

Full Length Research Paper

Efficacy of Panchagavya on seed invigoration of biofuel crops

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Studies on organic seed fortification with *Jatropha curcas* and *Pongamia pinnata* using 'Panchagavya' at one, two, three, four and five per cent concentrations with the three different soaking durations revealed that Panchagavya at 2 and 5% with the soaking duration of 16 and 8 h were superior than the control and other concentrations in terms of germination and seedling vigour for *Jatropha curcas* and *Pongamia pinnata* respectively.

Key words: Organic fortification, biofuel species, seed germination, seedling vigour.

INTRODUCTION

Panchagavya means "mixture of five products (cow dung, cow urine, milk, ghee and curd) of cow. Of these, the three direct constituents are cow dung, urine, and milk; and the two derived products are curd and ghee. It has been used in traditional Indian rituals throughout history. It is also called cowpathy treatment based on products obtained from cows used in Ayurvedic medicine and of religious significance for Hindus. Panchgavya is also used as fertilizers and pesticides in agricultural operations. Panchagavya is an organic product recommended for crop improvement in organic agriculture (Sangeetha and Thevanathan, 2010). In Sanskrit, Panchagavya means the blend of five products obtained from cow. Each individual of these five products is called 'Gavya' and together termed as 'Panchagavya'. The literatures on Vedic (Vrkshayurveda) depict organizations of the practices that the farmers practice Panchagavya at field level. It has a place, in a theoretical framework and also has certain plant growth stimulants. Panchagavya plays an important role in the quality of

fruits and vegetables. It is used as a foliar spray, soil application along with irrigation, as well as seed treatment (Natarajan, 2002). Farmers in South India practice Panchagavya for sustainable agriculture (Nayagam, 2001). Use of chemical fertilizers and pesticides in agriculture fields led to environmental degradation and hence as an alternative to chemicals. Panchagavya is also being sought to improve crop establishment and health (Shakuntala et al., 2012). Therefore, Panchagavya has played a significant role in providing resistance to pests and diseases, resulting in increased overall yields (Tharmaraj et al., 2011; Sumangala and Patil, 2009). Panchagavya possess the properties of fertilizers and bio pesticides (Sireesha, 2013). Panchagavya has resulted in positive effect on growth and productivity of crops as reported by Somasundaram et al. (2007).

Jatropha curcas (L.) belongs to the family Euphorbiaceae, commonly named as physic nut and *Pongamia pinnata* (L.) Pierre belongs to the family

Leguminosae, commonly known as Indian beech tree or pongam oil tree, that is, trees grown in backyards of forest based industry because of their utility as an alternative of fossil fuel. These underutilized trees are houses based on their multipurpose utility. At present, these trees are getting more popularity for plantation in generally propagated through seeds (Daniel and Hegde, 2007). Seed is one of the basic inputs of agriculture normally invigorated before sowing for the benefit of endogenous improvement of needy substances. Irrespective of the invigorative agent, the success of pretreatment is highly dependent on its concentration and the soaking duration. Promotive influence of Panchagavya has been well documented in agricultural and horticultural crops to enhance the growth and yield (Natarajan, 2002), but there is no evidence found on biofuel tree species. Hence studies were initiated with *Jatropha* and Pungam seeds to evaluate the influence of Panchagavya for its seed invigorative influence with different doses and durations.

MATERIALS AND METHODS

Seed source and experimental materials

Fresh seeds of *J. curcas* and *P. pinnata* were collected from Theni (10°04'N 77°45'E) and Coimbatore (11°16'N 76°58'21"E) districts of Tamil Nadu, India and used for Panchagavya seed fortification study during the year 2010 to 2011. The commercial product of Panchagavya was obtained from Tamil Nadu Agricultural University (TNAU), Coimbatore, India.

Approach

Panchagavya (TNAU product) was diluted to 1, 2, 3, 4 and 5% concentration using distilled water (Panchagavya were measured as 1 / 2 / 3 / 4 / 5 ml and the volume was made up to 100 ml using 99 / 98 / 97 / 96 / 95 ml of distilled water respectively). In each of the dilutions, the seeds of *J. curcas* and *P. pinnata* were soaked along with water adopting the seed to solution ratio of 1:1. The seeds were removed at various soaking durations *viz.*, 8, 16 and 24 h and were sown in sand media under germination room condition (25°C, 95 ± 2% RH). Seven replications with 100 seeds in each were used in each treatment.

Observations

Seed germination per cent was calculated on 5th, 8th, 12th and 16th day and on 10th, 14th, 18th and 22nd day (after sowing) for *J. curcas* and *P. pinnata* respectively. After 16 and 22 days after sowing, the seeds were evaluated for the initial seed and seedling quality characteristics *viz.*, Germination (%) (ISTA, 2010), root length (cm) (the distance between the collar region to the tip of the primary root), shoot length (cm) (the distance between collar region to the tip of the primary leaf), dry matter production of 10 seedlings⁻¹ (g) (dried in a hot air oven maintained at 85°C for 48 h and cooled in a desiccator for 30 minutes and weighed in an electronic digital balance). Vigour index values were also computed as per Abdul-Baki and Anderson (1973) adopting the following formula.

Vigour index¹ = Germination (%) × Total seedling length (cm)

Statistical analysis

The data were analyzed statistically adopting the procedure described by Gomez and Gomez (1984). Wherever necessary, the percentage values were transformed to angular (arc sine) values before carrying out the statistical analysis. The critical difference (CD) were worked out at 5% (P = 0.05) level. Since all the experiments were laboratory basis, the experimental design adopted was completely randomized design.

RESULTS

Organic products are natural substances containing growth regulators and nutrients in different proportions (Somasundaram et al., 2007). Though their utility has been well established, for the selectivity of botanicals, the present study was carried out on Panchagavya with five different concentrations (1, 2, 3, 4 and 5%) and three different durations of soaking (8, 16 and 24 h) for invigoration of *Jatropha* and Pungam, the biofuel crops to have a better nursery establishment. The results expressed significant variation among the concentrations of Panchagavya and the durations of soaking (Tables 1 and 2).

Jatropha curcas

The variation in *J. curcas* seed germination percentage recorded at various durations to express the influence of invigorative agent during growth period as 5th, 8th, 12th, and 16th day after sowing (Figure.1). The results revealed that the earliest germination to the tune of 20% was recorded at T_{1b} (16 h soaking at 1% Panchagavya) treatment followed 18% by T_{3b} (16 h soaking at 3% Panchagavya) in five days after sowing while highest germination percentage (83%) were recorded for T_{1b} (16 h soaking at 1% Panchagavya) followed (78%) by T_{6b} (16 h water soaking) on 16th day after sowing.

Among the different concentrations and soaking durations of Panchagavya, *Jatropha* seeds had better invigorated at 2% concentration with 16 h soaking (83%) which were 17 and 6% higher than control and water soaking respectively (Table 1). Similarly, the seedling vigour was also higher with 2% concentration of Panchagavya than control and water soaked seeds. But, seed germination and seedling quality characteristics were reduced with increasing concentration levels and duration.

Pongamia pinnata

The *P. pinnata* seeds on 10th day after sowing at 5% concentration of Panchagavya, T_{5a} scored highest germination (88%) followed by T_{4a} (80%). However, there was no germination observed on 10th day after sowing of Pungam seeds under the treatments T_{1c} (24 h soaking at

Table 1. Influence of seed fortification treatment with Panchagavya on seed invigoration of *Jatropha curcas*.

Concentration (C)	Soaking durations (h) (D)							
	8	16	24	Mean	8	16	24	Mean
	Germination (%)				Shoot length (cm)			
1%	58 (49.4)	63 (52.3)	58 (49.4)	59 (50.3)	28.5	27.3	29.0	28.3
2%	63 (52.3)	83 (65.3)	65 (53.9)	70 (56.9)	31.3	30.4	22.9	28.2
3%	63 (52.3)	76 (60.3)	60 (50.8)	66 (54.5)	27.1	28.8	25.7	27.2
4%	68 (55.3)	68 (55.6)	58 (49.3)	64 (53.4)	23.9	28.4	24.3	25.5
5%	65 (53.8)	68 (55.6)	48 (44.1)	60 (51.1)	27.3	28.9	25.7	27.3
Water	69 (56.4)	78 (62.3)	45 (42.0)	64 (52.9)	27.3	27.6	21.0	25.3
Control	69 (56.4)	69 (56.4)	69 (56.4)	69 (56.4)	30.4	30.4	30.4	30.4
Mean	65 (53.7)	72 (58.3)	58 (49.4)		28.0	28.8	25.6	
CD (P=0.05)	C	D	CD		C	D	CD	
	4.0	3.1	NS		NS	2.0	NS	
	Root length (cm)				Fresh weight 10 seedlings ⁻¹ (g)			
1%	7.6	9.7	7.9	8.4	39.5	39.7	38.8	39.3
2%	8.3	9.0	7.5	8.3	39.7	47.0	42.5	43.0
3%	8.0	10.0	8.3	8.8	39.4	41.5	43.7	41.5
4%	8.0	8.7	8.2	8.3	37.0	43.7	43.1	41.2
5%	8.2	8.2	7.3	7.9	42.4	43.5	39.6	41.8
Water	11.5	11.7	8.1	10.4	51.0	55.2	48.6	51.5
control	8.0	8.0	8.0	8.0	38.2	38.2	38.2	38.2
Mean	8.5	9.3	7.9		41.0	44.1	42.1	
CD (P=0.05)	C	D	CD		C	D	CD	
	NS	0.8	NS		NS	2.5	NS	
	Dry weight 10 seedlings ⁻¹ (g)				Vigour index			
1%	3.6	4.4	3.3	3.8	2085	2308	2116	2170
2%	3.4	4.5	4.1	4.0	2483	3281	1983	2582
3%	3.3	4.4	3.5	3.7	2183	2928	2040	2383
4%	3.3	3.6	3.4	3.4	2144	2521	1871	2178
5%	3.3	4.3	3.3	3.6	2309	2524	1597	2143
Water	3.8	3.9	2.0	3.2	2654	3087	1301	2347
control	2.2	2.2	2.2	2.2	1256	1256	1256	1256
Mean	3.3	3.9	3.1		2159	2558	1738	
CD (P=0.05)	C	D	CD		C	D	CD	
	NS	0.3	NS		NS	254.7	NS	

C – Concentration, D – Duration of soaking hours (h), C x D – Interaction between concentration and duration of soaking duration, and NS – Non-significant. Figures in parentheses are arc sine transformed values.

1% Panchagavya), T_{2c} (24 h soaking at 2% Panchagavya) and T_7 (control) (Figure 2). The results on *P. pinnata* revealed that seeds had better invigorative effect only at 5% with the soaking duration of 8 h (Table 2) probably due to the size of the seeds and the thickness of the seed coat and was followed by 4% for 8 h soaking. *P. pinnata* seeds pretreated with Panchagavya at 5% concentration for 8 h soaking enhanced the germination by 20 and 10% compared to control and water soaking respectively. Seed fortification with

Panchagavya (5%) had also increased the seed and seedling vigour of Pungam seeds compared to control and water soaking.

DISCUSSION

The studies clearly indicated that there were significant improvement in the seed invigoration with Panchagavya fortified seeds and might be due to the action of

Table 2. Influence of seed fortification treatment with Panchagavya on seed invigoration of *Pongamia pinnata*.

Concentration (C)	Soaking durations (h) (D)							
	8	16	24	Mean	8	16	24	Mean
	Germination (%)				Shoot length (cm)			
1%	70 (56.8)	58 (49.4)	38 (37.8)	55 (48.0)	36.4	31.6	36.5	34.8
2%	70 (56.9)	45 (42.1)	35 (36.2)	50 (45.1)	43.6	30.2	30.2	34.7
3%	73 (58.4)	50 (45.0)	40 (39.2)	54 (47.5)	39.3	37.7	34.9	37.3
4%	80 (63.4)	68 (55.4)	40 (39.2)	63 (52.7)	39.2	35	33	35.7
5%	88 (69.4)	68 (55.3)	48 (43.6)	68 (56.1)	41.6	39.2	38.7	39.8
Water	78 (62.0)	67 (54.6)	48 (43.6)	64 (53.4)	38.8	38.5	37.3	38.2
Control	68 (55.3)	68 (55.3)	68 (55.3)	68 (55.3)	27.9	27.9	27.9	27.9
Mean	75 (60.3)	61 (51.0)	45 (42.1)		38.1	34.3	34.1	
CD (P=0.05)	C	D	CD		C	D	CD	
	4.6	3.2	7.9		4.1	2.9	7.1	
Concentration (C)	Root length (cm)				Fresh weight 10 seedlings ⁻¹ (g)			
1%	18.0	16.1	16.2	16.8	55.1	49.7	49.7	51.5
2%	18.7	15.5	12.5	15.6	57.8	53.3	47.6	52.9
3%	20.2	17.1	15.9	17.7	57.0	52.2	50.2	53.1
4%	18.0	15.7	15.7	16.5	57.5	52.3	54.4	54.7
5%	20.1	16.9	16.7	17.9	59.2	57.1	50.0	55.4
Water	20.5	18.1	17.4	18.7	56.5	55.6	48.1	53.4
Control	13.9	13.9	13.9	13.9	50.7	50.7	50.7	50.7
Mean	18.5	16.2	15.5		56.3	53.0	50.1	
CD (P=0.05)	C	D	CD		C	C	D	
	2.4	1.6	3.9		NS	3.9	NS	
Concentration (C)	Dry weight 10 seedlings ⁻¹ (g)				Vigour index			
1%	12.9	11.8	11.8	12.2	3805	2740	1974	2840
2%	13.3	12.7	12.2	12.7	4358	2057	1493	2636
3%	12.6	12.1	12.2	12.3	4344	2815	2430	3196
4%	14.7	14.6	12.8	14.0	4572	3419	1928	3306
5%	14.8	12.8	12.2	13.3	5430	3682	2439	3850
Water	13.9	11.9	12.0	12.6	4561	3763	2599	3641
Control	10.9	10.9	10.9	10.9	2815	2815	2815	2815
Mean	13.3	12.4	12.0		4269	3042	2240	
CD (P=0.05)	C	D	CD		C	D	CD	
	NS	1.2	NS		507.1	358.6	878.3	

C – Concentration, D – Duration of soaking hours (h), C x D – Interaction between concentration and duration of soaking duration, and NS – Non-significant. Figures in parentheses are arc sine transformed values.

microorganisms and growth hormones (IAA and GA₃) which are present in the Panchagavya (Ratnoo and Bhatnagar, 1993). Saritha et al. (2013) and Pathak and Ram (2002) also reported that Panchagavya possess almost all the major nutrients, micronutrients and growth hormones enhances the metabolic activity of plants and supports better seed invigoration. Naik and Sreenivasa (2009) opined that Panchagavya contains bacteria producing plant growth promoting substances as well as bacteria having biological deterrent activities. Microbes such as *Rhizobium*, *Azotobacter*, *Azospirillum*,

Phosphorous solubilizing bacteria, *Trichoderma* and *Pseudomonas* present in Panchagavya act as liquid bio fertilizer and bio-pesticides (Ali, 2011). Sometimes seed germination and seedling quality characteristics were reduced with increasing concentration levels and duration with organic fortification which might be due to supra optimal dose of the organic product which is normally specific to crops (Henig-Seve et al., 2000).

Natarajan (1999) also reported that, Panchagavya as foliar spray on 10th, 20th, 30th, 40th, and 50th days after planting gave better germination, growth and yield of New

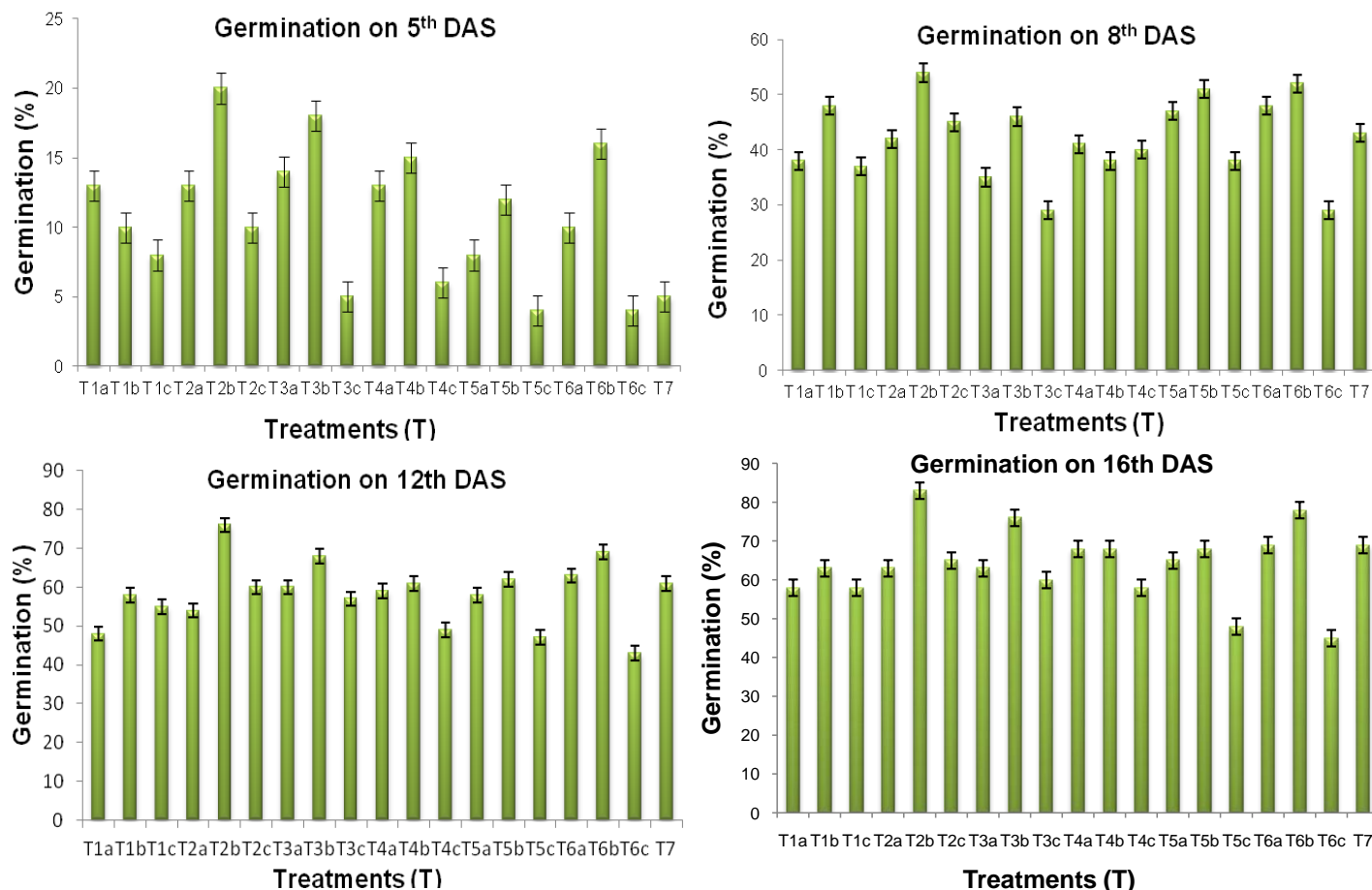


Figure 1. Influence of Panchagavya on seed germination of *Jatropha curcas*. T_{1a}- 8 h soaking at 1% Panchagavya, T_{1b}- 16 h soaking at 1% Panchagavya, T_{1c}- 24 h soaking at 1% Panchagavya, T_{2a}- 8 h soaking at 2% Panchagavya, T_{2b}- 16 h soaking at 2% Panchagavya, T_{2c}- 24 h soaking at 2% Panchagavya, T_{3a}- 8 h soaking at 3% Panchagavya, T_{3b}- 16 h soaking at 3% Panchagavya, T_{3c}- 24 h soaking at 3% Panchagavya, T_{4a}- 8 h soaking at 4% Panchagavya, T_{4b}- 16 h soaking at 4% Panchagavya, T_{4c}- 24 h soaking at 4% Panchagavya, T_{5a}- 8 h soaking at 4% Panchagavya, T_{5b}- 16 h soaking at 4% Panchagavya, T_{5c}- 24 h soaking at 4% Panchagavya, T_{6a}- 8 h water soaking, T_{6b}- 16 h water soaking, T_{6c}- 24 h water soaking, and T₇- Control.

Zealand spinach (*Tetragonia tetragonoides*). Under pre-sowing condition, the green gram seedlings showed significant growth increase at 4% concentration of Panchagavya (Kumaravelu and Kadamban, 2009). Sumangala and Patil (2009) reported that paddy seeds treated with Panchagavya enhanced the seed germination by 91% and with higher vigour index value of 1036. Mohan (2008) also reported that Panchagavya is the most effective growth promoter in brinjal (*Solanum melonogena*) and tomato (*Lycopersicon esculentum*) than other organic promoters.

Albert and Krishnasamy (2007) and Gore and Sreenivasa (2011) in tomato, Kumawat et al. (2009) in Cumin, Sangeetha and Thevanathan (2010) in pulses, Vijayakumari et al. (2012) in soya bean, Somasundaram et al. (2003) in maize, sunflower and green gram, Suresh Kumar et al. (2011) in black gram, Chadha et al. (2012) in pea, and Shakuntala et al. (2012) in rice also expressed that Panchagavya has better influence in seed and

seedling invigoration.

Conclusion

J. curcas and *P. pinnata* seeds fortification with Panchagavya at 2 and 5% for 16 and 8 h, respectively of soaking had highest invigoration effect than water soaking and control. Thus, this study may suggest that Panchagavya application is one of the traditional, ecofriendly and low cost technique to enhance the better seed invigoration and promote the successful large scale afforestation in tree species.

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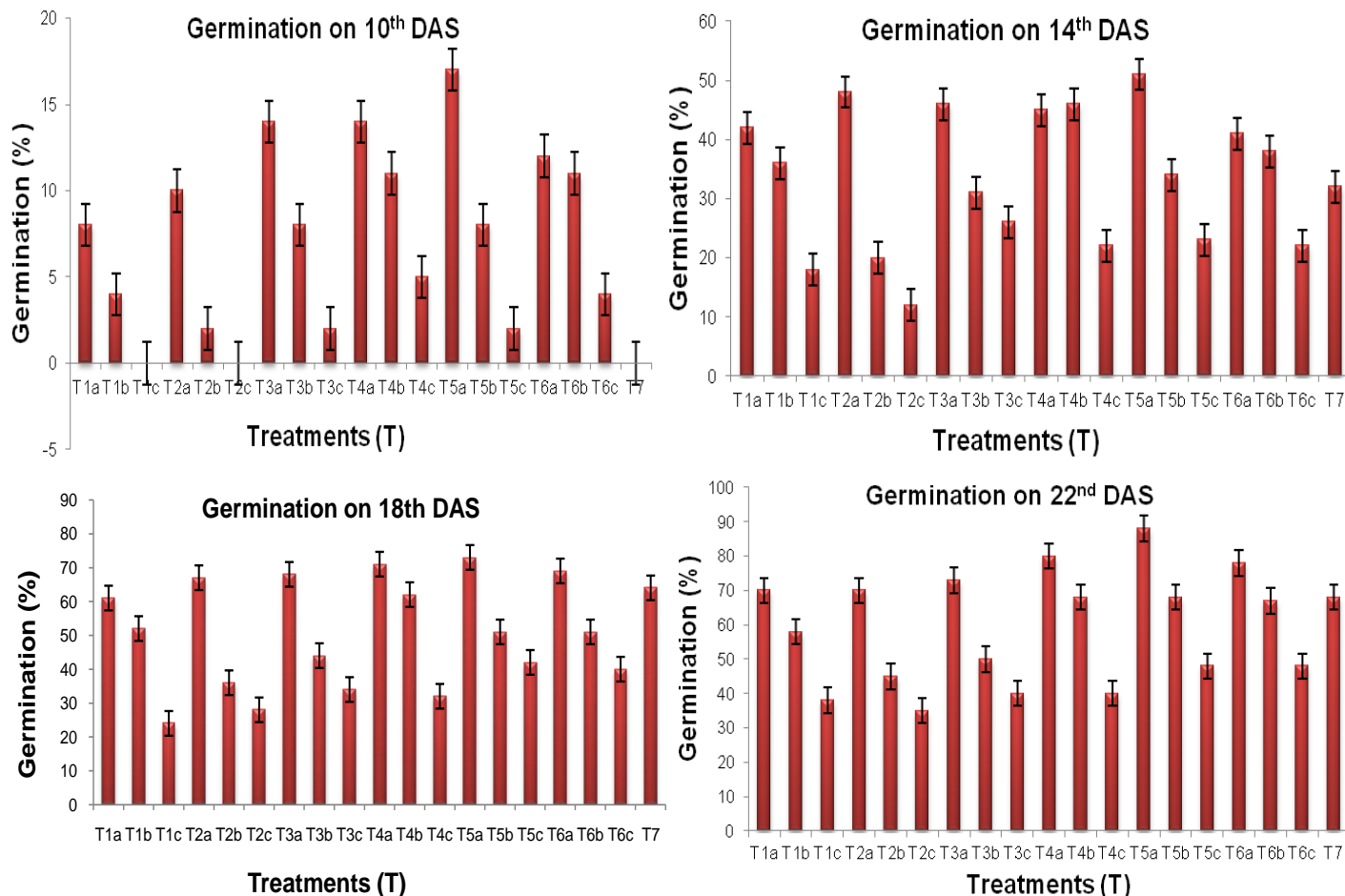


Figure 2. Influence of Panchagavya on *Pongamia pinnata* seed germination. T_{1a}- 8 h soaking at 1% Panchagavya, T_{1b}- 16 h soaking at 1% Panchagavya, T_{1c}- 24 h soaking at 1% Panchagavya, T_{2a}- 8 h soaking at 2% Panchagavya, T_{2b}- 16 h soaking at 2% Panchagavya, T_{2c}- 24 h soaking at 2% Panchagavya, T_{3a}- 8 h soaking at 3% Panchagavya, T_{3b}- 16 h soaking at 3% Panchagavya, T_{3c}- 24 h soaking at 3% Panchagavya, T_{4a}- 8 h soaking at 4% Panchagavya, T_{4b}- 16 h soaking at 4% Panchagavya, T_{4c}- 24 h soaking at 4% Panchagavya, T_{5a}- 8 h soaking at 4% Panchagavya, T_{5b}- 16 h soaking at 4% Panchagavya, T_{5c}- 24 h soaking at 4% Panchagavya, T_{6a}- 8 h water soaking, T_{6b}- 16 h water soaking, T_{6c}- 24 h water soaking, and T₇- Control.

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