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Effect of Panchagavya on Seed Germination, Seedling Growth and Nutrient Content of Some Leafy Vegetables

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Abstract— Improving seed germination can result in increased crop production. Various methods have been used and formulated to increase seed germination and growing efficiency of agricultural crops. Seed priming is one of the successful technologies to maximise the natural potential of seeds in the field. In the present study, growth parameters and nutrient contents were studied in the seeds of three different leafy vegetables such as *Amaranthus gangeticus*, *Hibiscus sabdariffa* and *Trigonella foenum - graecum* primed with 1% solution of Panchagavya at different time intervals. The results showed that seed priming with Panchagavya had a significant effect on seed germination, seedling growth and nutrient contents of all the three selected leafy vegetables.

Keywords— Germination, Leafy vegetables, Panchagavya, Seedling growth, Seed priming

I. INDRODUCTION

Agriculture, for decades, had been associated with the production of basic food crops. Seeds are the foundation of agriculture. Technology has improved much of farming's day-to-day operations, but without a steady supply of high-quality seed, yields and crop quality would be greatly decreased. Successful germination and seedling establishments are important for maintenance and expansion of plant populations and recovery from perturbations. Main reason for the successful crop stand is high germination percent and good vigour of seedlings [1]. Modern strategic approaches are necessary for sustainable development of crops as to meet to increasing demand in both domestic and export market [2].

Priming is a water-based process performed on seeds to increase germination uniformity, and thus enhances vegetable stand establishment. Seed priming is a low cost and low risk intervention, used to overcome poor stand establishment. Seeds are soaked in water before being surface dried to storage moisture. The storage of such primed seeds can result in high germination and seedling emergence rates, vigorous early growth early flowering, maturity and higher yields than unprimed seeds. Several methods have been used to precondition seeds as an attempt to improve germination and seedling establishment of many field crops.

Seed invigoration is a post harvest, pre-sowing technique foe improvement of seedling emergence and stand establishment. The most promising invigoration technique for improving the rate and uniformity of plant stand is seed priming [3].

The use of organic nutrients for plant growth enhances the quality of the product and sustains shelf life period [4]. Panchagavya is a foliar nutrition and priming medium prepared by organic growers of Tamil Nadu and used widely for various agricultural and horticultural crops. In Sanskrit, Panchagavya means a combination of five products obtained from cow. When suitably mixed and used, these have miraculous effects. Panchagavya preparation varies with the people although ingredients are common. Panchagavya has been reported to contain micronutrients, many vitamins, essential amino acids, growth promoting factors and beneficial microbes [5].

Vegetables play important role in food and nutritional security. Particularly, green leafy vegetables are considered as exceptional source for vitamins, minerals and phenolic compounds. Mineral nutrients like iron and calcium are high in leafy vegetables than staple food grains. Also, leafy vegetables are the only natural sources of folic acid. It is also recommended that one of the five servings of vegetables should be green leafy vegetables.

It is very essential to formulate a strong, economic, eco-friendly scientific approach technique to increased yield of agricultural crops. The concept of priming is often used by farmers and has been a recommended practice but not been extensively implemented. In recent years, the use of priming

has increased following participatory approach in India, Pakistan and Bangladesh. Many crops are primed before planting.

Hence, the present work was designed to evaluate the effect of Panchagavya (PG) on seed germination, seedling growth and nutrient status of some selected leafy vegetables.

II. MATERIAL AND METHODS

Study plants

Amaranthus gangeticus

It is an annual herb grows up to 2-3 feet, belongs to the family Amaranthaceae. The stems often are reddish in colour. Leaves are simple and alternatively arranged. Flowers are small clusters, whitish -green in colour. The fruit is capsule.

***Hibiscus sabdariffa* L.**

It is an erect annual herb of the family Malvaceae. Leaves are simple, blade 3-5 lobed, the lobes serrated or obtusely toothed. Flowers are solitary, axial. Calyx is thick, red and fleshy, cup-like. Stamens are numerous. Stigma capitate. The fruit is capsule.

***Trigonella foenum - graecum* (Linn.)**

Fenugreek is an aromatic, 30-60 cm tall, annual herb, belongs to the family Fabaceae. Leaves are alternate, compound and trifoliate. Stipulets not toothed. Leaflets 2-2.5 cm long, oblanceolate-oblong, toothed. Flowers are white or pale yellow, sessile axiliary, Calyx-teeth linear. Corolla much exserted. Pod 5-7.5 cm long, with a long persistent beak, often falcate, 10-29 seeded, without transverse reticulations.

Preparation of Panchagavya

Panchagavya was prepared from cow products viz. Cow milk (5 L), ghee (2 L), curd (2 kg), cow urine (5 L) and cow dung (5 kg); these ingredients were mixed together along with 15 kg of jaggery in a circular container. The mixture was added with 15 L of water and kept as such for 30 days. Fermentation took place by making the mixture to a fine concentrate giving out the sweet odour [6]. The fermented liquid was filtered through cotton and the final volume of filtrate was made 1000 ml. The solution was stored in refrigerator. 1 % solution was used for treatments.

Pot experiment was conducted using leafy vegetables. Seeds of the above said leafy vegetables procured from local nursery at Tenkasi, in Tirunelveli district of Tamilnadu, India. Twenty seeds of each plant sample were soaked in 1% solution of Panchagavya. The treatments were given at intervals of 6hrs, 12hrs, 18hrs, and 24hrs. Seeds directly sown in soil without treatment were used as control. The priming media were sprayed at regular intervals. Plants were allowed to grow in the greenhouse. Seedlings were harvested after 15days of planting. Ten seedlings of different leafy vegetables in each treatment were randomly selected for the measurement of root and shoot length, fresh and dry weight. Germination percentage and seedling growth recorded up to 15 days.

Germination percentage was calculated by

Percentage of Germination = No. of seeds germinated/No of seeds sown x100

Biochemical constituents like nitrogen, ash, sodium, potassium and phosphorous, were also measured in studied plant samples.

Growth parameters

The various growth parameters were measured on 15 days after seeding.

Root and shoot length

Root and shoot length was recorded from randomly selected ten plants in each treated pot.

Vigour Index (VI) was calculated according to the method suggested by [7]

Vigour Index = (Root length + shoot length) x Germination percentage

Fresh weight and Dry weight per plant

For this purpose, ten plants from each treatment were uprooted cleaned and fresh weight was taken. The respective plants were kept in oven separately at 80^{o}C in oven for 72 hours and then dry weights were recorded.

Sample preparation

To the powdered plant sample, 5ml of 65% HNO_3 was added and then the mixture was boiled gently for 30-45 minutes. After cooling, 2.5ml of 70% $Hclo_4$ was added and the mixture was gently boiled until dense white fumes appeared. Later the mixture was allowed to cool and 10ml of deionised water was added followed by further boiling until the fumes were totally released [8]. The contents were allowed to cool and then filtered through what man No_4 filter paper in a flask. The filtrate was diluted to 50ml with deionised H_2O and stored for further analysis.

Determination of Ash, N, Na, K and P

Ash content

20g fresh sample (W1) was taken in porcelain dish. The weighed sample with porcelain was weighed (W2) and was heated at 90^{o}C for 1hr. It was then kept in muffle furnace about 525^{o}C until it was converted in to white ash. It was cool in desiccator and weighed (W3). Ash content was obtained by following formula:

$$\textbf{Ash content } (g/100\ g) = \frac{\textbf{(W2 - W3) – W1}}{\textbf{Wt. of sample}} \times 100$$

Nitrogen

Pipette out 1-2ml of aliquote in 25ml volumetric flask a d add 2-5ml of distilled water to it. Now add 1ml of 10% sodium silicate solution. Wash the neck of the flask thoroughly from inside. Add required quantity of 10% sodium hydroxide. Wash the neck of flask thoroughly once again. Now add 2ml of Nessler's reagent. Yellow colour appears. Make the volume and take the reading at 440nm.

Sodium [9]

The quantity of sodium in the sample was determined. The solution under analysis is sprayed in Flame photometer using appropriate filter. The flame photometer was standardized using the known standard sodium solution; 5ml of the solution was fed directly into the flame photometer. The sodium content was read as ppm. For samples containing high concentration of sodium appropriate dilution with deionised distilled water were made before feeding into the flame photometer.

Potassium [9]

5ml of the digested sample was neutralized with equal amount of ammonia solution and fed into the flame photometer. The potassium content was directly read out as ppm. The instrument was standardized using different concentration of working standard solution.

Phosphorous [10]

Various volumes of working standard solution 1.0, 2.0, 3.0, 4.0 and 5.0ml were pipette out into a series of test tubes. The concentrations of above solution were 8, 16, 24, 32 and 40mg of phosphorous respectively. One millilitre of the digested sample was pipette in to another test tube. ANSA (0.4ml) and 1.0 ml of molybdate I were added to standard and 1.0 ml of molybdate II was pipette into the unknown samples respectively. The volume was made up to 10ml with distilled water. It was mixed well and the developed color was read in spectrometer at 660nm after 20 minutes. The standard graph was drawn using the standard values.

III. RESULTS AND DISCUSSION

The results show that seed priming with Panchagavya had a significant effect on seed germination, seedling growth and nutrient contents of all the three selected leafy vegetables.

Table-1 shows the effect of Panchagavya on seed germination. Soaking of seeds in panchgavya significantly increased the germination percentage of all the three plant samples. Highest (100%) percentage of seed germination was recorded for the seeds of *Hibiscus sabdariffa* at the time interval of 18hrs. This finding supported by [11] who studied the effect of biopriming on the seeds of black gram. They observed all the treatments promoted significantly earlier germination when compared with the control. Similar results in okra where seed treatment with the coconut water solution was more effective in improving the rate of germination [12]. Pre soaking at a concentration of 4 and 5 percent of panchagavya, the germination and meristic growth of *Abelmoschus esculentus* was high when compared to control [13]. An enhanced seed invigoration in panchagavya pre treated seeds might be due to chemical constituents in the panchagavya.

The height (shoots and root length) of the all the plant samples were significantly higher when compared to control. Highest shoot and root length was also recorded for all the seeds soaked at 18hrs. The higher root and shoot length (Table-2) may be due to the presence of easily available organic C, N, P, K. This availability is very much required for plant nutrition.

Priming with Panchagavya also increased the seed vigour index (Table-3) of all studied leafy vegetables compared to control. Seeds primed with cow urine at 2% recorded increased speed of germination (9.5), germination percentage (98%), root length (14.47 cm), shoot length (16.05 cm), vigour index I (2991), vigour index II (49.98) and dry matter production (0.51 g/10 seedlings) compared to control (8.5, 90, 13.05, 14.75, 2502, 42.30 and 0.47) for speed of germination, germination percentage, root length, shoot length, vigour index I, vigour index II and dry matter production respectively [14](Tagore *et al*., 2017). These results are in confirmation with that of [15]. Shakuntala *et al*., (2012), they reported that organic priming enhances the seedling vigour by increasing enzyme activity in paddy.

Similarly, soaking of seeds in Panchagavya increased fresh and dry weights (Table-4) of all the three seedlings. Increase in the fresh and dry weight of different plant parts due to improved mobilization of nutrients. These result approved the findings of [16] who found the significant effect of hydropriming on germination percentage, seedling dry weight and seedling vigour. The germination percentage (78%), seedling dry weight (1.32 g) and seedling vigour (102.96) were achieved by 24 h hydropriming as compared with unprimed. Moreover, it was found that seed priming significantly increased fresh as well as dry weight in different wheat varieties [17].

Priming with Panchagavya had a significant effect on biochemical constituents such as ash, nitrogen, sodium, potassium and phosphorus (Table-5).

Ash content varied from 12.5 to 28.1%. Highest content (28.1) of ash recorded in seeds of *Hibiscus sabdariffa* soaked

in Panchagavya for 18hrs. Ash content shows the increased level of mineral content in studied plant samples.

The content of nitrogen ranged from 9.28mg/g to 40.7mg/g which was higher compared to control. It is reported that panchagavya possess almost all the major nutrients, micronutrients and growth hormones enhances metabolic activitiy of plants and supports better growth and nutrient content[18]. Chemotrophs and autotrophic (ammonifers and nitrifers) present in Panchagavya which colonize in the leaves increase the ammonia uptake and enhance total nitrogen supply [19].

The value of Na varied in a range of 0.53ppm to 15.9ppm. Highest content of sodium (15.9) was found in seeds of *Amaranthus gangeticus* soaked for 18hrs. Sodium is essential to all living organisms. Sodium remains one of major electrolyte in the blood. Na and K are of great importance for many regulation systems in the body.

Vast difference established in potassium content of all the primed seeds compared to control. Highest value (92.1ppm) was recorded for the seeds of *Hibiscus sabdariffa* soaked at 18hrs. The K is the most abundant among the minerals quantified. Potassium is an essential nutrient used to maintain fluid and electrolyte balance in the body.

Highest concentration of phosphorus (121.3mg/g) was recorded in the seeds of *Hibiscus sabdariffa* primed for 18hrs in Panchagavya. The effect of the liquid manure was significant which might be due to the microbial population enhancement in the soil which on the other hand enhanced the availability of the nutrients in the soil. Microbes such as *Rhizobium* *Azotobacter*, *Azospirillum*, Phosphoruous solubilising bacteria, *Trichoderma* and *Pseudomonas* present in panchagavya act as liquid bio fertilizer and bio-pesticides [20].

Figures and Tables

Table-1.Effect of Panchagavya on seedgermination of some selected leafy vegetables

S.No	Plant samples	% of Seed germination				
		Control	6hrs	12hrs	18hrs	24hrs
1.	*Amaranthus gangeticus*	60%	84%	92%	98%	96%
2.	*Hibiscus sabdariffa*	50%	90%	96%	100%	100%
3.	*Trigonella foenum – graecum*	80%	94%	96%	100%	98%

Table-2.Effect of Panchagavya on shoot and root length of some selected leafy vegetables

S.No	Plant samples	Time duration									
		Control	6hrs	12hrs	18hrs	24hrs	Control	6hrs	12hrs	18hrs	24hrs
		Shoot length in cm					Root length in cm				
1	*Amaranthus gangeticus*	2.92	4.16	4.24	4.52	3. 63	1.28	1.74	1.80	1.95	1.62
2.	*Hibiscus sabdariffa*	9.31	11.3	13.7	16.2	13.9	4.18	4.88	6.18	6.84	6.12
3.	*Trigonella foenum – graecum*	4.14	5.78	5.76	6.00	4.78	2.56	2.76	3.08	3.20	2.94

Table-3.Effect of Panchagavya on Seed vigour index of some selected leafy vegetables

S.No	Plant samples	Vigour Index				
		Control	6hrs	12hrs	18hrs	24hrs
1.	*Amaranthus gangeticus*	252	495.6	555.68	634.06	504
2.	*Hibiscus sabdariffa*	674.5	1456.2	1908.48	2304	2002
3.	*Trigonella foenum – graecum*	536	802.76	848.64	920	756.56

Table-4.Effect of Panchagavya on Fresh and Dry weight of seedlings of some selected leafy vegetables

S.No	Plant samples	Time duration									
		Control	6hrs	12hrs	18hrs	24hrs	Control	6hrs	12hrs	18hrs	24hrs
		Fresh Wt in gms					Dry Wt in gms				
1.	*Amaranthus gangeticus*	0.028	0.044	0.034	0.056	0.04	0.01	0.14	0.016	0.016	0.016
2.	*Hibiscus sabdariffa*	0.532	0.892	1.246	1.258	0.994	0.076	0.254	0.391	0.39	0.138
3.	*Trigonella foenum – graecum*	0.18	0.096	0.15	0.206	0.168	0.018	0.016	0.046	0.034	0.04

Table-5. Effect of Panchagavya on biochemical composition of some selected leafy vegetables

Compositions		*Amaranthus polygonoides*				*Hibiscus sabdariffa*					*Trigonella foenum - graecum*				
	Control	6hrs	12hrs	18hrs	24hrs	Control	6hrs	12hrs	18hrs	24hrs	Control	6hrs	12hrs	18hrs	24hrs
Ash(%)	20.1	21.5	21.9	25.7	23.5	24.0	25.3	26.2	28.5	27.1	12.0	12.5	13.1	16.5	13.5
Nitrogen (mg/g)	4.28	15.7	19.3	35.7	20.7	3.57	9.28	24.3	40.7	30.3	9.28	10.7	13.6	39.3	32.3
Sodium(ppm)	0.99	14.5	15.3	15.9	14.6	0.49	0.53	0.65	1.83	0.71	0.28	0.74	0.82	1.63	1.03
Potassium(ppm)	0.21	29.5	32.1	42.7	33.7	12.6	36.4	86.2	92.1	58.4	0.47	0.52	1.05	2.23	1.42
Phosporous (mg/g)	25.3	28.7	36.6	38.7	33.2	10.6	27.6	72.3	121.3	89.3	17.2	27.7	36.2	38.3	31.2

IV. CONCLUSION

From the result of the present study, it sums up that the when seeds of leafy vegetables such as *Amaranthus gangeticus*, *Hibiscus sabdariffa* and *Trigonella foenum - graecum* primed with Panchagavya, showed increased rate of germination, biomass and enhanced growth. Based on the results of this study, 18 hrs is an optimum priming duration for all the three studied samples. Results further revealed that treated plant samples shown to contain higher concentration of biochemical constituents such ash, nitrogen, sodium, potassium and phosphorus when compared to control. Hence seed priming with panchagavya could be a promising approach to improve the productivity of agricultural crops.

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