THE INFLUENCE OF THE MOON PHASE ON THE DEVELOPMENT OF SOME AGRICULTURAL CROPS

INFLUENȚA FAZEI LUNII ASUPRA DEZVOLTĂRII UNOR CULTURI AGRICOLE

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Sumar. *Această lucrare prezintă rezultatele unui studiu privind influența fazelor lunare asupra absorbției de apă, germinării semințelor și dezvoltării timpurii a culturilor agricole. Trei specii de culturi au fost selectate pentru experiment: grâul (Triticum aestivum L.), porumbul (Zea mays L.) și fasolea comună (Phaseolus vulgaris L.), considerate culturi esențiale pentru majoritatea populației mondiale. Studiul a arătat că semințele plantate în timpul fazei de lună plină au prezentat o perioadă de germinare mai scurtă comparativ cu cele plantate în alte faze ale ciclului sinodic, precum și o rată de germinare mai mare — în medie cu 25% mai ridicată. Faza lunară a influențat, de asemenea, creșterea răsadurilor: plantele dezvoltate în timpul lunii pline au prezentat rate de creștere sporite, măsurate la 7 zile după plantare, cu îmbunătățiri de 15,05% pentru grâu, 26,12% pentru fasole și 30,21% pentru porumb, comparativ cu semințele semănate în faza de lună nouă.*

Cuvinte-cheie: *faze lunare, gravitație luni solară, germinarea semințelor.*

INTRODUCTION

The idea that the lunar cycle influences certain aspects of everyday life, particularly plants and other living organisms, is as old as humanity and continues to be investigated today. Following a series of experimental studies, controversies have emerged among scientists: some dismiss it as an old superstition, while others have attempted to examine phenomena related to moonrise and its possible influence on plants [1–13]. In 1627, Francis Bacon was among the first researchers to propose that crops should be sown at specific points in the synodic cycle [1]. Over the years, similar but inconclusive experiments have been repeated by other scientists. Published works [2–8] have provided evidence that plants may respond during this cycle to parameters such as germination rate, water absorption, and even changes in the amount of DNA in cell nuclei in relation to synodic values. In 1924, Rudolf Steiner, the founder of biodynamic farming, suggested that sustainable agriculture should not only account for factors such as crop rotations, proper storage, and organic fertilizer, but also cosmic influences. Based on his observations, he indicated a relationship between the position of the moon relative to the sun (synodic rhythm), planting date, and crop growth. Several studies conducted in the 1930s and 1940s sought to test this relationship but reported mixed results [8]. For example, Zürcher's studies showed that germination rate, mean height, and maximum height after four months were systematically linked to the sowing time relative to the moon phase [9, 10]. By contrast, research by Nick Kollerstrom indicated that the synodic cycle does not generally affect crop yield; he concluded that, overall, there is little reliable evidence that sowing at a particular lunar phase significantly influences the final yield [7, 11–13]. Due to the Earth's rotation on its axis and the relative orbital movements of the Earth and the moon around the sun, the Earth's gravitational field is continuously modulated by lunisolar tidal forces. On Earth's surface, this modulation can be observed and measured not only in the daily rise and fall of ocean tides but also in the small elastic deformations of the Earth's crust [14]. Dorda G. postulated a lunar gravity effect on organic structures, arguing that the lunisolar gravitational field modulates the coherent state of water molecules within cells and that these assemblies respond to diurnal variations of the tidal force in a defined manner. Whenever a change in the gravity of the luni-solating is perceived, a certain mass of water molecules shall be released or entered into a coherent assembly. It follows that, as the monthly gravity varies continuously, due to the orbital movement of the earth and the moon, the number of water molecules associated with the coherent state varies similarly within cells [15].

The orbital movement of the moon generates a gravitational field system that periodically changes gravitational force on Earth. This monthly tidal acceleration (Etide) is known to act as an external environmental factor affecting many growth and development phenomena in plants.

EXPERIMENTAL

To assess the effect of lunar cycles on plants, seeds of three agricultural crop species were used: wheat (*Triticum aestivum L.*), maize (*Zea mays L.*), and common bean (*Phaseolus vulgaris L.*). The experiments were conducted over a four-month period (December 2024 – March 2025) under laboratory conditions. Each day, a batch of 20 seeds was germinated in water, while another batch was planted in soil in vegetation pots. The parameters investigated included seed water absorption, germination dynamics, and the initial growth stage of seedlings.

Prior to the experiments, seeds were weighed and kept for 24 h in a dark, electrically shielded chamber at 18 °C and 35% relative humidity. Daily weighing was performed to determine the variation in seed mass relative to the initial weight. Measurements were taken at 24-hour intervals, and in cases of deviations from the expected trend, additional measurements were conducted every 4 hours.

A key tool for evaluating seed lot performance is the accurate quantification of germination through statistical analysis of cumulative germination data. These indices provide insight into the potential developmental performance of a plant organism.

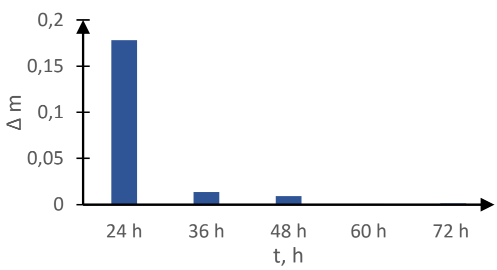
The germination parameters determined were: Final Germination Percentage (FGP), Mean Germination Time (MGT), Coefficient of Variation of Germination Time (CVt), Mean Germination Rate (MGR), Germination Speed (GSP), Germination Rate Index (GRI), Germination Index (GI), Synchronization Index (Z), and Germination Uncertainty (U) [16–19].

RESULTS AND DISCUSSION

Plants are highly responsive organisms that adapt to environmental changes. They are influenced by numerous, constantly shifting forces, and dynamic biochemical adjustments are essential for survival. One of the fundamental characteristics of seeds during germination is hygroscopicity. Figure 1 shows the variation in the mass of Phaseolus vulgaris L. seeds over time, depending on the lunar phase. As illustrated, seeds absorbed the most water during the first 24 hours, increasing their mass by up to 120% of the initial weight due to osmotic processes within the cells.

To initiate germination, a seed requires an amount of water approximately equal to its own mass. At the point of maximum turgidity, endosmosis ceases even though the vacuolar sap remains hypertonic relative to the external solution.

The minimum points on the graph corresponded to the onset of germination, which varied depending on the lunar phase. Seeds germinated during the full moon phase (fig. 1c) reached this point in about 40 h, whereas those germinated during the new moon phase (fig. 1a) required over 60 h. A clear parallel was observed between water absorption and germination dynamics.



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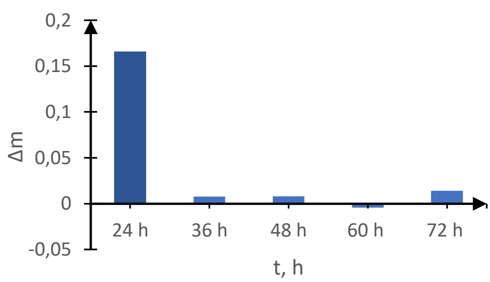

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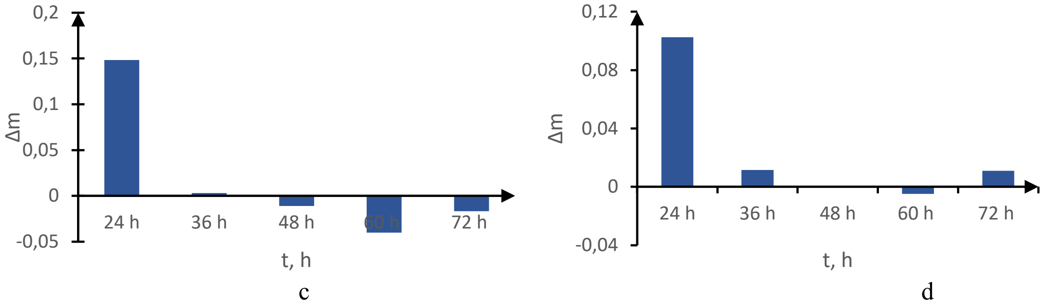

Figure 1. Dependence of the seed variation of Phaseolus vulgaris L. on germination time and moon phase: a – new moon; b – first square; c – full moon; d- last square

Figure 2. Shows the germination rate of Triticum aestivum L., Zea mays L. and Phaseolus vulgaris L. seeds, depending on the phase of the moon after 5 days

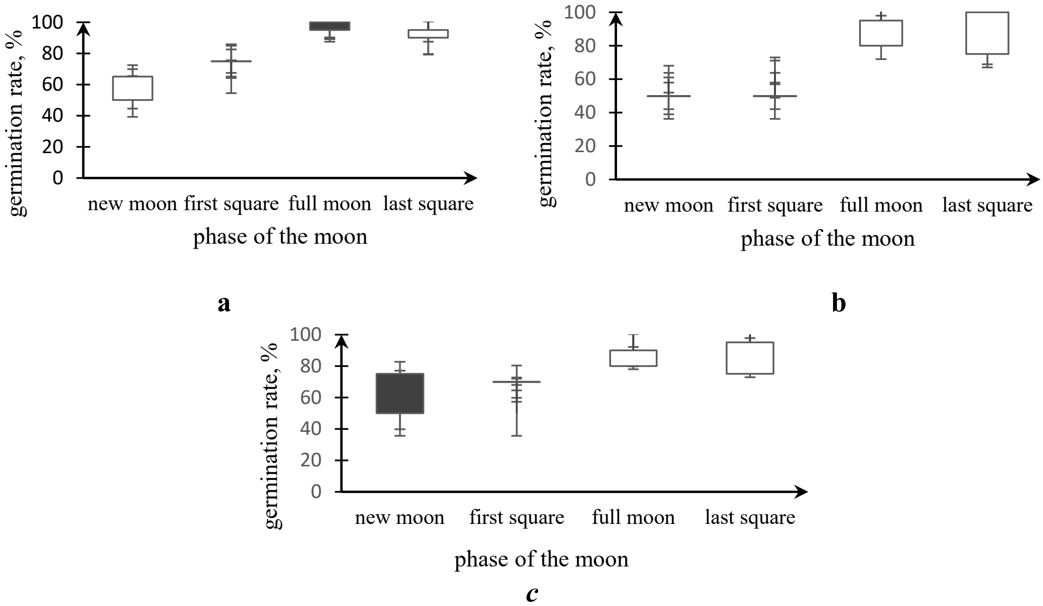

Figure 2. Germination rate of the seeds after 5 days: (A) Triticum aestivum L., (b) Zea mays L. and (c) Phaseolus vulgaris L., depending on the phase of the moon

According to the results, a similar trend was observed for all seed species, with the best performance recorded for *Triticum aestivum L*. The maximum germination rate was obtained from seeds sown during the full moon phase, followed by those germinated in the first quarter, exceeding by an average of 25% the seeds germinated during the new moon and last quarter phases. In the new moon phase, seeds absorbed the largest amount of water, which contributed to delayed germination. These experimental results therefore support Dorda's postulate [15].

After three days of germination, bean seedlings in this group showed elongated roots, with the

radicle emerging around 40 hours and growing relatively rapidly. By the seventh day, bean plants displayed a well-developed root system, a long and robust hypocotyl, and the emergence of the plumule between the two cotyledons.

In maize seedlings, the embryonic roots reached an average length of 3 cm by the third day of germination, with 4–5 secondary roots and, at the hypocotyl level, two adventitious roots emerging near the caryopsis, some penetrating from within the grain itself.

As shown in figure 3, for all studied species the highest germination rate was recorded in seeds germinated during the full moon phase, with the most significant resuls obtained for wheat.

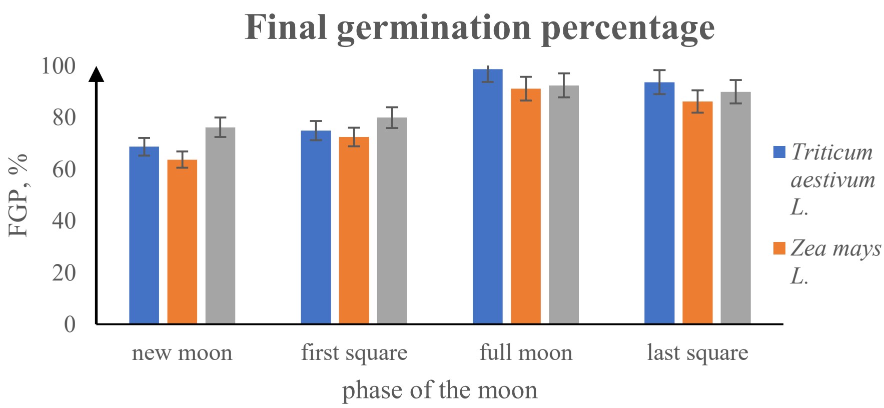

Figure 3. The final germination percentage of the seeds depending on the phases of the moon

Thus, the highest germination rate of 98.75% was obtained for the seeds subjected to germination when the moon is full compared to 68.75% corresponding to the new moon phase. The same trend is observed for the other species, with a difference of 27.5% for corn and 16.25% for beans. For the seeds subjected to germination in the first square phase, compared to the new moon, there was a difference of only 6.25% for wheat, 8.75% for corn and 3.75% for beans. And the position of the moon in the last square influences the germination rate, obtaining values slightly lower than in the full moon phase, but higher than the new moon by 23% for wheat, 22.5 for corn and 13.75 % for beans.

In figure 4 shows the average germination rate of *Triticum aestivum L., Zea mays L.* and *Phaseolus vulgaris L.* seeds, depending on the phase of the phases of the moon. The mean germination rate (MGR) is a measure of the germination rate and the temporal spread of germination. Thus, the number of germinated seeds from the first day and the total number of germinated seeds up to the seventh day were determined, taking into account the number of viable germinated seeds.

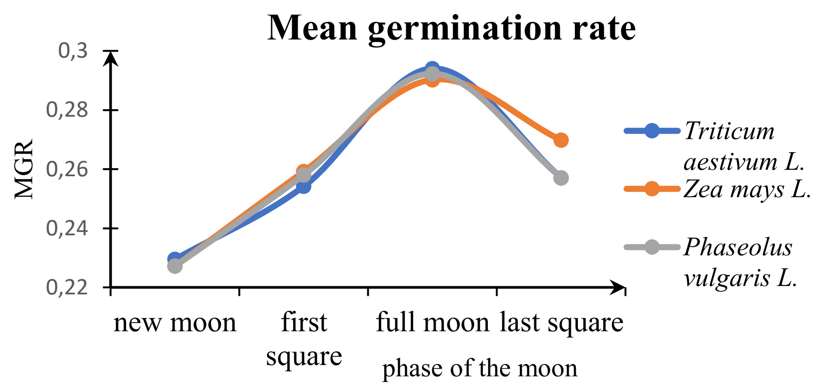

Figure 4. Variation of the mean germination time of the seeds of Triticum aestivum L., Zea mays L. and Phaseolus vulgaris L., depending on the phases of the moon

As can be seen from Fig. 4, the same trend of variation of the MGR parameter was registered for all seed species. Thus, from the new moon phase, a continuous increase is observed until the maximum value is reached in the full moon phase, only to later decrease in the last square.

Figure 5 shows the variation of the germination rate index depending on the phases of the monthly cycle. High percentage rates of germination rate (GRI) indicate higher and faster seed germination.

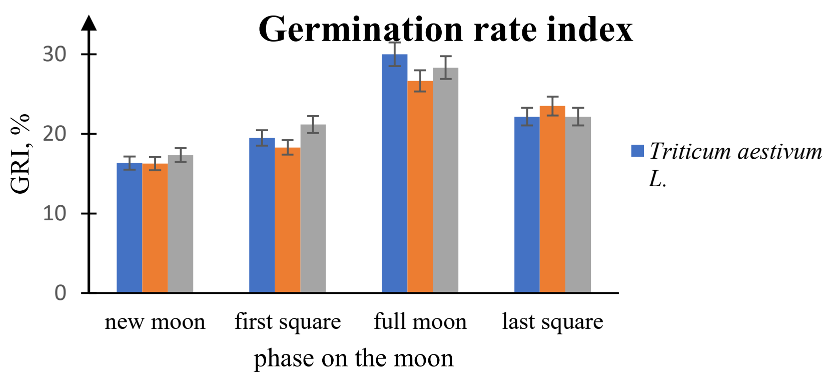

Figure 5. Variation of the germination rate index depending on the phases of the moon

We observe this for the sample of seeds subjected to germination in the full moon stage. Thus, the wheat reached the highest average GRI percentage (30%) of all the analyzed variants. The lowest GRI (16.25% was recorded for corn seeds in the group corresponding to the new moon phase. The germination rate (CV_t) gives us an indication of the speed of seed germination.

The CV_t index increases when the number of germinated seeds increases and the time required for germination decreases. In Fig. 6 the variation of the CVt coefficient is represented in the position of the month. As can be seen from the Fig. 6, the highest CVt values were recorded for the seed samples of *Zea mays* L. placed in germination during the full month period. For other seed species the coefficient of CVt shall not differ greatly from the month phase, an ascent being observed for the last square samples.

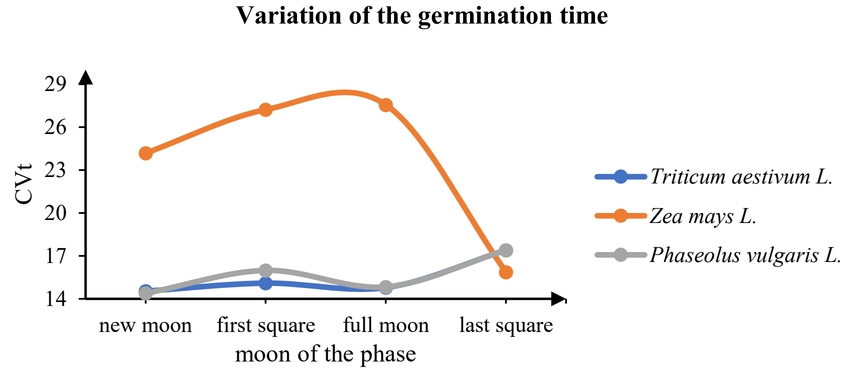

Figure 6. The germination rate coefficient of the seeds of Triticum aestivum L., Zea mays L. and Phaseolus vulgaris L., depending on the phases of the moon

In Table 1, several germination indices are presented, including the germination timing index and the germination process uncertainty.

Table 1.

Moon phase	G, %	tt, day	CV_t, %	MGR, (day^{-1})	U	Z
***Triticum aestivum* L.**						
new moon	68,75	4,357143	14,53529789	0,229508	1,094914	0,042553
first square	75	3,933333	15,09195355	0,254237	0,77756	0,041667
full moon	98,75	3,4	14,78307912	0,294118	0,528771	0,021505
last square	93,75	3,888889	17,39313107	0,257143	0,901936	0,035088
***Zea mays* L.**						
new moon	63,75	4,307692	24,17469	0,232143	0,890492	0,04878
first square	72,5	3,857143	27,21655	0,259259	0,618687	0,042553
full moon	91,25	3,444444	27,5502	0,290323	0,519967	0,027778
last square	86,25	3,705882	15,86309	0,269841	0,690754	0,033898
***Phaseolus vulgaris* L.**						
new moon	76,25	4,4	14,37399	0,227273	1,158939	0,04
first square	80	3,875	15,97779	0,258065	0,798795	0,039216
full moon	92,5	3,421053	14,82752	0,292308	0,525443	0,02439
last square	90	3,888889	17,39313	0,257143	0,901936	0,035088

Since seed germination is generally asynchronous, it is possible to quantify this feature by a measurement called timing index, uncertainty associated with the distribution of the relative germination or information entropy frequency. Thus, higher values for this index show high diversity and numbers in the direction of zero – low diversity.

When applied to seed germination, conventional interpretation is in the opposite direction, i.e., lower values indicate more synchronized germination. For U, low values indicate frequencies with a few peaks, i.e., more concentrated germination. As can be seen from Table 1, for all seed species U and L Z values are the lowest for samples characteristic of the full moon phase. It follows that the germination process is particularly intense during this period.

The growth conditions have been maintained within 25 ± 1 °C and humidity 65 ± 3 per cent. For the exact determination of stem height, the horizontal dial gauge ИЗА – 2 has been used. Figure 7 is the growth dynamics of *Triticum aestivum L., Zea mays L.* and *Phaseolus vulgaris L.* plants, depending on the monthly cycle phase, 7 days after planting.

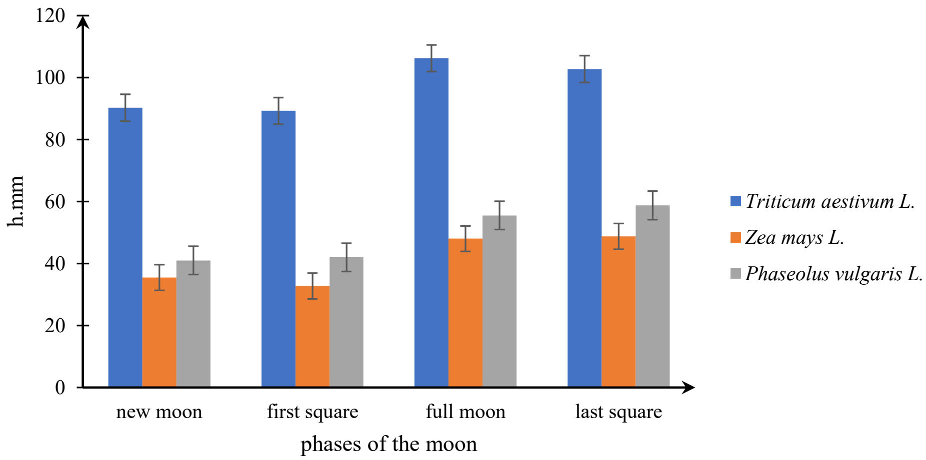

Figure 7. Growth dynamics of Triticum aestivum L., Zea mays L. and Phaseolus vulgaris L., depending on the phases on the moon, 7 days after planting

To determine growth differences among experimental variants for each vegetative organ, biometric measurements were applied. Figure 7 shows that lunar phases influence the growth process to some extent, although overall plant height did not vary greatly. The best growth results were recorded in batches sown during the full moon and last quarter phases across all three species. The maximum wheat height of 106.25 mm in the full moon batch was 17% greater than in the new moon batch, 18% greater than in the first quarter batch, and 4.2% greater than in the last quarter batch. The maximum differences observed between batches were 7.6% for maize and 9.86% for beans.

This phenomenon may be explained by the fact that during the full moon phase, moonlight intensity reaches its peak, potentially favoring plant growth and leaf development. During the new moon phase, changes in lunisolar gravitational forces may alter water uptake, contributing to seed swelling and irregular germination. The interaction of gravitational effects and light conditions may therefore support more balanced root and shoot growth.

CONCLUSION

This study, which evaluated the effect of lunar cycles on *Triticum aestivum* L., *Zea mays* L., and *Phaseolus vulgaris* L., demonstrated a measurable influence on plant development, assessed through parameters such as water absorption, germination, and stem height. The results indicated that seeds germinated during the full moon phase exhibited higher performance than those germinated during the new moon, particularly in terms of germination rate, germination time, and early seedling development. Specifically, seeds germinated in the full moon phase reached the shortest germination period of 48 hours, compared to 60 hours for seeds in other phases. Maximum germination rates were also achieved only in the full moon batches, whereas seeds in other synodic phases displayed lower germination capacity, with minimum values recorded in the new moon batches: 68.75% for wheat, 63.75% for maize, and 76.25% for beans.

Furthermore, a parallel was observed between seedling growth rates and the synodic cycle. Sowing during the full moon increased growth rates by 15.05% for wheat, 26.12% for beans, and 30.21% for maize compared with seedlings sown during the new moon phase, measured seven days after planting.

Based on both the literature review and our findings, we support the hypothesis that the lunar cycle may influence plant bioactivity. However, given the relatively small sample size, these results should be considered preliminary. Future studies should be conducted on larger batches, over longer experimental periods, and across a wider range of plant species to confirm the robustness and generalizability of these observations.

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