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Organic Fertilizing Effect of Panchagavya on Growth and Biochemical Parameters of Holy Basil (*Ocimum sanctum* L.)

Veeranan Uthirapandi[1*], Selvam Suriya[2], Ponnerulan Boomibalagan[3], Saminathan Eswaran[4], Subramanian Sivasangari Ramya[5], Narayanan Vijayanand[6] and Durairaj Kathiresan[7]

[1]*Centre for Research in Botany, Saraswathi Narayanan College Madurai, Tamil Nadu, India*
[2]*Research Centre in Botany, The Madura College, Madurai, Tamil Nadu, India*
[3]*Department of Botany, Pasumpon Thiru Muthuramalingam Memorial College, Kamuthi, Tamil Nadu, India*
[4]*Department of Botany, RDM Government Arts College, Sivagangai, Tamil Nadu, India*
[5]*Department of Biochemistry, Sri Sarada Niketen College for Women, Amaravathipudur, Tamil Nadu, India*
[6]*Department of Botany, Arumugam Pillai Seethai Ammal College, Thiruppathur, Tamil Nadu, India*
[7]*Centre for Research in Botany, Saraswathi Narayanan College Madurai, Tamil Nadu, India*

**Corresponding author*

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A B S T R A C T

A work was conducted to identify the potential of panchagavya on growth and bio-chemical parameters of *Ocimum Sanctum*. Panchagavya were given to the tested plant in form of foliar spray. After 60 days, growth parameters such as shoot length, root length, total plant height, leaf area, number of the leaves, fresh and dried weight and biochemical parameters such as starch, glucose, protein, chlorophyll content were observed in the treated plants. Foliar application of 2%, 4%, 6% and 8% (T1, T2, T3 and T_4) enhanced the overall growth and physiology of *Ocimum Sanctum.* But, there was an appreciable increase in growth and biochemical parameters in the treated plants that received 8% (T4) when compared to other treatment and control. This might may be due to synergistic and cumulative effect of qualitative and quantitative active ingredients such as micro and macro elements, vitamins and phytohormones present in the Panchagavya. Thus, Panchagavya could serve as an promising effective organic biostumulant to replace the synthetic fertilizers for sustainable agriculture.

Introduction

Based on the literature and repots world population is increasing by an estimated 97 million per year (Saravi *et al.,* 2011). Medicinal and aromatic plants use by 80% of global population for their medicinal therapeutic effects as reported by WHO. It has been estimated that India has 47,000 species of plants. Out of these medicinal plants

comprise 8,000 species (Rajat Rashmi, 2002). As per WHO estimates, traditional medicines, mostly plant drugs, cater to the health needs of nearly 80% of world population. Out of 4.22 lakes plants species documented worldwide, about 12.5% are reported to have medicinal or other comparable values (Rao *et al.,* 2004). But only a few hundred were known to be in cultivation, whereas majority is collected from natural habitats. India exploited about 1400 tonnes of plant products during 2000-2001 (Anonymous, 2001). The Green Revolution is one of the biggest revolutions in history of agriculture result in increasing agricultural yield mainly in developing world. It involves investment in research, technology transfer during 1930s to late 1960 (Hazell, 2009).

The initiatives has been planned to achieve in association with agro-chemical as fertilizer and biocontrol, regulated irrigation and new methods of cultivation (Farmer, 1986). Application of chemical inputs especially chemical fertilizers, plowing and monocropping are some common agricultural activities which results in declined soil productivity, an imbalance in soil nutrients, and long-term decreasing crop yields (Khodaei *et al.,* 2012). Panchagavya contains several nutrients i.e. macronutrients like nitrogen, phosphorus, potassium and micronutrients which are required for the growth and development of plants and also contains various amino acids, vitamins, growth regulators like Auxins, Gibberellins and also beneficial microorganisms like *pseudomonas*, *azatobacter* and *phosphor bacteria* etc.

Effective Micro Organisms (EMO) in panchagavya are the mixed culture of naturallyoccurring, beneficial microbes' mostly lactic acid bacteria (*Lactobacillus*), yeast (*Saccharomyces*), photosynthetic bacteria (*Rhodo psuedomonas*) and certain fungi (*Aspergillus*) (Swaminathan *et al.,* 2007). Yadav & lourduraj (2006) observed bio fertilizers such as Azospirillum, Azotobactor, Phosphobacteria and Panchagavya is a foliar nutrition prepared by organic growers of Tamil Nadu and used widely for various agricultural and horticultural crops.

Materials and Methods

Requirements of ingredients added for the preparation of Panchagavya

Fresh cow's dung - 3kg
Fresh cow's urine - 5L
Cow's milk - 1L
Cow's curd - 1L
Cow's ghee - 500mg
Tender coconut water - 2L
Sugarcane juice - 1L
Well Ripe banana fruit - 5
Water - 5L

Mode of Preparation

Panchagavya liquid fertilizer was prepared according to method of Selvaraj *et al.,* (2006). After 30 days the panchagavya which was filtered properly sieving through a fine cloth. The filtrates was kept as 100% stock of panchagavya and 2 to 8% solution was prepared with mixing of appropriate distilled water and used for further treatment.

Elemental composition and hormone analyses of SLE

The composition of elements such as copper, manganese, iron, zinc, cobalt, potassium, magnesium and sodium were estimated using ICP-MS method (B'Hymer *et al.,* 2000). Similarly, estimation of nitrogen was done as per Kjeldahl Method (Bremmer, 1960). In addition, liquid extracts were subjected for estimation of auxin (Gordon and Paleg, 1957) gibberellin (Graham and Henderson, 1961) and cytokinin (Syono and Torrey, 1976).

Selected medicinal plant

Viable seeds of *Ocimum sanctum* were procured from seed storage bank of Agriculture College Madurai, Tamil Nadu. Healthy seeds free from visible infection, with uniform size were segregated. They were surface sterilized with 0.1% mercuric chloride and then sown in earthen ware pots (9cm dia) filled with sterilized standard soil mix supplemented with sufficient quantity of NPK. The seed to seed distance in pot was maintained as 4 cm and the pots were irrigated regularly.

After 30 days of germination, different percentage of panchagavya were given in the form of foliar spray to potted plants. Separate set of potted plants were used for percentage of panchagavya.

The potted plants received 50 ml of panchagavya 2% (T_1), 4% (T_2), 6% (T_3) and 8% (T_4) as foliar spray. The pachagavya were given at interval of 5 days for a period of 60 days. Growth parameters viz., shoot and root length, total plant height, leaf area, number of leaves and branch, fresh a dry weight of whole plant and biochemical parameters such as starch (Rose *et al.,* 1991), glucose (Nelson, 1944), protein (Lowry *et al.,* 1951), chlorophyll a, b and total (Arnon, 1949) were observed.

Results and Discussion

Elemental Composition and hormonal analyze of panchagavya

The panchagavya exhibited highest amount of macro and minor nutrients such as Nitrogen, Potassium, Magnesium, sodium, Iron, Molybdenum. This was followed, highest amount of phytohormones such as auxin, gibberellin and cytokinin were present in *panchagavya* (Table 1).

Foliar application of panhagavya on growth parameters of *Ocimum sanctum*

Panchagavya were sprayed as various percentage among that 8% of panchagavya have found to be the potential concentration in promoting growth in *Ocimum sanctum* as observed. The length of shoot and roots was gradually increased and found to be maximum at 8% of panchagavya. The maximum increase in shoot length was 104 % and root length was 117% in panchagavya at 8% concentration and followed by 6% of panchagavya increased the shoot ant roots length was 63% and 103% in *Ocimum sanctum* against untreated plants. The total height of the plant was increased by 103% over control when treated with 8% and 6% of panchagavya showed total height as 87% but the remain percentage like 2% and 4% o panchagavya have acceptable values in shoot and roots length and also total height of the *Ocimum sanctum* plants compared with untreated plants. (Table. 2)

The application of panchagavya from 2%/pot to 8%/pot seen gradually increased the fresh and dry weight of *Ocimum sanctum* plants. When *Ocimum sanctum* treated with panchagavya (8%) was increased in fresh 237% and dry (246%) weight of the seedlings over the control. Similarly considerable increase was seen in 6%/pot of panchagavya in the fresh (136%) and dry (175%) weight respectively over control in *Ocimum sanctum* plants. The significant values were obtained when *Ocimum sanctum* plants were treated with 2% and 4% of panchagavya compared with control plants.

Leaves are the main organ in plants which absorb the nutrients quickly when given in the form of foliar spry. The leaf area of the panchagavya *Ocimum sanctum* plants was maximum increased at 8% of panchagavya and followed by other concentrations of panchagavya.

Table.1 Elemental Composition and hormonal analyze of seaweed liquid extracts

	Panchagavya g/1litre
Physico chemical parameters	
Colour	Yellowish green
Ph	4.3
Chemical parameters	
Boron (B)	20.74±0.1546
Sodium (Na)	0.004±0.0004
Magnesium (Mg)	0
Aluminium (Al)	61.40±0.2594
Potassium (K)	NC
Calcium (Ca)	0
Chromium (Cr)	0
Manganese (Mn)	0.95±0.026
Iron (Fe)	0.99±0.061
Nickel (Ni)	0
Copper (Cu)	0
Zinc (Zn)	0
Arsenic (As)	0
Selenium (Se)	0.039±0.006
Molybdenum (Mo)	0
Cadmium (Cd)	0
Lead (Pb)	
Nitrogen (N) %	2.35%
Growth hormones	
Auxin	6.7 mg/l
Cytokinin	4.5 mg/l
Gibberellin	3.5 mg/l

Table.2 Fertilizing efficiency of panchagavya on growth parameters of *Ocimum sanctum*

S.No	Treatment	Shoot length (cm)	Root length (cm)	Total plant height (cm)	Leaf Area (cm^2)	Number of leaves (n)	Number of branch (n)	Fresh weight (g)	Dry weight (g)
1	Control T_1	28.93± 0.4041	7.06± 0.4041	32.03± 0.4509	7.5± 0.3	30.4± 0.2	4.1± 0.4582	5.01± 0.11	2.04± 0.0636
2	2%/pot T_2	34.43± 0.5033 117	11.96± 0.3511 168	46.4± 0.4582 143	14.13± 0.4163 187	46.1± 0.5567 167	4.23± 0.5859 102	5.89± 0.4392 121	2. 30± 0.1026 124
3	4%/pot T_3	45.1± 0.4582 153	13.03± 0.3511 183	58.4± 0.6 181	14.43± 0.305 191	65.16± 0.4725 208	10.06± 0.4041 244	8.65± 0.0793 215	3.25± 0.0529 216
4	6% /pot T_4	46.11± 0.45 156	14.4± 0.4582 203	60.43± 0.5033 187	18.16± 0.6658 241	67.93± 0.7023 217	10.96± 0.4509 266	9.48± 0.06 236	3.87± 0.0568 275
5	8%/pot T_5	60.03± 0.5507 204	15.43± 0.2081 217	75.46± 0.3 203	24.13± 0.4163 320	84.13± 0.5131 269	14.2± 0.7 345	13.55± 0.0655 337	4.31± 0.03 346

Table.3 Fertilizing efficiency of panchagavya on biochemical parameters of *Ocimum sanctum*

S. No	Treatments	Starch mg/g	Glucose mg/g	Protein mg/g	Chlorophyll a mg/g	Chlorophyll b mg/g	Total chlorophyll mg/g
1	Control T_0	37.6±1.24	36.5±2.16	37.3±1.24	0.62±0.02	0.88±0.02	1.51±0.04
2	2%/pot T_1	43.3±1.24 112	47.3±0.94 127	39.3±1.24 102	1.14±0.01 183	1.59±0.01 180	2.75±0.03 181
3	4%/pot T_2	52.6±1.69 136	56.5±0.81 152	48.6±0.81 126	1.34±0.01 215	2.01±0.03 228	3.39±0.05 223
4	6%/pot T_3	69.6±1.24 180	60.6±2.05 163	69.3±1.24 180	1.46±0.03 234	2.19±0.05 248	3.68±0.08 242
5	8%/pot T_4	89.6±1.24 232	90.3±2.05 243	97.2±1.41 252	1.97±0.07 315	2.34±0.01 265	4.35±0.09 286

All the percentage of panchagavya increased the leaf area by 87-220%. The leaf area was found to be maximum (220%) when 8% of panchcgavya was given to *Ocimum sanctum* plants. 6% of panchagavya increased the leaf area to 141% more than untreated plants. The application of other concentrations as such 2% and 4% of panchagavya has also found to be significant increase values when compared with control plants. The number branch and leaves showed the maximum increase when applied 8% of panhagavya by 245% and 169% and 6% of panchagavya has also increased the number of branch and leaves as 166% and 117% with compared to untreated plants. The application of minimum concentrations of panchagavya such as 2% and 4%/pot has lighted significant increase values when compared with control plants. (Table. 2)

Foliar application of panchagavya on biochemical parameters of *Ocimum sanctum*

In case of biochemical constituents, the maximum increase of biochmicals were seen in 8% of panchagavya that was starch (132 %), glucose (143 %), protein (152 %), chlorophyll a (215 %), chlorophyll b (165 %) and total chlorophyll (186 %) compared to the untreated plant. The concentration of 6 % of panchagavya (T_3) enhanced the starch content, Glucose, Protein, Chlorophyll a, Chlorophyll b, Total Chlorophyll by 80 %, 63 %, 80%, 134%, 148%, 142% respectively. 2% and 4% concentration of panchagavya (T_1 and T_2) enhanced the biochemical constituents but it was found to be lesser than T3 treatment. (Table 3).

Panchagavya is an organic formulation that enhances the biological efficiency of crop plants and quality of fruits and vegetables. Panchagavya is reported to contain biofertilizers like *Azospirillum*, *Azotobactor*, Phosphobacteria, *Pseudomonas* and *Lactobacillus* (Yadav and Lourduraj, 2006).

Perumal *et al., (*2006) reported that presence of growth regulatory substances such as Indole Acetic Acid (IAA), Gibberlic Acid (GA3), Cytokinin and essential plant nutrients from panchakavya caused a tremendous influence on the growth rate in *Alium cepa.* Papen *et al.,* (2002) noted that the macro (N. P, K and Ca) and micro (Zn, Fe, Cu, Mn) nutrients besides total reducing sugars (glucose) prances in panchagavya and Chemolithotrops and autotropic nitrifiers (ammonifers and nitrifers) present in panchagavya which colonize in the leaves increased the ammonia uptake and enhance the total N supply.

In our results, the growth parameters like shoot and root length, total plant height, leaf area, number of leaves, number of branch, fresh and dry weight similarly, biochemical parameters like starch, glucose, protein and chlorophyll content were increased when *Ocimum sanctum* plant treated with 8% of panchagavya. The obtained results are in agreement with the findings from the previous work done by Suchitra Rakesh *et al.,* (2017) they said that the plant height (18.24, 68.35 and 74.68 cm), no. of leaves (5, 24 and 28), fresh weight (25.67, 99.02 and 99.69 mg) and dry weight (9.60, 26.12 and 24.25mg) at three different stage like seedling, flowering and yielding stage of *Abelmoschus esculentus* plant were observed in the treatment of 3% concentration of panchagavya.

The number of leaves (233.10) and leaf area (25.91) of *Jasminum sambac* were indicated that the Vermicompost @ 2.5 t/ha + Panchagavya @ 3 per cent foliar spray were good resulting candidate stated by Sendhilnathan *et al.,* (2017). The treatment of panchagavya at 2.5% and neem oil 4ml per liter increased the chlorophyll content (4.15) in Capsicum *sp* (Mishra *et al.,* 2015). The protein was enhanced by the application of 4% concentration of panchagavya (Gopal Lal Choudhary *et al.,* 2017). The cow dung in panchagavya act as a medium for the growth of beneficial microbes and cow urine provides nitrogen which is essential for crop growth upon fermentation with other ingredients in panchagavya has beneficial effect on growth and yield (Patil *et al.,* 2012). The pH of panchagavya was lowered to 4.52 at 30 days of fermentation and this might be due to *Lactobacillus* bacteria in panchagavya, which produced more organic acids during fermentation stated by Mathivanan *et al.,* (2006). Further, the authors have reported the acetate, propionate and butyrate levels in panchagavya were ranged from 60.05 to 68.28, 14.39 to 17.79 and 6.40 to 7.65 percent, respectively, during the period from 10 to 40 days of fermentation. *Lactobacillus* count was increased from 8.62 at 10 days of fermentation to 8.71 log10 cfu/g at 30 days of fermentation. The total volatile fatty acids (TVFA) were higher at 30 days of fermentation. Panchagavya also known to contain biofertilizers such as Azospirillum, Azotobactor, Phosphobacteria and Pseudomonas were found besides *Lactobacillus* in Panchagavya (Yadav and Lourduraj, 2006). Besides these, growth regulatory substances such as Indole Acetic Acid (IAA), Gibberlic Acid (GA3), Cytokinin and essential plant nutrients from panchakavya (Perumal *et al.,* 2006)) which caused a tremendous influence on the growth rate in *Alium cepa* and panchagavya at 30 days of age recorded better proposition of chemical and microbial composition favorable for utilization as a growth.

In our study, growth and biochemical parameters of *Ocimum sanctum* exhibited significant increase by all the panchagavya. Among the treatments, better results exhibited, 8% concentration o panchagavya showed positive results when compared to individual and control treatment. In general, magnesium and iron plays a pivotal role in synthesis of chlorophyll in the plant metabolism. Presence of magnesium and iron in seaweed extracts could have induced the metabolism involved in chlorophyll synthesis (Table 1). In addition, presence of growth hormones like IAA, cytokine, in panchagvya might also be responsible for enhancement in growth and physiology of *Ocimum sanctum.* Increase in growth and biochemical parameters on our experimental plant might be due to the cumulative action of the phytohormones and macro and micronutrients present in 8% of panchagvya (T4). Further studies are in underway to examine the optimal concentration and best combination of panchagavya on different medicinal plants.

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