSB)	106.7	39.04	131.1	149.42	79.54	397.09
100 % RDN through FYM (33 %) (3.75 t ha <sup>-1</sup> ) + vermicompost (33 %) (1.66 t ha <sup>-1</sup> ) + neem cake (33 %) (0.57 ha <sup>-1</sup> )	86.02	31.16	87.69	163.10	71.05	426.14
100 % RDN through FYM (33 %) (3.75 t ha <sup>-1</sup> ) + vermicompost (33 %) (1.66 t ha <sup>-1</sup> ) + neem cake (33 %) (0.57 ha <sup>-1</sup> ) + Bio-fertilizers ( <i>Azospirillum</i> + PSB)	105.23	38.83	129.48	144.89	80.12	385.03
100 % RDN through urea (0.195 t ha <sup>-1</sup> )	174.87	27.99	84.02	74.97	37.22	427.18
CD ( <i>P</i> = 0.05)	17.16	8.28	22.61	17.16	12.57	7.81
SEm ±	5.85	2.82	7.71	5.85	4.15	2.66

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