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Seed Germination and Early Seedling Growth of Different Vegetable Species Treated by Organic Liquid Preparations of *Dasagavya* and *Beejamrita*

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Abstract

Seed germination and seedling growth are the most crucial stages of the plant life that exert a pivotal influence on production and economic yield. The present study was conducted to examine the effect of *Dasagavya* and, two organic liquid preparations on seed germination and early seedling growth of okra (*Abelmoschus esculentus*) var. MI5, winged bean (*Psophocarpus tetragonolobus*) var. Green, Chinese spinach (*Amaranthus* spp) var. Red, cooking melon (*Cucumis melo*) var. mal, ridge gourd (*Luffa acutangula*) var. local, cabbage (*Brassica oleracea*) var. jumbo, brinjal (*Solanum melongena*) var. *leenairi* and tomato (*Solanum lycopersicum*) var. local. The experiment consisted of eight sub-experiments, was set up as a completely randomized design with four replicates using germination trays and black color pots. *Dasagavya* and *Beejamrita* were used as organic seed treatments and pure water as the control treatment.

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The highest final seed germination, Germination Index (GI), Mean Daily Germination (MDG) and the lowest Mean Germination Time (MGT) observed in *Dasagavya* and *Beejamrita* treated seeds compared to the control in eight vegetable species. The highest average seedling height, stem girth, number of leaves, leaf length, leaf width, number of roots and root length were not significantly different between *Dasagavya* and *Beejamrita* treated seedlings. However, all these parameters were greater than the control. The highest seed vigor index was recorded in *Dasagavya* treated seedlings of all vegetable species while the lowest was in the control treatment. However, the Seed Vigor Index (SVI) of *C. melo, L. acutangula*, *B. oleracea* and *S. lycopersicum* were not significantly different among *Dasagavya* and *Beejamrita* treated seeds. Based on the results, it can be suggested that the *Dasagavya* and *Beejamrita* could be effectively used as organic seed primers and liquid fertilizers for seedlings of eight vegetable species evaluated in the present study. Furthermore, *Dasagavya* and *Beejamrita* have exhibited the potential of escalating germination and early seedling growth through hydro priming.

Keywords: *Beejamrita*; *Dasagavya;* Organic liquid preparation; Seeds; Seedlings

Introduction

Seedling growth is modulated by cell division, expansion and differentiation through cell biochemistry and physiology (Kalve *et al.*, 2014). The secondary cells begin the vacuolation and enlarge with the growth of the meristem (Cosgrove, 2000). Seed germination is an intricate procedure entailed with different metabolic activities that resulted in radical and plumule emergence. Stored food reserves in the seeds are used for this purpose (Pritchard *et al.*, 2002). Unfavorable environmental conditions and abiotic stresses are the major issues affecting seed germination, seedling vigor and ultimately on crop yield (Khalid *et al.*, 2019). These factors can reduce plant growth rate, delay seeds germination and impact on soil biota, resulting in massive economic loss. Agricultural countries like Sri Lanka impulse the need for simple and cost effective technologies to enhance the seedling establishment under different environmental conditions (Pawar and Laware, 2018).

Seed treatments reduce the excessive use of fertilizers and soil amendments while improving crop yield by synchronizing seed germination and seedling growth (Mavi *et al.*, 2006). Seed treatments are done before sowing involve: hydration of seeds to enable metabolic activities prior to the germination (Lutts *et al.*, 2016). Seed treatment is an approach that involves nursing seeds with different organic or inorganic compounds for a specified time period under controlled conditions (Chormule *et al.*, 2018). This stimulates various metabolic processes in seeds that improve germination rate in several seed species, including vegetables, grasses and ornamental species while reducing the detrimental outcomes of seed deterioration (Afzal *et al.*, 2016). Application of *Dasagavya* and *Beejamrita* as a seed treatment consider as a cheap, easy, effective and low-risk technique.

Treated seeds have enormous benefits including uniformity in growth, early and faster germination with optimum vigor (Abinaya *et al.*, 2020). Seed treatments further enhance the water use efficiency, roots growth and germination of dormant seeds by increasing metabolic processes, initiate the growth of reproductive organs and early flowering (Farooq *et al.*, 2019). Mainly, treated seeds compete with weeds and combat against the biotic and abiotic stresses (Harris*et al.*, 2002). Generally, the seeds undergo three phases in germination (Bradford, 2002) and during seed priming, the first and second stages undergo with several metabolic and translation processes but not the third stage of germination (Hussain *et al.*, 2016). With this sequence, many benefits are levied to seeds for increasing the growth and germination rate. Hence it reduces the time needed for cellular activities and Deoxyribonucleic acid synthesis in seeds (Yu *et al.*, 2015). This leads to have many biochemical changes in seeds including starch metabolism (Waqas *et al.*, 2019).

Improper use of synthetic agro-chemicals resulted in manifesting adverse effects on the environment, soil and groundwater. Reduction of soil quality is becoming ubiquitous and adversely impacts sustainability, quality of food and nutritional security (Vasu *et al.*, 2020). Insatiable use of agricultural inputs has led to developing resistance to pests and diseases while destroying beneficial ecosystem dynamics. Diminishing favorable densities of pollinators, parasitoids and predators due to the use of inappropriate quantities of agrochemicals were affected on food productivity and food safety (Losey *et al.*, 2006). In organic farming, there is a lack of quality input to be used in seeds and nursery management (Dedefo *et al.,* 2017). *Dasagavya* and *Beejamrita* are two key components of organic farming and emerged as cost effective biological enhancers (Ram and Pathak, 2019). Drawing farmer's attention to organic farming was exorbitant as it is a sustainable farming system with zero chemicals and can regain ecosystem prosperity (Naikwade *et al*., 2012).

Cow dung and cow urine are well known as pools of nutrients while *Dasagavya* and *Beejamrita* are derivatives of cow excreta. *Dasagavya* and *Beejamrita* are techniques of seed treatments designed from locally available raw materials and the use of these organic treatments is well recommended for seeds than synthetic treatments (Ram, 2019). Seeds treated with poisonous fungicide can destroy useful and effective microbes living in the rhizosphere (Shahid *et al.*, 2019). Furthermore, poisonous chemicals and synthetic compounds are absorbed by the roots and deposited in various tissues of the plant leading many implications (Shahid *et al.*, 2017). *Dasagavya* was composed of several medicinal plant extracts together with *Panchagavya*. Due to the combination effects of medicinal plants extracts, *Dasagavya* exhibited a relatively high level of insecticidal properties. There is 5% mortality at 10% concentration of *Dasagavya* in diamondback moth and aphids (Chandrashekharaiah *et al.*, 2013).

Artemisia nilagirica, Leucas aspera, *Lantana camera*, *Datura metal* and *Phytolacca dulcamera* plant species are recommended for temperate countries as these species are abundant in the regions. However, Neem (*Azadirachta indica*), *Calotrophis gigantia*, *Pongamia pinnata, Tephrosia purpurea*, *Jatropha curcas*, *D. metel*, *Adathoda vasica* and *Vitex negundo* plant species are recommended in tropical areas (Selvaraj, 2006*).* The *r*egular use of *Dasagavya* preparation effectively controls a wide range of pests and diseases including: leaf spot, powdery mildew, blight and rust (Kumaranag *et al.*, 2013). Treated plants with 3% concentration of *Dasagavya* manifested inhibitory effects against aphids, thrips, whiteflies, mites and caterpillar (Selvaraj, 2006). *Beejamrita* is a conventional biofertilizer that used to treat seeds which enhance seed germination, avoid phytopathogenic infections and improve seedling vigor (Palekar, 2006). It has the capability to protect the crop from detrimental soil and seed-borne diseases during the early seedling stage. *Beejamrita* showed anti-bacterial, anti-fungal and anti-viral properties against crop diseases (Vyankatrao, 2019). Preparations of these bio-enhancers are very cheap and easy for small-scale and resource poor marginal farmers. Hence, the present study was deliberated to compare the impact of *Dasagavya* and *Beejamrita* as organic seed treatment and growth enhancer at early seedling stage of different vegetable varieties commonly grown in Sri Lanka.

Materials and Methods

Two organic seed primers, *Dasagavya* and *Beejamrita*, were used as the treatments along with the control treatment of water. The present experiment was conducted in sand trays and black color pots from July to October 2021. The average daily temperature, relative humidity and mean rainfall of the area were 32 °C, 73% and 1165 mm, respectively. This experiment consisted of eight sub-experiments, each for a vegetable species, which was carried out with four replicates and setup as a completely randomized design. Eight vegetable species such as: okra (*A. esculentus*) variety (var) MI5, winged bean (*P. tetragonolobus)* var. Green, Chinese spinach (*A.* spp) var. Red, cooking melon (*C. melo)* var. Mal, ridge gourd (*L. acutangula*) var. Local, cabbage (*B. oleracea*) var. *Jambo*, brinjal (*S. melongena*) var. *Lenairi,* tomato (*S. lycopersicum*) var. Local were used as test crops and 120 seeds from each species were used.

The *Dasagavya* was prepared by using healthy leaves of plant species of *A. indica (Kohomba), C. gigantia* (wara), *V. negundo (nika), T. purpurea (pila), J. curcas (edaru), D. metel (aththana)*, *P. pinnata (magul karada)* and *A. vasica (adathoda).* The collected leaves were cleaned properly before obtaining the leaf extract. 1 kg of matured leaf samples from each species was separately soaked in 1 L of cow urine for ten days. After that, 1 L of each filtered extract was added to 5 L of the *Panchagavya* preparation. The mixture was again kept for another 25 days for fermentation. During that period the mixture was stirred well to ensure thorough mixing of *Panchagavya* and the eight plants extracts (Chandrashekharaiah *et al.*, 2013). *Panchagavya* was prepared using 500 g of fresh cow dung, 300 mL of cow urine, 200 mL of curd, 200 mL of cow milk and 100 mL of ghee (Ali *et al.*, 2011; Athavale *et al.*, 2021). *Dasagavya* should filter well before applying to plants and 3% concentration was recommended as foliar sprays and seeds treatments. All seed samples were soaked in *Dasagavya* for 20 minutes before sowing.

Beejamrita was composed of farmyard waste materials: cow dung, cow urine, topsoil and lime powder (Shyamsunder, 2021). First, 2.5 kg of fresh cow dung collected from a native cow was wrapped in a cotton cloth and hang in a 10 L water bucket for 12 hours. Then 2.5 L of cow urine collected from the native cattle, a handful of topsoil and 25 g of lime powder were added to 10 L of water and stirred well. Seed lots were wrapped in a cotton cloth prior to soak in *Beejamrita* solution at the 7th day of the preparation. Generally, newly prepared fresh *Beejamrita* was used for seed treatment but, microbial analysis of *Beejamrita* showed that, it is the best to be used on the 7th day of preparation (Ram and Pathak, 2019). The solution was stirred in a clockwise direction before using for seed treatments. Wrapped seed lots were dipped in *Beejamrita* solution and placed there for 20 minutes until whole seed lots get completely soaked.

Finally, soaked seeds were air-dried in a shade place without exposing to the direct sunlight and rain. Air drying brings back them to their original moisture content, hence radicles were not appearing before sowing. Similarly, coating and combining or mixing *Beejamrita* can be practiced by hands during seed treatments. A similar procedure was adhered by Shyamsunder (2021) with the use of 20 L of water, 5 L of cow urine, 5 kg of cow dung, 50 g of lime powder and a handful soil for the preparation of *Beejamrita*. Under control treatment, all seed samples were soaked in clean running water for 12 hours while wrapping in a cotton clothes.

Treated seeds were sown in washed-fine sand trays with optimum moisture. Randomly selected ten seeds were sown in each sand tray after been treated with *Dasagavya, Beejamrita* and water separately. Daily germination was noted for 10 days and seeds having 2 mm radical emergence was considered as germinated seeds. The Final Germination Percentage of seeds (FGP; number of germinated seeds per total number of seeds sown and present as %), Mean Germination Time (MGT; equation 1), GI (equation 2), and Mean Daily Germination (MDG; ratio between final germination percentage and total number of days) were calculated (Ekanayake and Fernando, 2021). Similarly, a standard equation for SVI was used to find the vigor of eight vegetable species (Williamson and Richardson, 1988) (equation 3).

$$MGT = \frac{\sum_{i=1}^{k} NiTi}{\sum_{i=1}^{k} Ni}$$ Equation 1

Ni = number of germinated seeds at the i^{th} time (not the cumulative number, Ti = time taken from the beginning to the i^{th} observation, only take the corresponding number relevant to the i^{th} observation), k = last time of seeds germination

$$GI = N1/T1+N2/T2+N3/T3+....+Nn/Tn$$ Equation 2

N1, N2, N3,……, Nn = number of germinated seeds at a time (days)
T1, T2, T3, …..,Tn = number of germinated seeds at a specific time (not the cumulative number)

$$\text{Seed Vigor Index (SVI)} = \frac{Germination\ percentage \times Seedling\ length\ (Root+Shoot)}{100}$$ Equation 3

All germinated seeds were transferred to black color pots with 10 cm of diameter filled with the potting mixture prepared by mixing sand: topsoil: coir dust: compost in 1:1:1:1/4 ratio (v/v). Early seedling growth was examined after 15 days of germination. 50 mL of *Dasagavya* and *Beejamrita* were applied at 3% concentration once per two days. Average seedling height, stem girth at 5 cm above the soil level, number of leaves, number of adventurous roots, root length per seedling and leaf length and width were recorded at the end of 15^{th}day. SAS software version 9.1 was used to perform ANOVA for all measured parameters. Means were compared at 5% probability level using Duncan's Multiple Range Test.

Results and Discussion

The FGP of vegetable species, except cabbage, was significantly higher in T1 compared to control treatment ($P<0.05$; Table 1). The FGP was significantly different among *Dasagavya* and *Beejamrita* treated seeds of okra and winged beans. *Dasagavya* was identified as a biofertilizer and a pesticide rather than a seed primer and, current literature lacks information on *Dasagavya* as a seed treatment. *Panchagavya* was well recommended as a seed treatment to promote seed germination and it was included in *Dasagavya*. Hence, *Dasagavya* also recorded comparatively higher seeds germination percentage. Kumaravelu *et al.* (2009) reported that, the 4% of *Panchagavya* stimulated the germination of green gram while Srimathi *et al*. (2013) revealed that, *Panchagavya* at 2% and 5% with the 8–16 hours soaking gave superior seed germination in biofuel crops like *J. curcas* and *P. pinnata*. *Beejamrita* was considered as an enhancer of plant growth and, plays important role in seed germination and rejuvenation. According to Vyankatrao (2019), 100% *Beejamrita* showed high germination, seedling development and seed vigor index in legume seeds. *Beejamrita* provides excellent strength during the seed germination stage and gives an extraordinary strength for saplings to withstand as individual plants (Smith *et al.*, 2020).

Similarly, the GI was not significantly ($p>0.05$) different among *Dasagavya* and *Beejamrita* treatments in cooking melon, ridge gourd, cabbage, brinjal and tomatoes. But the GI was significantly different among *Dasagavya* and *Beejamrita* treated seeds of okra, winged beans and Chinese spinach seeds. Moreover, MDG was not significantly different among *Dasagavya* and *Beejamrita* treatments of okra, winged bean, ridge gourd and tomato. The MDG of Chinese spinach, cooking melon, cabbage and brinjal seeds treated with *Dasagavya* and *Beejamrita* were significantly different. In contrast, *Dasagavya* and *Beejamrita* showed the lowest MGT as they showed the fastest germination in okra, winged bean, Chinese spinach, cooking melon, cabbage, brinjal and tomato. Ridge gourd is the only vegetable species which showed significantly different MGT for *Dasagavya* and *Beejamrita* treated seeds.

Table 1: Effect of different seed treatments on FGP, GI, MGT, MDG of vegetable seeds

Vegetable varieties	Parameters	T1	T2	T3	CV%
Okra	FGP	95.0^{a}	82.5^{b}	70.0^{c}	7.8
	GRI	4.35^{a}	3.85^{b}	3.00^{c}	6.4
	MGT	2.13^{b}	2.20^{ab}	2.45^{a}	7.2
	MDG	31.65^{a}	27.53^{a}	20.40^{b}	10.1
Winged bean	FGP	92.5^{a}	80.0^{b}	67.5^{c}	7.8
	GRI	4.33^{a}	3.73^{b}	2.93^{c}	8.6
	MGT	2.18^{b}	2.18^{b}	2.48^{a}	5.9
	MDG	30.83^{a}	26.68^{a}	19.78^{b}	11.8
Chinese spinach	FGP	77.5^{a}	65.0^{ab}	52.5^{b}	13.1
	GRI	3.45^{a}	2.75^{b}	2.00^{c}	10.2
	MGT	2.27^{b}	2.50^{b}	2.83^{a}	6.6
	MDG	25.83^{a}	19.15^{b}	13.95^{b}	17.4
Cooking melon	FGP	90.0^{a}	80.0^{a}	67.5^{b}	9.2
	GRI	2.58^{a}	2.30^{a}	1.88^{b}	8.6
	MGT	3.58^{a}	3.53^{a}	3.75^{a}	3.7
	MDG	22.50^{a}	20.00^{b}	14.25^{c}	8.1
Ridge gourd	FGP	95.0^{a}	92.5^{ab}	80.0^{b}	9.0
	GRI	4.25^{a}	3.95^{a}	3.18^{b}	9.1
	MGT	2.30^{c}	2.43^{b}	2.65^{a}	1.8
	MDG	31.65^{a}	30.83^{a}	23.13^{b}	9.3
Cabbage	FGP	97.5^{a}	97.5^{a}	90.0^{a}	6.6
	GRI	4.83^{a}	4.65^{a}	3.90^{b}	7.3
	MGT	2.03^{b}	2.13^{b}	2.38^{a}	3.8
	MDG	44.58^{a}	32.48^{b}	30.00^{b}	13.7
Brinjal	FGP	100^{a}	95.0^{a}	82.5^{b}	6.9
	GRI	1.83^{a}	1.70^{a}	1.48^{b}	6.8
	MGT	5.48^{b}	5.60^{ab}	5.70^{a}	1.5
	MDG	16.63^{a}	14.65^{b}	11.80^{c}	5.8
Tomato	FGP	97.5^{a}	92.5^{a}	70.0^{b}	9.0
	GRI	2.20^{a}	2.05^{a}	1.55^{b}	9.4
	MGT	4.53^{a}	4.58^{a}	4.60^{a}	2.7
	MDG	19.50^{a}	18.50^{a}	12.93^{b}	11.6

T1 – Dasagavya, T2 – Beejamrita, T3 – control/water, means with similar letters in each row are not significantly different from each other in α=0.05

The highest seedling height, stem girth, leaf length, leaf width, root length and the number of adventurous roots were recorded in *Dasagavya* treatment in cabbage and brinjal seedlings while, the lowest values for above growth parameters were observed in the control treatment (Table 2). The seedling height, stem girth, the number of leaves, leaf width, root length and number of adventurous roots of okra was not significantly different among *Dasagavya* and *Beejamrita* treatments. However, all these parameters were significantly greater than the control treatment. Further, the seedling height, stem girth, number of leaves, leaf width and root length, of winged beans and ridge gourd were not significantly different among *Dasagavya* and *Beejamrita* treatments. In Chinese spinach, the seedling height, stem girth, the number of leaves, leaf length, leaf width and root length were not significantly different in *Beejamrita* and *Dasagavya*. In cooking melon, all the growth parameters were not significantly different in *Dasagavya* and *Beejamrita* treatments. In cabbage, stem girth, the number of leaves, leaf length, leaf width, root length and the number of roots were not significantly different in the first and second treatments.

The number of leaves, root length and number of roots were not significantly different among *Dasagavya* and *Beejamrita* treatments in brinjal. In tomatoes, growth parameters: seedling height, stem girth, number of leaves, leaf length and width were not significantly different in *Dasagavya* and *Beejamrita* treatments. *Dasagavya* consists of miraculous effects on plant growth when all ingredients are suitably mixed in correct proportions. Ram (2019) pointed that the *Dasagavya* enriched with fermentative bacteria, *Lactobacillus* and derive various beneficial metabolites including organic acids, hydrogen peroxide and antibiotics, effectively fight against pathogenic organisms. Selvaraj *et al*. (2007) found that *Dasagavya* owned the potential to increase the shelf life, quality, quantity and taste of many fruits and vegetable varieties with high biological efficiency in crops. *Beejamrita* is a rich source of macro and micronutrients and provides protection to the crops from various seed borne diseases while ensures better plant establishment with Total Nitrogen (770 ppm), Phosphorus (166 ppm), Potassium (126 ppm), Zinc (4.29 ppm), Copper (1.58 ppm) and Ferrous (282 ppm) as the main components included in the *Beejamrita* solution (Shyamsunder, 2021)

Table 2: Average seedling height, stem girth, number of leaves, leaf length, leaf width and the number of roots under different seed treatments

Vegetable varieties	Parameters	T1	T2	T2	CV%
Okra	Seedling height (cm)	30.0^{a}	29.35^{a}	28.22^{b}	2.1
	Stem girth (mm)	3.85^{a}	3.68^{a}	3.38^{b}	3.5
	Number of leaves	4.0^{a}	4.0^{a}	3.5^{a}	8.7
	Leaf length (cm)	4.60^{a}	4.33^{b}	3.93^{b}	3.3
	Leaf width (cm)	4.08^{a}	3.95^{a}	3.70^{b}	2.7
	Root length (cm)	9.6^{a}	9.4^{a}	9.08^{b}	1.5
	Number of roots	22.75^{a}	20.25^{ab}	18.0^{b}	9.2
Winged bean	Seedling height (cm)	40.88^{a}	39.98^{a}	38.40^{b}	2.3
	Stem girth (mm)	5.20^{a}	5.03^{ab}	4.63^{b}	5.1
	Number of leaves	6.0^{a}	6.0^{a}	5.5^{a}	5.7
	Leaf length (cm)	5.3^{a}	5.1^{b}	4.83^{c}	1.7
	Leaf width (cm)	4.15^{a}	4.0^{ab}	3.88^{b}	3.5
	Root length (cm)	18.70^{a}	18.40^{a}	17.95^{b}	1.4
	Number of roots	18.5^{a}	16.75^{b}	15.5^{c}	3.3
Chinese spinach	Seedling height (cm)	11.35^{a}	11.13^{a}	10.70^{a}	3.6
	Stem girth (mm)	1.00^{a}	0.93^{a}	0.78^{b}	10.1
	Number of leaves	4.0^{a}	4.0^{a}	3.5^{a}	8.8
	Leaf length (cm)	2.13^{a}	2.05^{a}	1.80^{b}	4.0
	Leaf width (cm)	1.50^{a}	1.38^{a}	1.15^{b}	7.8
	Root length (cm)	6.13^{a}	5.95^{ab}	5.75^{b}	2.9
	Number of roots	4.5^{a}	3.5^{b}	3.0^{b}	12.9
Cooking melon	Seedling height (cm)	26.20^{a}	26.03^{ab}	25.80^{b}	0.7
	Stem girth (mm)	3.60^{a}	3.50^{a}	3.20^{b}	2.4
	Number of leaves	4.0^{a}	4.8	3.5^{a}	8.7
	Leaf length (cm)	4.55^{a}	4.45^{a}	4.28^{b}	2.5
	Leaf width (cm)	5.08^{a}	4.95^{a}	4.73^{b}	1.7
	Root length (cm)	5.08^{a}	4.95^{a}	4.73^{b}	1.7
	Number of roots	29.0^{a}	27.25^{ab}	25.75^{b}	4.8
Ridge gourd	Seedling height (cm)	25.4a	24.88^{ab}	24.30^{b}	2.3
	Stem girth (mm)	5.03^{a}	4.83^{a}	4.53^{a}	6.5

	Parameters	T1	T2	T2	CV%
	Number of leaves	7.0^{a}	7.0^{a}	6.5^{a}	4.9
	Leaf width (cm)	7.00^{a}	6.75^{ab}	6.48^{b}	2.7
	Root length (cm)	7.45^{a}	7.23^{a}	6.95^{b}	2.3
	Number of roots	36.0^{a}	32.5^{b}	28.25^{c}	5.0
Cabbage	Seedling height (cm)	9.35^{a}	9.13^{b}	8.78^{c}	1.5
	Stem girth (mm)	1.05^{a}	1.05^{a}	0.90^{b}	8.16
	Number of leaves	3.0^{a}	3.0^{a}	2.5^{a}	11.8
	Leaf length (cm)	1.08^{a}	0.98^{a}	0.85^{a}	14.0
	Leaf width (cm)	1.05^{a}	0.98^{ab}	0.80^{b}	14.1
	Root length (cm)	4.28^{a}	4.13^{ab}	3.98^{b}	3.6
	Number of roots	12.75^{a}	12.75^{a}	10.5^{b}	10.0
Brinjal	Seedling height (cm)	7.18^{a}	6.48^{b}	6.08^{c}	3.2
	Stem girth (mm)	1.20^{a}	1.00^{b}	0.75^{c}	12.2
	Number of leaves	3.5^{a}	3.5^{a}	3.0^{a}	14.1
	Leaf length (cm)	2.58^{a}	2.20^{b}	1.90^{c}	3.9
	Leaf width (cm)	1.53^{a}	1.35^{b}	1.08^{c}	8.2
	Root length (cm)	4.15^{a}	3.95^{a}	3.58^{b}	3.7
	Number of roots	13.75^{a}	12.25^{a}	10.5^{b}	7.9
Tomato	Seedling height (cm)	11.90^{a}	11.63^{a}	9.85^{b}	6.0
	Stem girth (mm)	1.08^{a}	1.0^{ab}	0.90^{b}	8.7
	Number of leaves	4.0^{a}	3.75^{a}	3.5^{a}	11.8
	Leaf length (cm)	2.00^{a}	1.88^{a}	1.58^{b}	7.2
	Leaf width (cm)	1.08^{a}	0.98^{a}	0.70^{b}	8.5
	Root length (cm)	4.68^{a}	4.38^{b}	4.10^{c}	3.5
	Number of roots	12.75^{a}	10.25^{b}	8.25^{b}	14.4

T1- Dasagavya, T2- Beejamrita, T3- control/water, means with similar letters in the same row are not significantly different from each other in α=0.05

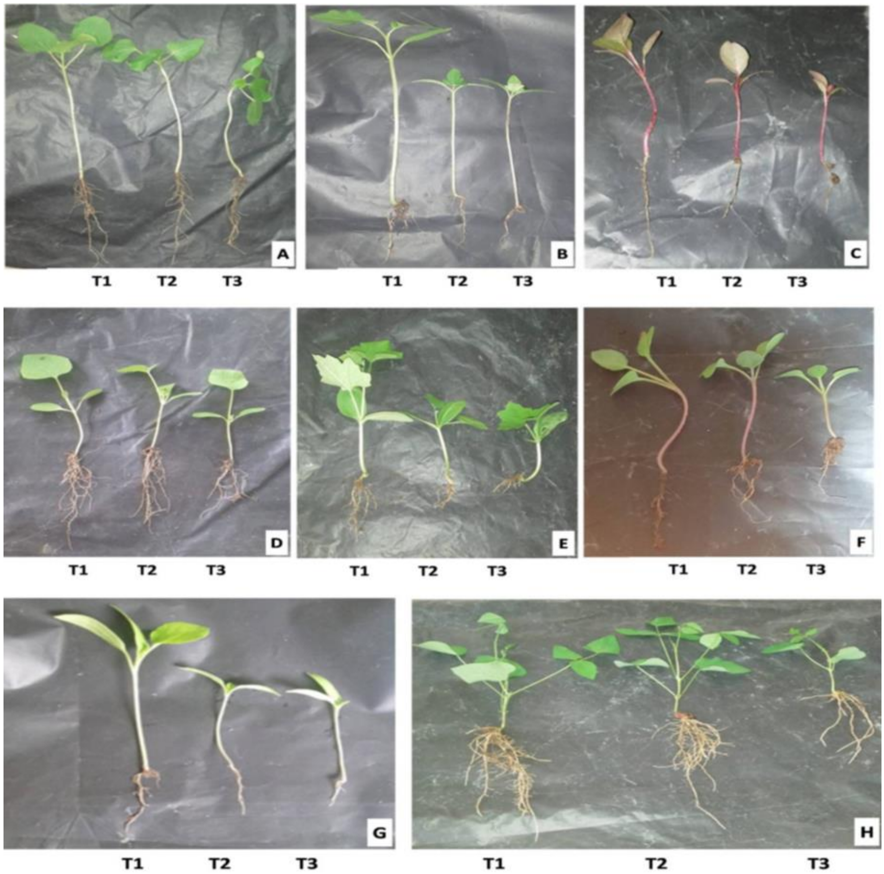

Plate 1: Effect of different seed treatments on growth of seedlings (A) okra; (B) tomato; (C) Chinese spinach; (D) Cooking melon (E); ridge gourd (F); cabbage (G); brinjal (H) and winged bean (T1- *Dasagavya*, T2- *Beejamrita* and T3- control/water)

Significantly higher ($p<0.05$) seed vigor index was observed in *Dasagavya* treated okra, winged bean, Chinese spinach and brinjal while the lowest seed vigor index was reported in control treatment for all vegetable species (Figure 01). Vyankatrao (2019) found that 100% *Beejamrita* treatment showed the highest percentage of germination, seed vigor index and seedling growth in ground nut, soybean, moth bean and green gram. Further, it has been emphasized that *Beejamrita* was recommended for organic agriculture as its regular use as a seed treatment can alleviate dependence on chemicals and synthetic materials. *Beejamrita* is well known for root protection and strengthening the root system during transplanting (Padmavathy and Poyyamoli, 2011).

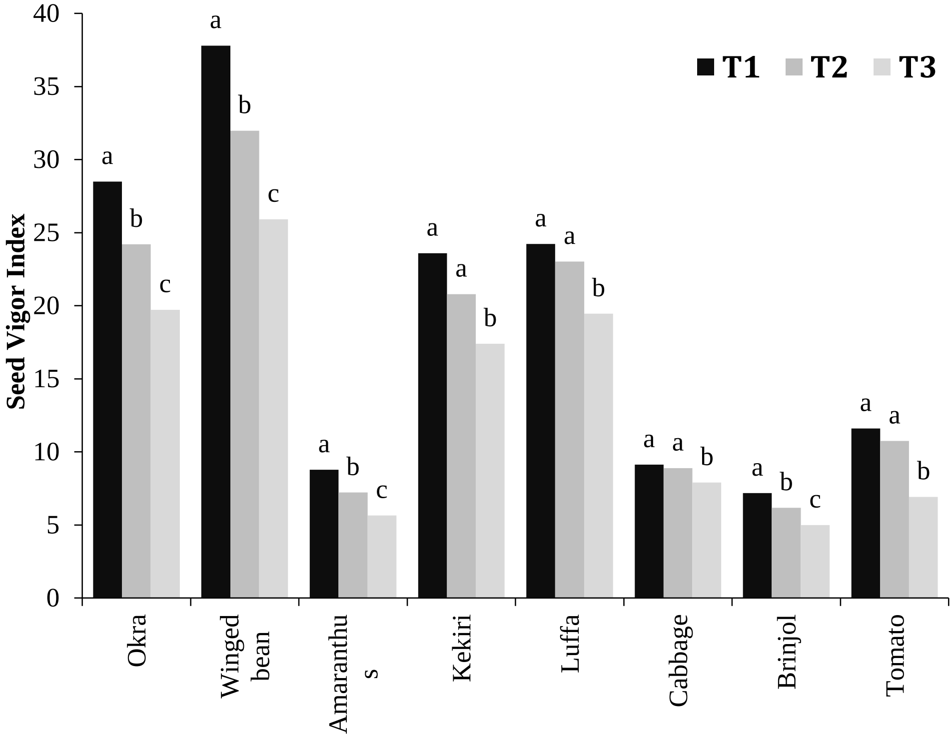

Figure 1: Seed vigor index of eight vegetable species under different seed treatments (T1 - *Dasagavya*; T2 – *Beejamrit;* T3 – control/water), Means with similar letters on the bar are not significantly different from each other in α=0.05 for a given vegetable species

The secondary plant metabolites in *L. camara*, *D. metal*, *Calotrophis* and other herbs highly contributed to the insecticidal properties in *Dasagavya* (Chandrashekharaiah *et al.*, 2015). *Dasagavya* is a growth promoter while it has the potential in boosting immunity against pests and diseases in plants (Pathak and Ram, 2013). Moreover, there is huge number of positive effects of *Dasagavya* on hill crops. Thrips and powdery mildew of rose and gerbera were effectively controlled by applying *Dasagavya* (3%) solution while blister blight disease in tea plantations was controlled by regular application of 3%

Dasagavya at 15 days (Selvaraj, 2006). Moreover, beneficial microbes in *Beejamrita* protect the crop from soil-borne pathogens and avoid seed borne diseases mainly during the seedling stage. It exhibits vast scope of properties: fertilizer, pesticide and manure (Ahilandeswari and Maheswari, 2018).

There were no disadvantages or consequences recorded on seeds, soil and a crop from *Beejamrita* as it is an organic formulation. Supporting our findings, Devakumar *et al*. (2008) and Sreenivas *et al.* (2010) observed that the *Beejamrita* consists of numerous valuable microorganisms including: actinomycetes, phosphorus solubilizers, nitrogen fixers and beneficial fungi that can positively influence on growth and yield of plants. Khan *et al.* (2020) emphasized that, the presence of Abamectin, Bifenthrin, and Difenoconazole commonly used as pesticides and seed treatments are crossing the thresholds in fruit and vegetable samples and, consumers are under possible health risks around the world due to the presence of these synthetics. Biological seed treatment techniques are expected to be growing rapidly in large scale cultivations in the present era due to their environmental friendly nature (Sharma *et al.*, 2015). One of the main limitations of efficient nursery management is the lack of awareness of seed treatments and early seedling among workers. Therefore, it is essential to make extra efforts at farmer level to adapt new organic technologies.

Conclusion

Organic seed treatments and biofertilizers can be effectively utilized to enhance the seed germination and seedling growth at early stages of life of different vegetable species. *Dasagavya* and *Beejamrita* seed treatments were reported to have better seed germination and fast germination compared to the control. *Dasagavya* applied seedlings of okra, winged bean, Chinese spinach and brinjal showed vigorous seeding growth. *Dasagavya* and *Beejamrita* exhibited the potential to be used as seed primers for intensifying germination and seedling growth than water soaking for the vegetable species examined in the present study.

References

Abinaya, K., Sundareswaran, S., and Raja, K. (2020). Effect of pre-germination technique on enhancing seed and seedling vigour in ridge gourd (*Luffa acutangla* Roxb.). *Madras Agricultural Journal*, *107*(4/6), 119-124.

Afzal, I., Rehman, H.U., Naveed, M. and Basra, S.M.A. (2016). Recent advances in seed enhancements. *New Challenges in Seed Biology-Basic and Translational Research Driving Seed Technology,* IntechOpen, pp4774.

Ahilandeswari, K. and Maheswari, N.U. (2018). Impact of integrated nutrient and pest management system through organic farming in the traditional rice varieties. *Asian Journal of Multidimensional Research,* 7(9): 159-167.

Ali, M.N., Ghatak, S. and Ragul, T. (2011). Biochemical analysis of Panchagavya and Sanjibani and their effect in crop yield and soil health. *Journal of Crop Weed,* 7(2): 84-86.

Aravind, J., Vimala, D., Radharani, J., Jacob, S. R., and Srinivasa, K. (2020). The germination metrics package: A brief introduction. *New Delhi, India: ICAR-National Bureau of Plant Genetic Resources*.

Athavale, A., Jirankalgikar, N., Nariya, P. and Des, S. (2012). Evaluation of in-vitro antioxidant activity of panchagavya: a traditional ayurvedic preparation. *International Journal of Pharmaceutical sciences and Research,* 3(8): 2543-9.

Bradford, K. J. (2002). Applications of hydrothermal time to quantifying and modeling seed germination and dormancy. *Weed Science*, *50*(2), 248-260.

Chandrashekharaiah, M., Sannaveerappanavar, V. T., Chakravarthy, A., and Verghese, A. (2013). Biological activity of select plant and indigenous extracts against diamondback moth, *Plutella xyllostella* (L.) (Lepidoptera: Plutellidae) and cowpea aphid, *Aphis craccivora Koch* (Hemiptera: Aphididae). *Current Biotica*, *7*(3), 134-144.

Chandrashekharaiah, M., Satish, S., Vasudev, K., Arya, V. V., and Narasimhamurthy, G. M. (2015). Efficacy of plant and aboriginal preparations against diamondback moth, *Plutella xylostella* (L.) (Lepidoptera: Plutellidae). *Journal of Entomology and Zoology Studies*, *3*(4), 18-23.

Chormule, S. R., Changade, N. M., and Patel, J. B. (2018). Effect of seed treatments on storability of vegetable seeds: a review. *Plant Archives*, *18*(1), 28-32.

Cosgrove, D. J. (2000). Expansive growth of plant cell walls. *Plant Physiology and Biochemistry*, *38*(1-2), 109-124.

Dedefo, K., Derero, A., Tesfaye, Y., and Muriuki, J. (2017). Tree nursery and seed procurement characteristics influence on seedling quality in Oromia, Ethiopia. *Forests, Trees and Livelihoods*, *26*(2), 96-110.

Devakumar, N., Rao, G.G.E., Shubha, S., Imrankhan, N. and NagarajandGowda, S.B. (2008). Activates of Organic Farming Research Centre. Navile, Shimoga, University of Agriculture Sciences Bangalore: pp12.

Ekanayake, E.M.U.I. and Fernando, K.M.C. (2021). Development of ex-situ conservation protocol of Ceylon gooseberry [*Dovyalis hebecarpa* (Gardner) Warb.]. *International Journal of Minor Fruits, Medicinal and Aromatic Plants,* 7(1): 62-71.

Farooq, M., Usman, M., Nadeem, F., Rehman, H., Wahid, A., Basra, S.M. and Siddique, K.H. (2019). Seed priming in field crops: potential benefits, adoption and challenges. *Crop and Pasture Science,* 70(9): 731-771.

Harris, D., Tripathi, R. S., and Joshi, A. (2002). On-farm seed priming to improve crop establishment and yield in dry direct-seeded rice. *Direct seeding: Research Strategies and Opportunities, International Research Institute, Manila, Philippines*, 231-240.

Hussain, S., Khan, F., Hussain, H. A., and Nie, L. (2016). Physiological and biochemical mechanisms of seed priming-induced chilling tolerance in rice cultivars. *Frontiers in plant science*, *7*, 116.

Kalve, S., De Vos, D., and Beemster, G. T. (2014). Leaf development: a cellular perspective. *Frontiers in plant science*, *5*, 362.

Kaya, M. D., Okçu, G., Atak, M., Cıkılı, Y., and Kolsarıcı, Ö. (2006). Seed treatments to overcome salt and drought stress during germination in sunflower (*Helianthus annuus* L.). *European journal of agronomy*, *24*(4), 291-295.

Khalid, M.F., Hussain, S., Ahmad, S., Ejaz, S., Zakir, I., Ali, M.A., Ahmed, N. and Anjum, M.A. (2019). Impacts of abiotic stresses on growth and development of plants. *Plant tolerance to environmental stress,* CRC Press, pp 1-8.

Khan, N., Yaqub, G., Hafeez, T., and Tariq, M. (2020). Assessment of health risk due to pesticide residues in fruits, vegetables, soil, and water. *Journal of Chemistry*, *2020*.

Kumaranag, K.M., Kedar, S.C. and Patil. M.D. (2013). Insect Pest Management in Organic Farming Systems. *Popular Kheti*. 1(4): 3.

Kumaravelu, G., and Kadamban, D. (2009). Panchagavya and its effect on the growth of the greengram cultivar K-851. *International Journal of Plant Sciences (Muzaffarnagar)*, *4*(2), 409-414.

Losey, J. E., and Vaughan, M. (2006). The economic value of ecological services provided by insects. *Bioscience*, *56*(4), 311-323.

Lutts, S., Benincasa, P., Wojtyla, L., Kubala, S., Pace, R., Lechowska, K., and Garnczarska, M. (2016). Seed priming: new comprehensive approaches for an old empirical technique. *New challenges in seed biology-basic and translational research driving seed technology*, 1-46.

Marcos Filho, J. (2015). Seed vigor testing: an overview of the past, present and future perspective. *Scientia agricola*, *72*, 363-374.

Mavi, K., Ermis, S., and Demir, I. (2006). The effect of priming on tomato rootstock seeds in relation to seedling growth. *Asian Journal of Plant Sciences*, *5*(6), 940-947.

Naikwade, P. V., Sankpal, S. T., and Jadhav, B. B. (2012). Management of waste by composting, vermicomposting and its use for improvement of growth, yield and quality of fodder maize. *ARPN Journal of Science and Technology*, *2*(5), 184-194.

Padmavathy, K., and Poyyamoli, G. (2011). Alternative farming techniques for sustainable food production. In *Genetics, Biofuels and Local Farming Systems* (pp. 367-424). Springer, Dordrecht.

Palekar, S. (2006). Textbook on Shoonya Bandavalada Naisargika Krushi. *Pub: Swamy Anand, Agri Prakashana, Bangalore, India*, 43-149.

Pathak, R. K., and Ram, R. A. (2013). Bio-enhancers: A potential tool to improve soil fertility, plant health in organic production of horticultural crops. *Progressive Horticulture*, *45*(2), 237-254.

Pawar, V. A., and Laware, S. L. (2018). Seed priming a critical review. *Int. J. Sci. Res. Biol. Sci*, *5*, 94-101.

Srimathi, P., Mariappan, N., Sundaramoorthy, L., and Paramathma, M. (2013). Efficacy of Panchagavya on seed invigoration of biofuel crops. Scientific Research and Essays, 8(41), 2031-2037.

Vasu, D., Tiwary, P., Chandran, P., and Singh, S. K. (2020). Soil quality for sustainable agriculture. In Nutrient dynamics for sustainable crop production (pp. 41-66). Springer, Singapore.

Vyankatrao, N.P. (2019). Effect of Bijamrita and other organic liquid treatments on seed germination and seedling growth of legume crops. *Online International Interdisciplinary Research Journal*, 9(3): 59-68.

Waqas, M., Korres, N. E., Khan, M. D., Nizami, A. S., Deeba, F., Ali, I., and Hussain, H. (2019). Advances in the concept and methods of seed priming. In *Priming and pretreatment of seeds and seedlings* (pp. 11-41). Springer, Singapore.

Williamson, G. B. and Richardson, D. R. (1988). Bioassay for allelopathy: Measuring treatment responses within dependent controls. *Journal of Chemical Ecology,* 14(1):181-187.

Yu, X., Li, A., and Li, W. (2015). How membranes organize during seed germination: three patterns of dynamic lipid remodelling define chilling resistance and affect plastid biogenesis. *Plant, cell and environment*, *38*(7), 1391-1403.