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Panchagavya and its effect on the growth of the greengram cultivar K-851

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SUMMARY

Seeds of greengram [*Vigna radiata* (L.) Wilczek cv. K-851] were selected for Petriplate and pot studies. Experiments were initially conducted in Petriplates using Panchagavya (2, 3, 4, 5, and 6%). The germination study in Panchagavya (pre-soaking) revealed the stimulation of germination at 4%. Under irrigated conditions, the seeds germinated quickly in 2 and 3% Panchagavya treatment. In pot study, Panchagavya was foliar-sprayed at 10 DAS. The growth parameters were studied at 20 DAS. Seed germination was stimulated in pre-soaked condition than under irrigation. In Petriplate culture, under pre-soaked condition, the greengram seedlings showed significant growth increase at 4% Panchagavya treatment, whereas under Panchagavya irrigation, growth was promoted at 2%. Panchagavya promoted epicotyl elongation almost in all the treatments. Panchagavya of 6% irrigation generally inhibited the plant height, fresh and dry mass of the seedlings. In pot study, 3% Panchagavya spray at 10 DAS significantly increased the growth of greengram plants. The lateral roots, number of nodules, fresh and dry mass of the plants increased significantly at 3 and 4% treatment. At 5% foliar spray, growth was comparable to the control. The total leaf area of the plant also increased by 2 and 3% Panchagavya spray.

Key words : Panchagavya, Greengram, Pre-soaked treatment

Agriculture is the means of livelihood for millions of people in India with crops chiefly dependent on rainfall and fertilizers. India is not only self-sufficient in food production but also has a substantial reserve. The traditional practice followed in agriculture is application of chemical fertilizers, biofertilizers and organic manures. India is the third largest producer and consumer of fertilizers in the world. The increasing cost and unavailability of fertilizers, growing ecological concern and the governments interest in promoting the organic farming have forced us to try new methods of application of nutrients in the form of Panchagavya, vermiwash, vermicompost etc. Nene (1999) symphasized that cow dung had been used since long back in India as reported by Kautilya (321 – 296 BC), Varahamithira (505 – 587 AD), Surapala (1000 AD) and Someshwara Deva (1126 AD). It contained undigested fibre, epithelial cells, pigments and salts rich in nitrogen, phosphorus, potassium, sulphur, micronutrients, and intestinal bacteria and mucous. Singh (1996) recorded that cow dung had water 82% and solid matter 18% (minerals 0.1%, ash 2.4% organic manure 14.6%, Ca and Mg 0.4%, SO_4 0.05%, silica 1.5%, N 0.5%, P 0.2%, and K 0.5%).

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The beneficial role of Panchagavya on several crop plants was confirmed by several workers *viz.*, Beaulah (2001) Beaulah *et al.* (2002), Pathak and Ram (2002), Boomiraj (2003), Somasundaram (2003), Sridhar (2003), Yadav and Lourduraj (2005).

MATERIALS AND METHODS

The current trend in agriculture is the adoption of organic farming system. In India, pulse crops have been grown extensively in different parts because of their main adaptability to extreme stress conditions. Since the pulses are able to tolerate stressful conditions, *Vigna radiata* (L.) Wilczek (greengram) cultivar K - 851 was selected for the present study. Seeds of greengram were procured from a local seed farm in Puducherry. The seeds were surface sterilized in 0.1% mercuric chloride and thoroughly washed in glass distilled water before using it for the experiments. Seeds of uniform size, shape and colour were selected for the study.

Preparation of Panchagavya

Panchagavya nutrient solution was purchased from an agricultural research station, located near Puducherry. The stock solution (20 litres) contained cow dung (5 kg), cow's urine (3 litres), cow's milk (2 litres) cow's curd (2 litres), and cow's clarified butter / ghee (1 litre). The contents were allowed to ferment for ten days before use. From this stock solution, the following grades of solutions were prepared *viz.*, 2, 3, 4, 5 and 6% for the study. For control experiment glass distilled water was

used. Two types of experiments were planned in Petriplate study.

Experiment - I:

Surface sterilized greengram seeds were presoaked in different concentrations of Panchagavya (2, 3, 4, 5 and 6%) for 24 hours. For control, the seeds were pre-soaked in glass distilled water. Fifteen pre-soaked seeds were then transferred to glass Petriplates (15 cm dia.) lined with a pair of whatman No.1 filter paper circles. Three replicates were maintained for each treatment and control. Germination percentage was calculated for the first three days and growth measurements relating to hypocotyl and epicotyl length, biomass, number of lateral roots etc. were recorded at 3, and 6 days of growth. The pre-soaked seeds were irrigated with distilled water just to keep the seeds in moist condition.

Experiment - II:

In this experiment, the seeds were irrigated with 2, 3, 4, 5 and 6% Panchagavya in the Petridish just to keep them in moist condition. Growth measurements were taken on the 3rd and 6th day as was done in experiment I.

Pot culture studies:

Apart from the Petriplate culture, few experiments were conducted in small earthenware pots (15 × 15 cm) containing the field soil, small amounts of DAP (10mg) and garden manure. The soil sample and garden manure were mixed in the ratio of 4:1. Fifteen healthy seeds were selected and sown equidistantly at a depth of 2cm in each pot. The arrangement of pots was in the form of randomized block design for the different treatments and these were replicated thrice. The pots were maintained in near-field conditions. Since the experimental plant was a legume, ten day –old seedlings were inoculated with 200 mg of the commercial preparation of *Rhizobium* (cowpea strain) inoculum suspended in 10ml of water. The plants were allowed to grow for a period of ten days. At 10 DAS, the plants were foliar sprayed with different concentrations of Panchagavya (2, 3, 4 and 5%) using a sprayer. At 20 DAS, the growth measurements were recorded. The measurements for growth parameters *viz.*, root and shoot length and plant height were made. The plant parts were weighed in Anamed Digital balance for fresh weight. They were then dried in an oven at 80^0C for 48 h and dry mass measurements were recorded. Besides these, the R/S ratio, S/R ratio (Racey *et al.*, 1983), number of lateral roots, nodules were also monitored at 20 DAS. The results of the experiments were tested by a multiple range testing programme. Tukey's Multiple Range Test (TMRT) was applied for the experimental data at 5% level of significance (Zar, 1984).

RESULTS AND DISCUSSION

The results on the germination study clearly revealed that under pre-soaked conditions, 4% Panchagavya - treated seeds showed a high rate of germination compared to other treatments (Table 1). In the second experiment under irrigated conditions, the seeds germinated quickly in 2 and 3% Panchagavya (Table 1).

Table 1 : Effect of Panchagavya on the germination percentage of greengram seeds in Petriplates

Treatments (concentration)	24 hours	48 hours	72 hours
Pre-soaking			
Control	73.3	86.7	100
2%	80.0	93.3	100
3%	86.7	93.3	100
4%	86.7	100	100
5%	80.0	86.7	86.7
6%	66.7	73.3	73.3
Irrigation			
Control	73.3	86.7	100
2%	80.0	93.3	100
3%	86.7	93.3	100
4%	80.0	86.7	93.3
5%	80.0	86.7	86.7

For the germination study 15 seeds were used in each Petriplate

Panchagavya of all concentrations promoted the epicotyl elongation at 3 days of growth. Generally the growth was vigorous at 3 and 4% concentrations. In the second experiment where the plants were grown under irrigation, increased length of various plant parts was observed at 2%. Both 5 and 6% Panchagavya solutions failed to evoke any positive influence on the growth of the seedling. Compared to the pre-soaking experiment, the inhibition was more under irrigation (Tables 2 and 5). Since the plants were allowed to grow in the solution itself, inhibition was noticed generally in all higher concentrations.

The R\S ratios were significantly low in pre-soaked and irrigated conditions in the early stage. This clearly indicated that the epicotyl growth was faster than the hypocotyl in both the treatments. The nutrients in the growing medium promoted the growth of the epicotyl. After 3 days of growth, the hypocotyl elongation was more than the epicotyl and so a reverse trend in the R\S ratio was observed at 6 days of growth. Another interesting observation was seen in the formation of lateral roots. In the early stage, significant increase in the number of lateral

Table 2 : Effect of Panchagavya on the growth characteristics of greengram cv. K-851 (Petriplate culture using pre-soaked seeds)

Age	Treatments	Length (cm)			Rs. Ratio	No. of lateral roots
		Hypocotyl	Epicotyl	Total		
3 days	Control	11.28 a	1.32 a	12.60 a	8.54 a	4.5 a
	2%	13.38 bc	2.23 b	15.61 b	6.00 b	7.0 b
	3%	13.63 bc	2.50 b	16.13 bc	5.45 b	7.3 b
	4%	15.10 c	2.42 b	17.52 c	6.24 b	8.2 b
	5%	13.50 bc	2.30 b	15.80 b	6.43 b	5.7 c
	6%	12.70 ab	2.10 b	14.80 b	6.05 b	6.6 b
6 days	Control	15.02 a	7.28 a	22.30 a	2.06 a	8.5 a
	2%	18.15 bc	8.95 b	27.10 bc	2.03 a	16.6 b
	3%	19.58 b	8.90 b	28.48 bc	2.20 ac	12.0 c
	4%	20.86 b	8.56 bc	29.42 c	2.44 bc	15.5 b
	5%	18.63 bc	8.46 abc	27.09 bc	2.18 ac	17.1 b
	6%	16.85 ac	7.50 ac	24.35 ab	2.25 ac	12.5 c

Within a column, values followed by different letters are significantly different according to Tukey's HSD Multiple Range Test (TMRT) at 5% level of significance (n=15).

roots was observed and this continued in the next stage also. Compared to the pre-soaking treatment, the lateral root initiation was significantly inhibited in irrigated plants. Under irrigated condition, Panchagavya solutions inhibited the growth of both the main root and the lateral roots. The stimulatory effect of 4% Panchagavya seen in the pre-soaked treatment was earlier reported by Emily (2003), Kanimozhi (2003) and Sridhar (2003) on crop plants.

The fresh and dry weights of the plant parts were recorded in both experiments using Panchagavya. In pre-soaked condition, both fresh and dry weights of the 3 day – old plants were significantly increased in all concentrations, the maximum being at 4% treatment. This marked influence of Panchagavya treatment in the initial stage did not continue in the next stage except at 4% treatment where increased biomass was noted. In 6 day-old plants, the dry mass of epicotyl was reduced in the highest concentration used. This was clearly confirmed by the significantly low S\R ratios in higher concentrations (Table 3). Compared to the pre-soaking treatment, under irrigated condition, the fresh and dry weights of the epicotyls were significantly low and consequently the S\R ratios were very low in all irrigated plants. After 6 days of growth, the plants survived the inhibitory effect of Panchagavya concentrations, and accordingly the fresh mass of the plant parts increased. This is clearly exhibited by low S\R ratios in irrigated plants (Table 6). High concentrations of Panchagavya inhibited the shoot growth and biomass and so the S\R ratios were significantly less

Table 3 : Effect of Panchagavya on the biomass (g) contents of green gram cv. K-851 (Petriplate culture using pre-soaked seeds)

Age	Treatments	Fresh weight			Dry weight			S/R ratio
		Hypocotyl	Epicotyl	Total	Hypocotyl	Epicotyl	Total	
3 days	Control	0.961 a	0.090 a	1.051 a	0.098 ab	0.016 a	0.114 a	0.163 a
	2%	1.285 b	0.196 c	1.481 b	0.090 ab	0.012 a	0.102 a	0.133 b
	3%	1.362 b	0.145 b	1.507 b	0.110 a	0.015 a	0.125ab	0.136 b
	4%	1.513 c	0.176 c	1.689 c	0.104 a	0.036 b	0.140 b	0.346 c
	5%	1.304 b	0.194 c	1.498 b	0.086 b	0.022 b	0.108 a	0.225 c
	6%	1.235 b	0.184 c	1.419 b	0.085 b	0.027 b	0.112 a	0.317 c
6 days	Control	1.277 a	0.557 a	1.834 a	0.057 a	0.048 a	0.105 a	0.842 a
	2%	1.405 a	0.581 a	1.986 ab	0.070 b	0.051 a	0.121 ab	0.728 ab
	3%	1.333 a	0.694 b	2.027 ab	0.077 b	0.040 a	0.117 a	0.519 c
	4%	1.418 a	0.730 b	2.148 b	0.078 b	0.060 b	0.138 b	0.769 ab
	5%	1.285 a	0.612 ab	1.897 ab	0.063 a	0.046 a	0.109 a	0.730 ab
	6%	1.227 a	0.633 ab	1.860 ab	0.059 a	0.041 a	0.100 a	0.695 b

Within a column, values followed by different letters are significantly different according to Tukey's HSD Multiple Range Test (TMRT) at 5% level of significance (n=15).

Table 4 : Effect of Panchagavya on the biomass (g) contents of cotyledons of greengram cv. K-851 (3 days-old) (Petriplate culture)

Type of treatment	Treatment (Concentration)	Fresh weight	Dry weight
Pre-soaking	Control	0.562 a	0.033 a
	2%	0.309 bc	0.065 b
	3%	0.271 c	0.060 b
	4%	0.364 b	0.070 bc
	5%	0.398 b	0.082 c
	6%	0.458 b	0.086 c
Irrigation	Control	0.424 a	0.119 ac
	2%	0.275 b	0.078 b
	3%	0.385 a	0.104 a
	4%	0.464 a	0.132 c
	5%	0.401a	0.104 a
	6%	0.367 a	0.094 b

Within a column, values followed by different letters are significantly different according to Tukey's HSD Multiple Range Test (TMRT) at 5% level of significance (n=15).

than the normal plants.

The cotyledonary biomass was estimated separately since the growing seedlings take their nutrients from the cotyledons during the early stage of growth. When the cotyledonary biomasses in both the experiments are compared, it is found that the fresh and dry weights of the cotyledons showed contrasting results. Increased dry mass shows that the pre-soaked seeds possess enough nutrients for the growth of plants and so a minimum amount of the cotyledonary biomass was utilized. Hence there is an increase in the dry mass of the cotyledons in the early stage. A significantly high level of dry biomass was recorded in the cotyledon of 5 and 6% Panchagavya pre-soaked treatments. A low level of fresh and dry mass in irrigated plants showed the maximum use of cotyledonary biomass by the growing plants in most of the Panchagavya concentrations. High concentrations of Panchagavya under irrigated condition definitely inhibited the growth of greengram plants and so the cotyledonary biomass decreased (Table 4).

The greengram plants were allowed to grow for 10 days in pots and Panchagavya was sprayed on the leaves. Since Panchagavya of concentrations 5 and 6% failed to evoke any positive response in Petriplate studies only four concentrations *viz*. 2, 3, 4 and 5% were selected for the pot culture studies. At 20 DAS, the measurements were taken. A significant increase in plant growth was observed at 3% Panchagavya sprayed plants (Table 7). Since the shoot growth was promoted almost in all the treatments, the R/S ratios were significantly less than the control in all the treatments. Both the lateral roots and total number of nodules increased significantly by 3% Panchagavya spray. Increased plant length, roots and nodules due to Panchagavya spray were earlier reported in many crop plants. The findings here are in line with the reports of Emily (2003) in *Withania somnifera*, where she had reported increased plant height, number of laterals, nodules, etc. by spraying 4% Panchagavya. A similar response was also reported by Kanimozhi (2003) in *Coleus forskohlii* and Sridhar (2003) in crop plants.

Out of the four Panchagavya concentrations used, at 3% both the fresh and dry weights of the plant parts were significantly increased by Panchagavya spray. In the other three concentrations, the values were almost

Table 5 : Effect of Panchagavya on the growth characteristics of greengram cv. K-851 (Petriplate culture under Panchagavya irrigation)

Age	Treatment	Length (cm)			R/s ratio	Number of lateral roots
		Hypocotyl	Epicotyl	Total		
3 days	Control	7.22 a	1.56 a	8.78 a	4.63 a	5.4 a
	2%	7.60 a	1.58 a	9.18 a	4.81 a	4.8 a
	3%	5.84 bc	1.68 a	7.52 ab	3.48 b	2.8 b
	4%	5.36 b	1.40 a	6.76 b	3.83 b	3.5 b
	5%	6.40 ac	1.54 a	7.94 a	4.16 ac	3.0 b
	6%	6.10 ab	1.54 a	7.64 ab	3.96 bc	3.6 b
6 days	Control	8.76 a	6.84 ab	15.60 a	1.28 a	9.8 a
	2%	11.74 b	7.22 a	18.96 b	1.63 b	12.0 bc
	3%	9.96 a	7.48 a	17.44 ab	1.33 a	13.8 b
	4%	10.08 a	6.22 ab	16.30 ab	1.62 b	11.2 ac
	5%	10.20 ab	6.00 b	16.20 a	1.70 b	12.3 b
	6%	9.62 a	5.92 b	15.54 a	1.63 b	10.6 a

Within a column, values followed by different letters are significantly different according to Tukey's HSD Multiple Range Test (TMRT) at 5% level of significance (n=15).

Table 6 : Effect of Panchagavya on the biomass (g) contents of greengram cv. K-851 (Petriplate culture- under panchagavya irrigation)

Age	Treatments	Fresh weight			Dry weight			S/r ratio
		Hypocotyl	Epicotyl	Total	Hypocotyl	Epicotyl	Total	
3 days	Control	0.305 a	0.240 a	0.545 ac	0.051 a	0.043 a	0.094 a	0.843 a
	2%	0.381 bc	0.268 a	0.649 b	0.082 b	0.067 b	0.149 b	0.817 a
	3%	0.355 ac	0.146 b	0.501 c	0.072 b	0.052 b	0.124 b	0.722 a
	4%	0.328 a	0.106 b	0.434 c	0.063 c	0.045 a	0.108 a	0.714 a
	5%	0.289 a	0.098 c	0.387 d	0.059 c	0.026 c	0.085 a	0.440 b
	6%	0.376 bc	0.088 c	0.464 c	0.031 d	0.018 c	0.049 c	0.581 b
6 days	Control	0.591 a	0.306 a	0.897 a	0.073 a	0.051 a	0.124 a	0.698 a
	2%	0.804 b	0.522 b	1.326 b	0.088 b	0.080 b	0.168 b	0.909 b
	3%	0.808 b	0.436 c	1.244 b	0.085 b	0.053 a	0.138 a	0.623 ac
	4%	0.754 b	0.428 c	1.182 b	0.072 a	0.043 a	0.115 a	0.597 ac
	5%	0.856 b	0.318 a	1.174 b	0.069 a	0.045 a	0.114 a	0.652 ac
	6%	0.653 a	0.345 a	0.998 a	0.055 c	0.032 c	0.087 c	0.581 c

Within a column, values followed by different letters are significantly different according to Tukey's HSD Multiple Range Test (TMRT) at 5% level of significance (n=15).

Table 7 : Effect of Panchagavya foliar spray on the growth of greengram cv. K-851 (pot culture)

Treatments	Root (cm)	Shoot (cm)	Total	R/s ratio	No. of lateral roots	No. of root nodules
Control	9.60 a	9.18 a	18.78 a	1.045 a	16.4 a	11.8 a
2%	9.87 a	11.06 b	20.93 ab	0.892 b	19.2 b	14.9 b
3%	10.40 a	12.74 b	23.14 b	0.816 b	24.8 c	16.6 b
4%	8.28 b	10.68 ac	18.96 a	0.775 b	18.4 a	18.0 b
5%	10.52 a	11.34 bc	21.86 b	0.927 a	20.4 b	22.2 c

At 10 DAS, plants were sprayed with different concentrations of Panchagavya. Measurements were taken at 20 DAS. Within a column, values followed by different letters are significantly different according to Tukey's HSD Multiple Range Test (TMRT) at 5% level of significance (n=15).

Table 8 : Effect of Panchagavya on the biomass (g) contents of greengram cv. K-851 (pot culture)

Treatments	Fresh weight			Dry weight			Total leaf area
	Root	Shoot	Total	Root	Shoot	Total	
Control	0.765a	2.306a	3.071a	0.153a	0.324a	0.477a	19.68a
2%	0.781 a	2.425ab	3.206ab	0.162a	0.347ab	0.509a	25.36b
3%	0.795a	2.755b	3.550b	0.172a	0.388b	0.560a	31.45b
4%	0.769a	1.743c	2.512c	0.210c	0.449b	0.650b	22.46a
5%	0.652b	2.130a	2.782ac	0.159ac	0.396b	0.555a	20.51a

At 10 DAS, plants were sprayed with different concentrations of Panchagavya. Measurements were taken at 20 DAS. Within a column, values followed by different letters are significantly different according to Tukey's HSD Multiple Range Test (TMRT) at 5% level of significance (n=15).

parallel to the control (Table 8). At 5% foliar spray, a slight inhibition in growth was noticed. The Panchagavya spray of 3% concentration, when sprayed on plants, acted as a foliar nutrient and promoted the metabolic activities of the plant. The total leaf area of the plant was significantly increased by 3% Panchagavya spray. In other concentrations the leaf areas were reduced when compared to the control plants (Table 8). The primary leaf area showed an increase at 3 and 4% Panchagavya sprays. In 10 day-old plants, eventhough the primary leaves were almost mature, Panchagavya spray increased the area. The findings in this pot study are in close agreement with the works of Emily (2003) in *Withania somnifera,* Kanimozhi (2003) in *Coleus forskohlii* and Sridhar (2003) in *Solanum nigrum.*

From this study, it is concluded that the pre-soaking of seeds with Panchagavya of 4% concentration evoked a positive response whereas under irrigated condition, the same concentration was inhibitory to growth. At 2% concentration, Panchagavya was effective. In pot study,

a single spray of Panchagavya at 10 DAS did not show any significant response in greengram plants. Looking at these findings, Panchagavya is definitely a promising formulation in the years to come. Panchagavya can be effectively used as a foliar nutrient in plants. The time, duration and the frequency of the spray is to be determined for each plant.

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