International Journal of Agriculture, Environment and Biotechnology
Citation: *IJAEB*: **16**(04): 241-245, December 2023
DOI: 10.30954/0974-1712.04.2023.2

ASSOCIATION FOR AGRICULTURE ENVIRONMENT AND BIOTECHNOLOGY

RESEARCH PAPER

Impact of Seed Priming on Germination and Seedling Vigor in *Coreopsis tinctoria* and *Callistephus chinensis*

C. Shamseena[1], P. Jaseena[2], V. Sumbula[2*], K. Shafna[2] and K. Musthafa[3]

[1]MES Kalladi College, Mannarkkad, Calicut University, Kerala, India
[2]Kerala Agricultural University, Division of Horticulture, Agricultural Research Station, Anakkayam, Kerala, India
[3]Agricultural Research Station, Anakkayam, Kerala Agricultural University, Kerala, India

*Corresponding author: sumbula.v@kau.in (**ORCID ID:** 0000-0002-7259-005X)

Paper No. 1096 **Received:** 15-08-2023 **Revised:** 22-11-2023 **Accepted:** 01-12-2023

ABSTRACT

Seed priming techniques are adopted for the enhancement of seed germination and seedling vigour. Among the different seed priming techniques adopted in the study, seed priming using humic acid and with *Pseudomonas fluorescence* showed better results in Coreopsis. For China aster (*Callistephus chinensis)*, Pseudomonas demonstrated superior results. Least performance was observed in fortified vegetable boosters in shoot and root length (Coreopsis) and fresh and dry weight of both shoot and root (Coreopsis & China aster). From the results, it was concluded that seed priming with Pseudomonas 10g/litre is very effective in enhancing seed germination. The superior performance of the Pseudomonas treatment may be attributed to its ability to enhance nitrogen fixation and phosphate solubilization. Studies revealed that *P. fluorescens* is capable of increasing nitrogen fixation, phosphate solubilization and production of growth promoting substances, thus increasing the dry matter production of the seedlings.

HIGHLIGHTS

- Seed priming with Pseudomonas fluorescens is effective in enhancing seed germination in coreopsis and china aster.

Keywords: China aster, Coreopsis, Humic acid, *Pseudomonas,* Seed priming

Seed priming is a pre-soaking seed treatment to improve seed germination and uniform seedling emergence in a wide range of crops. The principle of seed priming is to minimize the period of emergence and to protect seed from environmental stresses during the critical phase of seedling establishment to synchronize emergence, which leads to uniform establishment and improved yield. During seed priming, the seeds are soaked in a solution containing biostimulants for a definite time, after which the moisture content is brought to a level just below that which is required for radicle emergence (Rehman *et al.* 2020). Different types of Seed priming can be used, such as hydropriming, halopriming, osmopriming, hormonal priming, biopriming, nutrient priming, and solid matrix priming. Seed priming has a beneficial effect on germination, growth components, plant height, number of leaves, leaf area, fresh weight, dry weight and many other factors.

The priming effects depend on the nature of the priming agent, the priming duration, the concentration of the priming agent, and the plant

How to cite this article: Shamseena, C., Jaseena, P., Sumbula, V., Shafna, K. and Musthafa, K. (2023). Impact of Seed Priming on Germination and Seedling Vigor in *Coreopsis tinctoria* and *Callistephus chinensis*. *Int. J. Ag. Env. Biotech.*, **16**(04): 241-245.

Source of Support: None; **Conflict of Interest:** None

(Jeong *et al.* 2000). The report of Wasif *et al.* (2012), who reported rapid plant growth in primed seeds At 22 weeks after plantation, seeds showed an increase in total dry weight, leaf dry weight, root dry weight, and shoot dry weight compared to the non-soaked seeds (control). Priming induces a set of biochemical changes such as enzyme activation, metabolism of germination inhibitors, repair of cell damages, and unbibition to promote germination (Farooq *et al.* 2010).

According to Devika (2021), Seed priming is a viable option to boost the performance of crops in fragile ecosystems. Sidana *et al.* (2019) performed a study to determine the effect of seed priming in China aster cv. Kamini with different chemicals. Seeds primed with GA3 at 200 ppm showed the best performance in all the growth characteristics, i.e., Shoot length, root length, leaf length, leaf width, and fresh and dry weight of seedlings over all the treatments. Control seeds failed to exert any significant effect on seedling parameters. An experiment was conducted by Mirlofti *et al.* (2015) on Marigold (*Calendula marigold*) (*Calendula officinalis*) to understand the effect of seed priming on germination and seedling traits under saline conditions. And found that germination rate was promoted by priming treatments, which result in better establishment. Dina Margaret Samfield *et al.* (1990) revealed the effect of seed priming on the germination of *Coreopsis lanceolata* and *Echinacea purpurea* and found that priming improves the performance of *C. lanceolata* seed.

Evaluation of seed priming on germination of *Gladiolus alatus* was done by Musthaq *et al.* (2012). It was concluded that germination percentages can be increased by using lower concentrations of KNO_3 and hydropriming. Shivsubramanian and Ganeshkumar (2005) revealed the influence of vermiwash on the biological productivity of Marigold. The results revealed that vermiwash spray enhanced the growth parameters (plant height, number of laterals, number of leaves, and leaf area) and yield parameters (number of days to flowering, number of flowers per plant, and flower weight). The study conducted by Chattopadhyay (2014) on an Ornamental Flower, Zinnia sps indicated that vermiwash and vermicompost could be utilized effectively for sustainable plant production in low-input green farming.

Hartwigsen and Evans (2000) examined the effect of Humic acid on seedling root development of *Pelargonium hortorum* L.H. Bailey 'Freckles' (geranium) and *Tagetes patula* L. 'Bonanza' (marigold) and found that HA treatments increased the root fresh weight of marigold seedlings, and all treatments increased the geranium root fresh weight. Effects of Humic Acid on The Emergence and Seedling Growth of Safflower Varieties (*Carthamus tinctorius* L.) were examined by Basalma (2015). It was revealed that significant differences were determined among cultivars regarding seedling growth, and treatment of seeds using 60–120 g humic acid per 100 kg of seed before sowing affected seedling growth positively in safflower. Ebrahimi and Miri (2016) conducted a study to investigate the effect of humic acid on the germination properties of *Borago officinalis* and *Cichorium intybus*. The results showed that the application of 30 g of humic acid was effective in stimulating the germination of the plant species.

Pseudomonas fluorescens enhances biomass yield and ajmalicine production in *Catharanthus roseus* under water deficit stress, as studied by Jaleel *et al.* (2007). *Pseudomonas fluorescens* enhanced the growth parameters under drought stress and partially ameliorated the drought-induced growth inhibition by increasing the fresh and dry weights. An experiment on biopriming of sunflower *(Helianthus annuus* L.) seeds with *Pseudomonas fluorescens* for improvement of seed invigoration and seedling growth was conducted by A. Moeinzadeh *et al.* (2010). The experiment included the investigation of 30 strains of *Pseudomonas fluorescens* to improve seed germination and seedling growth. As a conclusion, biopriming with *Pseudomonas fluorescens* provided very good establishment and adherence of bacteria to the seed before planting and thus is suggested as a proper treatment for enhancement of seed indices and improvement of seedling growth. Mandana Khosravi *et al.* (2018) revealed that the use of bacterial inoculation treatments, such as seed bio-priming, can be recommended for improving the morphological indices of Moldavian balm, especially under water deficit stress conditions.

MATERIALS AND METHODS

The effect of seed priming was examined in flowering plants, such as *Coreopsis tinctoria* and

Callistephus chinensis, both of which belong to the Asteraceae family. *Callistephus chinensis* is commonly called China aster. It is an annual flowering plant that produces a vast range of colors of flowers. The plant grows to 20–80 cm tall with branched stems. The leaves are alternate, 4–8 cm long, ovate, and coarsely toothed. The flower heads are showy and solitary. It is a popular ornamental plant in gardens. *Coreopsis tinctoria* is commonly called tickseed. The plant ranges from 46 to 120cm in height, and the flowers are usually yellow with a toothed tip but may also be yellow and red bicolor. *Coreopsis tinctoria* possesses many biological activities, including hypoglycemic activity, hypolipidemia activity, blood pressure reduction activity, and antioxidant activity.

Organic input like vermiwash, fortified vegetable booster, humic acid, pseudomonas, coconut water, and fish amino acids at different concentrations were used for priming. Distilled Water was used as control. Vermiwash helps in germination and resists pests and diseases. Coconut water contains cytokinin hormones that trigger the plants to divide their cells into growing shoots and roots, resulting in bushier growth. Humic acid improves germination rate and nutrition uptake. Pseudomonas promotes seed germination and disease suppression. Fish aminoacid promote the growth of roots and leaves and enhance photosynthesis in seedlings.

Fresh and mature seeds were collected and the polybags were filled with potting mixture with soil and cow dung in 1:1 ratio. Priming solution was prepared and the seeds were treated for a period of 6 hours. Treated seeds were sown in polybags after proper labeling. The design followed was randomized block design (RBD) with three replications for each treatment. Seed germination percentage, Mean germination time, Germination index, Seedling vigor, Shoot length, Root length, Fresh weight of shoot and root, Dry weight of shoot and root, Number of leaves and branches and leaf area index were recorded after the 30th day of sowing. Treated seeds were sown in polybag. Treatments were T1: Distilled water; T2:100 ml/litre Vermiwash; T3:20 ml/litre Fortified Vermiwash; T4: 2 g/litre Humic acid; T5:10 g/litre Pseudomonas; T6: Coconut water; T7: 2 ml/litre Fish aminoacid.

RESULTS AND DISCUSSION

The results showed that primed seeds germinated earlier than non-primed seeds (control). A higher germination percentage and a shorter mean germination time were also observed in primed seeds. In Coreopsis, primed seeds germinated within 5–9 days after sowing, whereas unprimed seeds were found to germinate in 5–11 days. Similarly, in China aster, primed seeds germinated within 3-5 days after sowing, but unprimed seeds germinated in 4-6 days. Germination percentage expressed was 100 % in *Coreopsis* whereas China aster showed a range of 88.89 to 94.43 percentage. In Coreopsis, seed priming using humic acid at 2 g/litre showed better results for root length, fresh weight of root and shoot, number of leaves, and leaf area, on the other hand, pseudomonas at 10 g/litre resulted in better shoot length, dry weight of root, seedling vigour index and lowest mean germination time. Similarly, in China aster, pseudomonas @10 g/litre resulted in better shoot length, number of leaves, dry weight of root and shoot, and seedling vigour index. However, in both plants, the highest shoot length was observed in treatment T5. Whereas, the highest fresh weight of shoot was observed in

Table 1: Effects of different priming treatments on seeds of *Coreopsis tinctoria*

Treatment	Seed germination percentage	Mean Germination Time(Days)	Germination index	Seedling vigour index	Shoot length	Root length (c	Fresh weight of shoot(gm)	Fresh weight of root(gm)	Dry weight of shoot(gm)	Dry weight of root(gm)	Number of leaves	Leaf Area Index
T1	100±0.000	6.110±1.057	20.000±2.000	7.47 ±0.988	7.477 ±0.988	5.390 ±1.552	0.364 ±0.143	0.030±0.015	0.070±0.041	0.018±0.008	10.667±1.155	2.860 ±0.629
T2	100±0.000	5.220±0.381	16.667±1.155	8.42±0.876	8.420 ±0.876	5.680 ±1.165	0.411 ±0.072	0.033±0.005	0.064±0.019	0.016±0.003	11.667±2.082	2.720 ±0.410
T3	100±0.000	6.050±0.348	20.667±1.155	7.07±0.366	7.077 ±0.366	4.657 ±0.452	0.247 ±0.036	0.014±0.001	0.042±0.015	0.012±0.001	10.000±0.000	2.207 ±0.437
T4	100±0.000	5.832±0.600	18.667±1.528	8.90±0.300	8.900 ±0.300	7.197 ±2.223	0.504 ±0.071	0.059±0.019	0.081±0.004	0.017±0.004	13.000±2.000	3.760 ±0.209
T5	100±0.000	5.160±0.000	16.333±0.577	9.56±0.581	9.567 ±0.581	5.270 ±0.534	0.440 ±0.165	0.031±0.018	0.269±0.028	0.023±0.002	11.333±2.309	3.133 ±0.493
T6	100±0.000	5.720±0.485	16.333±0.577	8.92±0.233	8.923 ±0.233	5.380 ±0.458	0.503 ±0.043	0.036±0.008	0.327±0.016	0.019±0.001	12.000±1.000	3.257 ±0.707
T7	100±0.000	5.887±0.510	19.333±1.648	7.66±0.351	7.663 ±0.351	4.923 ±0.520	0.321 ±0.015	0.031±0.001	0.033±0.004	0.012±0.001	10.000±0.000	2.840 ±0.197

T1: Distilled water; T2: Vermiwash; T3: Fortified Vermiwash; T4: Humic acid; T5: Pseudomonas; T6: Coconut water; T7: Fish aminoacid.

Table 2: Effects of different priming treatments on seeds of *Callistephus chinensis*

Treatment	Seed germination percentage	Mean Germination Time(Days)	Germination index	Seedling vigour index	Shoot length (cm)	Root length (cm)	Fresh weight of shoot(gm)	Fresh weight of root(gm)	Dry weight of shoot(gm)	Dry weight of root(gm)	Number of leaves	Leaf Area Index
T1	88.88 ±9.624	5.337±0.232	14.667±1.528	3.67±1.167	4.192 ±1.167	3.017 ±0.496	0.062 ±0.021	0.005 ±0.002	0.005 ±0.001	0.010 ±0.001	6.667±0.144	1.017 ±0.275
T2	94.44 ±9.624	4.333±0.400	14.667±1.155	4.20±0.325	4.470 ±0.325	3.870 ±0.286	0.063 ±0.011	0.007 ±0.001	0.005 ±0.001	0.011 ±0.001	6.550±0.278	1.303 ±0.176
T3	88.88 ±9.624	4.600±0.577	15.000±2.000	3.69±0.487	4.203 ±0.487	3.808 ±0.322	0.054 ±0.006	0.003 ±0.002	0.004 ±0.001	0.010 ±0.000	6.387±0.237	1.167 ±0.289
T4	94.44 ±9.624	5.100±0.173	15.000±0.000	4.23±0.400	4.500 ±0.400	3.290 ±0.260	0.055 ±0.004	0.006 ±0.001	0.004 ±0.000	0.011 ±0.001	7.000±0.000	1.250 ±0.250
T5	94.44 ±9.624	4.733±0.306	15.333±0.577	4.80±0.571	5.112 ±0.571	4.580 ±0.348	0.070 ±0.008	0.007 ±0.002	0.006 ±0.001	0.010 ±0.000	7.887±1.261	1.083 ±0.144
T6	94.44 ±9.624	4.833±0.451	15.333±0.577	4.11±0.405	4.380 ±0.405	5.225 ±0.229	0.056 ±0.002	0.009 ±0.002	0.004 ±0.001	0.010 ±0.001	6.637±0.431	1.083 ±0.144
T7	94.44 ±9.624	4.677±0.792	15.333±0.577	3.65±0.210	3.887 ±0.210	4.16 3± 0.032	0.076 ±0.018	0.005 ±0.001	0.005 ±0.001	0.010 ±0.000	6.667±0.208	1.167 ±0.289

T1: Distilled water; T2: Vermiwash; T3: Fortified Vermiwash; T4: Humic acid; T5: Pseudomonas; T6: Coconut water; T7: Fish aminoacid.

T4 in Coreopsis and T7 in China aster. The same pattern was followed with respect to dry weight of the root. In Coreopsis and China aster, the highest fresh weight of root was observed in T4 and T6, respectively, whereas in the case of dry weight, the highest dry weight of root was observed in both Coreopsis and China aster for the treatment T5.

According to Jaleel *et al.* (2007) *P. fluorescens* enhances biomass yield and ajmalicine production in *Catharanthus roseus* under water deficit stress conditions. *P. fluorescens* enhanced the growth parameters under drought stress and partially ameliorated the drought-induced growth inhibition by increasing the fresh and dry weights. The positive effect of biopriming with *P. fluorescens* was reported in Sunflower by A. Moeinzadeh *et al.* (2010). Biopriming significantly improved the shoot height, root length, and seedling weight in comparison with other treatments and the control. *P. fluorescens* provided very good establishment and adherence of bacteria to the seed before planting and thus is suggested as a proper treatment for enhancement of seed indices and improvement of seedling growth. In this study, with respect to mean germination time and morphological parameters seed priming using Pseudomonas 10g/litre showed the best result.

ACKNOWLEDGMENTS

The authors thank Kerala Agricultural University, College of Agriculture, Vellanikkara, Thrissur, Kerala, India for providing the infrastructure and technical facilities.

REFERENCES

Basalma, D. 2015. Effects of Humic Acid on The Emergence and Seedling Growth of Safflower Varieties (*Carthamus tinctorius*). *J. of Agril. and Natural Science, pp.* 152–156.

Chattopadhyay, A. 2014. Effect of Vermiwash and Vermicompost on an Ornamental Flower, Zinnia sp. Department of Science and Technology. *Central Institute of Freshwater Aquaculture,* **1**(3).

Devika, S., Singh, S., Sarkar, S., Barnwal, D., Suman, J. and Rakshit, A. 2021. Seed priming: a potential supplement in Integrated Resource Management under Fragile Intensive ecosystems Sustain.Food Syst., July 2021, http://doi.org/10.3388/fsufs.2021.654001.

Ebrahimi, M. and Miri, E. 2016. Effect of Humic Acid on Seed Germination and Seedling Growth of *Borago **officinalis*** and *Cichorium intybus. ECOPERSIA,* **4**(1): 1239-1249.

Farooq, M., Basra, S.M., Wahid, A. and Ahmad, N. 2010. Changes in nutrient homeostasis and reserve metabolism during rice seed priming: consequences for seedling emergence and growth. *Agricult. Sci. China,* **9**: 191-198.

Hartwigsen, J.J. and Evans, M.R. 2000. Humic acid seed and substrate treatments promote seedling root development. *Hortscience,* **35**(7): 1231–1233.

Jaleel, C.A., Manivannan, P., Sankar, B., Kishorekumar, A., Gopi, R., R Somasundaram, R. and Panneerselvan, R. 2007. Pseudomonas fluorescens enhances biomass yield and ajmalicine production in Catharanthus roseus under water deficit stress. *Colloids and Surfaces B: Biointerfaces,* **60**(1): 7–11.

Khosravi, M., Shahraki, A.D. and Ghobadinia, M. 2018. The effect of seed bio-priming treatments on morphological indices of Moldavian balm (*Dracocephalum moldavica*) under water deficit stress. *Environ. Stresses in Crop Sci.,* **11**(2): 353–363.

Jeong, Y., Hang, S.M., Cho, J.L. and Jeong, Y.O. 2000. Germination of carrot,lettuce, onion, and Welsh onion seeds is affected by priming chemicals at various concentrations. *Korean J. Hirt. Sci. Tech.,* **18**: 93–97.

Mirlotfi, A., Bakhtiarian, S. and Bazrgar, A.B. 2015. Effect of seed priming on germination and seedling traits of Marigold (*Calendula officinalis)* in saline conditions. *Biological Forum: An Int. J.,* **7**(1): 1626–1630.

Moeinzadeh, A., Sharif-Zadeh, F., Ahmadzadeh, M. and Heidari Tajabadi F. 2010. Biopriming of Sunflower (*Helianthus annuus L*) Seed with *Pseudomonas fluorescens*' for Improvement of Seed Invigouration and Seedling Growth*. Aus. J. of Crop Sci.,* **4**(7): 564-570.

Mushtaq, S., Hafiz, I.A., Hasan, S.Z.U., Arif, M., Shehzad, M.A., Rafique, R., Rasheed, M., Ali, M. and Iqbal, M.S. 2012. Evaluation of seed priming on germination of *Gladiolus alatus. Af. J. of Biotechnol.,* **11**(52): 11520–11523.

Rehman, H., Rathika, s., Murugan, A., Soniya , R.R., Mohanta, K.K. and Prabharani, B. 2020. Foliar spray of fish aminoacid as liquid organic matter on the growth and yield of Amaranthus. *Chem. Sci. Rev. and Letters,* **9**: 511-515.

Samfield, D.M., Jayne, M., Zajicek and Cobb, B.G. 1990. Germination of *Coreopsis lanceolata* and *Echinacea purpurea* seeds in 2020 following priming and storage*. Hort. Sci.,* **25(12**): 1605–1606.

Shivsubramanian, K., Ganeshkumar, M. 2005. Influence of vermiwash on the biological productivity of marigold. *Madras Agril. J.,* **81**(4): 221-225.

Sidana, G., Hembrom, R., Sisodia, A., Padhi, M. and Singh. A.K 2019. Effect of seed priming on seedling growth in China aster cv. Kamini. *J. of Phagmacogsy and Photochem.,* **8**(5): 372-375.

Wasif, N., Muhammad, T.S. and Shahzad. 2012. *Moringa* leaf extract: an innovative priming Tool for rangeland grasses. *Turkish J. of Agric. and Forestry,* **36**(1): 65–75.