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Pre-sowing Seed Treatment for Elite Seedling Production in Arabica coffee (*Coffea arabica* L.)

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ABSTRACT: Study on identifying the suitability of different pre-sowing seed treatment for enhanced seed germination, seedling establishment and elite seedling production in Arabica coffee (*Coffea arabica* L.) cv. Chandragiri was conducted with aim to overcome the delayed and uneven germination leading to inferior seedling production. Pre sowing seed treatment for 36 h with different organic inputs *viz.*, Panchakavya, Jeevamirtham, Tender coconut water, Buttermilk, Fish amino acid and Egg amino acid was carried out at 5% and 10% concentrations. It was revealed from the study that, the earliness, enhanced germination and vigour of coffee seedling was greatly influenced by different pre sowing seed treatments undertaken. Coffee seeds pre-treated with Panchakavya 10% recorded early initial germination on 9 days, 50 % germination was observed on 18 days and final germination was observed on 38 days, speed of germination was also higher (1.29) when compared with other treatments and control. Maximum germination (92 %), shoot length (9.2 cm), root length (6.1 cm), dry matter production (0.96 g/10 seedlings), vigour index I (1407), vigour index II (88.2) was also observed in the Panchakavya 10% treatment. It also recorded the higher fresh root weight (0.710 g), dry root weight (0.315 g) and root volume (1.63 cm^3) when compared with control and other treatments.

Keywords: Coffee, Pre-sowing seed treatment, Panchakavya, Germination, Seedling vigour.

INTRODUCTION

Coffee (*Coffea* spp.) belongs to the family Rubiaceae. More than 120 varieties of coffee existed from which mainly two varieties Arabica (*Coffea arabica*) and Robusta (*Coffea canephora*) are widely cultivated and well known for flavor and taste (Vieira *et al*., 2006; Echeverria *et al.*, 2018; Ahmed *et al.*, 2020). It is a bushy shrub evergreen perennial plant well grown in tropical and sub-tropical region. Axil of coffee leaves bear small white sweet smelled flowers in cluster. Fruits developed from fertilized flowers once in a year. To date, regardless of the considerable effort being made to arrive at effective vegetative and micro-vegetative propagation techniques, coffee is primarily propagated by seedlings and produced directly from seeds. However, coffee has a slow and non uniform germination in terms of time which makes difficult to obtain uniform and vigor seedlings at the time of transplanting. In addition coffee loses its viability quickly (Amaral *et al*., 2006). Emergence of *C. arabica* seedlings from the soil starts 50-60 days after sowing in the warmer periods of the year (Maestri and Vieira, 1961; Ehrenbergerová *et al.*, 2017; Ashabul *et al.*, 2021) and can take up to 90 days when temperatures are lower (Wrigley, 1988; Bertrand *et al.*, 2021). This is because of the endogenous ABA-like substances and exogenous ABA that cause inhibition of germination by preventing growth of the embryo in the seed (Valio, 1976; DaMatta *et al.*, 2019 and Djerrab *et al.*, 2020). In addition the presence of the parchment (endocarp) severely inhibits the germination of coffee seeds (Valio, 1980; Dussert *et al.*, 2018). In response to the difficulty in coffee germination several efforts have been made to improve the germination capacity of coffee seeds. Different chemicals like hydrochloric acid, sulphuric acid, thiourea, indoleacetic acid, GA3, copper sulphate, manganese chloride, zinc sulphate and pyridoxine were all tested to improve the germination capacity of coffee seeds (Gopal and Ramaiah, 1971; Fătu *et al.*, 2017; Etienne *et al.*, 2018). Successful efforts were reported in enhancing seed germination of Arabica coffee

through constant temperatures (Riley, 1981; Gallo and De Souza., 2018), pre-soaking (Huxley, 1967 and Georget *et al.*, 2019), warm stratification (Riley, 1981 and Jezeer *et al.*, 2018), dark germination (Valio, 1976 and Lammerts *et al.*, 2018), removal of endocarp (Gopal and Ramaiah, 1972; Van der Vossen, 1980; Marie *et al.*, 2020), removal of endocarp and presoak in Kinetin (Valio, 1976; Mojo *et al.*, 2017; Moncada *et al.*, 2019), Thiamine Folic acid and Ferrous sulphate (Gopal and Ramaiah, 1971; Nasiro *et al.*, 2017; Rahn *et al.*, 2018; Nasiro, 2021). However, there is no much available research on the efficacy of the organic inputs *viz*., Panchakavya, Jeevamirtham, Tender coconut water, Buttermilk, Fish amino acid and Egg amino acid as the presowing seed treatment agents. By improving emergence and subsequent seedling growth through pre-sowing treatment of coffee seeds, it is possible to shorten the time taken to raise seedlings in the nursery and cost of nursery management can also be reduced.

MATERIALS AND METHODS

An experiment was conducted during 2020-21 at the Regional Coffee Research Station, Thandigudi, Tamil Nadu to know the suitable pre sowing seed treatment for enhanced seed germination, seedling establishment and elite seedling production in Arabica coffee (*Coffea arabica* L.) cv. Chandragiri. The required seeds were collected from Regional Coffee Research Station, Thandigudi. Coffee berries were collected, immediately after extraction of coffee seeds from berries, the Pre sowing seed treatment for 36 h with different organic inputs viz., Panchakavya, Jeevamirtham, Tender coconut water, Buttermilk, Fish amino acid and Egg amino acid was carried out at 5% and 10% concentrations. The pre treated coffee seeds were sown in three replications by adopting the statistical design of Completely Randomized Design (CRD). The biometric observations such as days to initial germination, 50 % germination and final germination (ISTA, 2013), speed of germination (Maguire, 1962), root length, shoot length, seedling vigour index I & II (Abdul-Baki and Anderson,1973), dry matter production, root fresh weight & dry weight and root volume were also observed. The data obtained from experiments were analyzed by the 'F' test for significance by following Completely Randomized Design. Wherever necessary, the percent values were transformed to angular (Arc-sine) values before analysis. The critical differences (CD) were calculated at 5 per cent probability level. The data were tested for statistical significance (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The earliness in germination of coffee seeds was noticed in the treatment (T_1) – Panchakavya 10% it recorded early initial germination on 9 days, 50 % germination was observed on 18 days and final germination was observed on 38 days, speed of germination was also higher (1.29) when compared with other treatments and control. Seed germination starts when the expansive force of the embryonic radicle exceeds the mechanical restraint of the surrounding tissues (Hilhorst *et al.*, 1998; Scalabrin *et al.*, 2020). Hopper *et al.* (1979) expressed that in primed seeds, radical and plumule appeared faster because of more water uptake efficiency and metabolic activity during germination. Maximum germination (92 %), shoot length (9.2 cm), root length (6.1 cm), dry matter production (0.96 g/10 seedlings), vigour index I (1407), vigour index II (88.2) was also observed in the Panchakavya 10% treatment. Pre germination treatment of *Tetrapleura tetrapera* seeds by using coconut water enhanced the seed germination (Omokhua *et al.*, 2015; Steinbrecher and Leubner, 2017). It also recorded the higher fresh root weight (0.710 g), dry root weight (0.315 g) and root volume (1.63 cm^3) when compared with control and other treatments. Panchakavya seed treatment enhanced all the plant biometrics in various crops (Wrigley, 1988; Trujillo *et al.*, 2019). The above results were in conformity with the earlier findings of (Vieira *et al*., 2006; Fătu *et al.*, 2017; Dussert *et al.*, 2018; Moncada *et al.*, 2019; Scalabrin *et al.*, 2020; Ashabul *et al.*, 2021; Nasiro, 2021; Bertrand *et al.*, 2021).

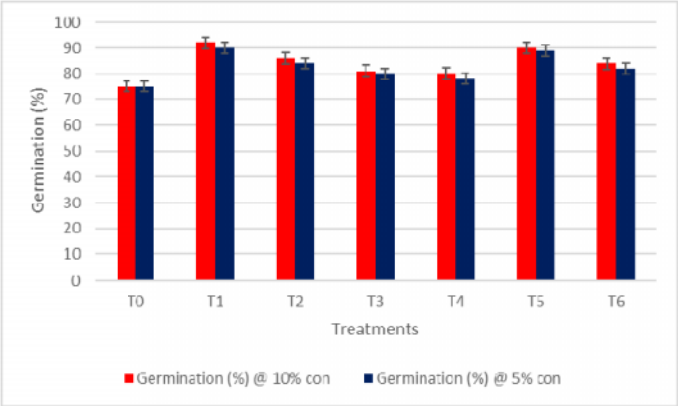

Fig. 1. Effect of different Pre-sowing seed treatment on Germination (%) for elite seedling production in Arabica coffee (*Coffea arabica* L.) cv. Chandragiri.

Table 1: Effect of different pre-sowing seed treatment on Days to initial, 50 % and final germination for elite seedling production in Arabica coffee (*Coffea arabica* L.) cv. Chandragiri.

Treatments (T)	(5 %)			(10 %)		
	Days to initial germination	Days to 50 (%) germination	Days to final germination	Days to initial germination	Days to 50 (%) germination	Days to final germination
T_0	15 (22.78)	25 (30.00)	45 (42.13)	15 (22.78)	25 (30.00)	45 (42.13)
T_1	10 (18.43)	19 (25.84)	37 (37.46)	9 (17.45)	18 (25.10)	38 (38.05)
T_2	12 (20.26)	20 (26.56)	40 (39.23)	11 (19.37)	20 (26.56)	39 (38.64)
T_3	13 (21.13)	22 (27.97)	42 (40.39)	12 (20.26)	21 (27.27)	41 (39.81)
T_4	14 (21.97)	24 (29.33)	44 (41.55)	13 (21.13)	22 (27.97)	43 (40.97)
T_5	11 (19.37)	20 (26.56)	38 (38.05)	10 (18.43)	19 (25.84)	38 (38.05)
T_6	12 (20.26)	21 (27.27)	42 (40.39)	12 (20.26)	21 (27.27)	40 (39.23)
Mean	**12.42**	**21.57**	**41.14**	**11.71**	**20.85**	**40.57**
SEd	0.234	0.436	0.970	0.216	0.241	0.879
CD (P = 0.05)	0.502	0.937	2.082	0.463	0.518	1.886

Treatments : T0 – Control; T1 – Panchakavya; T2 – Jeevamirtham; T3 - Tender coconut water; T4 – Buttermilk; T5 - Fish amino acid; T6 - Egg amino acid
Soaking duration - 36 hours

Table 2: Effect of different pre-sowing seed treatment on Speed of germination for elite seedling production in Arabica coffee (*Coffea arabica* L.) cv. Chandragiri.

Treatments (T)	(5 %)	(10 %)
	Speed of germination	Speed of germination
T_0	1.01	1.01
T_1	1.26	1.29
T_2	1.19	1.21
T_3	1.07	1.12
T_4	1.03	1.06
T_5	1.24	1.27
T_6	1.08	1.18
Mean	**1.126**	**1.163**
SEd	0.029	0.026
CD (P = 0.05)	0.063	0.056

Table 3: Effect of different pre-sowing seed treatment on Germination (%), Shoot length (cm) and Root length (cm) for elite seedling production in Arabica coffee (*Coffea arabica* L.) cv. Chandragiri.

Treatments (T)	(5 %)			(10 %)		
	Germination (%)	Shoot length (cm)	Root length (cm)	Germination (%)	Shoot length (cm)	Root length (cm)
T_0	75 (60.00)	7.8	4.9	75 (60.00)	7.8	4.9
T_1	90 (71.56)	9.1	6.0	92 (73.57)	9.2	6.1
T_2	84 (66.42)	8.7	5.6	86 (68.02)	8.8	5.7
T_3	80 (63.43)	8.3	5.3	81 (64.15)	8.5	5.4
T_4	78 (62.02)	7.9	5.1	80 (63.43)	8.2	5.2
T_5	89 (70.63)	8.9	5.8	90 (71.56)	9.1	5.9
T_6	82 (64.89)	8.4	5.5	84 (6.42)	8.6	5.5
Mean	**82.57**	**8.443**	**5.458**	**84.00**	**8.599**	**5.528**
SEd	1.810	0.229	0.072	1.656	0.119	0.097
CD (P = 0.05)	3.88	0.491	0.156	3.553	0.255	0.209

Table 4: Effect of different pre-sowing seed treatment on dry matter production (g 10 seedlings^{-1}), vigour index I & II for elite seedling production in Arabica coffee (*Coffea arabica* L.) cv. Chandragiri.

Treatments (T)	(5 %)			(10 %)		
	Dry matter production (g 10 seedlings^{-1})	Vigour index I	Vigour index II	Dry matter production (g 10 seedlings^{-1})	Vigour index I	Vigour index II
T_0	0.64	952	48.3	0.64	952	48.3
T_1	0.93	1359	83	0.96	1407	88.2
T_2	0.79	1201.	66	0.81	1247	69.1
T_3	0.70	1088	56	0.71	1125	57.5
T_4	0.67	1014	52	0.68	1072	54.4
T_5	0.85	1308	75	0.89	1350	80.1
T_6	0.72	1139	59	0.76	1184	63.84
Mean	**0.758**	**1151.57**	**62.757**	**0.777**	**1190.99**	**65.92**
SEd	0.008	26.768	1.404	0.017	33.260	1.633
CD (P = 0.05)	0.018	57.419	3.011	0.037	71.344	3.503

Table 5: Effect of different pre-sowing seed treatment on Fresh root weight (g), dry root Weight (g), Root volume (cc) for elite seedling production in Arabica coffee (*Coffea arabica* L.) cv. Chandragiri.

Treatments (T)	(5 %)			(10 %)		
	Fresh root weight (g)	Dry root weight (g)	Root volume (cc)	Fresh root weight (g)	Dry root weight (g)	Root volume (cc)
T_0	0.473	0.210	1.02	0.473	0.210	1.02
T_1	0.688	0.305	1.48	0.710	0.315	1.63
T_2	0.584	0.259	1.41	0.599	0.266	1.44
T_3	0.518	0.230	1.35	0.525	0.233	1.39
T_4	0.495	0.220	1.32	0.503	0.223	1.40
T_5	0.629	0.279	1.45	0.658	0.292	1.47
T_6	0.532	0.236	1.38	0.562	0.249	1.41
Mean	0.559	0.249	1.344	0.576	0.255	1.393
SEd	0.015	0.006	0.024	0.013	0.005	0.035
CD (P = 0.05)	0.032	0.014	0.053	0.027	0.012	0.075

CONCLUSION

The present research findings indicate that earliness in germination, improved germination, enhanced growth and vigour of coffee seedlings were greatly influenced by different organic pre sowing treatments. Pre sowing treatment of coffee seeds with 10 % Panchakavya for 36 h recorded early initial germination, 50 % germination and final germination, speed of germination was also higher when compared with other treatments and control. Maximum germination, shoot length, root length, dry matter production, vigour index I, vigour index II was also observed in the Panchakavya 10% treatment. It also recorded the higher fresh root weight, dry root weight and root volume when compared with control and other treatments. Thus, from the above results, it could be concluded that the Pre sowing treatment of coffee seeds with 10 % Panchakavya for 36 h is the best Pre sowing treatment for elite seedling production in Arabica coffee.

FUTURE SCOPE

Panchakavya and other organic inputs can be developed as a new organic commercial formulations with better efficacy and improved shelf life for promoting earliness and improved germination, enhanced growth and vigour of coffee seedlings.

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Conflict of Interest. None.

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