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Influence of organic manures and bio-stimulants on physiological parameters of Senna (*Cassia angustifolia* Vahl.)

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Abstract

Senna is an important medicinal plant of India particularly grown in drier parts. Young leaves and pods contain sennoside as active principle which is said to be laxative and purgative. Application of farm yard manure 6.25 t/ha, poultry manure 2 t/ha, vermicompost 2 t/ha and foliar spray of panchagavya 2 %, vermiwash 20 % and humic acid 0.1 % registered the highest chlorophyll 'a' (1.171 mg, 1.303 mg, 1.288 mg and 1.264 mg/g of leaf, respectively), chlorophyll 'b' (0.471 mg, 0.493 mg, 0.562 mg and 0.525 mg/g of leaf respectively) and total chlorophyll content (1.558 mg, 1.634 mg, 1.661 mg and 1.651 mg/g of leaves) at different growth stages *viz.*, 30, 60, 90 and 130 Days After Sowing (DAS), respectively. With the application of farm yard manure 6.25 t/ha, poultry manure 2 t/ha, vermicompost 2 t/ha and foliar spray of panchagavya 2 %, vermiwash 20 % and humic acid 0.1 % the maximum leaf area index of 1.88, 1.88 and 1.93 was registered at 60, 90 and 130 DAS, respectively. Similarly the highest crop growth rate of 7.67 g/m^2/day and dry matter production of 16.90 g, 34.65 g and 66.25 g/plant also recorded with the same treatment.

Key words: organic manures, bio-stimulants, senna, *Cassia anguistifolia*, chlorphyed, leaf area index

INTRODUCTION

Senna (*Cassia angustifolia* Vahl.) is a small perennial under shrub belonged to the family Ceasalpiniaceae. Senna is a much branched herb with strong tap root system. Leaves are bluish green in colour; leaflets are narrow with acute tip. The leaves and pods contain a glycoside, used mostly as laxatives all over the world. India is the major supplier of the senna leaves and pods as well as its glycosides to the world market. Approximately 75 per cent India's production is exported. In India, senna was first introduced in southern parts of Tamil Nadu i.e., Tirunelveli district and is rightly called as Tinneveli senna. Tamil Nadu ranks first in area and production of senna, which is commercially cultivated in Madurai, Ramnad, Virudhunagar, Tirunelveli and Tuticorin districts. Organic cultivation practices have been well documented in many crops. Since residual toxicity and microbial contamination have been reported in the crop due to the chemical intensive farming, there has been an exponential growth in the market for organic produce especially culinary herbs and botanicals all over the world. Any crop management practice should aim in keeping the physiological process of the plants in an active stage, so that the plants can produce biomass with the least destructive processes. A higher photosynthetic activity is a good indication of physiological efficiency in plants. This paper explains the influence of selected organic manures and bio-stimulants on selected physiolocial parameters of Senna (*Cassia angustifolia* Vahl.).

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MATERIALS AND METHODS

A field study was conducted to standardize the organic production technology of Senna (*Cassia angustifolia.* Vahl.) at the Botanic Garden of Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. Totally 23 treatments were tested

T_1 - Absolute control

T_2 - Recommended dose of fertilizers (75 : 25: 40 kg of NPK/ha)

T_3 - FYM (12.5 t/ ha)

T_4 - Poultry manure (4t/ha)

T_5 - Vermicompost (4t/ha)

T_6 - FYM (6.25t/ha) + Poultry manure (2t/ha)

T_7 - FYM (6.25 t/ha) + Vermicompost (2t/ha)

T_8 - Poultry manure (2t/ha) + Vermicompost (2t/ha)

T_9 - FYM (6.25t/ha) + Poultry manure (2t/ha) + Vermicompost (2t/ha)

T_{10} - FYM (12.5 t/ha) + spraying of Panchagavya (2 per cent) + Vermiwash (20 per cent) + Humic acid (0.1 per cent)

T_{11} - Poultry manure (4t/ha) + spraying of Panchagavya (2 per cent) + Vermiwash (20 per cent) + Humic acid (0.1 per cent)

T_{12} - Vermicompost (4t/ha) + spraying of Panchagavya (2 per cent) + Vermiwash (20 per cent) + Humic acid (0.1 per cent)

T_{13} - FYM (6.25 t/ha) + Poultry manure (2t/ha) + spraying of Panchagavya (2 per cent) + Vermiwash (20 per cent) + Humic acid (0.1 per cent)

T_{14} - FYM (6.25 t/ha) + Vermicompost (2t/ha) + spraying of Panchagavya (2 per cent) + Vermiwash (20 per cent) + Humic acid (0.1 per cent)

T_{15} - Poultry manure (2t/ha) + spraying of Panchagavya (2 per cent) + Vermiwash (20 per cent) + Humic acid (0.1 per cent)

T_{16} - FYM (6.25t/ha) + Poultry manure (2t/ha) + Vermicompost (2t/ha) + spraying of Panchagavya (2 per cent) + Vermiwash (20 per cent)+ Humic acid (0.1 per cent)

T_{17} - FYM (12.5 t/ha) + spraying of Plant Growth Promoting Microbes

T_{18} - Poultry manure (4t/ha) + spraying of Plant Growth Promoting Microbes

T_{19} - Vermicompost (4t/ha) + spraying of Plant Growth Promoting Microbes

T_{20} - FYM (6.25 t/ha) + Poultry manure (2t/ha) + spraying of Plant Growth Promoting Microbes

T_{21} - FYM (6.25 t/ha) + vermicompost (2t/ha) + spraying of Plant Growth Promoting Microbes

T_{22} - Poultry manure (2t/ha) + vermicompost (2t/ha) + spraying of Plant Growth Promoting Microbes and

T_{23} - FYM (6.25 t/ha) + Poultry manure (2t/ha) + vermicompost (2t/ha) + spraying of Plant Growth Promoting Microbes.

The field experiment was laid out in a randomized block design with three replications. Physiological parameters *viz.*, chlorophyll 'a' (mg/g of leaf), chlorophyll 'b' (mg/g of leaf), total chlorophyll (mg/g of leaf), leaf area index, crop growth rate ($g/m^2/day$) and dry matter production were recorded from randomly selected ten plants and the data were subjected to statistical analysis.

RESULTS AND DISCUSSION

The organic manures and bio stimulants tested have positive and significant influence on quality characters *viz.*, chlorophyll content, leaf area index, crop growth rate, nutrients uptake, total phenol content and dry matter production of *C. anguistifolia* (Tables 1-3).

Chlorophyll content

Chlorophyll content of senna leaves was measured at different growth stages *viz.*, 30, 60, 90 and 130 Days After Sowing (DAS). It was significantly influenced by different treatments. The highest chlorophyll 'a' (1.171 mg, 1.303 mg, 1.288 mg and 1.264 mg/g of leaf), chlorophyll 'b' (0.471 mg, 0.493 mg, 0.562 mg and 0.525 mg/g of leaf) and total chlorophyll content (1.558 mg, 1.634 mg, 1.661 mg and 1.651 mg/g of leaves) were registered with the treatment T_{16} (FYM 6.25 t/ha, poultry manure 2 t/ha, vermicompost 2 t/ha and foliar spray of panchagavya 2 per cent) vermiwash 20 per cent and humic acid 0.1 per cent for 60, 90 and 130 DAS, respectively. It was followed by the treatments T_{23} and T_{14}. The chlorophyll 'a' content of 1.110 mg, 1.110 mg, 1.118 mg and 1.102 mg/g of leaves, chlorophyll 'b' content of 0.422 mg, 0.419, 0.452 and 0.445 mg/g of leaf at 30, 60, 90 and 130 DAS, respectively, and total chlorophyll content of 1.434 mg, 1.462, 1.497 mg and 1.466 mg/g of leaves at 30, 60, 90 and 130 DAS, respectively, were recorded in the untreated control. Organic manures improve the soil physical condition and facilitates higher nutrient uptake in plants which might be the reason for triggering of the physiological activity of the system.

Active growth regulators present in panchagavya particularly the cytokinin due to the presence of coconut water is another possible reason for higher chlorophyll content in the leaves of Senna treated with Panchagavya. Sridhar *et al.* (2001) also reported that the coconut water spray increased the chlorophyll content in chillies. Similarly Kanimozhi (2003) also reported the influence of panchagavya on chlorophyll content in *Coleus forskohlii*.

Vermiwash is a rich source of macro - and micro-nutrients particularly N, Mg and Fe. Mg is an important component of chlorophyll which might have increased the chlorophyll content. N and Fe are the integral part of the chlorophyll structure and play a vital role in N fixation and pigment synthesis (Jayashree, 2006).

Leaf area index

The maximum leaf area indices of 1.88, 1.88 and 1.93 were registered with combined application of organic manures and biostimulants at 60, 90 and 130 DAS, respectively. It was closely followed by T_{23} and T_{14}. The untreated control registered only 0.97, 1.07 and 1.2 Leaf Area Index (LAI) at 60, 90 and 130 DAS, respectively. Leaf area index is a positive indication on plant growth with a direct influence on net photosynthetic activity of the plant. In the present study, greater LAI was observed with application of FYM, poultry manure and vermicompost and foliar spraying of panchagavya, vermiwash and humic acid. This might be possible due to higher uptake of nutrients owing to the improved physical condition of soil by the application of FYM, poultry manure and vermicompost. The results are in line with the findings of Amanullah (1997) in cassava. The application of FYM could have increased the friability, aggregation and the level of humus in soil there by enhancing the microbial activity and synthesis of phytohormones necessary for plant growth and development.

Another possible reason for the increase in the leaf area might be the spraying of biostimulants which have growth promoting substances like IAA and GA. Natarajan (2002) observed that panchagavya sprayed plants produced comparatively large sized leaves and also there was no chlorotic symptom which might be due to the availability of macro - and micro-nutrients necessary for the synthesis of chlorophyll.

Crop Growth Rate

The physiological parameters always play a vital role in the yield of any crop. The crop growth rate (CGR) is

Table 1. Effect of organic inputs on chlorophyll content (mg / g) of *Cassia angustifolia*

Treatments	Chlorophyll 'a'				Chlorophyll 'b'				Total chlorophyll			
	30 DAS*	60 DAS	90 DAS	130 DAS	30 DAS	60 DAS	90 DAS	130 DAS	30 DAS	60 DAS	90 DAS	130 DAS
T_1	1.110	1.110	1.118	1.102	0.422	0.419	0.452	0.445	1.434	1.462	1.497	1.466
T_2	1.135	1.183	1.144	1.143	0.462	0.436	0.468	0.451	1.484	1.571	1.588	1.562
T_3	1.137	1.203	1.102	1.105	0.450	0.462	0.452	0.445	1.467	1.572	1.573	1.568
T_4	1.143	1.193	1.113	1.115	0.449	0.462	0.463	0.451	1.457	1.591	1.590	1.564
T_5	1.141	1.194	1.066	1.084	0.449	0.467	0.466	0.466	1.515	1.555	1.503	1.504
T_6	1.126	1.206	1.105	1.112	0.438	0.454	0.458	0.456	1.518	1.557	1.512	1.506
T_7	1.123	1.218	1.091	1.074	0.446	0.473	0.442	0.433	1.514	1.559	1.593	1.504
T_8	1.142	1.218	1.093	1.104	0.435	0.458	0.445	0.443	1.497	1.541	1.513	1.504
T_9	1.122	1.203	1.094	1.106	0.460	0.467	0.463	0.437	1.515	1.567	1.533	1.513
T_{10}	1.113	1.226	1.140	1.127	0.429	0.456	0.478	0.456	1.487	1.516	1.504	1.485
T_{11}	1.116	1.226	1.247	1.193	0.430	0.410	0.456	0.455	1.468	1.588	1.494	1.473
T_{12}	1.134	1.279	1.255	1.256	0.456	0.433	0.453	0.454	1.489	1.445	1.527	1.504
T_{13}	1.125	1.263	1.275	1.247	0.428	0.466	0.454	0.465	1.518	1.584	1.591	1.518
T_{14}	1.148	1.281	1.283	1.226	0.462	0.485	0.496	0.446	1.523	1.598	1.641	1.601
T_{15}	1.120	1.252	1.199	1.221	0.446	0.468	0.448	0.434	1.513	1.533	1.641	1.553
T_{16}	1.171	1.303	1.288	1.264	0.471	0.493	0.562	0.525	1.558	1.634	1.661	1.651
T_{17}	1.125	1.268	1.241	1.211	0.431	0.459	0.458	0.456	1.456	1.456	1.646	1.594
T_{18}	1.126	1.253	1.200	1.172	0.447	0.467	0.451	0.452	1.500	1.476	1.612	1.596
T_{19}	1.118	1.223	1.180	1.159	0.44	0.460	0.447	0.4471	1.507	1.473	1.651	1.599
T_{20}	1.139	1.236	1.186	1.126	0.446	0.454	0.445	0.427	1.525	1.435	1.640	1.605
T_{21}	1.117	1.264	1.204	1.206	0.431	0.471	0.475	0.448	1.543	1.475	1.652	1.614
T22	1.120	1.241	1.241	1.257	0.446	0.459	0.443	0.415	1.513	1.473	1.601	1.557
T23	1.155	1.286	1.284	1.156	0.462	0.492	0.510	0.506	1.553	1.634	1.650	1.641
Mean	1.120	1.200	1.180	1.164	0.445	0.460	0.465	0.453	1.502	1.535	1.583	1.552
SE (d)	0.010	0.022	0.028	0.016	0.010	0.008	0.015	0.022	0.019	0.024	0.022	0.067
CD (at 5%)	0.030	0.046	0.059	0.033	0.021	0.017	0.032	0.046	0.041	0.049	0.046	0.140

* Days After Sowing (DAS)

Table 2. Effect of organic inputs on leaf area index, dry matter production and crop growth rate of *Cassia angustifolia*

Treatments	Leaf area index			Dry matter production (g/plant)			Crop Growth Rate ($g/m^2/day$)
	60 DAS*	90 DAS	130 DAS	60 DAS	90 DAS	130 DAS	
T_1	0.97	1.07	1.20	9.10	19.20	34.15	3.97
T_2	1.68	1.68	1.74	15.10	28.50	54.60	6.26
T_3	1.49	1.49	1.57	12.50	22.60	49.85	5.92
T_4	1.42	1.42	1.53	12.60	23.10	49.10	5.79
T_5	1.39	1.39	1.51	12.90	23.30	50.95	6.03
T_6	1.49	1.49	1.60	12.80	23.75	50.70	6.01
T_7	1.51	1.53	1.59	13.30	23.40	51.95	6.13
T_8	1.42	1.42	1.57	12.90	23.70	50.95	6.03
T_9	1.57	1.57	1.77	13.20	24.20	52.15	6.18
T_{10}	1.59	1.59	1.71	13.90	27.85	52.30	6.09
T_{11}	1.52	1.52	1.62	14.20	27.10	51.55	5.92
T_{12}	1.55	1.55	1.62	14.30	28.35	54.90	6.44
T_{13}	1.59	1.59	1.66	14.30	30.30	57.50	6.85
T_{14}	1.72	1.72	1.78	15.55	31.70	60.15	7.07
T_{15}	1.52	1.52	1.62	14.55	30.40	58.25	6.93
T_{16}	1.88	1.88	1.93	16.90	34.65	65.25	7.67
T_{17}	1.56	1.56	1.73	13.50	29.85	52.10	6.12
T_{18}	1.57	1.57	1.63	14.25	28.85	53.55	6.23
T_{19}	1.58	1.58	1.67	14.55	30.10	54.75	6.38
T_{20}	1.61	1.61	1.66	14.15	29.70	56.40	6.70
T_{21}	1.70	1.70	1.76	15.15	29.85	56.20	6.51
T_{22}	1.58	1.60	1.74	15.30	29.60	56.35	6.51
T_{23}	1.76	1.76	1.83	15.75	31.90	60.60	7.11
Mean	1.36	1.55	1.65	13.94	27.47	53.66	7.46
SE (d)	0.04	0.02	0.04	0.20	0.48	0.48	0.34
CD (at 5%)	0.08	0.04	0.09	0.43	1.00	0.99	0.71

* Days After Sowing (DAS)

defined as the rate at which dry matter is produced per unit area of land per unit time. If the crop growth rate is more, it leads to accumulation of more dry matter in the plants. In the present study, the combined application of organic manures and foliar spray of bio stimulants exhibited a greater CGR in Senna.

The data on crop growth rate is presented in the Table 2. The treatment with the combination of basal application of FYM 6.25 t/ha, poultry manure + 2 t/ha vermicompost 2 t/ha + foliar spray of panchagavya 2 per cent, vermiwash 20 per cent and humic acid 0.1 per cent (T_{16}) registered the highest crop growth rate of 7.67 g/m^2/ day. It was followed by the treatment T_{23} and T_{14} which registered 7.11g/m^2/day and 7.07 g/m^2/day, respectively, which were on par with each other. The control registered the lowest value of 3.97 g/m^2/day. Organic manures are decomposed products which significantly increases the soil organic carbon, N and P content. FYM and poultry manure facilitate the continuous and slow release of nutrients and other organic compounds in soil that would have increased the efficiency of plants with enhanced uptake of nutrients, which resulted in increased crop growth rate as reported by Chakravarthi (2000).

Dry matter production

From the Table 2 it has been inferred that different nutrient sources contributed for increased dry matter production in Senna. Application of organic manures and spraying of bio stimulants significantly increased the dry matter production. The maximum dry matter production of 16.90 g, 34.65 g and 66.25 g/plant at 60, 90 and 130 DAS, respectively, was recorded in the treatment consisting of basal application of FYM 6.25 t/ ha, poultry manure 2 t/ha + vermicompost 2 t/ha + foliar spray of panchagavya 2 %, vermiwash 20 % and humic acid 0.1 % (T_{16}). It was closely followed by T_{23} and T_{14} which registered 15.758, 81.90 g and 60.60 g / plant and 15.55g, 31.70 and 60.15 g / pl at 60, 90 and 130 DAS, respectively. The lowest values of 9.10 g 19.20 and 34.15 g/plant at 60, 90 and 130 DAS, respectively, were recorded with the untreated control plots. This might be due to the positive effect of increased growth characters *viz.*, plant height, number of branches, plant spread and physiological characters such as chlorophyll content and CGR observed with the application of FYM, poultry manure and vermicompost. The organic manures improved the physical status of soil and increased the soil microbial activity resulting in higher uptake of available nutrients. This would have greatly enhanced the morphological and physiological characters leading to higher dry matter production. Further, maintenance of slow and continuous release of nutrients from the organic manure throughout the cropping period made the plant more active and increased the growth rate.

Panchagavya not only supplied IAA, macro - and micro-nutrients, but also enhanced the activity of IAA which might have promoted the dry matter production. Similar trend was also reported by David *et al.* (1994) in tomato. With regard to humic acid, the presence of quinones might be the reason for increased dry matter production (Raina and Goswami, 1988). The quinones help in the formation of tyrosine to p-hydroxyphenyl acetic acid and tryptophan to IAA. Another possible reason is that the humic acid increased the dry matter production due to the increased rate of respiration caused by humic acid as reported by Piccolo *et al.* (1993).

Increased respiration leads to liberation of greater amount of energy which is utilized for cell division and growth. Increased respiration leads not only to more rapid utilization of reserve substances but also to more rapid synthesis of proteins and nucleic acids, which might have resulted in high growth and increased dry matter production.

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