RESEARCH ARTICLE Volume 2, 2018

ISSN Print 2663-0141
ISSN Online 2663-015X

THE INTERNATIONAL JOURNAL OF GLOBAL SCIENCES (TIJOGS)

Development of Seed Enhancement Technology for Improving the Quality of Sunflower Seeds

Talha Javed[1]✉, Rubab Shabbir[2], Muhammad Saqib Mushtaq[3], Habel Parwaiz[4], Ahmed Mukhtar[1] and Tahawar Ali Syed[4]

1. Seed Physiology Lab, Department of Agronomy, University of Agriculture, Faisalabad-38040, Pakistan
2. Seed Physiology Lab, Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad-Pakistan
3. Department of Plant Pathology, University of Agriculture, Faisalabad
4. Department of Entomology, University of Agriculture, Faisalabad, Pakistan

✉**Corresponding author:**
Talha Javed
Seed Physiology Lab, Department of Agronomy, University of Agriculture, Faisalabad-38040, Pakistan
Email: talhaagron@hotmail.com

Article History
Received: 28 October 2018
Accepted: 17 January 2019
Published: 11 February 2019

How to Cite?
(Javed *et al., 2019*)
Talha Javed, Rubab Shabbir, Muhammad Saqib Mushtaq, Habel Parwaiz, Ahmed Mukhtar and Tahawar Ali Syed. Development of Seed Enhancement Technology for Improving the Quality of Sunflower Seeds. *The Int. J. Global. Sci*. 2019,2(1),38-44 (ISSN2663 -0141(print); ISSN2663-015X(online). (http://www.rndjournals.com/)

ABSTRACT

Crop establishment is the first step and one of the most important stage in the vegetative cycle of sunflower plants. Uneven emergence and low stand density will compromise the subsequent stages of growth, limiting potential yield and economic outcome under varying climate and soil conditions. However, seed enhancement technology could be better approach towards mitigation of above stated problem. The objective is to see if the improved stand establishment, vigour and biochemical traits could be corelated with seed priming and coating techniques in sunflower. Thus, an experiment was conducted including seed priming, coating and combination. The treatments selected for that purpose were hydropriming, priming with moringa leaf extract, priming with magnetic treated water, seeds treated with combination of magnetic treated water and moringa leaf extract, seed coating with CaO (8g CaO/20g seed) and seed coating with moringa leaf powder (7g MLP/20g seed). All the experimental units having primed and coated seeds were compared to control seed (non-primed and un-coated). Results of experiment shows a significant improvement in stand establishment of treated seeds as compared to control. Final emergence percentage of seed primed with a combination of moringa leaf extract and magnetic treated water increased to 21% as compared to control. Though all seed enhancements show a tremendous increase in seedling growth however maximum growth was observed in seed treated with moringa leaf extract and magnetic water followed by seeds coated with CaO. Increased plant height, yield and yield related attributes in primed and coated seeds was linked with high vigour and health of sunflower thereby better survival in changing climatic and soil conditions. Our finding suggests that seed priming with a combination of moringa leaf extract and magnetic water also seed coating with CaO could be helpful in solving the problem of decreased plant population and improved vigour to overcome incompatible soil and environmental conditions.

Keywords: Coating; priming; moringa leaf extract; calcium oxide

INTRODUCTION

Seed enhancement or seed invigoration for germination enhancement and seedlings development including vigorous seedlings and delivery of materials required for better growth and health of seedlings (Taylor *et al*., 1998). Including seed priming, coating and pelleting are being included used as shotgun approaches for the development of technology rich seeds for the last 24 years (Afzal *et al*., 2011). Completion of metabolic activities before the delivery of seed in soil via seed priming results in improvement in germination that is in direct in line with improved and faster growth of seedlings thus surviving the stressed conditions having impact on germination (Khan, 1992), thus curtailing the time between sowing of seeds and emergence of seedlings and the synchronization of emergence (Parera and Cantliffe, 1994). Seed drenched in water for specific time and then drying to almost original weight (Coolbear and

McGill, 1990), results in improvement in final emergence percentage and speed of emergence, high germination energy and improved growth of seedlings in terms of high vigour (Basra *et al.,* 1991) ultimately improved crop performance under adverse conditions like chilling, salinity etc. (Zhang *et al.,* 2007).

Application of calcium oxide as seed coating agent enhances seedlings growth by improving respiratory activity thereby enhanced vigour (Mei *et al*., 2017). Use of moringa leaf extract (MLE), a natural and cheapest source of plant growth substances involving cytokinin and potassium that enhance plant growth (Foidl *et al.,* 2001). Maize seed priming involving MLE as priming agent have a positive impact on stand establishment, vigour of seedlings, biochemical attributes and ultimately survival of plants under stressed environmental conditions (Afzal *et al*., 2012). These facts highlight its opportunity of being used as a foliar spray to promote growth of young plants (Yasmeen *et al.,* 2013). Magnetic field pre-treatment not just expands the rate of germination, development and yield (Balouchi and Sanavy, 2009). In many agronomic and horticultural crops attainment of quick germination and seedling growth linked with magnetic water treatment of seeds (Aladjadjiyan, 2010). By stimulating the enzymatic activity necessary for germination and development of seedlings, magnetic seed stimulation improve the vigour of seeds (Mamat *et al*., 2005). Advantageous effects in terms of enhanced final germination percentage and length of epicotyl and hypocotyl was obtained in asparagus seeds when treated with magnetic water before sowing (Soltani *et al.,* 2006a). Almost similar observations were recorded with *Ocimun basilicum* (Soltani *et al.,* 2006b).

In Pakistan changing climate and adverse soil conditions are going to be severe for declining crop productivity. Therefore, present study was conducted by using the seed enhancement technology to compensate the adverse effects of climate change.

MATERIALS AND METHODS

Crop Husbandry

To evaluate the impact of different priming and coating techniques under climate change scenario, a field experiment was conducted at Agronomic research area, University of Agriculture Faisalabad during summer season of 2017. The experiment was laid out in Randomized Complete Block Design (RCBD) and with three replications. Experimental trial consists of 3 replications and 6 treatments i.e hydropriming, priming with moringa leaf extract, priming with magnetic treated water, seeds treated with combination of magnetic treated water and moringa leaf extract, seed coating with CaO (8g CaO/20g seed) and seed coating with moringa leaf powder (7g MLP/20g seed) that were compared with non-treated sunflower seeds. A plot size of 5m x 3m was selected for each experimental unit. All other agronomic practices were kept constant and applied according to recommendation to each experimental unit.

Stand Establishment

Experimental units having control and treated seed were visited daily and seedling emerged were counted daily based on emergence of cotyledons above soil surface.

Following procedure was used to collect the data

Final emergence percentage was computed at the end of research trial by dividing the number of emerged seeds above soil surface to total number of seed sown in each experimental unit.

$$\text{FEP (\%)} = \frac{\text{Final number of seedling emerged}}{\text{Total number of seed sown}} \times 100$$

According to the equation described by Ellis and Roberts, (1981), Mean emergence time taken by seeds in each experimental unit receiving different coating and priming treatments also non-treated seeds.

$$MET = \frac{\sum Dn}{\sum n}$$

Vigour Evaluation

Seedlings from each experimental unit were harvested along with their roots, washed and dried. Seedlings were separated into roots and shoots. By using a measuring tape length of root and shoot was determined. Then the average was computed to obtain single seedling root and shoot length.

Yield and yield related attributes

At the end of experimental trial at harvest maturity, plant height and head diameter were computed with the help of measuring tape from an area of one square meter and mean was calculated to obtain single plant height and head diameter (ISTA, 2015).

Number of achene per head having a major contribution in yield and was computed by removing all achenes from the head of plants in one square meter and then average value was calculated (ISTA, 2015).

1000 achene weight is an important parameter towards yield. Grain weight was recorded with the help of weighing balance. Achene yield, biological yield was computed with the help of weighing balance (ISTA, 2015).

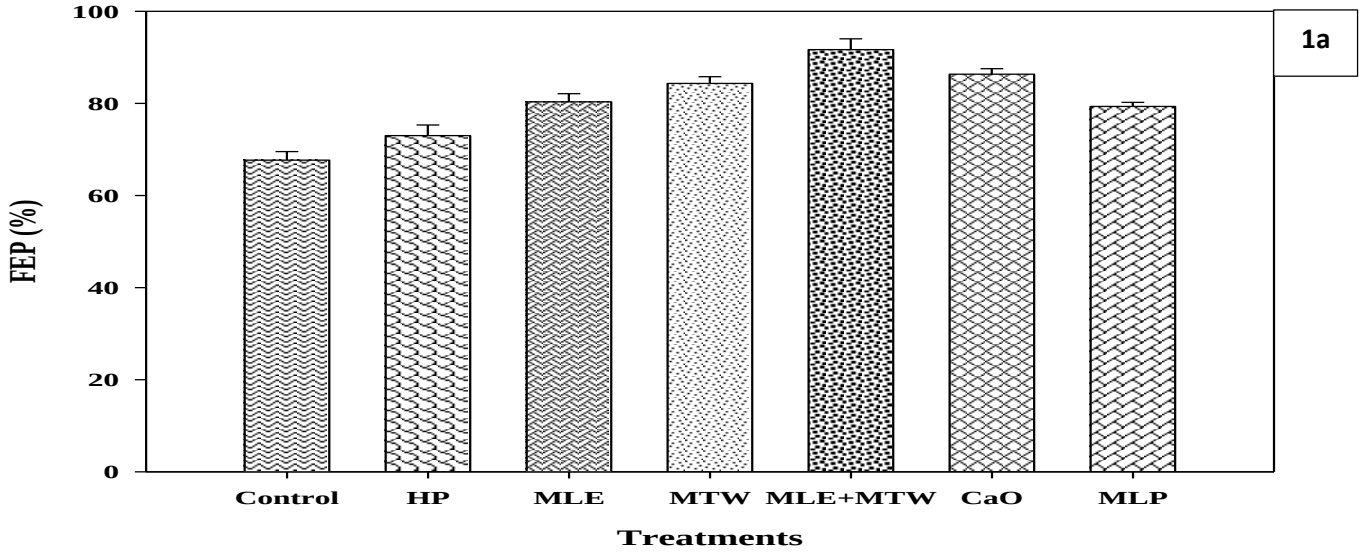
Harvest Index (%)

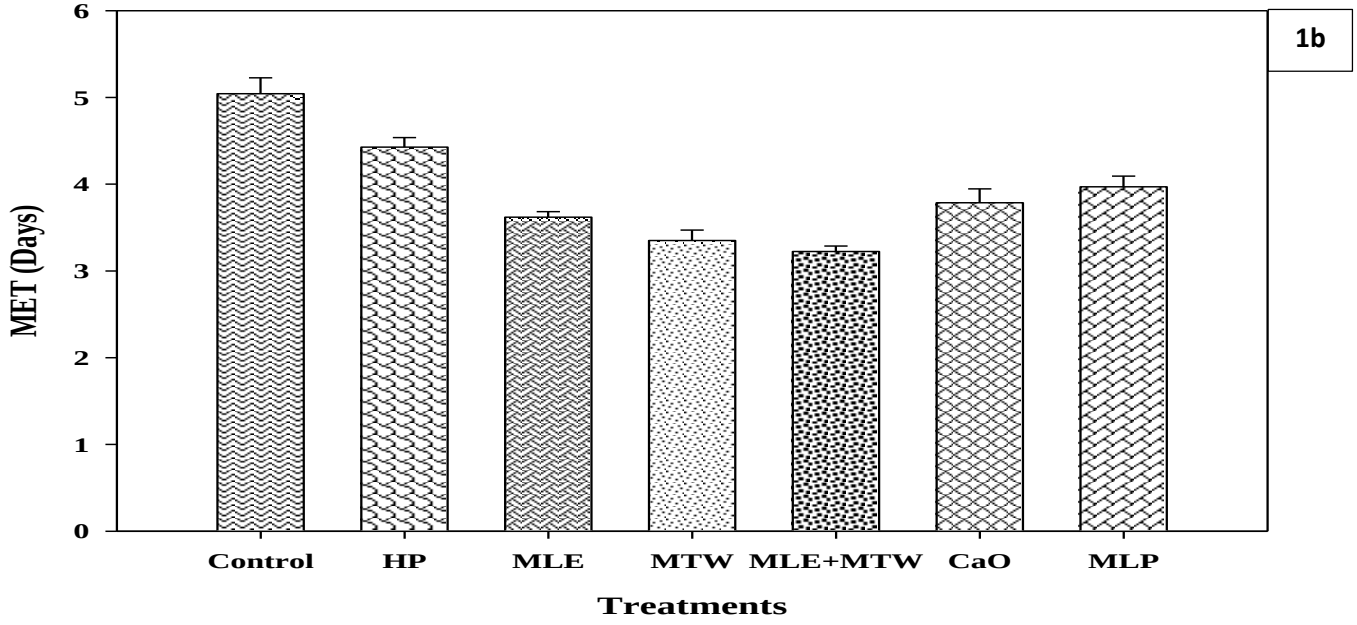
Harvest Index was calculated by following formula described by ISTA, (2015).

$$H.I = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

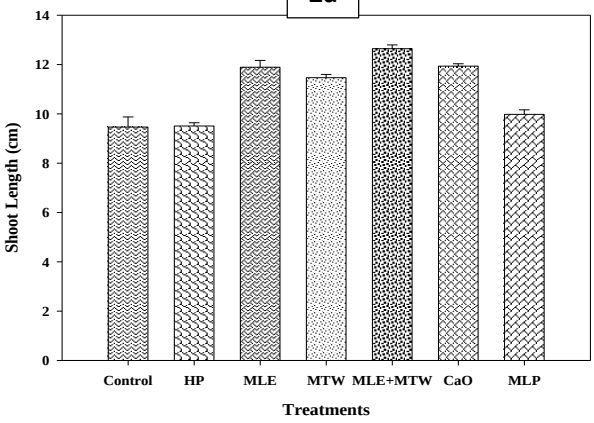
RESULTS

Results shown in Fig (1a, b) depicts that a significant improvement in stand establishment was linked with experimental units receiving seeds treated with a combination of moringa leaf extract and magnetic treated water followed by seeds treated with calcium oxide and magnetic treated water. Similarly, minimum time for emergence was linked with experimental units receiving seeds treated with a combination of moringa leaf extract and magnetic treated water while lowest values for emergence potential was linked with control.

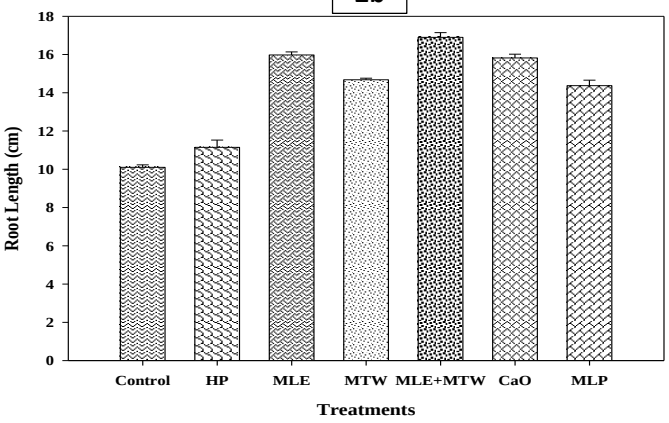




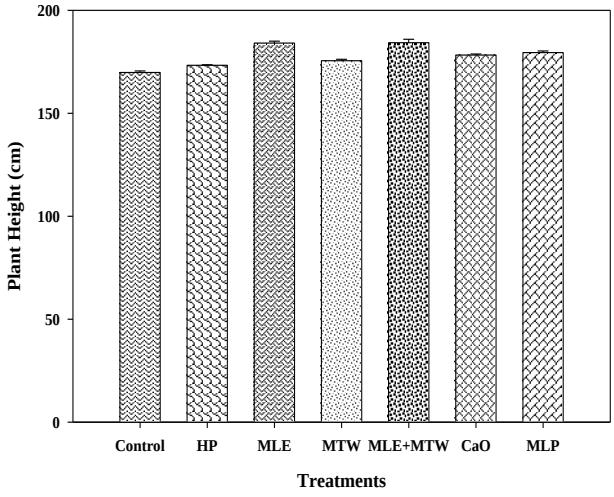
2a



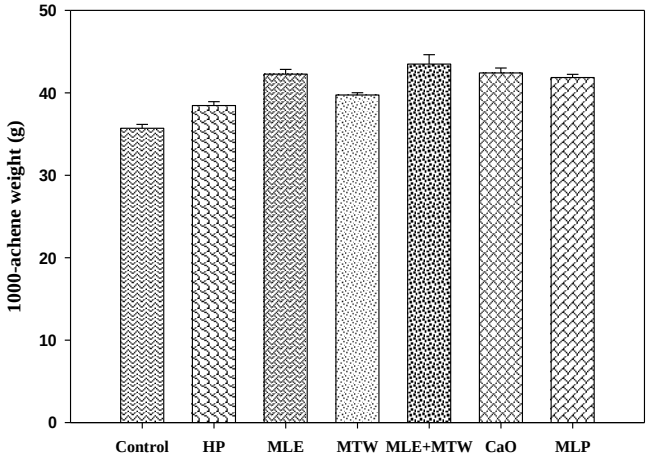
2b



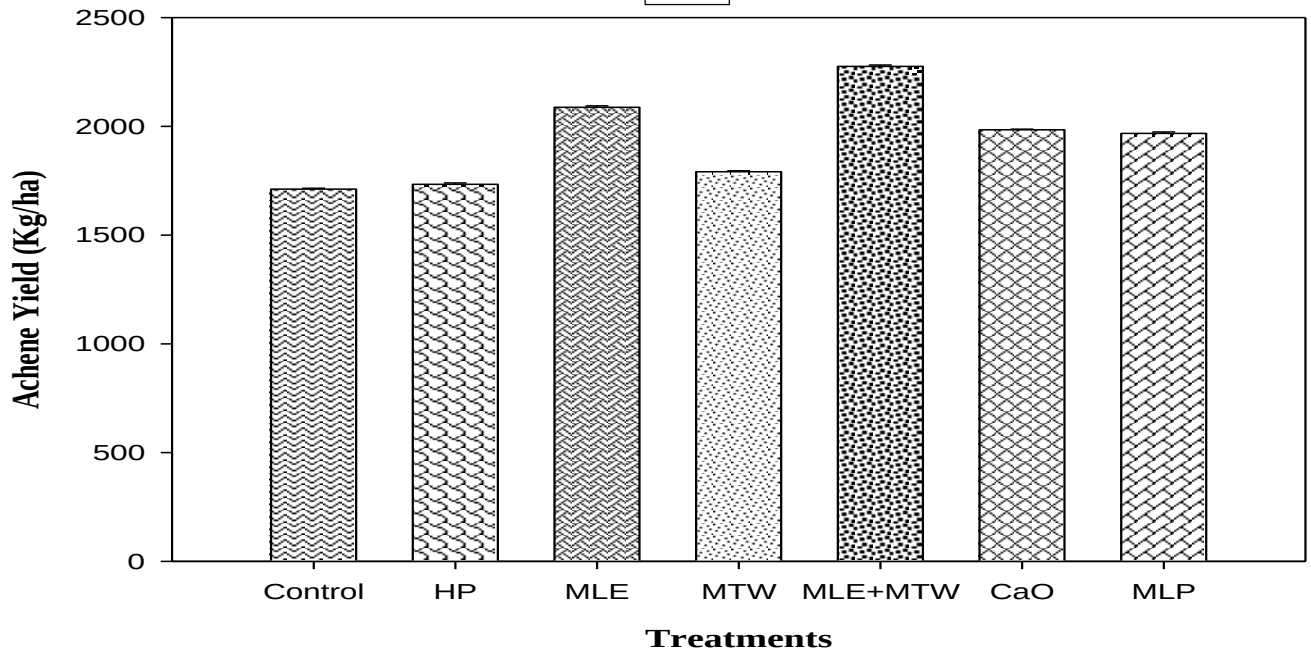
2c

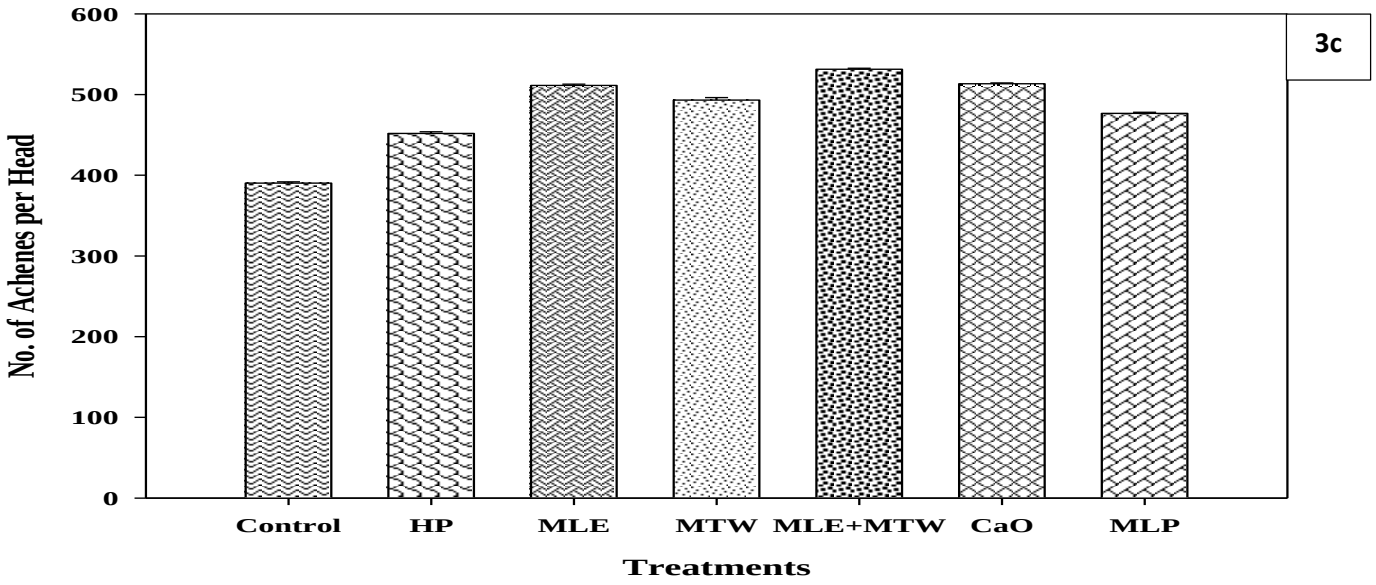


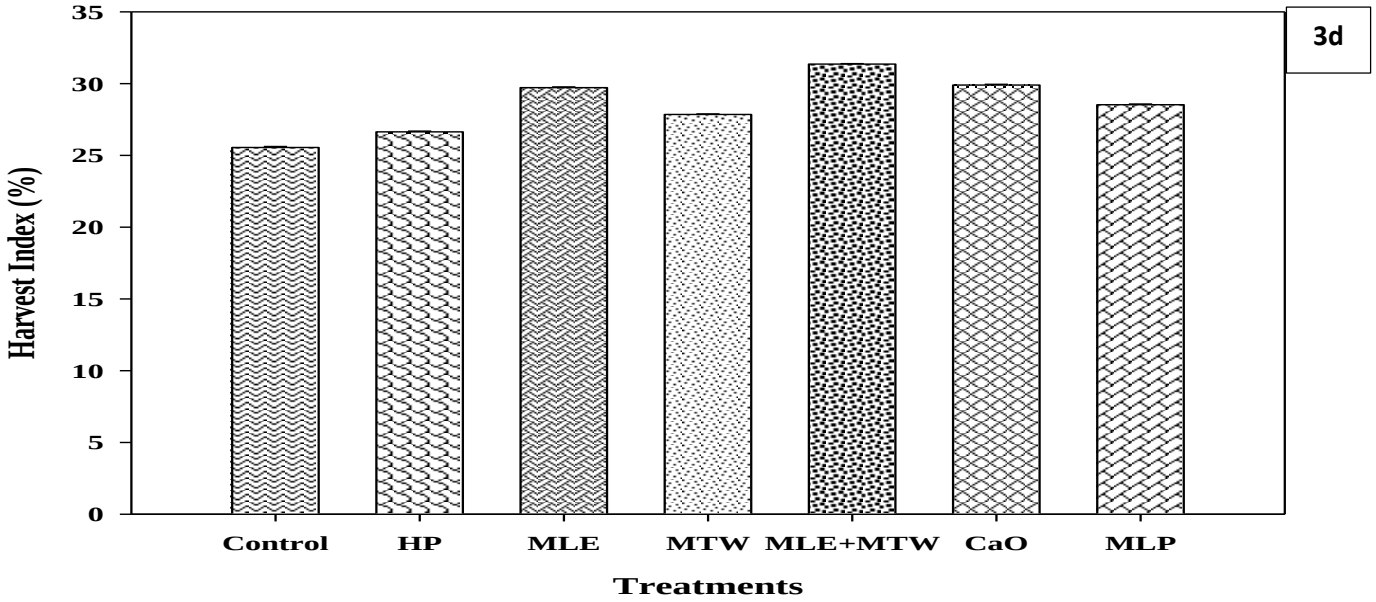
3a



3b







A significant improvement in pant height, shoot length and root length was observed in experimental units having seeds treated with a combination of moringa leaf extract magnetic treated water. Experimental units received seeds treated with calcium oxide also shows a significant improvement in vigour followed by seeds treated with magnetic water as compared to control (Fig 2a, b,c).

Fig (3 a,b,c,d) illustrate that seeds treated with a natural and synthetic growth promoting substance (MLE+MTW) shows a significant improvement in yield and yield contributing factors. Thought all experimental units promote yield and yield contributing factors but lowest values were linked with control.

DISCUSSION

However, most of priming treatments were effective in improving stand establishment of sunflower plants (Fig. 1a, b). Suboptimal temperatures often reduce both the percentage and rate of germination and the emergence of seedlings (Chin *et al.,* 2002). These results agree well with the studies of Razzaq *et al.* (1986) which have proved that late sowing resulted in less germination count. Invigorated seeds are more vigorous (Ruan *et al*., 2002) and have resulted in earlier germination of seeds as described by Herranz *et al*. (1998) that high vigor seeds performed better than low vigor seeds. Early emergence of seeds in treated seeds as indicated by lower MET may be due to the faster production of germinative metabolites (Basra *et al*., 2005). MLE proved an ideal plant growth enhancer in many experiments (Makkar and Becker, 2007). The reason for better stand establishment is that the magnetic field modifies

the cell membrane structure by causing an increase in membrane permeability and transport of ions in the ion channels, ultimately affecting the metabolic activities leading to boosted germination also the provision of natural growth promoting substance (Moringa leaf extract) also improve the seed quality.

All seed treatments improved the plant height, shoot and root length effectively except control. However, maximum vigour was recorded by moringa leaf extract and magnetic treated water experimental units (Fig 2). The finding of these studies is further supported by evidences in which scientists reported that number of secondary branches and yield was increased in broad bean (Podlesny *et al*., 2002), enhanced biomass production and root characters have been reported in chick pea (Vashisth and Nagarajan, 2008) which was all due to improved growth parameters like leaf area after magnetic field treatment.

Seed invigoration techniques not only improved the germination stand establishment but also yield and yield contributing attributes in sunfower. Among which seeds treated with moringa leaf extract and magnetic water gave early and better stand establishment and growth which ultimately contributed to improved grain yield (Fig 3). These results incorporated with the result of Pietruszewski and Kania (2010) who found that the wheat yield obtained from the pre-sowing stimulated seeds are higher as compared to control. Martinez *et al*, 2000 also found a significant increase in the barley yield when seeds were exposed to magnetic field of 125 mT for 24 hours. This is because the electromagnetic field produces physiological, biochemical and physical changes in cell structures (Ueno *et al.*, 2006), that could be preserved in the plant during growth and reflected finally in the physical characteristics of wheat grains, because of the electromagnetic field influence both in the activation of ions and the polarization of dipoles in living cells (Galland and Pazur, 2005). Makkar *et al.* (2007) found the moringa leaves are an excellent source of plant growth substances like, β-carotene, antioxidants, and vitamin C.

CONCLUSION

Application of natural and synthetic growth promoting substances as seed treatment can be a good adaptive approach in mitigating the germination and vigour related problems in sunflower.

CONFLICT OF INTREST: Nothing to declare

SOURCE OF FUNDING: Nothing to declare

REFERENCES

1. Afzal, I., Hussain, B., Basra, S.M.A. and H. Rehman. (2012). Priming with MLE Reduces Imbibitional Chilling Injury in Spring Maize. Seed Science and Technology. 40, 271-276.
2. Afzal, I.K., Mukhtar, Qasim, M., Basra, S.M.A., Shahid, M. and Haq, Z. (2011). Magnetic Stimulation of Marigold Seed. International Agrophys. 26, 335-339.
3. Aladjadjiyan, A. (2010). Influence of Stationary Magnetic Field on Lentil Seeds. International Agrophysics. 24, 321-324.
4. Balouchi, H.R. and Sanavy, S.A.M.M. (2009). Electromagnetic Field Impact on Annual Medics and Dodder Seed Germination. International Agrophysics. 23, 111-115.
5. Basra, A.S., Grewal, R.D. and Malik, C.P. (1991). Germination Performance of Maize Seeds at unfavourable Temperature by Potassium Salts. Indian Journal of Plant Physiology. 34, 378-381.
6. Basra, S.M.A., Farooq, M. and Tabassum, R. (2005). Physiological and Biochemical Aspects of Seed Vigor Enhancement Treatments in Fine Rice (*Oryza sativa* L.). Seed Science and Technology, 33, 623-628.
7. Chin, K.Y., Chen, C. L. and Sung, J. M. (2002). Effect of Priming Temperature on Storability of Primed Sh-2 Sweet Corn Seed. Crop Science, 42, 1996–2003.
8. Coolbear, P. and McGill, C.R. (1990). Effect of A Low Temperature Pre- Sowing Treatment on Germination of Tomato Seed under Temperature and Osmotic Stress. Journal of Horticulture Science, 44, 43-54.
9. Foidle, N., Makkar, H.P.S. and Becker, K. (2001). The Potential of *Moringa oleifera* for Agricultural and Industrial uses. In: Fuglie, L., Ed., The miracle Tree: The Multipurpose Attributes of Moringa. 45-76. CTA publications. Wageningen, the Netherlands.
10. Galland, P. and Pazur, A. (2005). Magneto Reception in Plants. Journal of Plant and Research, 118, 371-389.
11. Herranz, J., Ferrandis, M.P. and Martinez, S.J.J. (1998). Influence of Heat on Seed Germination of Seven Mediterranean Leguminosae Species. Plant Ecology, 136, 95-103.
12. Khan, A.A. (1992). Pre-plant physiological seed conditioning. Horticultural Reviews 14 (ed. J. Janick). John Willey and Sons, New York, 131-181.
13. Makkar, H.P.S. and Becker, K. (2007). Nutritional Value and Antinutritional Components of whole and

Ethanol Extracted Moringa Oleifera Leaves. Animals Feed Science and Technology, 63, 211-228.
14. Mamat, H.I.N., Aini. M., Said, and Jamaludin, R. (2005). Physicochemical Characteristics of Palm Oil and Sunflower Oil Blends Fractionated at Different Temperatures. Food Chemistry 91, 731-736.
15. Martinez, E., Carbonell, M.V., Amaya, J.M. (2000). A Static Magnetic Field of 125 Mt Stimulates the Initial Growth Stages of Barley (*Hordeum Vulgare* L.). Electro- and Magnetobiology, 19, 271-277.
16. Mei, J., Wang, W., Peng, S. and Nie, L. (2017). Seed Pelleting with Calcium Peroxide Improves Crop Establishment of Direct-Seeded Rice under Waterlogging Conditions. Scientific Reports. 7, 4878.
17. Parera, C. A. and Cantliffe, D. J. (1994). Improved Germination and Modified Inhibitions of Shrunken-2 Sweet Corn by Seed Disinfections' and Solid Matrix Priming. J. Amer. Soc. Hort Sci.116(6): 942-945.
18. Pietruszewski, S. and Kania, K. (2010). Effect of Magnetic Field on Germination and Yield of Wheat. International Agrophys, 24, 297-302.
19. Podlesny, J., Misiak, L. and Koper, R. (2002). Concentration of Free Radicals in Faba Bean Seeds after the Pre-Sowing Treatment of the Seeds with Laser Light. Int. Agrophys, 15, 185–189.
20. Razzaq, A., Shah, P., Sartaj, B., Khan, K., Saeed and Mohammad, D. (1986). Effect of Planting Times on the Growth and Straw Yield of Wheat Varieties. Sarhad Journal of Agriculture, 2(2), 327-330.
21. Ruan, S., Xue, Q. and Tylkowska, K. (2002). The Influence of Priming on Germination of Rice (*Oryza sativa* L.) Seeds and Seedling Emergence and Performance in Flooded Soil. Seed Science and Technology, 30, 61-67.
22. Soltani, F., Kashi, A. and Arghavani, M. (2006a). Effect of Magnetic Field on *Asparagus officinalis* L. Seed Germination and Seedling Growth. Seed Science and Technology, 34, 349-353.
23. Soltani, F.A., Kashi and Arghavani. (2006b). Effect of Magnetic Field on *Ocimun Basilicum* Seed Germination and Seedling Growth. ISHS Acta Horticulture,723, 60.
24. Taylor, A.G.P.S. Allen, M.A. Bennett, J.K. Bradford, J.S. Burris and M.K. Misra. 1998. Seed Enhancements. Seed Science Research, 8, 245–256.
25. Ueno, S. and Shigemitsu, T. (2006). Bioengineering and Biophysical Aspects of Electromagnetic Fields. Taylor & Francis Group.
26. Vashisth, A. and Nagarajan, S. (2008). Exposure of Seeds to Static Magnetic Field Enhances Germination and Early Growth Characteristics in Chickpea (*Cicer Arietinum* L.). Bioelectromagnetic, 29, 571-578.
27. Yasmeen, A., Basra, S.M.A., Wahid, A., Nouman, W. and Rehman, H. (2013). Exploring the Potential of *Moringa oleifera* Leaf Extract (MLE) as A Seed Priming Agent in Improving Wheat Performance. The Turkish Journal of Botany, 37, 512-520
28. Zhang, C.F.J., Hu, J., Lou, Zhang, Y. and Hu, W.M. (2007). Sand Priming in Relation to Physiological Changes in Seed Germination and Seedling Growth of Waxy Maize under High-Salt Stress. Seed Science and Technology. 3, 733–73.

