АУЫЛ ШАРУАШЫЛЫҒЫ ҒЫЛЫМДАРЫ

Сәкен Сейфуллин атындағы Қазақ агротехникалық зерттеу университетінің Ғылым жаршысы: пәнаралық = Вестник науки Казахского агротехнического исследовательского университета имени Сакена Сейфуллина: междисциплинарный. – Астана: С. Сейфуллин атындағы Қазақ агротехникалық зерттеу университеті, 2025. -№ 2/1 (126). - P.6-16. - ISSN 2710-3757, ISSN 2079-939X

doi.org/ 10.51452/kazatu.2025.2/1(126).1916
UDC 613.262:630*232.318(045) **Research article**

Effect of mung bean seed treatment before planting on germination and some vegetative growth indicators

Shaymaa O. H. Al-Mamoori[1,2], Noor Mahmood Naji[2], Rihab Edan Kadhim[2], Anmar M. K. Al-Maamori[2]

[1]College of Science and Engineering, Flinders University, Adelaide, South Australia, Australia
[2]Department of Biology, College of Science, University of Babylon, Iraq

Corresponding author: Shaymaa O. H. Al-Mamoori: alma0321@flinders.edu.au
Co-authors: (1: ShA) alma0321@flinders.edu.au; (2: NN) sci.noor.mahmood@uobabylon.edu.iq; (3: RK) sci.rihab.edan@uobabylon.edu.iq ; (4: AA) sci.anmar.mahdi@uobabylon.edu.iq
Received: 12-04-2025 **Accepted:** 24-06-2025 **Published:** 05-07-2025

Abstract

Background and Aim. The mung bean (*Vigna radiata*, also known as Mash) is a summer crop. Its importance in human nutrition is highlighted by the fact that its seeds contain a high con-centration of protein and are rich in the amino acid lysine, as well as other compounds such as car-bohydrates, oils, vitamins, and various secondary metabolites. This experiment was conducted to determine the effect of three seed soaking treatments (tap water, mash enzyme solution, and saline solution), in addition to a comparison treatment (control) without soaking, on germination and se-lected vegetative growth indicators of mung bean plants.

Materials and Methods. A germination experiment was conducted using Petri dishes, fol-lowed by a pot experiment in the field with containers filled with a 1:1 mixture of soil and peat moss. The seeds were soaked for 12 hours before sowing. Treatments included soaking in tap water, mash enzyme solution, and 1% NaCl saline solution, along with an unsoaked control group. Germination traits and vegetative growth parameters were recorded. Data were analyzed statistically using the Statistical Package for the Social Sciences (SPSS) and significant differences between means were determined using Duncan's Multiple Range Test at the 5% significance level.

Results. The laboratory results showed that soaking seeds in tap water produced the highest germination rate and plumule length. Most treatments did not differ significantly from each other, except for the saline solution, which significantly reduced germination percentage. In the pot exper-iment, soaking seeds in tap water and a mash enzyme solution resulted in superior performance across all vegetative growth parameters, including plant height, root length, fresh and dry weight of shoot and root, leaf length and width, and chlorophyll content.

Conclusion. Soaking mung bean seeds in tap water or mash enzyme solution significantly improved germination and vegetative growth parameters, while saline solution had a negative effect on these parameters. These findings confirm the effectiveness of natural priming treatments in en-hancing plant performance.

Keywords: Mung bean; mash enzyme; priming; saline solution; vegetative growth; germination; priming.

Introduction

The mung bean (*Vigna radiata L.*), *also known as* Mash, is a summer crop and belongs to the family Fabaceae [1, 2]. It is widely cultivated in various regions of the world, especially in the tropics and subtropics. Its global cultivated area is estimated at 7.3 million hectares, with a productivity of 2.5-3.0 tonnes per hectare. India, Bangladesh, Myanmar, China and Thailand are among the most productive countries for this crop [3, 4]. Its importance in human nutrition is highlighted by the fact that its seeds contain a high concentration of protein, ranging between 14.6-32.6%, **are** rich in the amino acid lysine and other compounds such as carbohydrates, oils, vitamins and various secondary compounds [5, 6]. Its dry leaves are also used as fodder for animals, as they contain protein levels ranging from 13 to 21% [7]. Research in seed physiology [8-10] indicate that soaking seeds before sowing for a short period (without allowing germination to begin) enhances germination traits and subsequent performance of the crop. Soaking refers to immersing seeds in water, osmotic, or nutrient solutions for brief period before germination begins, followed by drying them back to their original moisture content before sowing. This process is known as seed priming. Various priming solutions have been used, including hydropriming (water), halopriming (e.g.Sodium Chloride [NaCl], Potassium Chloride [KCl]), and osmopriming (e.g. Polyethylene Glycol [PEG], mannitol, the latter being the most widely used). Priming solutions that contain minerals, vitamins, or antioxidants, are referred to as nutrient seed priming. Studies by [11, 12] showed that seed soaking induces biochemical changes such as hydrolysis of stored food, enzyme activation, removal of inhibitors, and dormancy breaking, all of which promote faster germination. Research by [13, 14] confirmed that seed stimulation techniques enhance plant growth. A summary of studies conducted from 2001 to 2008, and presented by [15] concluded that soaking seeds often has a positive effect on the growth and yield characteristics of many field crops, including wheat, rice, barley, chickpeas, corn, lentils, and oats. [16] reported that soaking maize seeds for 12 hours in 1% Potassium Nitrate (KNO3) and 1% Calcium Chloride (CaCl2) solutions significantly improved all studied traits compared to the control. This study aims to assess the effect of pre-sowing seed soaking of mung bean seeds in a natural enzyme solution and a sodium chloride (NaCl) solution, compared to soaking in water and a no-soaking (control) treatment, on germination and various vegetative growth indicators.

Materials and Methods

Experimental site and soaking treatments

The experiment was conducted in the greenhouse of the Department of Biological Sciences, College of Science, University of Babylon, using mung bean (Vigna radiata L.) seeds. The seeds were soaked in three types of solutions: a saline solution (1% NaCl), a mash enzyme solution, and tap water. A control group of seeds was left unsoaked. After soaking, the seeds were divided into two groups for use in separate experiments.

Germination experiment

The first group of treated seeds was placed in Petri dishes lined with filter paper, 10 seeds per dish, with three replicates per treatment. The following parameters were recorded: germination percentage, germination speed, plumule length, and radicle length.

Field experiment

The second group of treated seeds was sown in plastic pots with a capacity of 5 kg. The pots were filled with a 1:1 mixture of soil and peat moss. Five seeds were sown per pot at a depth of approximately 1 cm, with three replications for each treatment. The experiment followed a Random-ized Complete Block Design (RCBD). Observations were recorded 50 days after sowing.

The following vegetative growth parameters were measured: plant height, root length, the fresh weight of shoots and roots, and the dry weight of shoots and roots [17], leaf length, leaf width, number of leaves per plant, and chlorophyll content [18].

Mash enzymes were prepared to enhance enzymatic activity in the seeds, including activation and synthesis of alpha-amylase, beta-amylase, lipase, protease, maltase, and others. It is known that priming seeds for germination increases the activity of the dormant enzymes or triggers the de novo synthesis of certain enzymes. After stimulating germination (typically marked by root emergence), the process is halted, and the seeds are dried at low temperatures to preserve enzymatic ac-tivity [19].

Statistical Analysis

Statistical analysis was performed using SPSS software. Differences between treatment means were tested using Duncan's Multiple Range Test (DMRT) at a 5% significance level.

Results and Discussion

The results presented in Table 1 and Figure 1 demonstrate the effect of soaking mung bean seeds for 12 hours on their germination performance. The highest germination rate was observed in seeds soaked in tap water (93.3%), while the lowest germination rate was recorded in seeds treated with saline solution (NaCl), at 80%. There were no significant differences in germination percentage among most treatments; the enzyme-soaked, tap-water-soaked and control (non-soaked) groups all achieved approximately 93%, indicating that these treatments preserved the seeds' viability and inherent capacity to germinate. In contrast, the germination percentage in the saline-treated group was lower, 83.3%. This reduction may be attributed to metabolic disruptions, caused by the accu-mulation of sodium and chloride ions within the seed tissues. These ions interfere with the activity of key enzymes such as invertase and amylase, which are responsible for breaking down starch into simple carbohydrates- an essential energy source during germination. Furthermore, salinity signifi-cantly impairs water uptake, a key physiological factor for successful germination [20, 21].

The highest average radicle length was 9.90 cm in the treatment with seeds soaked in the Mash enzyme solution, followed by the tap water treatment, which was 7.40 cm. In contrast, the lowest radicle length was 1.30 cm in the treatment of soaking saline solution. Table 1 shows significant differences in plumule length. The tap water treatment resulted in the greatest average plumule length (14.23 cm), while the control and saline treatments had the shortest length -3.83 and 4.60 cm, respectively. The reduction in radicle and plumule lengths in the saline treatment is attributed to the inhibitory effects of sodium chloride on plant growth, including the disruption of physiological processes and interference with cell division. Salinity negatively affects mitosis by reducing the number of dividing cells and prolonging the duration of the division cycle. It also impairs cell enlargement. These findings are consistent with previous studies [22-24].

Table 1 – Effect of priming treatments on germination and seedling growth traits of mung beans

Plumule length (cm)	Radicle length (cm)	Germination percentage (%)	Germination speed (%)	Priming treatments
3.83 a	5.93 b	93.30 b	83.30 a	Without priming (control)
14.23 d	7.40 c	93.00 b	93.30 b	Tap water
4.60 a	1.30 a	83.30 a	80.00 a	NaCl
11.03 c	9.90 d	93.00 b	90.00 b	Mash enzyme

According to Duncan's Multiple Range Test (DMRT), values in the table followed by the same letter do not differ significantly at the 5% significance level.

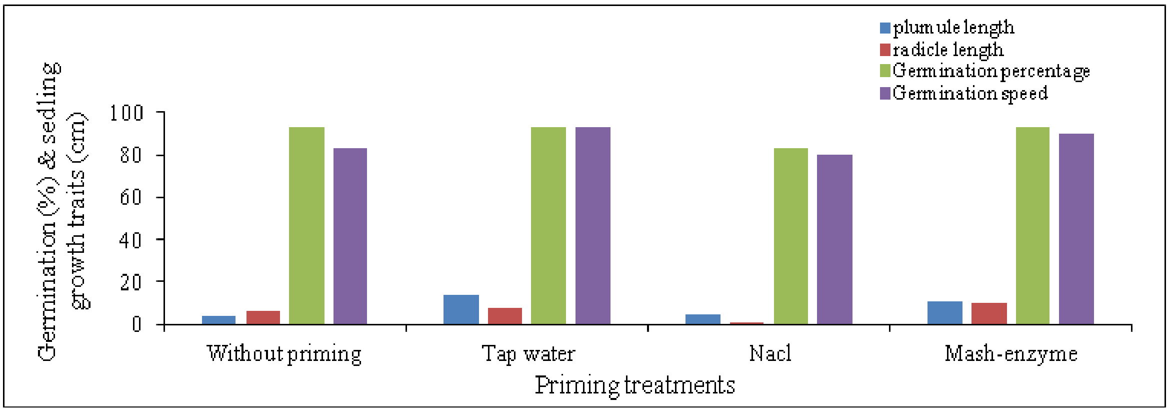

Figure 1 – Visual comparison of mung bean germination and seedling growth under different priming treatments

The results contained in Table 2 and Figure 2 illustrate the effects of seed soaking on vegetative growth characteristics of mung bean plants. According to Table 2, seeds soaked in mash enzyme solution produced the tallest plants, with an average height of 13.03 cm, while seeds treated with the saline solution produced the shortest plants, with an average height of 7.70 cm. This reduction is likely due to the inhibitory effect of salinity on meristematic activity and cell elongation at the shoot apex, which leads to dwarfism in plants [24, 25]. In terms of root length, seeds soaked in the control and saline treatments produced the lowest average levels -10.26 and 10.33 cm, respec-tively, whereas the highest root length (16.33 cm) was observed in the tap water treatment. These results are consistent with previous studies, which showed that water soaking enhances primary root growth [26-28].

The fresh weight of shoots did not differ significantly between the tap water (0.98 g) and mash-enzyme (0.95 g) treatments. Both were markedly higher than that of the control treatment (0.46 g). Similarly the fresh weight of the roots increased in all soaked treatments, while the con-trol(non-soaked) treatment exhibited the lowest root fresh weight (0.04 g) (Table 2; Figure 3). The increased fresh weight in the treated groups suggests improved water absorption and retention. There were no significant differences between the tap water and mashenzymes treatments in the dry weight of the shoots, both averaging 0.17 g. In contrast, the control treatment showed the lowest average shoot dry weight of 0.06 g. The highest root dry weight was recorded in the mash enzyme treatment, while the control treatment again exhibited the lowest value at 0.03 g.

Table 2. Effect of priming treatments on selected vegetative growth traits of mung bean plants

Priming treatments	Plant height (cm)	Root length (cm)	Fresh weight of shoots (g)	Fresh weight of roots (g)	Dry weight of shoots (g)	Dry weight of roots (g)
Without priming (control)	0.03 ^{a}	0.06 ^{a}	0.04 ^{a}	0.46 ^{a}	10.26 ^{a}	8.66 ^{ab}
Tap water	0.08 ^{b}	0.17 ^{b}	0.47 ^{ab}	0.95 ^{b}	16.33 ^{b}	10.66 ^{ab}
NaCl	0.06 ^{ab}	0.07 ^{a}	0.28 ^{ab}	0.48 ^{a}	10.33 ^{a}	7.70 ^{a}
Mash - enzyme	0.09 ^{b}	0.17 ^{b}	0.68 ^{b}	0.98 ^{b}	13.16 ^{ab}	13.03 ^{b}

According to Duncan's Multiple Range Test (DMRT), values in the table followed by the same letter are not significantly different at the 5% significance level.

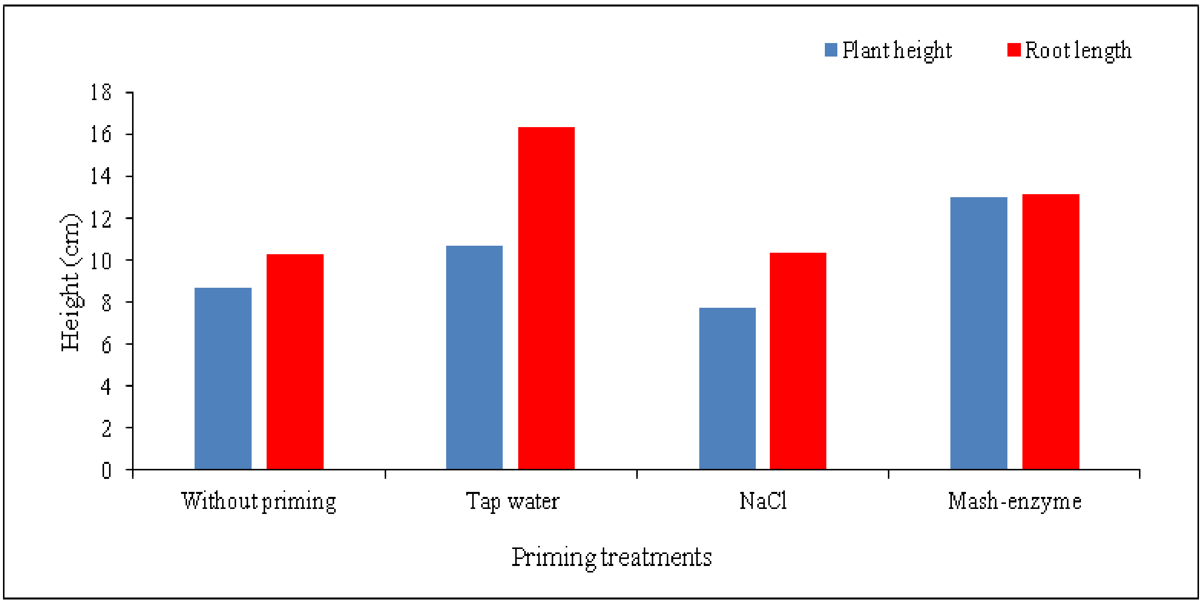

Figure 2 – Effect of priming treatments on plant height and root length in mung bean

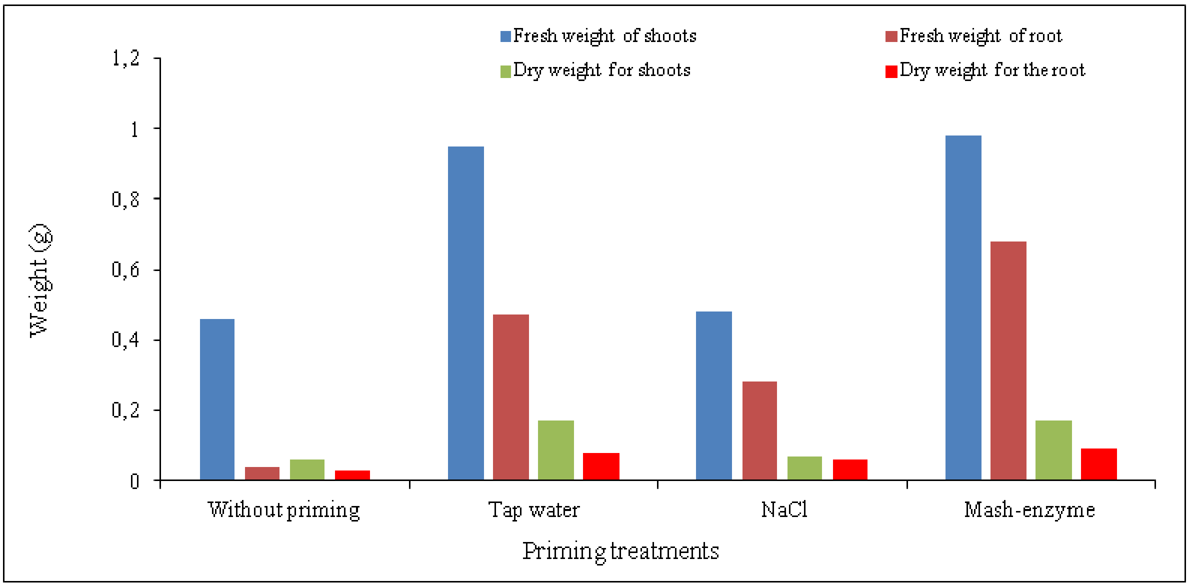

Figure 3 – Effect of priming treatments on fresh and dry weights

The results presented in Table 3 and Figure 4 show an increase in the average number of leaves in the tap water treatment, which reached 9.00 leaves per plant. In contrast the control treat-ment recorded the lowest average number of leaves, with 6.66 leaves per plant. This finding contra-dicts the results reported by [29] in Sorghum bicolor, where seed soaking had no significant effect on leaf number. The highest average leaf length (4.70 cm) was observed in the mash-enzyme treatment. Additionally this treatment significantly increased the average leaf width, reaching 2.36 cm. However there were no significant differences in total chlorophyll content among the treat-ments. In general, the highest average chlorophyll content was recorded in the tap water treatment (29.4) (Table 3 and Figure 5). This suggests that water soaking enhances chlorophyll accumulation, as also reported in[30]. Overall, the study demonstrated differential responses of mung bean plants to the various priming treatments. Both the tap water and enzyme mash treatments positively influ-enced germination and improved most vegetative growth parameters 50 days after planting.

Table 3 – Effect of priming treatments on leaf morphological traits and chlorophyll content of mung bean plants.

Priming treatments	Leaf length (cm)	Leaf width (cm)	Number of leaves per plant	chlorophyll content (SPAD units)
Without priming (control)	28.96 [a]	6.66 a	1.76 [a]	3.70 [a]
Tap water	29.46 [a]	9.00 [a]	1.73 [a]	3.83 [a]
NaCl	28.30 [a]	7.66 [a]	1.83 [a]	3.70 [a]
enzyme- Mash	28.94 [a]	8.00 [a]	2.36 [b]	4.70 [a]

According to Duncan's Multiple Range Test (DMRT), values followed by the same letter within each column are not significantly different at the 5% significance level.

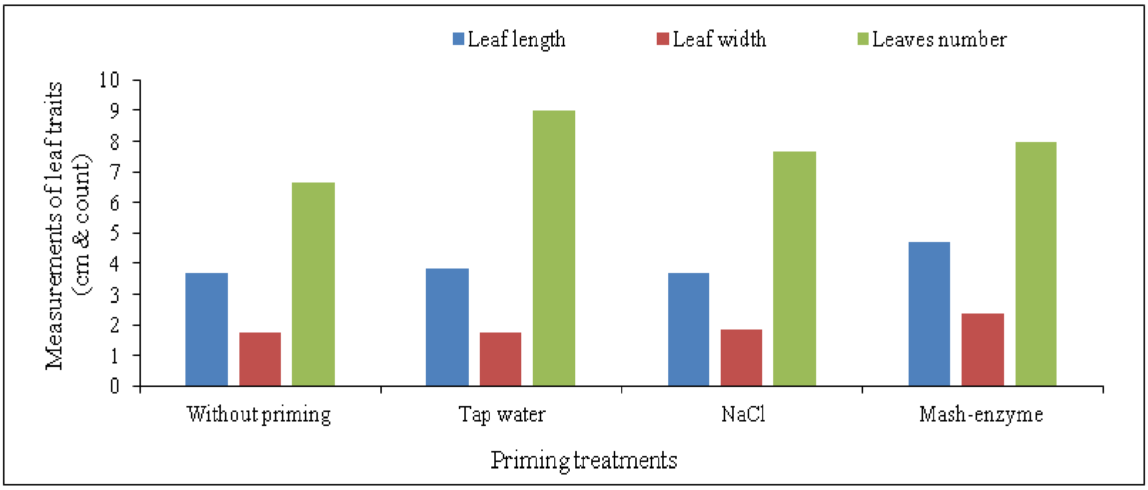

Figure 4 – Effect of priming treatments on leaf morphological traits of mung bean plants

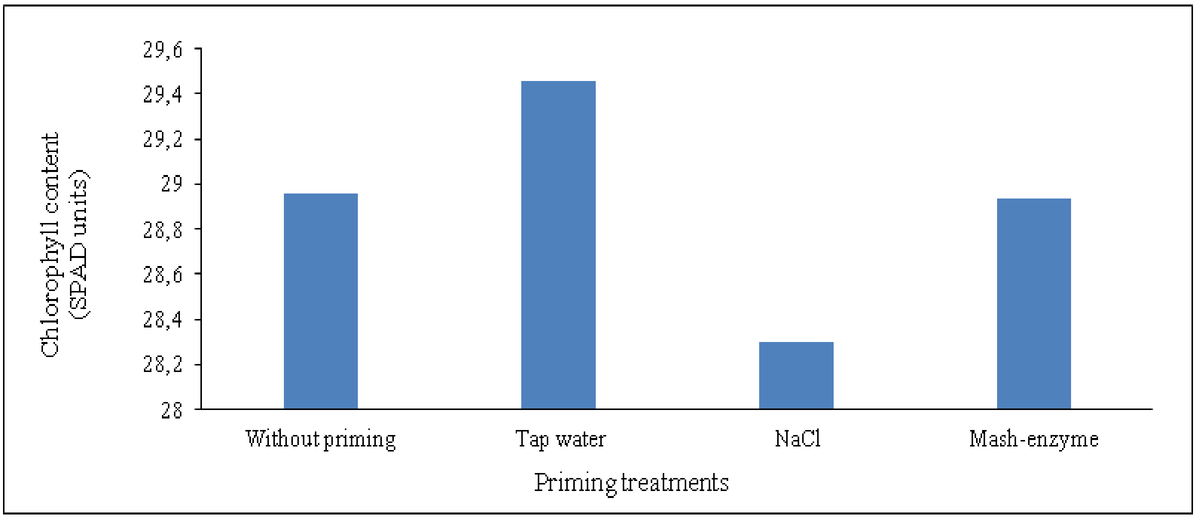

Figure 5 – Effect of priming treatments on chlorophyll content in mung bean plants

Conclusion

This study demonstrated that soaking mung bean seeds in a saline solution negatively im-pacts seed performance, resulting in reduced germination rates and weaker vegetative growth. In contrast, soaking mung bean seeds in tap water or in a mash enzyme solution led to significant im-provements in germination and vegetative growth traits, confirming the effectiveness of these treatments in enhancing overall plant performance.

References

1 Magar, VS, Pathak, SK, Parveen, S., Gupta, JP. (2024). Impact of Chemical Spray on Seed Longevity for Induction of Seed Dormancy in Mungbean (Vigna radiata L.). *Ecol. Environ. Conserv,* 30, S281-S287. DOI: 10.53550/EEC.2024.v30i02s.058

2 Lambrides, CJ, Godwin, I. (2007). *Mungbean. in Genome Mapping and Molecular Breeding in Plants: Pulses, Sugar and Tuber Crops,* C. Kole Ed.: Springer, 3, 69-90.

3 Ademe, BE. (2023). Mung bean [Vigna radiata L.] production Vis-Avis market potential in Ethiopia. *A Review'*, 3351, 614-622. DOI: 10.3923/ajbs.2023.614.622.

4 Kole, C. (2011). *Wild crop realitimes: Genomic and breeding resources – Cereals.* Berlin, Heidelberg Springer.

5 Shrestha, S. van't Hag, L., Haritos, VS, Dhital, S. (2023). Lentil and Mungbean protein iso-lates: Processing, functional properties, and potential food applications. *Food hydrocolloids,* 135, 108142. DOI: 10.1016/j.foodhyd.2022.108142.

6 Feng, Q. et al. (2024). Mung bean protein as an emerging source of plant protein: A review on production methods, functional properties, modifications and its potential applications. *Journal of the Science of Food and Agriculture,* 104: 5, 2561-2573. DOI: 10.1002/jsfa.13107.

7 Pataczek, L. et al. (2018). Beans with benefits the role of Mungbean (Vigna radiate) in a changing environment. *American Journal of Plant Sciences,* 9: 07, 1577. DOI: 10.4236/ajps.2018.97115.

8 Harris, D., Pathan, AK, Gothkar, P., Joshi, A., Chivasa, W., Nyamudeza, P. (2001). On-farm seed priming: using participatory methods to revive and refine a key technology. *Agricultural systems,* 69:1-2, 151-164. DOI: 10.1016/S0308-521X(01)00023-3.

9 Ashraf, M., Foolad, M. (2005). Pre-sowing seed treatment A shotgun approach to improve germination, plant growth, and crop yield under saline and non-saline conditions. *Advances in agronomy,* 88, 223-271. DOI: 10.1016/S0065-2113(05)88006-X.

10 Afzal, I. (2023). Seed priming: what's next? *Seed Science and Technology*, 51(3), 379-405. DOI: 10.15258/sst.2023.51.3.10.

11 Muhammad, MA, Arif, MW, Muhammad Waqas, KN, Khalid Nawab, Muhammad Shahid, M S. (2007). Effect of seed priming in Zn solutions on chickpea and wheat.

12 Ahmed, A., El-Mahdy, A. (2022). Improving seed germination and seedling growth of maize (Zea mays, L.) seed by soaking in water and moringa oleifera leaf extract. *Curr. Chem. Lett.*, 11(2), 147-156. DOI: 10.5267/j.ccl.2022.2.005.

13 Ghiyasi, M., Seyahjani, AA, Tajbakhsh, M. Amirnia, R., Salehzadeh, H. (2008). Effect of osmopriming with polyethylene glycol (8000) on germination and seedling growth of wheat (Triticum aestivum L.) seeds under salt stress. *Res. J. Biol. Sci*, 3(10), 1249-1251.

14 Devika, OS, Singh, S., Sarkar, D., Barnwal, P., Suman, J., Rakshit, A. (2021). Seed priming: a potential supplement in integrated resource management under fragile intensive ecosystems. *Frontiers in Sustainable Food Systems*, 5, 654001. DOI: 10.3389/fsufs.2021.654001.

15 Farooq, M., Wahid, A., Siddique, KH. (2012). Micronutrient application through seed treatments: a review. *Journal of soil science and plant nutrition*, 12(1), 125-142. DOI: 10.4067/S0718-95162012000100011...

16 Afzal, I., Basra, SA, Iqbal, A. (2005). The effects of seed soaking with plant growth regula-tors on seedling vigor of wheat under salinity stress. *Journal of Stress Physiology & Biochemistry*, 1(1), 6-15.

17 Yaseen, A. (2016). Laboratory studies on the effect of nano silver particles, organic fertilizer (Algastar) and salicylic acid on vegetative growth parameters and oxidizing enzymes in Sunflower (Helianthus annuus L.) cv. Viki. *Al-Qadisiyah Journal of Pure Science,* 2(21).

18 Blackmer, T., Schepers, J. (1995). Use of a chlorophyll meter to monitor nitrogen status and schedule fertigation for corn. *Journal of production agriculture,* 8(1), 56-60.

19 Al-Nori, M. (2017). Effect of wheat and barley seed priming treatments on behavior of growth and yield of plant. *Mesopotamia Journal of Agriculture*, 45(1), 243.0-256.0. DOI: 10.33899/magrj.2019.161282.

20 Dhingra, H., Varghese, T. (1985). Effect of salt stress on viability, germination and endoge-nous levels of some metabolites and ions in maize (Zea mays L.) pollen. *Annals of Botany,* 55(3), 415-420. DOI: 10.1093/oxfordjournals.aob.a086920.

21 Mohanrao, KS, Pramod, PA, Sopan, MA. (2023). Calcium chloride priming reverses the ef-fect of salinity stress on α-amylase activity during seed germination in Vigna radiata. J*ournal of Entomology and Zoology Studies,* 11(1), 169-172. DOI: 10.22271/j.ento.2023.v11.i1c.9152.

22 Jajarmi, V. (2009). Effect of water stress on germination indices in seven wheat cultivar. World Acad. Sci. Eng. Technol, 49, 105-106.

23 Khayatnezhad, M., Gholamin, R., Jamaatie-Somarin, S., Zabihi-Mahmoodabad, R. (2010). Effects of peg stress on corn cultivars (Zea mays L.) at germination stage. *World Appl. Sci. J,* 11(5), 504-506.

24 Zörb, C., Geilfus, CM, Dietz, KJ. (2019). Salinity and crop yield. *Plant biology*, 21, 31-38. DOI: 10.1111/plb.12884.

25 Azmi, A., Alam, S. (1990). Effect of salt stress on germination, growth, leaf anatomy and mineral element composition of wheat cultivars. *Acta Physiologiae Plantarum*, 12(3), 215-224.

26 Kakarash, S., Alnori, M. (2017). Effect of Invigoration Solution on the Aged and Non-aged Seeds it's reflecting on Germination and Seedling Characters of Chickpea (Cicer ariteinum L.). K*irkuk University Journal for Agricultural Sciences (KUJAS)*, 8(2).

27 Mohammady, S., Chaurasia, A., Dasthagiri, C., Jyothsna, C. (2021). Assessment of different priming methods on germination and seed quality parameters of groundnut (Arachis hypogea L.). *International Journal of Current Microbiology and Applied Sciences,* 10(02), 1061-1066.

28 Mori, RB, Patel, JB, Vaghasiya, KP, Bhoot, HV, Barad, AV. (2024). Effect of Seed Priming on Germination and Seedling Growth of Sesame (Sesamum indicum L.). *Biological Forum–An International Journal*, 16(3), 82-78. DOI: 10.13140/RG.2.2.17879.07845.

29 Dawood, WM, Aboud, RH. (2017). Effect of seeds soaking planting in the gibberellin, potassium chloride and ascorbic acid in the growth characters and hydrocyanic acid content of Sor-ghum bicolor (L) Moench. *Diyala Agricultural Sciences Journal,* 9(2), 128-134.

30 Sharaf-Eldin, MA. et al. (2022). Influence of seed soaking and foliar application using ozonated water on two sweet pepper hybrids under cold stress. *Sustainability,* 14:20, 13453. DOI: 10.3390/su142013453.

References

1 Magar, VS, Pathak, SK, Parveen, S., Gupta, JP. (2024). Impact of Chemical Spray on Seed Longevity for Induction of Seed Dormancy in Mungbean (Vigna radiata L.). *Ecol. Environ. Conserv,* 30, S281-S287. DOI: 10.53550/EEC.2024.v30i02s.058

2 Lambrides, CJ, Godwin, I. (2007). *Mungbean. in Genome Mapping and Molecular Breeding in Plants: Pulses, Sugar and Tuber Crops,* C. Kole Ed.: Springer, 3, 69-90.

3 Ademe, BE. (2023). Mung bean [Vigna radiata L.] production Vis-Avis market potential in Ethiopia. *A Review'*, 3351, 614-622. DOI: 10.3923/ajbs.2023.614.622.

4 Kole, C. (2011). *Wild crop realitiмes: Genomic and breeding resources – Cereals.* Berlin, Heidelberg Springer.

5 Shrestha, S. van't Hag, L., Haritos, VS, Dhital, S. (2023). Lentil and Mungbean protein iso-lates: Processing, functional properties, and potential food applications. *Food hydrocolloids*, 135, 108142. DOI: 10.1016/j.foodhyd.2022.108142.

6 Feng, Q. et al. (2024). Mung bean protein as an emerging source of plant protein: A review on production methods, functional properties, modifications and its potential applications. *Journal of the Science of Food and Agriculture*, 104: 5, 2561-2573. DOI: 10.1002/jsfa.13107.

7 Pataczek, L. et al. (2018). Beans with benefits the role of Mungbean (Vigna radiate) in a changing environment. *American Journal of Plant Sciences*, 9: 07, 1577. DOI: 10.4236/ajps.2018.97115.

8 Harris, D., Pathan, AK, Gothkar, P., Joshi, A., Chivasa, W., Nyamudeza, P. (2001). On-farm seed priming: using participatory methods to revive and refine a key technology. *Agricultural systems,* 69:1-2, 151-164. DOI: 10.1016/S0308-521X(01)00023-3.

9 Ashraf, M., Foolad, M. (2005). Pre-sowing seed treatment A shotgun approach to improve germination, plant growth, and crop yield under saline and non-saline conditions. *Advances in agronomy,* 88, 223-271. DOI: 10.1016/S0065-2113(05)88006-X.

10 Afzal, I. (2023). Seed priming: what's next? *Seed Science and Technology*, 51(3), 379-405. DOI: 10.15258/sst.2023.51.3.10.

11 Muhammad, MA, Arif, MW, Muhammad Waqas, KN, Khalid Nawab, Muhammad Shahid, M S. (2007). Effect of seed priming in Zn solutions on chickpea and wheat.

12 Ahmed, A., El-Mahdy, A. (2022). Improving seed germination and seedling growth of maize (Zea mays, L.) seed by soaking in water and moringa oleifera leaf extract. *Curr. Chem. Lett.*, 11(2), 147-156. DOI: 10.5267/j.ccl.2022.2.005.

13 Ghiyasi, M., Seyahjani, AA, Tajbakhsh, M. Amirnia, R., Salehzadeh, H. (2008). Effect of osmopriming with polyethylene glycol (8000) on germination and seedling growth of wheat (Triticum aestivum L.) seeds under salt stress. *Res. J. Biol. Sci,* 3(10), 1249-1251.

14 Devika, OS, Singh, S., Sarkar, D., Barnwal, P., Suman, J., Rakshit, A. (2021). Seed priming: a potential supplement in integrated resource management under fragile intensive ecosystems. *Frontiers in Sustainable Food Systems,* 5, 654001. DOI: 10.3389/fsufs.2021.654001.

15 Farooq, M., Wahid, A., Siddique, KH. (2012). Micronutrient application through seed treatments: a review. *Journal of soil science and plant nutrition*, 12(1), 125-142. DOI: 10.4067/S0718-95162012000100011...

16 Afzal, I., Basra, SA, Iqbal, A. (2005). The effects of seed soaking with plant growth regula-tors on seedling vigor of wheat under salinity stress. *Journal of Stress Physiology & Biochemistry,* 1(1), 6-15.

17 Yaseen, A. (2016). Laboratory studies on the effect of nano silver particles, organic fertilizer (Algastar) and salicylic acid on vegetative growth parameters and oxidizing enzymes in Sunflower (Helianthus annuus L.) cv. Viki. *Al-Qadisiyah Journal of Pure Science,* 2(21).

18 Blackmer, T., Schepers, J. (1995). Use of a chlorophyll meter to monitor nitrogen status and schedule fertigation for corn. *Journal of production agricultur*e, 8(1), 56-60.

19 Al-Nori, M. (2017). Effect of wheat and barley seed priming treatments on behavior of growth and yield of plant. *Mesopotamia Journal of Agriculture,* 45(1), 243.0-256.0. DOI: 10.33899/magrj.2019.161282.

20 Dhingra, H., Varghese, T. (1985). Effect of salt stress on viability, germination and endoge-nous levels of some metabolites and ions in maize (Zea mays L.) pollen. *Annals of Botany*, 55(3), 415-420. DOI: 10.1093/oxfordjournals.aob.a086920.

21 Mohanrao, KS, Pramod, PA, Sopan, MA. (2023). Calcium chloride priming reverses the ef-fect of salinity stress on α-amylase activity during seed germination in Vigna radiata. J*ournal of Entomology and Zoology Studies,* 11(1), 169-172. DOI: 10.22271/j.ento.2023.v11.i1c.9152.

22 Jajarmi, V. (2009). Effect of water stress on germination indices in seven wheat cultivar. World Acad. Sci. Eng. Technol, 49, 105-106.

23 Khayatnezhad, M., Gholamin, R., Jamaatie-Somarin, S., Zabihi-Mahmoodabad, R. (2010). Effects of peg stress on corn cultivars (Zea mays L.) at germination stage. *World Appl. Sci. J,* 11(5), 504-506.

24 Zörb, C., Geilfus, CM, Dietz, KJ. (2019). Salinity and crop yield. *Plant biology*, 21, 31-38. DOI: 10.1111/plb.12884.

25 Azmi, A., Alam, S. (1990). Effect of salt stress on germination, growth, leaf anatomy and mineral element composition of wheat cultivars. *Acta Physiologiae Plantarum*, 12(3), 215-224.

26 Kakarash, S., Alnori, M. (2017). Effect of Invigoration Solution on the Aged and Non-aged Seeds it's reflecting on Germination and Seedling Characters of Chickpea (Cicer ariteinum L.). *Kirkuk University Journal for Agricultural Sciences (KUJAS)*, 8(2).

27 Mohammady, S., Chaurasia, A., Dasthagiri, C., Jyothsna, C. (2021). Assessment of different priming methods on germination and seed quality parameters of groundnut (Arachis hypogea L.). *International Journal of Current Microbiology and Applied Sciences*, 10(02), 1061-1066.

28 Mori, RB, Patel, JB, Vaghasiya, KP, Bhoot, HV, Barad, AV. (2024). Effect of Seed Priming on Germination and Seedling Growth of Sesame (Sesamum indicum L.). *Biological Forum–An International Journal*, 16(3), 82-78. DOI: 10.13140/RG.2.2.17879.07845.

29 Dawood, WM, Aboud, RH. (2017). Effect of seeds soaking planting in the gibberellin, po-tassium chloride and ascorbic acid in the growth characters and hydrocyanic acid content of Sor-ghum bicolor (L) Moench. *Diyala Agricultural Sciences Journal*, 9(2), 128-134.

30 Sharaf-Eldin, MA. et al. (2022). Influence of seed soaking and foliar application using ozonated water on two sweet pepper hybrids under cold stress. *Sustainability*, 14:20, 13453. DOI: 10.3390/su142013453.

Маш тұқымын себу алдындағы өңдеудің өнгіштікке және вегетативті өсудің кейбір көрсеткіштеріне әсері

Shaymaa O. H. Al-Mamoori, Noor Mahmood Naji, Rihab Edan Kadhim, Anmar M. K. Al-Maamori

Түйін

Алғышарттар мен мақсат. Маш (жасыл бұршақ) – жаздық ауыл шаруашылығы дақылы. Адам ағзасы үшін маш бұршағының маңыздылығы оның тұқымдарында ақуыздың және аминқышқылдың жоғары мөлшерімен, сонымен қатар көмірсулар, майлар, дәрумендер мен әртүрлі қосалқы қосылыстарға бай болуымен түсіндіріледі. Тәжірибе тұқымдарды үш түрлі ерітіндіге (ағын су, маш ферменті ерітіндісі және тұзды ерітінді) салып қоюдың, сондай-ақ салыстырмалы бақылау ретінде ешқандай өңдеусіз қалдырудың маш өсімдігінің өнуі мен кейбір вегетативтік өсу көрсеткіштеріне әсерін анықтау мақсатында жүргізілді.

Материалдар мен әдістер. Алдымен Петри табақшаларында зертханалық тәжірибе жүргізілді, содан кейін 1:1 қатынасында топырақ пен шымтезек қоспасымен толтырылған ыдыстарда далалық тәжірибе өткізілді. Тұқымдар себер алдында 12 сағат бойы ерітіндіде тұндырылды. Өңдеу әдістеріне ағын суда, маш ферменті ерітіндісінде және тұзды ерітіндіде (1% NaCl) тұндыру, сондай-ақ тұқымды өңдеусіз қалдырған бақылау тобы кірді. Дақылдың өну мен өсу көрсеткіштері тіркелді. Деректер 5% деңгейіндегі маңыздылық шегінде SPSS бағдарламасы және Дунканның шынайылық критерийі арқылы статистикалық түрде талданды.

Нәтижелер. Зертханалық тәжірибе нәтижелері тұқымдарды ағын суда тұндыру ең жоғары өну пайызын және өскін ұзындығын қамтамасыз еткенін көрсетті. Көптеген өңдеу әдістері арасында айтарлықтай айырмашылықтар болмады, тек тұзды ерітіндіде тұндырылған тұқымдарда өну пайызы ең төмен болды. Далалық тәжірибе барысында тұқымдарды ағын суда және маш ферменті ерітіндісінде тұндыру өсімдіктің барлық вегетативтік өсу көрсеткіштері (өсімдік биіктігі, тамыр ұзындығы, сабақ пен тамырдың жас және құрғақ массасы, жапырақтың ұзындығы мен ені, сондай-ақ хлорофилл мөлшері) бойынша ең жақсы нәтижелер көрсетті.

Қорытынды. Маш тұқымдарын ағын суда және маш ферменті ерітіндісінде тұндыру өну мен вегетативтік өсу көрсеткіштерін жақсартады, ал тұзды ерітінді бұл көрсеткіштерге кері әсерін тигізеді. Алынған нәтижелер өсімдіктердің өнімділігін арттыруда табиғи тұқым тұндыру әдістерінің тиімділігін дәлелдейді.

Кілт сөздер: Маш бұршағы; маш ферменті; прайминг (тұқымды алдын ала өңдеу); тұзды ерітінді; вегетативтік өсу; өнгіштік.

Влияние обработки семян маша перед посевом на всхожесть и некоторые показатели вегетативного роста

Shaymaa O. H. Al-Mamoori, Noor Mahmood Naji, Rihab Edan Kadhim, Anmar M. K. Al-Maamori

Аннотация

Предпосылки и цель. Маш (зелёная фасоль) – это яровая сельскохозяйственная культура. Её значение в питании человека подчёркивается тем, что её семена содержат высокую концентрацию белка и богаты аминокислотой, а также другими соединениями, такими как углеводы, масла, витамины и различные вторичные вещества. Эксперимент был проведён с целью изучения влияния трёх вариантов замачивания семян (в водопроводной воде, растворе ферментов маша и солевом растворе) и контрольного варианта (без замачивания) на прорастание и некоторые показатели вегетативного роста растения маш.

Материалы и методы. Был проведён лабораторный эксперимент на чашках Петри, а затем - полевой эксперимент в горшках, заполненных смесью почвы и торфа в соотношении 1:1. Семена замачивались в течение 12 часов перед посевом. Обработка включала замачивание в водопроводной воде, ферментном растворе маша и солевом растворе (1% NaCl), а также контрольную группу без замачивания. Были зафиксированы показатели прорастания и вегетативного роста. Данные были проанализированы статистически с использованием программы SPSS и критерия достоверности по Дункану на уровне значимости 5%.

Результаты. Результаты лабораторного опыта показали, что замачивание семян в водопроводной воде обеспечило наивысший процент прорастания и длину побега. Существенных различий между большинством обработок не было, за исключением солевого раствора, который дал наименьший процент прорастания. В полевом эксперименте замачивание семян в водопроводной воде и ферментном растворе маша обеспечило лучшие показатели всех параметров вегетативного роста, включая высоту растения, длину корня, свежую и сухую массу побега и корня, длину и ширину листа, а также содержание хлорофилла.

Заключение. Замачивание семян маша в водопроводной воде и растворе ферментов маша улучшает прорастание и показатели вегетативного роста, в то время как солевой раствор оказывает отрицательное влияние на эти параметры. Полученные результаты подтверждают эффективность природных методов замачивания в повышении продуктивности растений.

Ключевые слова: Маш; фермент маша; прайминг (предпосевная обработка); солевой раствор; вегетативный рост; прорастание.