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Growth and development of greengram (*Vigna radiata*) under foliar application of panchagavya as organic source of nutrient

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Abstract
Panchagavya, a vedic formulation for increased productivity and disease resistance in plants. The present investigations were aimed to improve the growth and development of Greengram (*Vigna radiata*) under foliar application of panchagavya as organic nutrient. Field investigations were carried out during the rice fallow seasons of 2021 at the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamil Nadu and India. The experiments were laid out in randomized block design and replicated thrice. The experiment comprised of twelve treatments with different organic combinations *viz*., Panchagavya, Rhizobium, Phosphobacteria. The results of the experiments revealed that spraying of Panchagavya 3% at 15, 30 and 45 DAS + Rhizobium + Phosphobacteria seed treatment (T_{11}) significantly recorded a positive influence on all soil health-promoting characters and eventually increased the growth attributes *viz*. Plant height, LAI, DMP, number of effective nodules plant^{-1}, number of branches plant^{-1}, CGR and RGR when compared with other treatments and control.

Keywords: greengram, growth, panchagavya, phosphobacteria, rhizobium

Introduction
Foliar nutrient spray plays a vital role in pulse production by stimulating root development, nodulation, energy transformation, various metabolic processes, translocation activity in plants and pod setting thereby increases the yield. Foliar fertilization is a simple and effective method of providing nutrients to crops (Sudhagar Rao *et al*., 2018) [10]. Foliar application is more efficient than soil application at the late growth stage of crop when there is preferential assimilates translocation into seeds (or) fruits, (Vignesh and Sudhagar Rao. 2019) [11]. Panchagavya, an organic source of nutrition prepared by farmers of Tamil Nadu is an indigenous material which is used widely for agricultural and horticultural crops. Panchagavya constituted of five products obtained from cow. When suitably mixed and used, it has positive influence on living organisms. Rhizobium is a bacterial, which induces nitrogen fixing nodules on the roots of greengram etc., thereby, playing an important role in agriculture. Phosphobacteria is also a kind of bio-fertilizer, which releases insoluble phosphorous in the soil, making it more fertile (Sarkar *et al*., 2014) [6]. Research information on Panchagavya spray and its combination with biofertilizers like Rhizobium and Phosphobateria are scanty in rice fallow greengram. Therefore, the present investigation were planned to develop a growth, development and sustainable nutrient management practice for rice fallow greengram under Cauvery Deltaic Zone of Tamil Nadu (India).

Materials and Method
Field experiments were conducted during rice fallow seasons of 2021 in the experimental farm, department of agronomy, Annamalai University, Tamil Nadu, India (11°24 North latitude. 78°41 East longitude and +5.79 MSL). The present investigations were aimed to improve the growth and development of Greengram (*Vigna radiata*) under foliar application of panchagavya as organic nutrient. The climate at the experimental farm is moderately warm with hot summer months. The maximum temperature ranged from 28.1 to 38.3°C with a mean of 33.2°C and the minimum temperature ranged from 18.9 to 27.5°Cwith a mean of 23.2°C. The relative humidity ranged from 78 to 96 per cent. The mean hours of bright sunshine were 7.5 hours for the study period. The textural class of experimental soil was clay loam with 43.1% of clay, 14.2% silt and 41.8% of sand in the surface (0-15cm) soil.
The surface soil possesses pH 7.8, Electrical conductivity 0.72, organic carbon of 0.52 and the available N, P and K *viz*. 160.2, 25, 280 kg/ha respectively. The experiments were laid out in randomized block design (RBD) and replicated thrice. The experiment comprised of 12 treatments with different organic combinations *viz*., Panchagavya, Rhizobium, Phosphobacteria. Five plants from each plot were chosen by simple random sampling method and were tagged. These tagged plants were used for recording all biometric observations at different stages of crop growth. The data recorded were statistically analyzed and whenever the results were found significant, the critical differences were arrived at 5 per cent level and drawn statistical calculations.

Results and Discussion
Growth components
The nutrition through organic manures showed remarkable influence in various growth attributes of greengram viz. Plant height, LAI, DMP, number of effective nodules plant^{-1}, number of branches plant^{-1}, CGR and RGR in both rice fallow seasons.

Plant height

Dilute 3 ml of this solution in 100 ml water. Spray the diluted solution over plants and soil. For best results apply regularly- once every 15 days. The treatment application of Panchagavya 3% at 15, 30 and 45 DAS + Rhizobium + Phosphobacteria seed treatment (T_{11}) significantly recorded taller plants with plant height of 36.30, 47.36 and 69.16 cm at 30, 45 DAS and at harvest respectively. This might be due to better enhancement of physico-chemical properties of soil which leads to imparting soil structure as well as slow-releasing pattern and a steady supply of nutrients throughout the period of crop growth. Panchagavya spray and biofertilizers like Rhizobium and Phosphobacteria application might be due to increase in protein synthesis and cell growth. The results of the present study are in line with the findings of Sudhagar Rao *et al* (2019a) [9].

Leaf area index

In addition to that, the influence of organic fertilization through Panchagavya 3% at 15, 30 and 45 DAS + Rhizobium + Phosphobacteria seed treatment on LAI could be attributed by the increment of metabolic process in plants which seems to have promoted meristematic activities through the thorough supply of enzymes causing apical growth. These findings are in accordance with the reports of Natarajan and Balachandar (2001) [4] and (Sudhagar Rao *et al*., 2019) [11].

Dry matter production

Dry matter production was significantly higher under Panchagavya spray 3% at 15, 30 and 45 DAS + Rhizobium + Phosphobacteria seed treatment. The resulted higher leaf area with this treatment might be due to better solar radiation interception and photosynthetic rate, contributing to higher values of varied growth attributes. The results are in agreement with the findings of (Rajeshkumar r*et al*, 2017) [5].

Number of effective nodules plant^{-1}

Among the treatments, the highest number of effective nodules plant^{-1} was recorded with Panchagavya spray 3% at 15, 30 and 45 DAS + Rhizobium + Phosphobacteria seed treatment (T_{11}) which recorded 18.21 and 18.03 nodules plant^{-1} during the rice fallow season. These findings are in accordance with the reports of Hemalath and Sreemathi (2018) [3] and (Sudhagar Rao *et al* 2020) [7].

Number of branches plant^{-1}

Panchagavya spray 3% at 15, 30 and 45 DAS + Rhizobium + Phosphobacteria seed treatment (T_{11}) significantly recorded the highest number of branches plant^{-1} of 9.42 and 9.11. Anandha Krishnaveni *et al* (2021) [21].

Crop indices

The crop indices like CGR and RGR indicate the actual growth rate of greengram crop. Irrespective of the stages of crop growth, the values of crop indices were significantly higher with the treatment combination of Panchagavya spray 3% at 15, 30, and 45 DAS + Rhizobium + Phosphobacteria seed treatment. Adequate availability of nutrients might have enhanced the crop to take part in the effective photosynthetic activity at initial stage for crop canopy development and subsequent portioning of assimilates to sink during maturity. On the other hand, the comparative reduction was noticed with the rest of the treatments revealed their ineffectiveness in supporting the normal growth to achieve the sustainable yields. The results are in agreement with the earlier findings of Balachandrakumar.V and G.B.Sudhagar Rao (2018) [2].

Summary

Based on the results of experiment, it is concluded that 3% Panchagavya spray at 15, 30, and 45 DAS + Rhizobium + Phosphobacteria seed treatment significantly increased the growth of greengram plants. The lateral roots, number of nodules, fresh and dry mass of the plants increased, number of branches plant^{-1} and the total leaf area of the plant also increased and the values of crop indices by 3% Panchagavya spray at 15, 30, and 45 DAS + Rhizobium + Phosphobacteria seed.

Table 1: Effect of Panchagavya and biofertilizers on growth components

T. no	Treatments	Rice fallow season		
		Plant height	LAI	DMP
T_1	Control	51.63	1.70	1945
T_2	Panchagavya spray 3% at 15, 30, 45 DAS	59.02	2.35	2398
T_3	Panchagavya spray 4% at 15, 30, 45DAS	59.02	2.26	2330
T_4	Rhizobium seed treatment	56.85	2.05	2193
T_5	Phosphobacteria seed treatment	56.79	1.95	2125
T_6	Panchagavya spray 3% at 15, 30, 45 DAS + Rhizobium seed treatment	63.82	2.99	2861
T_7	Panchagavya spray 3% at 15, 30, 45 DAS + Phosphobacteria seed treatment	61.46	2.72	2660
T_8	Panchagavya spray 4% at 15, 30, 45 DAS + Rhizobium seed treatment	63.70	2.90	2794
T_9	Panchagavya spray 4% at 15, 30, 45DAS + Phosphobacteria seed treatment	61.35	2.64	2598
T_{10}	Rhizobium + Phosphobacteria seed treatment	59.20	2.44	2464
T_{11}	Panchagavya spray 3% at 15, 30, 45 DAS + Rhizobium + Phosphobacteria seed treatment	69.16	3.35	3127
T_{12}	Panchagavya spray 4% at 15, 30, 45 DAS + Rhizobium + Phosphobacteria seed treatment	66.18	3.17	2994
	SE_M	1.06	0.07	64.91
	CD (p = 0.05)	2.13	0.15	130.05

Table 2: Effect of Panchagavya and biofertilizers on growth components

T. no	Treatments	Rice fallow season			
		No. of nodules plant^{-1}	No. of branches plant^{-1}	CGR	RGR
T_1	Control	12.41	6.23	38.86	5.52
T_2	Panchagavya spray 3% at 15, 30, 45 DAS	16.25	7.27	43.53	7.14
T_3	Panchagavya spray 4% at 15, 30, 45DAS	16.04	7.11	42.93	6.81
T_4	Rhizobium seed treatment	15.72	6.75	42.33	6.08
T_5	Phosphobacteria seed treatment	15.48	6.60	41.80	5.75
T_6	Panchagavya spray 3% at 15, 30, 45 DAS + Rhizobium seed treatment	17.57	8.66	46.26	9.04
T_7	Panchagavya spray 3% at 15, 30, 45 DAS + Phosphobacteria seed treatment	17.05	8.07	45.06	8.30
T_8	Panchagavya spray 4% at 15, 30, 45 DAS + Rhizobium seed treatment	17.38	8.45	45.80	8.81
T_9	Panchagavya spray 4% at 15, 30, 45DAS + Phosphobacteria seed treatment	16.83	7.88	44.80	8.01
T_{10}	Rhizobium + Phosphobacteria seed treatment	16.48	7.49	44.20	7.43
T_{11}	Panchagavya spray 3% at 15, 30, 45 DAS + Rhizobium + Phosphobacteria seed treatment	18.21	9.42	47.66	9.92
T_{12}	Panchagavya spray 4% at 15, 30, 45 DAS + Rhizobium + Phosphobacteria seed treatment	17.90	9.03	47.06	9.48
	SE_M	0.14	0.17	0.30	0.21
	CD (p = 0.05)	0.29	0.35	0.61	0.43

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