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Research Article

Studies on Organic Priming on Germination and Seedling Vigour in Sorghum [*Sorghum bicolor* (L.)]

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ABSTRACT

The experiment was conducted in Seed science post Graduate Laboratory, Department of Genetics and Plant Breeding, SHUATS, Allahabad, U.P. In order to standardize the best method of Organic priming specific to Sorghum, to evaluate the effect of different seed priming techniques on germination and morphological characters of sorghum an experiment was conducted in 2017-18 in a experiment based on the complete randomized block design with two variety M35-1 (Maldandi) and SPV 1411 (Parbhani Moti) Seed priming is a technique which improves the germination and early growth under prevailing environmental conditions. Organic priming they were evaluated by screening a range of durations and concentrations viz., T0 - Unprimed Control(for 08 hrs),T1 - Parthenium Leaf Extract 3%, T2 – Neem Leaf Extract 3%, T3– Custrad leaf extract at 3%, T4 – Calotropis leaf extract (CLE) at 3%, T5 – Panchgavya 3%, It found that all the Organic priming methods showed significance difference with the control and the highest germination %, seedling length (cm), seedling fresh weight (g), seedling dry weight (g) and vigour index were observed in Custrad Leaf Extract @3% followed by Panchgavya @3% similar trend was also observed in all treatment. Among the treatments Calotropis leaf extract (CLE) recorded minimum. and Custrad Leaf Extract @3% was found to be the best priming treatment. Moreover priming treatments have more pronounced effect SPV 1411 maintained highest quality parameters followed than M35-1 of sorghum seeds.

The study helps to improve the quality of seeds with the help of seed organic priming treatments which are cost effective and economic, nontoxic, ecofriendly sources.

Key words: *Calotropis leaf extract, Custard leaf extract, Neem Leaf Extract, and Panchgavya, Parthnium leaf extract, Seed priming, Sorghum seed.*

INTRODUCTION

Sorghum (*Sorghum bicolor* (L.) Moench) the word sorghum is derived from the Latin word 'Sorgo' which mean 'rising above'. The cultivated sorghum originated in Ethiopia[18]. It is one of the most important grain and fodder crop grown in tropical and subtropical regions in India commonly known as great millet due to larger size of grain among millets and vast area under it.

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It is predominantly a self-pollinated crop. It has chromosome number 2n=20. Sorghum belongs to family Poaceae, subfamily Panicoidae, tribe Andropogonae and the sub tribe Sorghastrae[13].

Sorghum is one of the most important cereal crop grown in Africa, Asia, USA, Australia, and Latin America. The sorghum crop has wide range of flexibility to grow in various climatic conditions of the world hence it is known by diverse names *viz*., *Jowar, Jaur, Cholam or Jola in India, Guinea corn, Kofir corn* and *Dhuma* in Africa, *kaoling* in China and *Milo* maize in America.

In India, it is third major cereal after rice and wheat and it is most important food crop grown under rainfed conditions. With the present scarcity situation, sorghum cultivation is the heart of dry land agriculture, being C_4 plant it can utilize sunlight and water efficiently[7]. Sorghum is the main staple diet of the people of Maharashtra, Karnataka and Andhra Pradesh. Maharashtra ranks first in terms of area and production.The grains are used for making bread, pop beer and fodder is used as animal feed in the form of chops, hays, silage and pasture etc. Sorghum grain contain about 56-63% starch, 10-12% protein, 72.6% carbohydrate, 1.6% mineral matter, 1.9%fat, 7.6-9.2% dietary fiber. It plays predominant role in the food and fodder security for millions of rural families in arid and semi-arid regions of the world.

Seed priming is a controlled hydration process followed by re-drying that allows seeds to imbibe water and begin internal biological processes necessary for germination, but which does not allow the seed to actually germinate. The priming process gives the seed a "head-start" at germination and emergence when planted in the soil[8].

Seed vigour and seedling establishment have, in several species, been related to the time course of germination[12].

Devarani and Rangasamy[5] reported that sorghum seed hardening with 2 % calotropis leaf extracts improved the growth attributes and resulted in higher seed yield compared to other hardening agents. Hareesh[9] reported that, pigeonpea and chickpea seeds primed with 3 % custard apple leaf extract showed highest germination, seedling vigour index, dehydrogenase activity and α amylase activity at the end of tenth month of storage period followed by panchagavya @ 3% compared to control.

While the custard apple has countless health benefits like being rich inantioxidants and minerals like calcium, magnesium and potassium, its leaves are equally nutritious. They are prized for their health benefits especially in Ayurveda. The leaves are often used for medicinal purposes due to their quick healing capability. Panchagavya is known to boost immunity and promote plant growth. Cow dung and cow urine are the key ingredients of the preparation. It is usually mixed with water and is used to irrigate the fields. It can also be used as effect of priming treatments *viz.*, Neem Leaf Extract, Parthenium Leaf Extract, Calotropis leaf extract, Custrad leaf extract, Panchgavya and evaluate seed quality parameters *viz.*, germination per cent, shoot length, root length, seedling length, seedling dry and fresh weight of sorghum.

Hence, present studies were undertaken to assess the effect of organic priming on pre sowing seed treatments on germination and seedling vigour of Sorghum seed. To find out suitable does of organic priming on seedling parameters of sorghum seed.

MATERIALS AND METHODS

The present study entitled to investigate the comparative efficacy of different priming techniques on the germination and seedling growth and development.

The experiment was conducted in under Post graduate laboratory of Seed Science and Technology was conducted in the Department of genetics and plant breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Allahabad during 2017-2018. Allahabad is located in South Eastern part of Uttar Pradesh, India.

Genetically pure seeds of Sorghum M35-1 (maldandi) and SPV 1411 (parbhani moti) used for the study. SPV1411(Parbhani moti) seed colour Pearly white and size Very bold type and M35-1 seed colour Pale yellow type and size in Bold are produced & weight 3.8 gm 100 grains. M 35-1 (variety popular

with the farmers) and SPV 1411 (variety released for postrainy season cultivation and named Parbhani moti due to its pearly white grains) during 2006 postrainy season. From these varieties, based on grain size (≥3.7 gm 100-1 grains)

The seeds were treated with Custard leaf extract at the concentration of 3% and Panchgavya at the concentration of 3% along with distilled water and dry seed as control. The seeds were tested for the standard germination test adopting between paper (BP) method as per the ISTA rules. Neem leaf extract was prepared according to Paul and Sharma.

Two hundred and fifty matured neem leaves (250g) were homogenized in a pre-chilled pestle and mortar using 250 ml chilled, sterilized distilled water (Dilution of 1:1). The extract was filtered through four layers of moistened muslin cloth. The supernatant thus obtained was designated as concentrated leaf extract and seeds were soaked by making dilution of required concentration. Further, 3 ml filtrate was added to 100 ml to get 3 per cent solution. This solution is used for soaking the seeds as per the required weight by volume ratio of seed to solution. Seed to solution ratio of 1:0.5 were made and soaked for 8 hrs Then the seeds were air dried overnight and. The same procedure was followed for custard apple, parthnium and calotropis leaf extracts. T_0-Control, T_1-Parthnium leaf extract, T_2-Neem Leaf Extract, T_3-Custrad Leaf Extract T_4- Calotropis leaf extract T_5- Panchgavya.

Then seeds were dried overnight. The data collected from the experiments were analyzed statistically by the procedure prescribed by The investigations are details of materials and using of experimental The data collected from experiment were analyzed statistically by the procedure prescribed by Sundararaj *et al*.[17]. Critical differences were calculated at 5% level wherever 'F' test was significant. The data on percentage of germination and seed infection were transferred into arcsine square root percentage values and transferred data were used for statistical analysis[16].

The observation on the characters viz., Germination percent[10] [12], Speed of germination, Energy of emergence(%)[14] [23], Root length (cm), Shoot length (cm), Seedling length (cm), seedling fresh weight (g), seedling dry weight (g), Seedling vigour index Ist, Vigor index IInd [1] were recorded. The experimental data recorded were subjected to statistical analysis for calculating analysis of variance, range, mean, critical difference and coefficient of variation[6] Absolute control treatment was compared with rest of the treatment by following ANOVA Completely randomized block design used for statistical analysis.

RESULT AND DISCUSSION

3.1 Germination (%)

A significant Variation in germination of sorghum. onwards germination varied SPV 1411 in significantly maximum increase in total germination occurs by Custrad leaf extract @3 % (93.33) followed by Panchgavya @3 % (92.67) while lowest germination (79.67) was observed with unprimed control treatment. And Similar trend was also observed in M35-1. Among the treatments Custard leaf extract recorded maximum germination (92.67) followed by Panchgavya (89.33). The interaction effect of variety and treatments results were found significant.

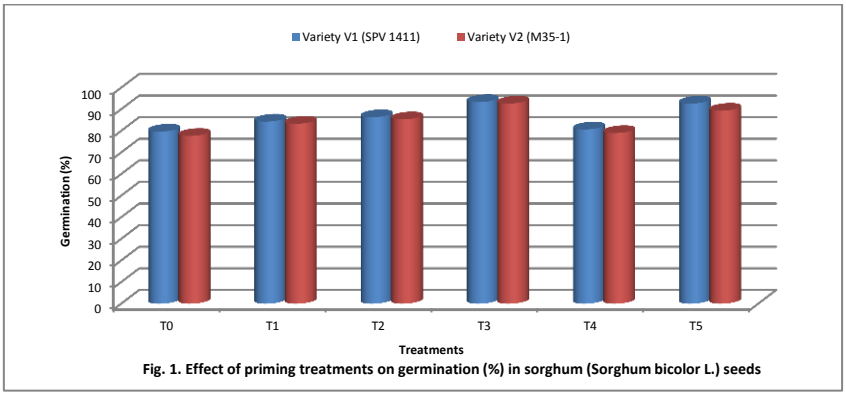

Fig. 1: Germination percentages as Influence by different Organic priming treatments on Sorghum seeds

3.2 Root length

The performance of seed treatments, the root length declined from 11.97 cm at initial stage to 16.77 cm the root length varied significantly among treatments. onwards root length varied SPV 1411 in significantly and higher root length was recorded in seeds treated with custard apple leaf extract @ 3 per cent (16.77 cm) followed by Panchgavya@ 3 per cent (16.67 cm) and lowest root length was recorded in untreated control (12.10 cm). This followed Similar trend was also observed in M35-1. Among the treatments Custard leaf extract recorded maximum germination (16.40 cm) followed by Panchgavya (15.32 cm). The interaction effect of variety and treatments results were found significant and lowest root length was recorded in untreated control (11.97 cm).

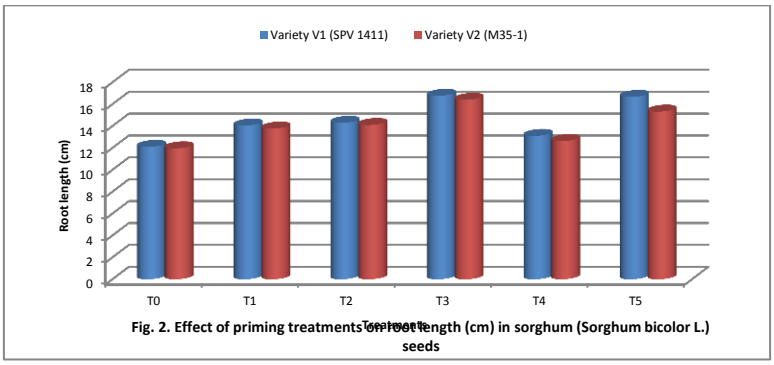

Fig. 2: Root length (cm) as Influence by different Organic priming treatments on Sorghum seeds

3.3 Shoot length

Among shoot length there exists a significant variation as influenced by irrespective of seed treatments, the shoot length declined from 8.50 cm at initial stage to 13.03 cm the root length varied significantly among treatments. onwards root length varied SPV 1411 in significantly and higher shoot length was recorded in seeds treated with custard apple leaf extract @ 3 per cent (13.03 cm) followed by Panchgavya @ 3 per cent (12.93 cm) and lowest shoot length was recorded in untreated control (09.13 cm). This followed similar trend was also observed in M35-1. Among the treatments Custrad leaf extract recorded maximum germination (12.63 cm) followed by Panchgavya (11.80 cm). The interaction effect of variety and treatments results were found significant. and lowest root length was recorded in untreated control (08.50 cm).

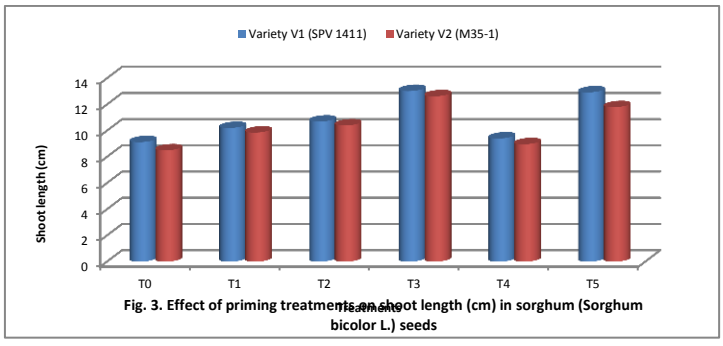

Fig. 3: Shoot length (cm) as Influence by different Organic priming treatments on Sorghum seeds

3.4 Seedling length

The performance of a statistically significant variation in seedling length of sorghum. It is evident from the table that maximum increase in seedling length occurs by custard apple leaf extract @ 3 per cent (29.80 cm) followed by Panchgavya @ 3 per cent (29.70 cm) while lowest seedling (22.87 cm) was observed with unprimed control treatment. Similar trend was also observed in M35-1. Among the treatments

unpriming recorded minimum seedling length (21.27 cm) Whereas maximum seedling length was noticed in the Custrad leaf extract recorded maximum germination (29.03 cm) followed by Panchgavya (27.64 cm). The interaction effect of variety and treatments results were found significant.

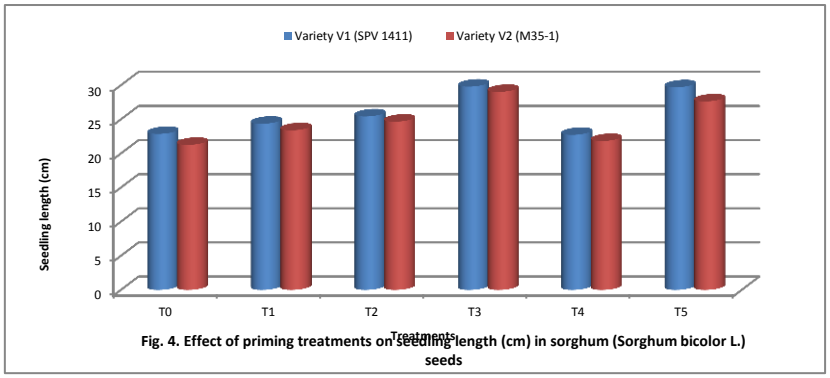

Fig. 4: Seedling length (cm) as Influence by different Organic priming treatments on Sorghum seeds

3.5 Seedling dry weight

The mean performance of seedling dry weight ranged declined from (334.47 mg) at initial stage to (335.42 mg) the dry weight varied significantly among treatments. onwards dry weight varied SPV 1411 in significantly and higher root length was recorded in seeds treated with custard apple leaf extract @ 3 per cent (338.67 mg) similarity Panchgavya @ 3 per cent (338.67 mg) followed by Neem leaf extract @ (337.42 mg). and lowest root length was recorded in untreated control (335.16 mg). This followed Similar trend was also observed in M35-1. Among the treatments Custrad leaf extract recorded maximum germination (338.55 mg) followed by Panchgavya (338.40 mg). The interaction effect of variety and treatments results were found significant. and lowest dry weight was recorded in untreated control (334.47 mg).

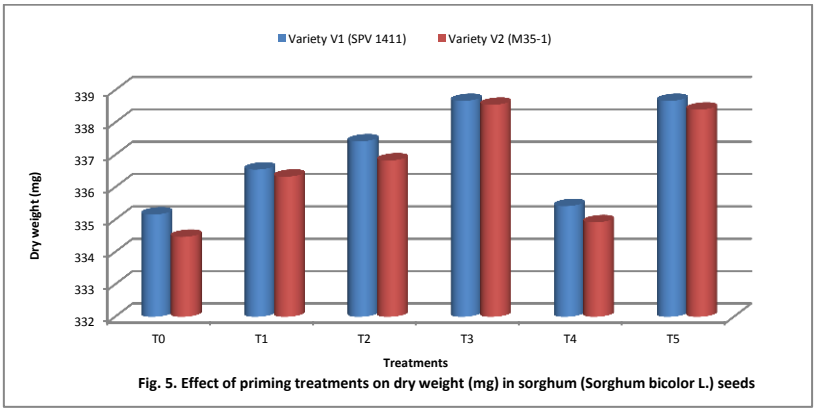

Fig. 5: Dry weight of seedling (g) as Influence by different Organic priming treatments on Sorghum seeds

3.6 vigour Index I

A statically significant variation in seed vigour index length-I of sorghum. It is evident from the table that maximum increase in seed vigour index length-I occurs by Custrad Leaf Extract (2771 cm) followed by Panchgavya (2739 cm) while lowest vigour index (1827) was observed with unprimed control treatment. Similar trend was also observed in M35-1. Among the treatments Custrad Leaf Extract recorded maximum seed vigour index length-I (2690 cm) followed by Panchgavya (2385 cm). whereas, minimum seed vigour index length-I was noticed in the unpriming treatment (1723 cm). The interaction effect of variety and treatments results were found significant.

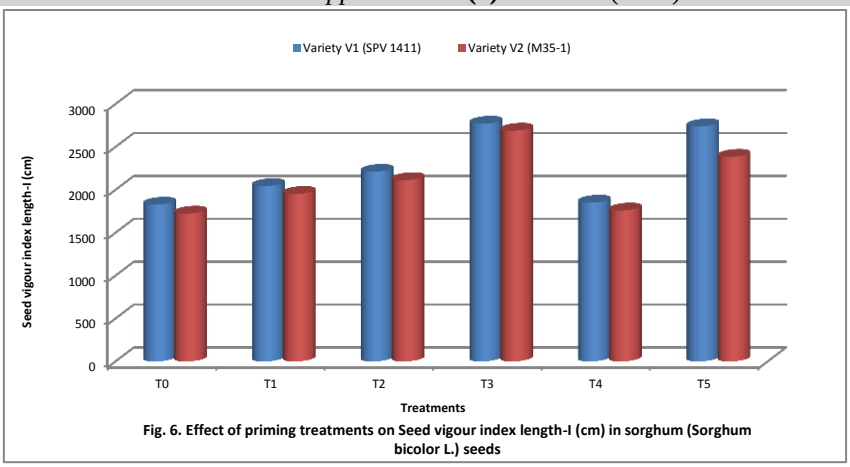

Fig. 6: Seed vigour index I as Influence by different Organic priming treatments on Sorghum seeds

3.7 Seed vigour Index II.

Seedling vigour index-II varied significantly and higher seedling vigour index-II was noticed in seeds treated with custard apple leaf extract (31.50 mg) followed by Panchgavya (31.27 mg) while lowest vigour index (27.33 mg) was observed with unprimed control treatment. Similar trend was also observed in M35-1. Among the treatments Custrad Leaf Extract recorded maximum seed vigour index length-I (31.37 mg) followed by Panchgavya (30.22 mg). Whereas, minimum seed vigour index length-I was noticed in the unpriming treatment (26.65 mg). The interaction effect of variety and treatments results were found significant.

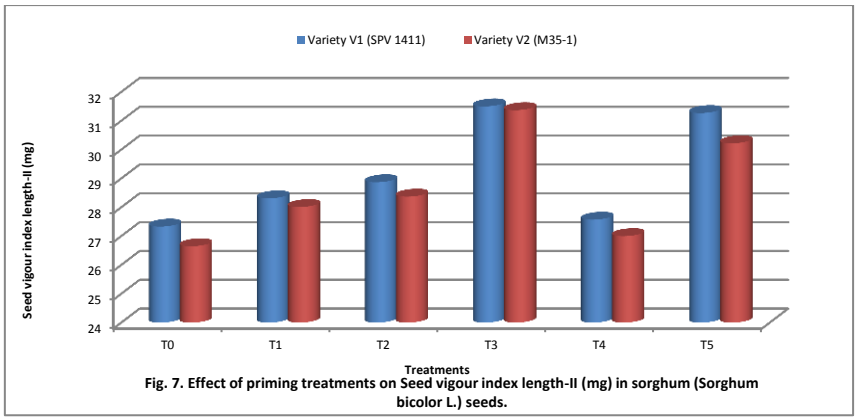

Fig. 7: Seed vigour index II as Influence by different Organic priming treatments on Sorghum seeds

3.8 Speed of germination

It is evident from the table that significantly maximum increase in seed speed germination occurs by Custrad Leaf Extract (21.44%) followed by Panchgavya (21.27%) while lowest speed germination (18.13%) was observed with unprimed control treatment. Similar trend was also observed in M35-1.Whereas, maximum seed speed germination was noticed in the Custrad Leaf Extract priming (21.30%). followed by Panchgavya (20.64%). Whereas, minimum speed germination was noticed in the unpriming treatment (26.65 mg). The interaction effect of variety and treatments results were found significant.

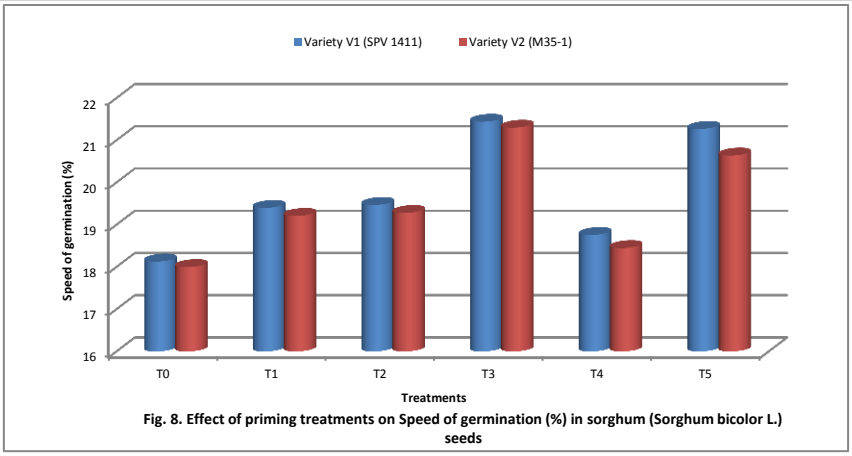

Fig. 8: Speed of germination as Influence by different Organic priming treatments on Sorghum seeds

RESULT AND DISCUSSION

The results of this study indicate that sorghum seedlings which are exposed to various seed priming treatments have shown increase in root and shoot length and thus their seedling dry weight content. The seed germination under control ranged up to 79.67 per cent. In this experiment germination of 93.33 per cent was recorded with seeds treated with Custrad leaf extract @3 per cent and 92.67 per cent seed germination with treatment of Panchgavya @3 per cent and shoot length (13.03 cm), root length (16.77 cm) and seedling length (29.80) seedling vigour index (2771) was significantly superior in treatment of Custrad leaf extract over the control & followed by Panchgavya leaf extract (12.93cm, 16.67cm, 29.70 cm, 2739) respectively. Seedling dry weight was recorded more in priming treatment Custrad leaf extract fallowed by Panchgavya leaf extract and Neam leaf extract priming treatment (337.42 mg) which are numerically superior over the control. In all our experiment the priming treatment with Calotropis leaf extract has recorded lower results compared to five priming treatment. and control with respect to germination and seedling vigour index. This is an indicative to say that Calotropis leaf extract priming has allopathic effect on the germination of the Sorghum seeds.

Table 1: Mean performance of Sorghum for 8 seedling characters

Seed priming	Germination (%)		Root length (cm)		Shoot length (cm)		seedling length (cm)	
Treatment	**SPV 1411**	**M35-1**	**SPV 1411**	**M35-1**	**SPV 1411**	**M35-1**	**SPV 1411**	**M35-1**
Control	79.680	77.670	12.100	11.970	9.130	8.500	22.870	21.270
Parthnium leaf extract@3%	84.300	83.310	14.050	13.770	10.210	9.860	24.360	23.410
Neam leaf extract @3%	86.330	85.330	14.300	14.100	10.700	10.400	25.430	24.670
Custrad leaf extract @3%	**93.330**	**92.670**	**16.770**	**16.400**	**13.030**	**12.630**	**29.800**	**29.030**
Calotropis leaf extract@3%	80.670	79.000	13.100	12.630	9.410	8.970	22.730	21.830
Panchgavya @3%	92.670	89.330	16.670	15.320	12.930	11.800	29.700	27.640
C.D.	**4.518**	**3.690**	**1.231**	**1.295**	**1.463**	**0.840**	**2.212**	**1.719**
SE(m)	**1.450**	**1.185**	**0.395**	**0.416**	**0.470**	**0.270**	**0.710**	**0.552**
C.V.	**2.915**	**2.427**	**4.722**	**5.131**	**7.462**	**4.510**	**4.763**	**3.879**
Seed priming	**Seedling vigour index-I**		**Seedling vigour index- II**		**Speed of germination (%)**		**Seedling dry weight *(mg)***	
Treatment	**SPV 1411**	**M35-1**	**SPV 1411**	**M35-1**	**SPV 1411**	**M35-1**	**SPV 1411**	**M35-1**
Control	1,827.000	1,723.000	27.330	26.650	18.130	18.000	335.160	334.470
Parthnium leaf extract@3%	2,043.000	1,953.000	28.310	28.010	19.400	19.210	336.550	336.330
Neam leaf extract @3%	2,210.000	2,113.000	28.870	28.370	19.470	19.280	337.420	336.830
Custrad leaf extract @3%	**2,771.000**	**2,690.000**	**31.500**	**31.370**	**21.440**	**21.300**	**338.670**	**338.550**
Calotropis leaf extract@3%	1,851.000	1,759.000	27.570	27.000	18.760	18.450	335.420	334.920
Panchgavya @3%	2,739.000	2,385.000	31.270	30.220	21.270	20.640	338.670	338.400
C.D.	**135.799**	**164.803**	**1.116**	**1.366**	**0.768**	**0.710**	**2.004**	**1.590**
SE(m)	**43.589**	**52.899**	**0.358**	**0.438**	**0.246**	**0.228**	**0.643**	**0.510**
C.V.	**3.370**	**4.355**	**2.129**	**2.654**	**2.162**	**2.027**	**0.331**	**0.263**

In case V1: SPV 1411genotypes in all the treatments best for Germination %, Root Length, Seedling Length, Seed Vigour Length, Seedling Shoot Length, Total Germination and Seed Vigour Index.

Custrad Leaf Extract (Cu.LE) @ 3% is best for Germination %, Root Length, Seedling Length, Seed Vigour Length, Seedling Shoot Length, Total Germination and Seed Vigour Index, followed by Panchgavya (Pan.)@ 3% similar trend was also observed in all treatment.

Calotropis leaf extract (CLE) @ 3 % is lowest mean Seed Vigour Index length, Seed Vigour Index, Seed Germination, Total Germination, Root Length and Shoot Length.

Table 2: Analysis of variance for 8 seedling characters in Sorghum

Characters	Mean Square			
	Treatments (Df=5)		Error (Df=12)	
Seed Varity	**SPV 1411**	**M35-1**	**SPV 1411**	**M35-1**
Germination (%)	101.638*	101.437	6.309*	4.209
Root length (cm)	10.695*	8.134	0.469*	0.518
Shoot length (cm)	8.7168*	7.722	0.662*	0.218
seedling length (cm)	30.858*	29.423	1.512*	0.914
Seedling vigour index-I	535,536.500*	425,654.900	5,700.000*	8,394.833
Seedling vigour index- II	9.966*	10.237	0.385*	0.576
Speed of germination (%)	5.383*	4.813	0.182*	0.156
Seedling dry weight *(mg)*	7.176*	8.707	1.242*	0.782

**** significant at 5% and 1% level of significance, respectively.**

CONCLUSION

Among all the priming treatments, Custrad Leaf Extract (Cu.LE @ 3% was found to be the best priming treatment. Moreover priming have more pronounced effect V1-SPV 1411 maintained highest quality parameters followed than V2-M35-1 of sorghum seeds. So we can integrate these treatments in priming seeds of sorghum.

Thus seed priming with Custrad leaf extract has the potential to increase the germination of sorghum, but also increases the seedling growth and development. The Custrad leaf extract is quite economic and environment friendly with no hazardous effect if applied in small concentration, so it can be an important priming tool replacing other priming agents and herein lies the novelty of this trial. However, there is a dire need of more research on Custrad leaf extract optimization for sorghum and future research should be focused on use of even lower concentration of Custrad leaf extract as a seed priming agent.

Seed priming is one of the method of seed invigoration treatment which is used for upgrading the quality of seeds because of less, cost, non toxic, eco-friendly and economically viable as they provide support to small and marginal farmers.

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