Biological Forum – An International Journal **13(3): 288-294(2021)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Influence of Seed Priming with Botanicals, Micronutrients and Bio-inoculants on Physiological Attributes in Sorghum (*Sorghum bicolour* L.)

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(Received 03 June 2021, Accepted 03 August, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: A laboratory experiment was conducted in a Completely Randomized Design (CRD) with four replications during *Rabi*, 2020-2021 at Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj. The genetically pure seeds of sorghum var. SPV 1411 (Parbhanimoti) was used for the study. The sorghum seeds primed with treatments (Neem leaf, Parthenium leaf, *Azospirillum* sp., *Pseudomonas fluorescens*, Boron, Zinc sulphate) were subjected to germination studies in laboratory, seed germination and seedling growth parameters were recorded. Analysis of variance revealed significant mean sum of squares due to seed priming treatments. The highest germination percentage (95%), root length (14.79 cm), shoot length (19.65cm), seedling length (34.44cm), fresh weight (1.71g), dry weight (0.20g), vigor index 1 (3272) and vigor index 2 (19.23) were observed in T12 (Combination of *Azospirillum* sp. + *Pseudomonas fluorescens* + Zinc sulphate + Boron) followed by T11 (Zinc sulphate + Boron). While significantly minimum was recorded in T0 (Control) (84.5%, 9.07cm, 14.01cm, 23.08cm, 1.28g, 0.14g, 1951.59, 11.40) respectively.

Keywords: Parthenium leaf, neem leaf, *Azospirillum* sp., *Pseudomonas fluorescens*, zinc sulphate, boron.

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. It is one of the most important grain and fodder crop grown in tropical and subtropical regions in India. It is commonly known as great millet due to larger size of grain among millets and vast area under it (Vavilov, 1935). It is believed to have spread from Africa to India.

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 (Price, 2005). Millets comprise of different types like finger millet, foxtail millet, proso millet, pearl millet including sorghum which are well considered as the crops of antiquity mainly known for their drought resistance, insects, pests and disease resistance (Devi *et al*., 2014). Sorghum is a warm-season cereal widely grown in semiarid, sub-humid, and humid tropical and subtropical regions of the world, where minimum mean temperatures during the growing season generally stay above l8°C (Singh, 1985).

Due to its versatile use, drought hardiness, stability of yield and adaptability over wide range of climates, sorghum has maintained its importance and dependability. Hence it proved its popularity with growers, especially in marginal areas with least fertile and low water holding capacity soils where, only few other crops can be grown.

Seed priming has presented promising and even surprising results, for many crop seeds. Priming in its traditional sense, is soaking of seeds in water before sowing, has been the experience of farmers in India in an attempt to improve crop stand establishment but the practice was without the knowledge of the safe limit of soaking duration. Heydecker, (1973) reported that seed priming is one of the most important developments to help rapid and uniform germination and emergence of seeds and to increase seed tolerance to adverse environmental conditions.

Research on priming has proved that crop seeds primed with water germinated early, root and shoot development started rapidly, grew more vigorously and seedling length was also significantly greater than non-primed seeds. This technique helps seeds to evenly germinate even under adverse soil conditions. Bio-priming could also reduce the amount of bio-control agents that must be applied to the seed (Singh *et al*., 2003). Bio-priming is a seed treatment system that involves coating the seed with fungal or bacterial bio-control agents. Bio-agents can be applied as seed treatment, seed coating, seed priming and soil drenching, of which, most effective technique is seed priming because it may be used for reducing diseases, improvement of germination, vigour, seedling establishment and yield in crops (Talebian *et al*., 2008).

Biopriming treatment is potentially able to promote quick and even germination as well as better plant growth (Moeinzadeh *et al*., 2010). Bio-priming is directly involved in the enrichment of plant development by the excretion of compounds and mineral solubilisation (Sukanya *et al.*, 2018). Azospirillum has the capacity of nitrogen fixation, synthesis of phytohormones and other compounds including auxins, gibberlins, ethylene and promotes plant growth. *Pseudomonas fluorescens* belong to plant growth promoting bacteria, enhances growth, solubilize minerals, produce antibiotic enzymes against pathogens, and help in its absorption by roots. The use of mixed inoculants was able to boost up higher vigor index and plant growth rather than the single one. Yadav *et al*., (2010) reported that mixed inoculant application had improved better seed germination and plant growth than the single one.

The role of zinc and iron in crop nutrition is well recognized as it is used for bio-synthesis of plant auxins, nitrogen metabolism, oxidation-reduction reactions, which are considered to be necessary for plant growth and development, chlorophyll formation, photosynthesis, important enzyme system and respiration in plants. Boron also plays a very important role in vital functions of the plant, including meristem, sugar and hydrocarbon metabolism and their transfer, RNA and cytokinin production and transfer, pollen building and seed formation Murthy *et al.*, (2006).

Realizing the importance of sorghum as a popular and commercially important annual cereal crop, need has been felt to investigate the effect of seed priming techniques to improve the germination characteristics of sorghum seeds and production of healthy and stocky seedlings besides producing the good quality and vigorous seeds that will exhibit profuse seedling parameter. Keeping in view the above facts, the present studies have been planned.

MATERIALS AND METHODS

The experimental material for present investigation comprised of thirteen priming treatments including control on sorghum seed. The experiment was conducted in Completely Randomized Design (CRD) with four replications.

Treatments details: The genetically pure seeds of sorghum var. SPV 1411 (Parbhanimoti) was used for the study. SPV 1411 (Parbhanimoti) seeds are very bold type with pearly white colour and were subjected to various pre sowing treatments like Neem leaf extract, Parthenium leaf extract, *Azospirillum* sp, *Pseudomonas fluorescens*, Boron, Zinc sulphate 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 ISTA (2013) rules. The observations for various seedling characters viz. Germination percent, root length, shoot length, seedling length, fresh weight of seedling, dry weight of seedling, vigor index 1, 2 were recorded.

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.

RESULTS AND DISCUSSION

All the seed quality parameters differed significantly due to seed priming treatments. Sorghum seeds primed with T12 (Combination of *Azospirillum* sp. @20%+ *Pseudomonas fluorescens* @20 %+ Zinc sulphate @0.1% + Boron @0.1%) recorded significantly higher seed germination percentage (95%), root length (14.79cm), shoot length (19.65cm), seedling length (34.44cm) fresh weight of seedling (1.71g) dry weight of seedling (0.20 g) vigour index I (3272) Vigor index II (19.23). While significantly minimum was recorded T0 (Control) (84.5%, 9.07cm, 14.01cm, 23.08cm, 1.28g, 0.14g, 1951.59, 11.40) respectively.

Germination Percent: For Germination percent T12 (Combination of *Azospirillum* sp. + *Pseudomonas fluorescens* + Zinc sulphate + Boron) (95%), T11 (Zinc sulphate + Boron) (0.1%) (93.5%), T2 (Parthenium leaf extract) (3%) (93.5%), and T10 (Boron) (0.1%) (91%), were significantly higher in comparison to control. However, these treatments were statistically at par to each other. The combined application enhanced germination rate and plant growth. The above data was confirmed with the findings of Yadav *et al*., (2013); Noumavo *et al*., (2013).

Root length: For root length, T12 (Combination of *Azospirillum* sp. + Pseudomonas fluorescens + Zinc sulphate + Boron) (14.79 cm), T11 (Zinc sulphate + Boron) (0.1%) (14.29cm), T5 (*Azospirillum* sp.) (20%) (13.7cm) and T8 (*Pseudomonas fluorescens*) (20%) (13.69cm) were significantly higher in comparison to control. The results showed are similar to the findings of Chakradhar *et al*., (2017); Suliasih and Widawati (2017).

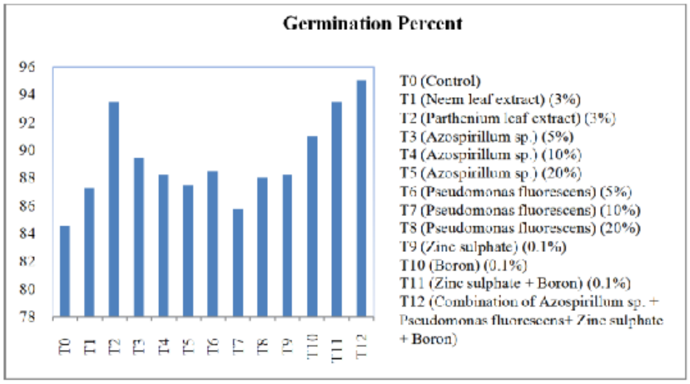

Fig. 1. Germination Percent as affected by various treatments in sorghum.

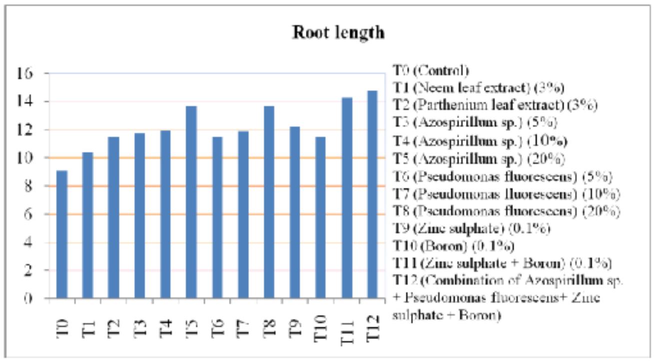

Fig. 2. Root length as affected by various treatments in sorghum.

Shoot length: For shoot length, highest shoot length was recorded in T12 (Combination of *Azospirillum* sp. + *Pseudomonas fluorescens* + Zinc sulphate + Boron) (19.65 cm) and T11 (Zinc sulphate + Boron) (0.1%) (18.42cm). The results of present study is in agreement with the findings reported by Sakthivel *et al*., (2009): Sivasankaridevi *et al*., (2013); Sivakalai and Krishnaveni, (2017).

Seedling length: For seedling length (cm), T12 (Combination of *Azospirillum* sp. + *Pseudomonas fluorescens* + Zinc sulphate + Boron) (34.44 cm), and T11 (Zinc sulphate + Boron) (0.1%) (32.71cm) were found significantly higher in comparison to control and other treatments. Similar findings has been reported by Sridevi and Manonmani, (2016); Gangadharayya *et al*., (2019).

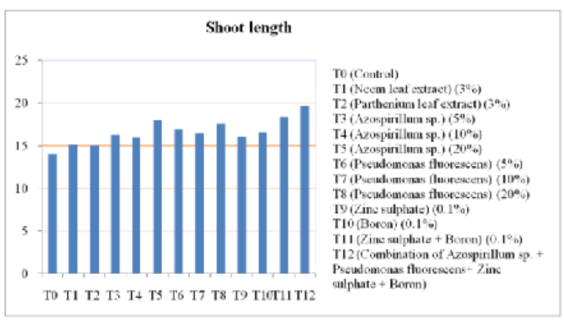

Fig. 3. Shoot length as affected by various treatments in sorghum.

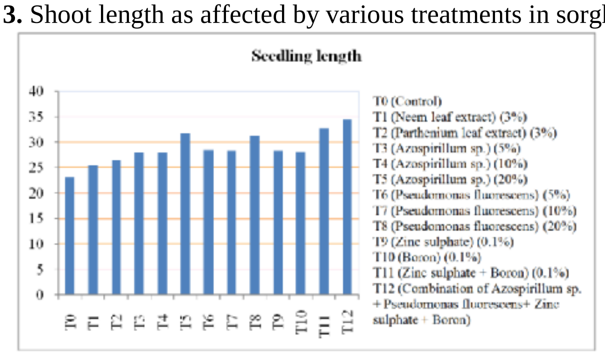

Fig. 4. Seedling length as affected by various treatments in sorghum.

Fresh weight of seedling: For seedling fresh weight (g), T12 (Combination of *Azospirillum* sp. + *Pseudomonas fluorescens* + Zinc sulphate + Boron) (1.71g), followed by T11 (Zinc sulphate + Boron) (0.1%) (1.61g), T9 (Zinc sulphate) (0.1%) (1.51g), T8 (*Pseudomonas fluorescens*) (20%) (1.51g), T10 (Boron) (0.1%) (1.47g) were found significantly higher in comparison to control.

Dry weight of Seedling weight: For seedlings dry weight (g), treatments, T12 (Combination of *Azospirillum* sp. + *Pseudomonas fluorescens* + Zinc sulphate + Boron) (0.2g) was significantly higher to control as well as other treatments.

Vigor index I: For Vigor index I, all the treatments were significantly higher in comparison to control. Among the treatments, T12 and T11, though was statistically at par to each other but significantly higher than control and other treatments.

Vigor index II: For Vigor index II, treatments T12 (Combination of *Azospirillum* sp. + *Pseudomonas fluorescens* + Zinc sulphate + Boron) (19.23) was significantly higher to control as well as other significant treatments. Similar findings have been reported by Shaukat *et al.*, (2006); Niranjan *et al.*, (2007); Hameeda *et al.*, (2006).

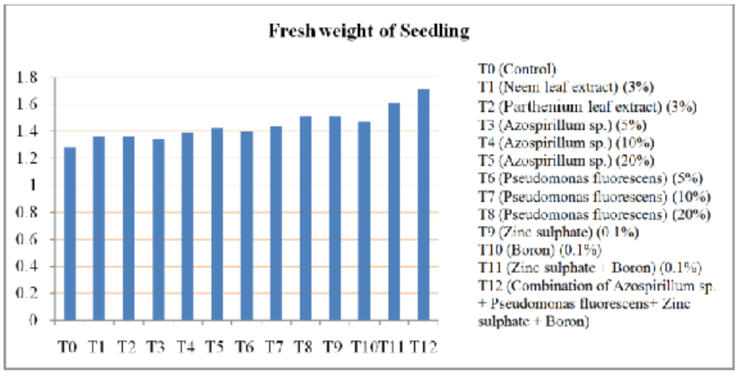

Fig. 5. Fresh weight of seedling as affected by various treatments in sorghum.

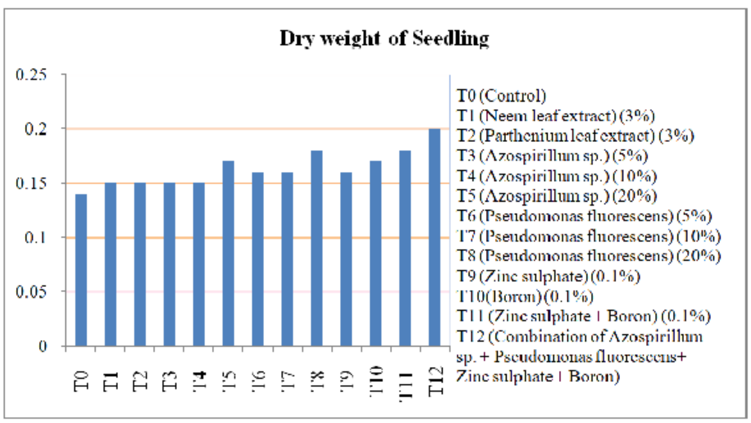

Fig. 6. Dry weight of Seedling as affected by various treatments in sorghum.

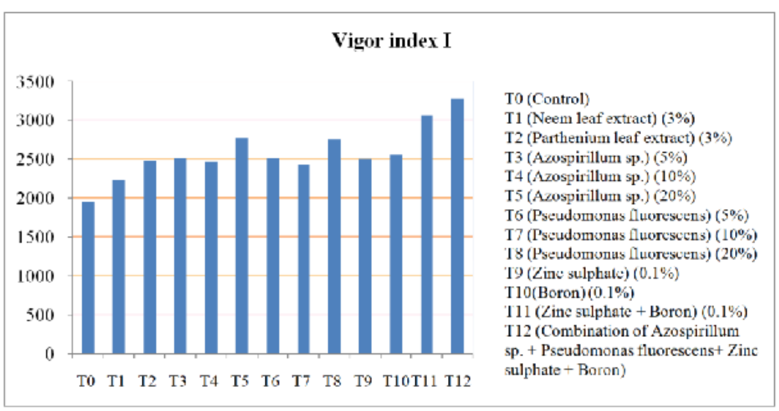

Fig. 7. Vigor index I as affected by various treatments in sorghum.

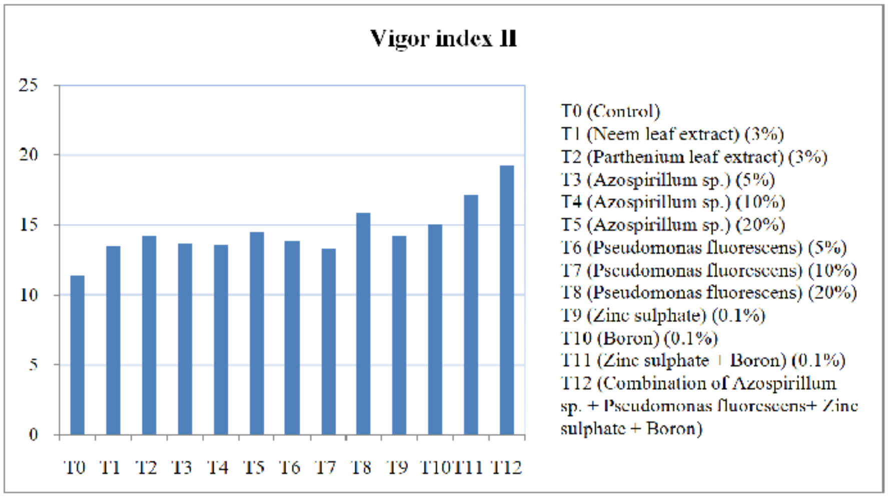

Fig. 8. Vigor index II as affected by various treatments in sorghum.

Table 1: Mean performance of treatments for different characters in sorghum (*Sorghum bicolour* L.)

Sr. No.	Treatment details	Germination %	Root length	Shoot length	Seedling length	Fresh weight of Seedling	Dry weight of Seedling	Vigor index I	Vigor index II
1.	T0 (Control)	84.50	9.07	14.01	23.08	1.28	0.14	1951.49	11.40
2.	T1 (Neem leaf extract) (3%)	87.25	10.35	15.15	25.50	1.36	0.15	2228.14	13.48
3.	T2 (Parthenium leaf extract) (3%)	93.50	11.51	15.03	26.54	1.36	0.15	2479.04	14.20
4.	T3 (*Azospirillum* sp.) (5%)	89.50	11.69	16.30	28.00	1.34	0.15	2505.71	13.69
5.	T4 (*Azospirillum* sp.) (10%)	88.25	11.93	16.00	27.93	1.39	0.15	2466.74	13.54
6.	T5 (*Azospirillum* sp.) (20%)	87.50	13.70	18.03	31.73	1.42	0.17	2774.73	14.49
7.	T6 (*Pseudomonas fluorescens*) (5%)	88.50	11.48	16.95	28.43	1.40	0.16	2517.81	13.81
8.	T7 (*Pseudomonas fluorescens*) (10%)	85.75	11.88	16.43	28.31	1.44	0.16	2428.21	13.33
9.	T8 (*Pseudomonas fluorescens*) (20%)	88.00	13.69	17.57	31.26	1.51	0.18	2751.51	15.82
10.	T9 (Zinc sulphate) (0.1%)	88.25	12.20	16.10	28.30	1.51	0.16	2498.37	14.25
11.	T10 (Boron) (0.1%)	91.00	11.51	16.60	28.11	1.47	0.17	2558.11	15.09
12.	T11 (Zinc sulphate + Boron) (0.1%)	93.50	14.29	18.42	32.71	1.61	0.18	3058.28	17.13
13.	T12 (Combination of *Azospirillum* sp. + *Pseudomonas fluorescens* + Zinc sulphate + Boron)	95.00	14.79	19.65	34.44	1.71	0.20	3272.00	19.23
	Mean	89.27	12.16	16.63	28.8	1.45	0.16	2576.16	14.57
	Minimum	84.50	9.07	14.01	23.08	1.28	0.14	1951.49	11.40
	Maximum	95.00	14.79	19.65	34.44	1.71	0.20	3272.00	19.23
	S.Em	1.474	0.566	0.496	0.683	0.067	0.005	81.616	0.5
	S.Ed	2.085	0.801	0.702	0.965	0.095	0.007	115.4	0.707
	CD(5%)	4.217	1.62	1.42	1.952	0.192	0.014	233.47	1.43
	CV	3.3	9.31	5.97	4.74	9.28	6.13	6.34	6.86

Bio-priming is the treatment of seeds with beneficial micro-organisms. Micro-organism which protect plants from pathogens and improve their growth are used Karthikeyan *et al*., (2009) observed that *Azospirillum brasilense* and *Pseudomonas fluorescens* primed seeds increased plant parameters such as leaf number, length of roots and height. These plant growth promoting Rhizobacteria show beneficial effect as they have the potential to produce growth hormones (GA3 and IAA), help in nitrogen fixation, produce antibiotic enzymes against pathogens, solubilize minerals and help in its absorption by roots. Primed seeds increased the emergence and development of seedling along with increased dry matter of roots.

Such seed treatment promotes germination through environmental signals, mRNA activation/depression, membrane permeability and effect on pathogens.

Pseudomonas fluorescens also helps to enhance the seed metabolic efficiency of primed seeds. The higher metabolic efficiency leading to mobilization of reserved food to the embryo for early initiation of germination was reported by Atia *et al*., (2006). The increase in the application of boron and zinc sulphate may be explained on the ground that boron is involved in the active photosynthesis which ultimately help towards the growth parameters. Increase in growth parameters might be due to improved physiological activity like photosynthesis and translocation of food material.

CONCLUSION

It is concluded from the present investigation of seed treatments with different kind of priming were found affecting significantly different characters of growth under study in sorghum. Priming with T12 (Combination of *Azospirillum* sp. + *Pseudomonas fluorescens* + Zinc sulphate + Boron) was found significantly superior which affected all the growth parameters in sorghum in comparison to control and other treatments. Thus, application of *Azospirillum* sp. + *Pseudomonas fluorescens* + Zinc sulphate + Boron) is useful for improving seed quality in sorghum. Therefore on behalf of this study suggested combination of bio-inoculants and micronutrients were capable to increase germination and seedling parameters. The use of bio-inoculants is an efficient approach to replace chemicals which are ecofriendly, non-hazardous and non-toxic for sustainable sorghum cultivation. Further investigations under field conditions might be needed to clarify the role of bio-inoculants and micronutrients in sorghum and other crops for commercial cultivation by farmers.

Acknowledgements. The authors are thankful to the University official, HOD of the Department of Genetics and Plant Breeding, NAI, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj U.P., and for Government of Uttar Pradesh for providing all necessary facilities and support.

Conflict of interest. Nil.

REFERENCES

Atia, A., Debez, A., Rabhi, M., Athar, H. U. R., & Abdelly, C. (2006). Alleviation of salt-induced seed dormancy in the perennial halophyte *Crithmum maritimum*. *Pakistan Journal of Botany*, *38*(5): 1367-1372.

Chakradhar, P., Laxmi, P. S., Supriya, D., & Anuj, K. R. (2017). Effect of bio-fertilizers and micronutrients on seed yield and quality in tomato (*Lycopersicon esculentum*). *International Journal of Science. Environment and Technology*, *6*(2): 1526–1534.

Devi, P. B., Vijayabharathi, R., Sathyabama, S., Malleshi, N. G., & Priyadarisini, V. B. (2014). Health benefits of finger millet (*Eleusine coracana* L.) polyphenols and dietary fiber: a review. *Journal of Food Science and Technology*, *51*(6): 1021-1040.

Gangadharayya, S. H., Prashant, S. M., Shakuntala, N. M., Vijay, K. K., Yogesh, L. N., & Krishnamurthy, D. (2019). Effect of seed priming with chemicals, micronutrients and bio-inoculants on physiological attributes of resultant seed in foxtail millet (*Setaria italica* L.). *International Journal of Chemical Studies*, *7*(6): 46-49.

Hameeda, B., Rupela, O. P., Gopal, R., & Satyavani, K. (2006). Application of plant growth promoting bacteria associated with composts and macro fauna for growth promotion of Pearl millet (*Pennisetum glaucum* L.). *Biol. Fertil. Soils*, *43*: 221–227.

Heydecker, W. (1973). Panel discussion-presowing treatments. (ln): Seed Ecology, pp. 521- 531. W. Heydecker (Ed). Butterworts, London.

ISTA (International Seed Testing Association). (2013). International rules for seed testing. *Seed Science and Technology. Supplement Rules*: 27-57.

Karthikeyan, B., Cheruth, A. J., & Azooz, M. M. (2009). Individual and Combined Effects of *Azospirillum brasilense* and *Pseudomonas fluorescens* on Biomass Yield and Ajmalicine Production in *Catharanthus roseus*. *Academic Journal of Plant Sciences*, *2*(2): 69-73.

Murthy, Dakshina, K. M., Rao, A., & Upendra (2006). Effect of organically bound micronutrients on growth and yield of rice. *Journal of Eco-friendlily Agriculture*, *3*: 86-87.

Moeinzadeh, A., Sharif-Zadeh, F., & Ahmadzadeh, M. (2010) Biopriming of sunflower (*Helianthus annuus* L.) seed with *Pseudomonas fluorescens* for improvement of seed invigoration and seedling growth. *Aust. Journal Crop Science*, *4*: 564.

Niranjan, S. R., Shetty, N. P., & Shetty H. S. (2007). Seed bio-priming with *Pseudomonas fluorescens* isolates enhances growth of pearl millet plants and induces resistance against downy mildew. *Journal of Pest Management*, *50*(1): 41-48.

Noumavo, P. A., Kochoni, E., Didagbe, Y. O., Adjanohoun, A., Allagbe, M., Sikirou, R., Gachomo, E. W., Kotchoni, S. O., & Baba-Moussa, L. (2013). Effect of Different Plant Growth Promoting Rhizobacteria on Maize Seed Germination and Seedling Development. *American Journal of Plant Sciences*, *4*: 1013-1021.

Price, M. L. (2005). The Moringa Tree. ECHO, 17391 Durrance Rd., North Ft. Myers FL 33917, USA.

Sakthivel, U., Mahalakshmi, S., & Karthikeyan, S. (2009). Studies on isolation and characterisation and its effect of seed inoculation of PGPR (*Pseudomonas fluorescens*) on yield of tomato. *International Journal of Current Microbiology and Applied Science*, *6*(12): 85-90.

Shaukat, K., Affrasayab, S., & Hasnain, S. (2006). Growth Responses of *Triticum aestivum* to Plant Growth Promoting Rhizobacteria used as a Biofertilizer. *Research Journal of Microbiology*, *1*(4): 330-338.

Singh, S. P. (1985). Sources of cold tolerance in grain sorghum. *Canada Journal of Plant Science*, *65*: 251-257.

Singh, U. S., Mishra D. S., Rohila, R., Singh, A., & Vishwanath (2003). Induced resistance: present status and future prospectus as disease management strategy. *International Journal of Biopesticide and Pest Management*, (1): 262-302.

Sivakalai, R., & Krishnaveni, K. (2017). Effect of Bio-Priming on Seed Yield and Quality in Pumpkin cv. CO_2. *International Journal of Current Microbiology and Applied Science*, *6*(12): 85-90.

Sivasankaridevi, T., Shivaprakash, M. K., & Maina, C. C. (2013). Efficacy of seed bio-priming enhancing vigour of cucumber (*Cucumis sativus* L.) under biotic stress conditions. *Mysore Journal of Agriculture Science*, *47*(1): 107-111.

Sridevi, R., & Manonmani, V. (2016). Influence of seed priming on physiological performance of foxtail, little and prosomillets. *International Journal of Agriculture Science and Research*, *6*(4): 179-186.

Sukanya, V., Patel, R. M., Suthar, K. P., & Singh, D. (2018). An Overview: Mechanism Involved in Bio-Priming

Mediated Plant Growth Promotion. *International Journal of Pure and Applied Bioscience*, *6*, 771−783.

Suliasih, & Widawati, S. (2017). Effect of Plant Growth Promoting Rhizobacteria and Molasses on Seed Germination and Seedling Growth of Sorghum (*Sorghum bicolor* L. Moench). *Micobiology Division*, Research Centre for Biology Indonesian Institute of Sciences Cibinong Science Center.

Talebian, M. A., Sharifzadeh, F., Jahansouz, M. R., Ahmadi, A., & Naghavi, M. R. (2008). Evaluation the effect of seed priming on germination, seedling stand and grain yield of wheat cultivars (*Triticum aestivum* L.) in three different regions in Iran. *Iranian Journal of Crop Science*, *39*(1): 145-154.

Vavilov, N. I. (1935). "Theoretical Basis for Plant Breeding," *in Origin and Geography of Cultivated Plants*, The Phytogeographical Basis for Plant Breeding Moscow, Transl. by D. Love (Cambridge: Cambridge University Press), *1*: 316–366.

Yadav, S. K., Anushree, D., Ankita, S., Harikesh, B. S., & Birinchi K. S. (2013). Co-inoculated Biopriming with *Trichoderma*, *Pseudomonas* and Rhizobium improves crop growth in *Cicer arietinum* and *Phaseolus vulgaris*. *International Journal of Agriculture, Environment and Bioresearch*, *6*(2): 255-259.

Yadav, J., Verma, J. P., & Tiwari, K. N. (2010). Effect of plant growth promoting rhizobacteria on seed germination and plant growth chickpea (*Cicer arietinum* L.) under in vitro conditions. *Journal of Biological Forum*, *2*(2): 15-18.

How to cite this article: Akhil, B. and Dayal, A. (2021). Influence of Seed Priming with Botanicals, Micronutrients and Bio-inoculants on Physiological Attributes in Sorghum (*Sorghum bicolour* L.). *Biological Forum – An International Journal*, *13*(3): 288-294.