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Influence of organic manures and biofertilizers on germination, growth and yield attributes of senna (*Cassia angustifolia* Vahl.) cv. Cim-Sona under central Telangana conditions

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Abstract
A field experiment was conducted during the season *Rabi* 2024-25 at Post Graduate Institute for Horticultural Sciences, SKLTGHU, Mulugu to know the influence of organic manures and biofertilizers on germination, growth and yield attributes of Senna (*Cassia angustifolia* Vahl.) cv. CIM-Sona. The experiment was laid out in a Randomized Block Design (RBD) with ten treatments and three replications. Significantly highest percentage of germination (83.87%) was observed with application of T_5-Vermicompost (6 t/ha) + AMC (7.5 l/ha), while growth parameters *viz.,* plant height (85.30 cm), no. of branches (16.60), leafarea (2792.23 mm^2) and yield parameters like fresh leaf yield/ha, dry leaf yield/ha, fresh pod yield/ha and dry pod yield/ha was observed best with application of T_8- Vermicompost (6 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3% whereas lowest germination, growth and yield parameters was observed in treatment T_{10} - control.

Keywords: Organic manures, bio-fertilizers, vermicompost, FYM, neemcake, AMC

Introduction
Cassia angustifolia, belongs to the family leguminaceae commonly known as "Swarnapatri or Sonamukhi" is one of the widely used medicinal herb in ayurveda, unani and also in the allopathic system of medicine. Leaves and pods of senna are predominantly cultivated and exported from India. In International trade, Indian senna leaves and pods are prized as good sources of sennosides. The annual production of senna herb is estimated to be over 7500 tonnes (Naik *et al.*, 2023) [16]. This herb is mainly cultivated across various Indian states *viz*., Tamil Nadu, Andhra Pradesh, Rajasthan, Gujarat, especially in southern India, districts of Madurai, Ramanathapuram, Tiruchirapally and Tinnevelley of Tamilnadu (Basak and Gajbhiye, 2018) [4]. Senna contains compounds such as sennosides A, B, C, D, rhein, aloe-amine, kaempferol and iso-rhein in both their free and glycosidic forms these compounds stimulate the intestinal muscles and promote purgation, making senna a valuable natural laxative (Farooqui and Sreeramulu, 2014) [7]. It grows well in fertile sandy loam, laterite soils, but it is primarily grown on red loams, alluvial loams and gravelly coarse soils. The pH range of the soil in which the crop can be cultivated is 7.0 - 8.5. It requires moderate temperatures and dry weather. It is also grown successfully as a perennial crop for leaf yield in the hot arid conditions of Rajasthan, where the temperature is around 45°C from May to June (Lal *et al.*, 2023) [12]. Medicinal and aromatic plants are key source of raw materials for the pharmaceutical, cosmetic, and drug industries. Due to their importance, there's a strong need to increase the production of their biomass without using harmful chemicals. Adopting organic farming practices, such as using organic fertilizers and biofertilizers, can improve the yield and quality of these plants (Badalingappanavar *et al.*, 2018) [3]. Chemical fertilizer applications have resulted in ecological issues, deteriorated soil fertility, and lead to decreased agricultural yields. Replacing chemical fertilizer is very crucial for protecting the environment, preserving soil fertility and for enhancing sustainable crop yields. Microbial inoculants, or biofertilizers and organic manures together will be a great replacement for chemical fertilizers (Liaqat *et al.*, 2018) [14].

To maintain sustainable agriculture in the future, using organic manures and biofertilizer to meet a crop's nutrient needs will be essential. Organic manures are key because they enhance the soil's physical, chemical, and biological properties. This, in turn, helps the soil retain moisture, which leads to improved crop growth, productivity and higher quality produce. Premsekhar and Rajashree (2009) [19]. In view of this background, this study was aimed to evaluate the effect of different organic manuresand biofertilizers on germination and growth attributes of senna.

Materials and methods

The present study was conducted during the season *Rabi* 2024-25 at Post Graduate Institute for Horticultural Sciences, SKLTGHU, Mulugu. The experiment was laid out in Randomized Block Design (RBD) with 10 treatments and 3 replications. The treatments used in this experiment are as follows: T_1- FYM (12 t/ha), T_2- Vermicompost (6 t/ha), T_3- Neem cake (2 t/ha), T_4- FYM (12 t/ha) +AMC (7.5 l/ha), T_5 - Vermicompost (6 t/ha) + AMC (7.5 l/ha), T_6- Neem cake (2 t/ha) + AMC (7.5 l/ha), T_7- FYM (12 t/ha) + AMC (7.5 l/ha) + Panchagavya @3%, T_8- Vermicompost (6 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3%, T_9-Neem cake (2 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3%, T_{10}- Control (No application). All the manures were applied according to treatment wise one week before sowing and incorporated into the soil. Foliar application of Panchagavya was performed at monthly interval. Germination, growth and yield observations were recorded from five randomly selected plants per treatment per replication. The data pertaining to germination, growth and yield parameters *viz*., Number of days taken for seed germination, Percentage of seed germination (%), Plant height (cm), Number of branches per plant (No's), Leaf area (mm^2), pod length (cm), pod width (cm), fresh leaf yield/hectare (q), dry leaf yield/hectare (q), fresh pod yield/hectare (q) and dry pod yield/hectare (q). The collected data were subjected to statistical analysis to know the effect of organic manures and biofertilizers treatments on germination, growth and yield attributes of senna, following the procedures outlined by Panse and Sukhatme (1985) [18].

Results and discussion

1. Germination Parameters

The data related to germination parameters, including number of days taken for seed germination and percentage of seed germination (%) were detailed in Table 1.

1.1 Number of days taken for seed germination

The data pertaining to number of days taken for germination as influenced by different organic manures and biofertilizer on senna recorded during the experiment was found non-significant among the treatments.

1.2 Percentage of seed germination

The percentage of seed germination exhibited significant difference with respect to treatments. The maximum percentage of germination (83.87%) was observed with treatment T_5-Vermicompost (6 t/ha) + AMC (7.5 l/ha) whereas minimum percentage of germination (75.35%) was recorded with treatment T_{10}-control (no application). This difference might be due to vermicompost is a highly effective organic amendment due to its rich nutrient content, beneficial microbial population in AMC has positive influence on soil physical and chemical properties. It provides an ideal environment for seeds to break dormancy and establish strong, healthy seedlings. These results are in accordance Amooaghaie and Golmohammadi (2017) [1] in thyme, Shariff *et al.* (2017) [23] in greengram, and Subbaiah *et al.* (2018) [25] in brinjal.

2 Growth Parameters

2.1 Plant height

Plant height is a fundamental trait that significantly influences overall growth, and development of plant. The influence of organic manures and biofertilizers on plant height was measured at 45, 60, 90, 120 and 150 DAS were presented in Table 2.

Significant differences were observed in plant height (31.77, 54.90, 73.03 and 85.30 cm at intervals of 60, 90, 120 and 150 DAS respectively) by the application oftreatment T_8 - Vermicompost (6 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3%, while least plant height (25.90, 45.33, 59.60 and 73.87cm at 60, 90, 120 and 150 DAS respectively) was observed in T_{10}-control (no application).

The increase in plant height with application of treatment T_8 over other treatments was due to vermicompost contains various nutrients and plant hormones which directly stimulate cell division and elongation, leading to increased stem length and plant height. (Canellas *et al.* 2002) [5]. According to Aswathi *et al.* (2020) [2] Arka microbial consortium works by improving nutrient cycling, solubilizing essential minerals and foliar application of panchagavya enhances photosynthetic activity that surplus energy can then be directed towards increasing plant height (Nilakhi *et al.*, 2023). These results are in harmony with Suresh *et al.* (2018) [26] in mint, Chandana *et al.* (2022) [6] in turmeric and Sharma *et al.* (2023) [24] in pea.

2.2 Number of branches per plant

There was a notable difference observed among the treatments was depicted in Table 3. Maximum number of branches per plant (9.21, 13.16 and 16.60 at 90, 120 and 150 DAS respectively) was recorded in the treatment T_8-Vermicompost (6 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3% andthe minimum number of branches (6.77, 9.79 and 11.83 at 90, 120 and 150 DAS respectively) were observed in T_{10} -Control (No application).

Increase in number of branches might be due to vermicompost and AMC provide a range of phytohormones to the rhizosphere, further stimulating root growth and nutrient uptake, which in turn supports the development of new shoots and branches. According to Golakiya *et al.* (2019) [8] effect of the inherent hormones in panchagavya delivers a quick boost of essential nutrients and naturally occurring plant growth regulators, cytokinins are particularly important for stimulating cell division and promoting the growth of lateral buds, leading to increased branching and a bushier plant habit. These results were in accordance with Raiyani *et al.*, 2018 [20] in fenugreek, Muruganandam *et al.* (2022) [15] in senna and Latifi *et al.* (2024) [13] in mint.

2.3 Leaf area

A considerable difference was observed in leaf area at 150 days after sowing was depicted in Table 4. Maximum leaf area (2792.23 mm^2) was recorded in the treatment T_8 which was applied with Vermicompost (6 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3%, while minimum leaf area (2500.63 mm^2) was observed in T_{10}- control (No application).

As nitrogen is a key component of chlorophyll the enhanced nutrient mobilization directly fuels vegetative growth, including leaf expansion. A larger leaf area directly translates to a greater surface for light interception combined with increased chlorophyll, this leads to significantly enhanced photosynthetic rates further driving plant growth and leaf development. The above results are in conformity with Sendhilnathan *et al.* (2017) in gundumalli, Rather *et al.* (2018) [21] in lettuce, Hadke *et al.* (2019) [10] in safed musli, Chandana *et al.* (2022) [6] in turmeric and Gunda *et al.* (2022) [9] in sweetbasil.

2.4 Pod length and width

The data pertaining to pod length and width as influenced by different organic manures and biofertilizer on senna was detailed in Table 4, it was found that there was no significant variation observed among the different treatments recorded at harvest (150 DAS).

3. Yield parameters

The data revealed that all the treatments significantly influenced fresh leaf, pod yield and dry leaf, pod yield of senna and are mentioned in Table 5 and 6. Maximum fresh leaf yield per hectare (84.78 q/ha) and dry leaf yield per hectare (21.30 q/ha) from cumulative yield of 90, 120 and 150 DASwas found in the treatment T_8 and minimum fresh leaf yield per hectare (50.40 q/ha) and dry leaf yield per hectare (13.01 q/ha) was observed in the treatment T_{10} -Control (No application). Among all the treatment applied significantly higher values was found for fresh pod yield (55.34 q/ha) and dry pod yield (10.87 q/ha) with application of T_8 whereas in treatment T_{10} lowest values for fresh pod yield (31.57 q/ha) and dry pod yield (6.50 q/ha) was observed.

Highest yield obtained with treatment T_8 this may be attributed due to the components present in vermicompost, AMC and panchagavya that helped in increased plant height, number of branches, enhanced root growth and weight during the crop growth period which promoted vigorous vegetative growth, including increased leaf size, number of leaves, and overall biomass, directly translating to higher fresh leaf and ultimately higher dry leaf yield. These findings are in line with the reports of Kumar *et al.* (2018) in senna, Kenea and Gedamu (2019) in garlic, Vali *et al.* (2020a) in senna and Gunda *et al.* (2022) [9] in sweetbasil.

Conclusion

From the present study it can be concluded that application of Vermicompost (6 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3% (T_8) resulted in highest germination, growth and yield parameters which is due to synergistic effect of vermicompost, Arka Microbial Consortium, and panchagavya on soil health, nutrient availability, plant growth and development. Vermicompost, a highly effective organic amendment along with AMC provides a wide range of phytohormones to the rhizosphere, stimulating nutrient uptake, further panchagavya delivers essential nutrients and naturally occurring plant growth regulators directly to the leaves, this enhanced nutrient availability and mobilization directly fuels vegetative and reproductive growth which promoted overall plant vigour and increased yield.

Table 1: Effect of organic manures and biofertilizer on days taken for seed germination and percentage of seeds germination (%)

Treatments		No. of days taken for germination (days)	Percentage of seed germination (%)
T_1	FYM (12 t/ha)	5.67	77.17^{c}
T_2	Vermicompost (6 t/ha)	5.33	80.27^{b}
T_3	Neem cake (2 t/ha)	5.67	79.00^{bc}
T_4	FYM (12 t/ha) +AMC (7.5 l/ha)	5.67	81.17^{ab}
T_5	Vermicompost (6 t/ha) + AMC (7.5 l/ha)	4.67	83.87^{a}
T_6	Neem cake (2 t/ha) + AMC (7.5 l/ha)	5.33	81.50^{ab}
T_7	FYM (12 t/ha) + AMC (7.5 l/ha) + Panchagavya @3%	5.33	82.40^{ab}
T_8	Vermicompost (6 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3%	4.67	83.33^{a}
T_9	Neem cake (2 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3%	5.00	81.43^{ab}
T_{10}	Control (No application)	6.33	75.35^{d}
	Over all Mean	5.37	80.55
SE(m) ±		0.33	1.14
CD at 5%		NS	3.46
C.V		10.70	2.45

Table 2: Effect of organic manures and biofertilizer on plant height (cm) at 45, 60, 90, 120 and 150 DAS in senna

Treatments		Plant height (cm)				
		45 DAS	60 DAS	90DAS	120DAS	150 DAS
T_1	FYM (12 t/ha)	18.70	26.40^{c}	46.93^{d}	61.77^{cd}	76.67^{d}
T_2	Vermicompost (6 t/ha)	19.27	27.50^{bc}	49.03^{bc}	62.73^{c}	79.13^{bc}
T_3	Neem cake (2 t/ha)	19.00	26.90^{bcd}	47.73^{c}	62.37^{cd}	77.97^{c}
T_4	FYM (12 t/ha) +AMC (7.5 l/ha)	19.70	27.97^{b}	49.83^{b}	63.53^{b}	79.20^{b}
T_5	Vermicompost (6 t/ha) + AMC (7.5 l/ha)	21.57	29.30^{abcd}	52.33^{abc}	68.03^{abc}	82.97^{abc}
T_6	Neem cake (2 t/ha) + AMC (7.5 l/ha)	20.53	28.57^{abcd}	51.03^{abc}	67.43^{abc}	81.33^{abc}
T_7	FYM (12 t/ha) + AMC (7.5 l/ha) + Panchagavya @3%	20.73	30.50^{abc}	53.10^{ab}	69.17^{ab}	82.10^{abc}
T_8	Vermicompost (6 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3%	22.07	31.77^{a}	54.90^{a}	73.03^{a}	85.30^{a}
T_9	Neem cake (2 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3%	21.10	30.60^{ab}	53.77^{ab}	71.20^{a}	84.20^{ab}
T_{10}	Control (No application)	17.80	25.90^{d}	45.33^{e}	59.60^{d}	73.87^{e}
	Over all Mean	20.05	28.54	50.40	65.89	80.27
	SE(m) ±	1.32	1.23	1.60	1.92	1.65
	CD at 5%	NS	3.75	4.87	5.81	5.02
	C.V	8.37	7.49	5.52	5.04	3.57

Table 3: Effect of organic manures and biofertilizer on No. of branches per plant at 90, 120 and 150 DAS in senna

Treatments		No. of branches per plant		
		90 DAS	120 DAS	150 DAS
T_1	FYM (12 t/ha)	7.04^{cd}	10.07^{cd}	12.10^{d}
T_2	Vermicompost (6 t/ha)	7.67^{bcd}	10.57^{c}	13.37^{bc}
T_3	Neem cake (2 t/ha)	7.20^{c}	10.11^{cd}	12.97^{c}
T_4	FYM (12 t/ha) +AMC (7.5 l/ha)	7.70^{bc}	11.31^{b}	14.30^{b}
T_5	Vermicompost (6 t/ha) + AMC (7.5 l/ha)	8.27^{ab}	12.72^{ab}	15.30^{abc}
T_6	Neem cake (2 t/ha) + AMC (7.5 l/ha)	7.97^{b}	12.07^{ab}	14.80^{abc}
T_7	FYM (12 t/ha) + AMC (7.5 l/ha) + Panchagavya @3%	8.40^{ab}	12.47^{ab}	15.67^{ab}
T_8	Vermicompost (6 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3%	9.21^{a}	13.16^{a}	16.60^{a}
T_9	Neem cake (2 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3%	8.70^{ab}	12.90^{a}	16.23^{a}
T_{10}	Control (No application)	6.77^{d}	9.79^{d}	11.83^{e}
	Over all Mean	7.89	11.51	14.32
	SE(m) ±	0.32	0.44	0.72
	CD at 5%	0.97	1.32	2.18
	C.V	7.03	6.56	8.67

Table 4: Effect of organic manures and biofertilizer on leaf area (mm^2), Pod length (cm) and Pod width (cm) in senna

Treatments		Leaf Area (mm^2)	Pod length (cm)	Pod width (cm)
T_1	FYM (12 t/ha)	2531.67^{de}	4.71	1.41
T_2	Vermicompost (6 t/ha)	2573.30^{cd}	4.81	1.42
T_3	Neem cake (2 t/ha)	2544.23^{d}	4.78	1.42
T_4	FYM (12 t/ha) +AMC (7.5 l/ha)	2605.90^{b}	4.85	1.45
T_5	Vermicompost (6 t/ha) + AMC (7.5 l/ha)	2586.80^{c}	4.93	1.51
T_6	Neem cake (2 t/ha) + AMC (7.5 l/ha)	2668.83^{abc}	4.73	1.49
T_7	FYM (12 t/ha) + AMC (7.5 l/ha) + Panchagavya @3%	2704.27^{abc}	4.86	1.50
T_8	Vermicompost (6 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3%	2792.23^{a}	5.10	1.53
T_9	Neem cake (2 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3%	2752.17^{ab}	4.94	1.52
T_{10}	Control (No application)	2500.63^{e}	4.63	1.38
	Over all Mean	2626.00	4.83	1.46
	SE(m) ±	3.11	0.03	0.03
	CD at 5%	143.25	NS	NS
	C.V	47.22	1.03	2.08

Table 5: Effect of organic manures and biofertilizer on Fresh leaf yield/ha (q) and fresh pod yield/ha (q) in senna

Treatments		Fresh leaf yield / ha (q)				Fresh pod yield/ha (q)
		90 DAS	120 DAS	150 DAS	Total yield (q)	150 DAS
T_1	FYM (12 t/ha)	18.18^{f}	24.66^{f}	13.79^{de}	56.64	35.15^{f}
T_2	Vermicompost (6 t/ha)	20.46^{de}	27.36^{d}	14.70^{d}	62.52	40.78^{de}
T_3	Neem cake (2 t/ha)	19.68^{e}	25.74^{e}	14.46^{de}	59.88	37.92^{e}
T_4	FYM (12 t/ha) +AMC (7.5 l/ha)	21.30^{d}	28.62^{c}	15.72^{c}	65.64	42.08^{d}
T_5	Vermicompost (6 t/ha) + AMC (7.5 l/ha)	23.58^{b}	30.90^{abc}	19.08^{bc}	73.56	50.43^{b}
T_6	Neem cake (2 t/ha) + AMC (7.5 l/ha)	22.62^{c}	30.18^{c}	17.46^{bcd}	70.26	45.61^{c}
T_7	FYM (12 t/ha) + AMC (7.5 l/ha) + Panchagavya @3%	25.38^{abc}	31.26^{abc}	19.68^{b}	76.32	52.27^{ab}
T_8	Vermicompost (6 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3%	27.60^{a}	33.96^{a}	23.22^{a}	84.78	55.34^{a}
T_9	Neem cake (2 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3%	26.66^{ab}	32.82^{ab}	20.88^{ab}	80.36	53.81^{a}
T_{10}	Control (No application)	15.60^{g}	22.44^{g}	12.36^{e}	50.40	31.57^{g}
	Over all Mean	22.11	28.79	17.13	68.00	44.50
	SE(m) ±	1.08	1.11	1.14		1.07
	CD at 5%	3.26	3.36	3.47		3.24
	C.V	8.43	6.66	11.56		4.16

Table 6: Effect of organic manures and biofertilizer on dry leaf yield/ha (q) and dry pod yield/ha (q) in senna

Treatments		Dry leaf yield/ ha (q)				Fresh pod yield/ha (q)
		90 DAS	120 DAS	150 DAS	Total yield (kg)	150 DAS
T_1	FYM (12 t/ha)	4.56^{h}	6.37^{d}	3.70^{g}	14.63	7.63^{g}
T_2	Vermicompost (6 t/ha)	4.89^{f}	7.21^{c}	4.33^{e}	16.43	8.57^{e}
T_3	Neem cake (2 t/ha)	4.67^{g}	6.94^{c}	4.09^{f}	15.70	8.15^{f}
T_4	FYM (12 t/ha) +AMC (7.5 l/ha)	5.41^{e}	7.75^{b}	4.83^{d}	17.98	9.55^{d}
T_5	Vermicompost (6 t/ha) + AMC (7.5 l/ha)	5.64^{c}	7.92^{b}	5.01^{c}	18.57	9.95^{cd}
T_6	Neem cake (2 t/ha) + AMC (7.5 l/ha)	5.52^{d}	7.84^{b}	4.87^{d}	18.23	9.63^{d}
T_7	FYM (12 t/ha) + AMC (7.5 l/ha) + Panchagavya @3%	6.21^{b}	8.67^{a}	5.83^{b}	20.70	10.34^{bc}
T_8	Vermicompost (6 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3%	6.33^{a}	8.92^{a}	6.05^{a}	21.30	10.87^{a}
T_9	Neem cake (2 t/ha) + AMC (7.5 l/ha) + Panchagavya @ 3%	6.19^{b}	8.68^{a}	5.98^{a}	20.85	10.52^{ab}

T_{10}	Control (No application)	4.12^{i}	5.76^{e}	3.13^{h}	13.01	6.50^{h}
	Over all Mean	5.35	7.61	4.78	17.74	9.17
	SE(m) ±	1.07	0.11	0.04		0.13
	CD at 5%	0.10	0.33	0.11		0.41
	C.V	1.07	2.51	1.36		2.55

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