Effect of Various Organic Priming Treatments on the Performance of Bittergourd (*Momordica Charantia* L)

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ABSTRACT

A field experiment was carried out in Godak-10, Ilam, during the cropping season of February to July 2021, to investigate the effect of organic seed priming treatments on bitter gourd growth performance. Hard seed coat of bitter gourd puts mechanical restriction on embryo development and it is the reason for poor seedling problems. Seed priming is the method not only to improve germinations, vigour and uniform emergence of seedlings in field conditions but also to improve crop establishment and ultimately enhance the yield. The experiment was done in a double-factor randomized complete block design with 3 replications and 8 treatments. Three varieties of bittergourd viz. Palee, Asmita (Syngenta), and local, were assigned as the first factor. Whereas, priming treatments with cow milk and water 1:1, cow urine and water 1:1, cow dung slurry and water 1:2, water and control (no priming) were assigned as second factor. Parameters such as seed germination percentage (83.66%), day to emergence (9 days), seedling's stem diameter (3.12 mm), shoot weight (1.8 gm), shoot length (11.5 cm), root length (14.4 cm), plant height 20 days after transplanting (67.4 cm) and 40 days after transplanting (125 cm), number of leaves 20 days after transplanting (21) and tendrils 20 days after transplanting (14), day to first flowering (33 days), day to first fruit set (39 days) and yield (3.02 kg/plant) were significantly higher in the variety Palee. Seed germination percentage (71.55%), seedling stem diameter (3.05 mm) were significantly higher with the priming treatment of cow urine and water 1:1, but other parameters, the priming treatment was significantly at par with all treatments except control. The study indicated that presoaking of bittergourd seeds in organic priming treatment, i.e., cow urine and water 1:1, could render better growth performance.

Keywords: Bittergourd, Cow dung slurry, Cow milk, Cow urine, Organic seed priming

1. Introduction

The bitter gourd (*Momordica charantia* L), which belongs to the cucurbitaceae family is one of the most popular vegetables in Southeast Asia as well in Nepal. The name "bitter-gourd" might also refer to bitter-melon, balsam pear, or karela, depending on geographic location (Palada & Chang 2003). Bittergourd, due to its medicinal properties, is well-liked for treating numerous illnesses like blood disorders, asthma, rheumatism, and diabetes (Tania *et al*. 2019). It is also recommended for treating other illnesses like anemia, diarrhea, dysentery, bronchitis, ulcer, cholera, and gonorrhea. The plant also has hypoglycemic, anti-tumor, anti-carcinogenic, anti-parasitic, anti-fertility, and anti-viral properties because of the numerous of biologically active plant chemicals it contains, such as alkaloids, proteins, triterpenes, and flavonoids (Sowmya *et al*. 2018).

Due to the presence of a hard seed coat all the bitter gourd genotypes show a problem with germination (Sowmya *et al*. 2018). Therefore seeds must undergo pre-sowing treatments despite having excellent germinability (Saleem *et al*. 2014). As compared to chemicals, organic priming (cow products) is cost-effective, environmentally friendly and easy to use by farmers (Kumhar *et al.* 2018). Poor seedling germination hampered emergence, and a sluggish growth rate due to a seed-coated embryo is the main issue with the bitter gourd's restricted yield (Khan *et al*. 2019). Cow products are superior to chemicals those increase soil fertility, are affordable, have a positive impact on subsequent crops, are non-polluting and harmless to beneficial soil bacteria, and require less special care and precautions (Kumhar *et al*. 2018).

Growth-promoting hormones are present in cow dung (Shinde & Malshe 2015). Growth regulators, nutrients, and trace elements are physiologically active chemicals that are present in cow urine (Tania *et al*. 2019).There is a paucity of knowledge regarding the impact of hormones from natural sources, such as fresh cow milk, on the germination of seeds of agroforestry tree species (Adelani & Bello 2016). Immerse the seeds in raw cow's milk for 24 hours to promote good germination and yield before planting (Sridhar & Kumar 2013). Seed germination, seedling growth, and bitter gourd yield can all be improved by hydro-priming (Malika & Rawat 2020). Hydropriming is an environmentally friendly, straightforward, and cost-effective method of seed priming (Tania *et al*. 2019). Cow urine, which contains nutrients like potassium and is known to have positive effects on germination, growth components such as plant height, number of leaves, and leaf area, and yield components such as number of grains, number of tillers, grain weight, and yield of crops, is a cheap input and easily available to rural farmers (Tiwari *et al*. 2018). Most of the modern seed priming involves chemical and hormonal priming. These modern priming are not economically affordable, easy to handle or environmentally friendly. Research related to organic priming is comparatively lower than that related to chemical priming in Nepal.

Hence, the objective of this research was to analyze the effect of various organic seed priming treatments on the growth performance of different genotypes of bittergourd.

2. Materials And Methods

The experiment was carried out in Godak Village in Ilam district of province number 1. It is Located at 26º 54' 42.12'' north latitude, 87º55'12.7'' east longitude, 849.4 masl. Ilam experiences fridge winters, pleasant summers, and hazy monsoons. The experiement was laid out in a Random Complete Block Design with a two-factor factorial with replications and 8 treatments namely factor 1 (Variety) and factor 2 (Priming Treatments).

Factor 1: Varieties of Bittergourd i.e., V1: Palee, V2: Asmita (Syngenta), and V3:Local.

Factor 2: Organic priming treatments (T1: cow milk and water at 1:1 ratio, T2 : cow urine and water at 1:1 ratio, T3 cow dung slurry and water at 1:2, T4 : water, T5: control (no seed priming).

Three tunnels were constructed, each measuring 2 meters in length and 1 meter in breadth. The distance between each tunnel was 0.5 meters. A polythene bag was used of 12 cm long by 6.5 cm wide and 100 gauge thick. A polythene bag was filled with the media after the soil, sand, and Farm Yard Manure completely mixed in a 2:1:1 ratio. For the research projects, 1,125 polythene bags 375 in each tunnel were utilized. A 1:1 ratio of raw cow's milk to tap water was employed. Clean tap water and cow dung were used in a ratio of 1:2. During hydro priming, clean tap water was used. After that the primed seeds were kept in the shade to dry. After drying, seeds were sown in polythene bags. Seeds were sown in each bag and were watered daily with the help of a

sprinkler can. Three seedlings of 25 old were selected and transplanted in each treatment plots in the field. The total number of plants transplanted in the field was 135 (45 plants from each replication and 3 from each treatment). Plant - to- Plant distance was maintained at 1.5 meter in the field.

Initially, bullock cards were used to plough the field. A pit of 30 cm by 30 cm was dug, and 4 kg of well-decomposed FYM was placed inside the pit. Irrigation and other interrelated tasks were completed after transplantation. On the 25 and 40 DAT, two-hand weeding was carried out. During the growing period, yellowing of lower leaves was seen; Cow urine mixed with water (1:5) was sprayed through a sprinkler can in the entire plants of the experimental field. No other issues related to insect pests were faced. All collected data were compiled and entered in Microsoft Excel (2007). Collected data were set in software named Rstat version 1.4.1106 and packages used in R (Agricolae version 1.3-5, readxl version 1.3.1, and rstatix version 0.7.0), DMRT (Duncan Multiple Range Test) for mean separation at a 5% level of significance was done.

3. Results and Discussion

3.1 Germination percentage and Day to Emergence

A significant result was recorded for the germination percentage under the different pre-sowing treatments. Among the three varieties, the Palee variety showed the significantly highest germination percentage (83.66%) followed by Asmita (56.33%) and the Local variety (40.73%). Likewise, among all the priming treatments, cow urine and water at 1:1-treated seed showed the highest germination percentage (71.55%), which is significantly at par with Tap water - treated seeds (69.55%)and significantly different from other priming treatments.

Among three varieties, Palee variety showed significantly lower days to emergence followed by Asmita and Local variety. Analysis of variance reveled significant differences between the priming treatments for the germination percentage and day to emergence (Table 1).

Interaction effect of different variety and priming treatment on day to emergence of bittergourd seedlings shows palee variety with cow dung slurry treatment showed lesser days to emergence while local variety with control (no seed priming) showed more days to emergence (Table 2).

Table 1: Effect of different variety and priming treatment on germination percentage (20 days after sowing) and day to emergence of bittergourd seedlings.

Treatment / Variety	Germination Percentage	Day to Emergence
Palee	83.6±2.60 ^{a}	9 ±0.44^{c}
Asmita	56.33±4.22^{b}	11±0.64^{b}
Local	40.73± 4.04^{c}	13±0.78^{a}
LSD 0.05	8.21***	0.64***
Priming Treatment		
Cow Milk (1:1)	63.00±6.82^{ab}	10±0.687^{b}
Cow Urine(1:1)	71.55±5.10^{a}	10±0.455^{b}
Cow Dung Slurry(1:2)	55.77±7.92 ^{b}	10±0.619^{b}
Tap water	69.55±6.73^{a}	10±0.588^{b}
control	41.33±10.5^{c}	15±0.986^{a}
mean	60.61	11
LSD0.05	0.83***	0.89***
CV%	1.42	7.62
Interaction(Variety * PrimingTreatment) LSD 0.05	1.44 ^{ns}	

Note: Means followed by common letter(s) in the superscript within a column are non significantly different at

5% by LSD, CV = Coefficient of variation, LSD = Least significant difference, SEM (±) = Standard error of mean difference, * significant at 5%, ** significant at 1%, *** significant at 0.1%, NS = non-significant.

Table 2: Interaction effect of different variety and priming treatment on day to emergence of bittergourd seedlings.

Treatment/Variety	Palee	Asmita	Local
Cow Milk soaking (1:1)	8.33 ±0.33^{gh}	10.33±1.20^{def}	12.33±0.33^{c}
Cow Urine soaking (1:1)	9.00± 0.57^{fgh}	9.67±0.33^{efg}	11.67±0.33^{cd}
Cow Dung Slurry (1:2)	8.00±0^{h}	11.00±0.58^{cde}	11.67±0.67^{cd}
Tap water	8.33±0.33^{gh}	10.00±0.58^{ef}	12.00±0.58^{c}
control	12.33±0.33^{c}	15.67±0.33^{b}	19.00±0.578^{a}
mean	11.09		
LSD 0.05	1.43*		
CV%	7.62		

Note: Means followed by common letter(s) in the superscript within a column are non significantly different at 5% by LSD, CV = Coefficient of variation, LSD = Least significant difference, SEM (±) = Standard error of mean difference,* significant at 5%, ** significant at 1%, *** significant at 0.1%, NS = non-significant.

3.2 Stem Diameter

Among three varieties Palee showed the significantly thicker stem diameter (3.12 mm) followed by Asmita and Local variety. Likewise, among all the priming treatments, cow urine and water at 1:1-treated seed showed the maximum stem diameter (3.05 mm), which is at par with cow milk (2.83 mm), cow dung slurry (3.03 mm), tap water (2.70 mm). The use all priming techniques recorded significantly higher stem diameter from the control (1.99 mm). Whereas, the interaction effect showed no significant influence on stem diameter. Analysis of variance revealed significant differences among the priming treatments for the stem diameter (Table 3).

Table 3: Effect of different Variety and Priming treatment on Stem diameter of Bittergourd seedlings (20 Days after Sowing)

Treatment / Variety	Stem diameter(mm)
Palee	3.12±0.08^{a}
Asmita	2.72±0.159^{b}
Local	2.32±0.16^{c}
LSD 0.05	0.25***
Priming Treatment	
Cow Milk (1:1)	2.83±0.14^{a}
Cow Urine (1:1)	3.05±0.09^{a}
Cow Dung Slurry (1:2)	3.03±0.11^{a}
Tap water	2.70±0.12^{a}
control	1.99±0.29^{b}
mean	2.76
LSD 0.05	0.32***
CV%	12.54
Interaction (Variety and Priming Treatment) LSD 0.05	0.57^{ns}

Note: Means followed by common letter(s) in the superscript within a column are significantly different at 5% by LSD, CV = Coefficient of variation, LSD = Least significant difference, SEM (±) = Standard error of mean difference, * significant at 5%, ** significant at 1%, *** significant at 0.1%, NS = non-significant.

3.3 Shoot Weight and Root Weight

Among the three varieties, the Palee variety showed the maximum shoot weight (1.8 gram), which was at par with the Asmita variety, followed by the Local variety. Meanwhile, the Asmita variety showed the maximum root weight (0.40 gram) which is at par with the Palee variety. Likewise, the Interaction effect showed none significantly influence shoot weight and root weight. Analysis of variance revealed significant difference among the priming treatments for the shoot and root weight (Table 4).

Table 4: Effect of different variety and priming treatment on shoot and root weight of bittergourd seedlings (20 days after sowing).

Treatment / Variety	Shoot Weight (gram)	Root Weight (gram)
Palee	1.8±0.10[a]	0.36±0.05[a]
Asmita	1.71±0.11[a]	0.40±0.06[a]
Local	0.79±0.09[b]	0.11±0.02[b]
LSD 0.05	0.30***	0.11***
Priming Treatment		
Cow Milk (1:1)	1.54±0.20	0.33± 0.09
Cow Urine (1:1)	1.63±0.12	0.33± 0.07
Cow Dung Slurry (1:2)	1.42±0.18	0.27± 0.08
Tap water	1.51±0.28	0.31± 0.08
control	1.07±0.24	0.24± 0.07
mean	1.43	0.29
LSD 0.05	0.39[ns]	0.15[ns]
CV%	26.96	36.16
Interaction (Variety and Priming Treatment)LSD 0.05	1.43[ns]	1.43[ns]

Note: Means followed by common letter(s) in the superscript within a column are non-significantly different at 5% by LSD, CV = Coefficient of variation, LSD = Least significant difference, SEM (±) = Standard error of mean difference, * significant at 5%, ** significant at 1%, *** significant at 0.1%, NS = non-significant.

3.4 Shoot Length and Root Length

Among the three varieties, the Asmita variety showed the maximum shoot and root length which is at par with the Palee variety but significantly longer than the Local variety. There was no significant influence priming treatments on shoot and root length (Table 5)

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Table 5: Effect of different variety and priming treatment on shoot length and root length of bittergourd seedlings (20 Days After Sowing)

Treatment /Variety	Shoot Length (cm)	Root Length (cm)
Palee	11.5±0.40[a]	14.4±1.27[a]
Asmita	10.5±0.63[a]	13.6±1.35[a]
Local	0.79±0.10[b]	8.16±1.23[b]
LSD0.05	1.31 ***	2.84***
Priming Treatment		
Cow Milk (1:1)	7.62±1.73	13.3±2.09
Cow Urine (1:1)	8.05±1.73	14.7±1.10
Cow Dung Slurry (1:2)	7.96±1.98	11.0±1.95
Tap water	7.37±1.76	11.7±1.72
control	6.93±1.76	9.47±2.20
mean	7.58	12.03
LSD0.05	1.7[ns]	3.67[ns]
CV%	23.20	31.62
Interaction (Variety*Priming Treatment)LSD 0.05	2.94[ns]	6.36[ns]

Note: Means followed by common letter(s) in the superscript within a column arenon significantly different at 5% by LSD, CV = Coefficient of variation, LSD = Least significant difference, SEM (±) = Standard error of mean difference, * significant at 5%, ** significant at 1%, *** significant at 0.1%, NS = non-significant.

3.5 Plant Height

The Palee variety showed the maximum primary branch length (67.4 cm) at twenty days after transplanting and (125 cm) at forty days after transplanting, which is significantly at par with Asmita and significantly different with Local variety. Likewise, among all the priming treatments cow urine and water at 1:1 treated seed showed the maximum stem diameter which is significantly at par with other priming treatments except control. Whereas, the interaction effect showed a non-significant influence on primary branch length (Table 6).

Table 6: Effect of different variety and priming treatment on primary branch length after 20 and 40 Days after Transplant (DAT).

Treatment Variety	Plant Height (cm) 20 DAT	Plant Height (cm) 40 DAT
Palee	67.4±12.0 [a]	125±9.34[a]
Asmita	60.1±10.6 [a]	118.8±8.03[a]
Local	43.4± 6.53[b]	104±4.17[b]
LSD	12.78**	11.56**
Priming Treatment		
Cow Milk (1:1)	57.4±12.0[a]	116.6±8.74[a]
Cow Urine (1:1)	66.3±14.0[a]	125.4±10.1[a]
Cow Dung slurry (1:2)	61.8±15.7[a]	120.30±11.9[a]
Tap water	63.6±14.9[a]	122.34±11.1[a]
control	35.9±7.22[b]	94.21±4.37[b]
mean	57.01	115.7
LSD	16.50**	14.92**
CV%	29.97	13.35
Interaction (Variety*Priming Treatment)LSD0.05	28.57[ns]	13.35[ns]

Note: Means followed by common letter(s) in the superscript within a column are non-significantly different at 5% by LSD, CV = Coefficient of variation, LSD = Least significant difference, SEM (±) = Standard error of mean difference, * significant at 5%, ** significant at 1%, *** significant at 0.1%, NS = non-significant.

3.6 Number of leaves and number of tendrils

The Palee variety had the highest number of leaves and tendrils par with the Asmita but significantly higher than the Local variety. Likewise, among all the priming treatments cow urine and water at 1:1-treated seed showed higher number of leaves and tendrils which was significantly at par with other priming treatments except control. Whereas, the interaction effect showed no significant influence on the number of leaves and tendrils (Table 7).

Table 7: Effect of different variety and priming treatment on number of leaves, number of tendrils of bitter gourd plants 20 Days after Transplant.

Treatment Variety	Number of Leaves	Number of Tendrils
Palee	21±2.12[a]	14 ±1.50[a]
Asmita	21±2.10[a]	10±1.25[b]
Local	16 ±1.22[b]	8± 0.91[c]
LSD	3.14 **	1.71***
Priming Treatment		
Cow Milk (1:1)	20±1.73[b]	13± 1.51[ab]
Cow Urine (1:1)	22±2.90 [a]	14±1.95[a]
Cow Dung Slurry(1:2)	20±2.53[b]	11±1.79[bc]
Tap water	21±2.82[ab]	10±1.52[c]
control	13 ±1.37 [c]	5±0.9[d]
mean	19	11
LSD	4.06**	2.21***
CV%	21.4	20.61
Interaction (Variety*Priming Treatment)LSD	7.03[ns]	3.83 *

Note: Means followed by common letter(s) in the superscript within a column arenone significantly different at 5% by LSD, CV = Coefficient of variation, LSD = Least significant difference, SEM (±) = Standard error of mean difference, * significant at 5%, ** significant at 1%, *** significant at 0.1%, NS = non-significant.

3.7 Day to first flowering and first fruit set

Among the three varieties, the Palee variety showed lower days to first flowering (33 days) and first fruit set (39 days), which is significantly different from the Local Variety. Likewise, among all the priming treatments cow urine and water at 1:1 treated seed showed lower days to first flowering and first fruit set. Whereas, the interaction effect showed no significant influence on Day to First flowering and First fruit set (Table 8).

Table 8: Effect of different variety and priming treatment on day to first flowering, day to first fruit set of bittergourd plant.

Treatment / Variety	Day to first flowering	Day to First fruit set
Palee	33±1.74[b]	39 ±1.59[b]
Asmita	35±2.06[b]	45±1.12 [a]
Local	40±2.23[a]	45±1.60[a]
LSD	3.14***	2.55***
Priming Treatment		
Cow Milk (1:1)	33±1.81[bc]	40±1.43[b]
Cow Urine (1:1)	31±1.87 [c]	40±1.48[b]
Cow Dung slurry (1:2)	36±2.13[b]	42± 1.44[b]
Tap water	34±1.91[bc]	40±1.43 [b]
control	46±2.87[a]	50±2.36[a]
mean	36	43
LSD	3.83***	3.29***
CV%	10.9	7.96
Interaction(Variety*Treatment)LSD 0.05	6.63[ns]	5.71[ns]

3.8 Yield (Fruit weight) kg per plant

Altogether, three harvests were done. Among the three varieties, the Palee variety showed the highest fruit weight per plant (3.02 kg) which is significantly at par with the Asmita variety and local variety. Likewise, among all the priming treatments, cow urine with water at 1:1 treated seed showed the maximum fruit weight kg per plant (2.72 kg) which is significantly at par with other treatments except control. Whereas, the interaction effect showed no ficant influence on the fruit weight per plant.

Table 9: Effect of different variety and priming treatment on fruit weight (yield) up to third harvest of bittergourd plant.

Treatment / Variety	Yield (Fruit weight) kg per plant
Palee	3.02±0.20[a]
Asmita	3.01±0.10[a]
Local	1.26±0.028[b]
LSD	0.31***
Priming Treatment	
Cow Milk (1:1)	2.63±0.33[a]
Cow Urine (1:1)	2.72±0.34[a]
Cow Dung slurry (1:2)	2.57±0.33[a]
GA3 (100)	2.51±0.34[a]
Tap water	2.34±0.33[a]
control	1.90±0.27[b]
mean	2.43
LSD	0.41**
CV%	17.52

Note: Means followed by common letter(s) in the superscript within a column are non significantly different at 5% by LSD, CV = Coefficient of variation, LSD = Least significant difference, SEM (±) = Standard error of mean difference, * significant at 5%, ** significant at 1%, *** significant at 0.1%, NS = non-significant.

4. Discussion

Among the three varieties of bittergourd, the palee variety showed a significantly better growth performance and yield. It might be superior genetic ability of this variety among others in all the priming treatment. Among all the priming treatments, seeds treated with organic

priming treatments showed significant results in terms of growth performance than the control. Cow urine and water at a ratio of 1:1- treated seed showed significant performances in terms of seed germination percentage, lesser days to emergence, and thicker stem diameter; This might be the result of presence of physiologically active substances such as growth regulators, nutrients and trace elements in cow urine.

These findings are also in line with the following findings.

Seeds from all varieties of chickpeas treated with cow urine showed the highest rate of germination in comparison to the control. (Tiwari *et al*. 2018). The treatment (1 kg of cow dung to 2 liter of water) induces seed germination five days earlier than normal sowing in Chilly and controls seed-borne diseases like fruit rot (Karthikeyan *et al*. 2006). Cow milk contains hormones that help to break the mechanical, thermo-dormancy, optical, and physiological of seeds. (Rahman *et al*. 2021). Increased concentrations of growth-promoting chemicals in cow urine may have an impact on seed germination (Tiwari *et al*. 2018).

Chickpea variety treated with organic priming (cow urine) significantly differed from the control in terms of maximum germination (%), seedling length, and fresh weight of chickpea variety seedlings. (Tiwari *et al*. 2018). A two percent urea priming treatment in spring rice produced the longest roots and shoots seven days after sowing (Koirala *et al*. 2019).

Under the agro-climatic circumstances of district Bhimber, Azad Kashmir, palee demonstrated to be the most effective in terms of highest germination and enhancing growth (Saleem *et al*. 2014).

5. Conclusion

Among the tested varieties, the Palee showed the highest growth performance as well the yield of bittergourd followed by the Asmita and Local varieties. It indicated that improved varieties were better than local variety due to their superior genetics abilities.

Among all the priming treatments, cow urine and water at a ratio of 1:1- treated seed showed significant performances in terms of seed germination percentage, shorter days to emergence, and thicker stem diameter. Also, this treatment recorded better performances in terms of growth parameters i.e. plant height, number of leaves and tendrils, lesser days to first flowering, and fruit yield.

Therefore, seed germination, seedling growth performances and yield of bittergourd could be improved through pre-soaking in organic priming cow urine and water at the rate of 1:1 which is cheap, non-toxic, and eco-friendly organic sources. However, such study should be carried out in other crops which have germination problem due to hard seed coat.

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References

Adelani, D. O., and M. I. Bello, 2016. Effect of fresh cow milk and coconut milk on the germination of *Tamarindus indica* seeds. *Applied Tropical Agriculture,* 21(3), 37-45.

Karthikeyan, C., D. Veeraragavathatham, D. Karpagam, and S. Firdouse, 2006. Cow based indigenous technologies in dry farming. *Indian journal of Traditional Knowledge,* 5(1), 47-50.

Khan, M., A. Ayaz, G. Ayub, and S. A. A. Shah, 2019. Influence of gibberellic acid concentrations and dipping durations on growth and yield of bitter gourd. *Sarhad Journal of Agriculture*, *35*(2), 587-593
DOI: 10.17582/journal.sja/2019/35.2.587.593

Koirala, N., D. Poudel, G. Bohara, N. Ghimire, and A. Devkota, 2019. Effect of seed priming on germination emergence and seedling growth of spring rice (*Oryza Sativa* L)cv.Hardinath-1. *Azarian Journal of Agriculture*, (6),7-12
DOI: 10.29252/azarinj.002

Kumhar, R. N., B. Baheti, and B. Chandrawat, 2018. Treatment of maize seed with cow-products: An eco-friendly management of maize cyst nematode (Heteroderazeae). *International Journal of Agriculture Science*, 10(9), 969-5971.

Malika, S., and S. Rawat, 2020. Effects of seed priming and it's duration on bitter. *Journal of Pharmacognosy and Phytochemistry*, 9(6),1950-1953.
DOI: 10.22271/phyto.2020.v9.i6ab.13237

Morshed, M., S. Rahman, I. Ahmed, S. Biswas, P. C. Sarker, A. Hossain, M. Islam, T. Jahan, and A. K. Choudhury, 2021. Effect of Milk and Hydropriming on Seed Germination Characteristics of Bitter Gourd (Momordica charantia L.). *Turkish Journal of Agriculture - Food Science and Technology*, *9*(2), 296-300.
DOI: 10.24925/turjaf.v9i2.296-300.3856

Palada, M. C., and L. C. Chang, 2003. Suggested cultural practices for bitter gourd. *Shanhua, Tainan: AVRDC - The World Vegetable Center* 03-547

Saleem , M. S., M. Sajid, Z. Ahmed, S. Ahmed, N. Ahmed, and M. Shahid, 2014. Effect of Seed Soaking On Seed Germination and Growth of Bitter Gourd Cultivars. *Journal of Agriculture and Veterinary Science (IOSR-JAVS)* ,6(6), 07-11
DOI: 10.9790/2380-0660711

Shinde, V. V., and K. V. Malshe, 2015. Effect of cattle urine and cowdung slurry as seed treatment on Khrini (Manikara hexandra L.). *Journal of ecofriendly agriculture* ,10(2) 128-130

Sowmya, H. M., S. Kolakar, S. Nadukeri, D. Lakshmama, V. Srinivasa, and S. Jakkeral, 2018. Influence of seed priming with gibberlic acid on antidiabatic vine - bitter gourd (*Momordica charantia* L.) Genotypes. *Journal of Pharmacognosy and Phytochemistry,* (3), 161-164.

Sridhar, S., and S. A. Kumar, 2013. Seed treatment techniques. *Centre for Indian Knowledge Systems (CIKS) Seed Node of the Revitalising Rainfed Agriculture Network.*

Tania, S., M. Hossain, and A. Hossain, 2019. Effects of hydropriming on seed germination, seedling growth and yield of. *Journal of Bangladesh Agricultural University*, 17(3), 281–287
DOI: 10.3329/jbau.v17i3.43197

Tiwari, S., A. K. Chaurasia, N. Nithyananda, and B. Bara, 2018. Effect of organic priming on seed germination behaviour and vigour of chickpea (*Cicer arietinum* L.). *Journal of Pharmacognosy and Phytochemistry,* 7(4): 1064-1067