

INFLUENCE OF BIOFERTILIZERS TO ORGANIC WINTER PEA CROP IN THE CONDITIONS OF THE COBADIN PLATEAU, ROMANIA

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Abstract

Organic peas (Pisum sativum L.) play an important role in agroecology by naturally fixing nitrogen, improving soil health and organic matter content through crop rotation, and reducing the need for synthetic nitrogen fertilizers and pesticides. Agroecological practices like cultivating organic peas increase the resilience of farming systems to climate change. By boosting soil fertility, reducing chemical inputs, and supporting a healthier ecosystem, the peas contribute to a more sustainable and stable food production system. From an agronomic point of view, peas are of great importance, because the crop is fully mechanized, it is harvested early, being a very good previous crop for many crops, especially autumn crops as wheat; it improves soil fertility, enriching it with nitrogen. This paper presents the results obtained on an organic winter pea crop to which 7 variants of biofertilisers were applied, in three repetitions. The results demonstrated the importance of applying these products in ensuring a balanced nutrition of the crop for achieving an optimal plant density and mass grains under the conditions of the Cobadin plateau in southeastern Romania.

Key words: agroecology, biofertilisers, organic winter pea, yield, soil fertility.

INTRODUCTION

The continuous growth of the global population is generating an ever-increasing demand for food, making it necessary to adopt agricultural practices capable of ensuring long-term productivity without compromising natural resources (Marjanović et al., 2025). In this context, agroecological practices aim to reduce or eliminate the use of controversial inputs, such as synthetic fertilizers and pesticides, and replace them with sustainable alternatives that enhance ecological interactions within agroecosystems. These practices contribute not only to increasing crop yields but also to improving the quality of agricultural production (Szczepanek et al., 2024). At the same time, modern agriculture is expected to meet both economic and environmental objectives by ensuring stable yields, promoting the efficient use of resources, adapting to climate change, and conserving biodiversity (Tamburini et al.,

2020). However, a continuous decline in biodiversity associated with agricultural systems and a degradation of essential ecosystem services, such as soil formation, nutrient cycling, and biological regulation, are being observed worldwide. These effects are primarily driven by land-use change, agricultural intensification, and the simplification of cropping systems (IPBES, 2019; Díaz et al., 2019; Beillouin et al., 2019; FAO, 2019). Increasing crop diversity by introducing a greater number of species and incorporating legumes, such as peas (*Pisum sativum* L.), into crop rotations represents an important strategy for promoting sustainable agriculture (Molla et al., 2025). These practices contribute to improving soil fertility and structure, enhancing biological nitrogen fixation, reducing the pressure of diseases, pests, and weeds, and increasing the stability and productivity of agricultural systems. In addition, pea plays a key role in improving the sustainability and productivity of cropping

systems owing to its unique ability to fix atmospheric nitrogen (N_2), thereby enriching soil nitrogen availability and benefiting subsequent crops (Molla et al., 2025). Furthermore, the root system of pea contributes to improved soil water retention and helps reduce nutrient losses through leaching. This is particularly relevant for winter pea, which can make more efficient use of autumn and winter precipitation, thereby contributing to more stable yields over time (Toader et al., 2025). Cultivation of winter pea in either autumn or spring planting systems is possible and could be decided depending on the immediate needs of farmers (Barbieru, 2022). The cultivation of peas presents a promising opportunity for promoting sustainable agriculture and ensuring food security in the face of contemporary challenges (Eana et al., 2025). This paper presents the results obtained regarding the effects of selected biofertilizers on an organically grown winter pea crop cultivated on the Cobadin Plateau in southeastern Romania.

MATERIALS AND METHODS

The field experiment was established in the autumn of 2025 in the Adamclisi area, Constanța County, Romania, in a certified organic farm. The experimental site is characterized by a chernozem soil with a slightly alkaline pH (8.2) and an organic matter content of 2.4%. The climatic conditions showed considerable variation in both air temperature and rainfall to the long-term averages (Figure 1 and Figure 2). Monthly average air temperatures ranged from -2.4°C in January to 22.5°C in July. Negative temperature deviations predominated during late winter and early spring, with the largest anomaly recorded in February (-6.5°C), followed by April (-2.9°C) and March (-2.6°C). Conversely, warmer-than-average conditions occurred in January ($+1.9^{\circ}\text{C}$), May ($+0.8^{\circ}\text{C}$), June ($+2.3^{\circ}\text{C}$), and October ($+0.9^{\circ}\text{C}$). Monthly rainfall varied from 31.1 mm in February to 72.3 mm in May. Overall, the climatic conditions were characterized by below-average temperatures and above-average rainfall in February, March, and April, followed by relatively warm and less rainfall conditions during late spring and early summer.

The winter pea experiment followed a protocol with eight experimental treatments, including

seven fertilization products approved for organic farming and one unfertilized control.

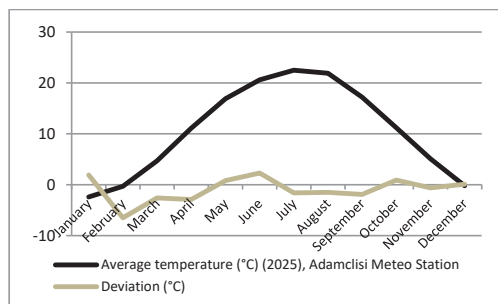


Figure 1. Average temperature, Adamclisi Meteo Station, 2025

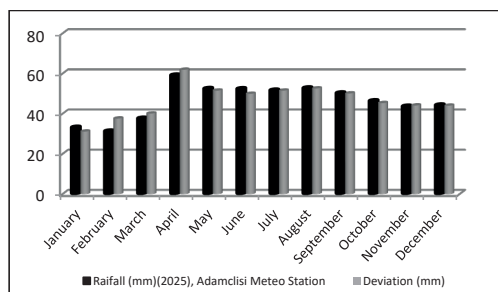


Figure 2. Rainfall (mm), Adamclisi Meteo Station, 2025

The trial was established as a single-factor experiment using a randomized complete block design with three replications. Each experimental plot covered an area of 12 m². The treatments were as follows: V1 - unfertilized control; V2 - Dolomite of Băița (minimum 92% calcium carbonate) applied at 1 t/ha soil during seedbed preparation (this product can be incorporated into the soil during seedbed preparation, applied at sowing, or used as a top-dressing during crop growth); V3 - Bio-Ceres NPK (pelletized organic poultry manure enriched with NPK 4-3-3 + 1% MgO) applied at 250 kg/ha and incorporated into the soil during seedbed preparation; V4 - granulated vermicompost produced by earthworms, applied at 25 kg/ha during seedbed preparation before sowing (incorporated at sowing depth); V5 - BlackJak liquid biostimulant containing a minimum of 28% organic matter, including humic, ulmic, and fulvic acids, applied before sowing at 4 L/ha; V6 - liquid Biohumus applied at 2 L/ha in combination with Etamin, an organic NPK biostimulant enriched with

micronutrients and L-amino acids, applied at 1 L/ha at crop emergence; V7 - Effective Microorganisms (EM), consisting of 500 mL EM-1 and 500 mL molasses, applied once before sowing and once at crop emergence; and V8 - Aminotop N biostimulant containing 30% amino acids, 2% humic substances, and 1.2% seaweed extract (*Ascophyllum nodosum*), applied at 1 L/ha in 300 L water/ha at crop emergence.

Winter wheat was the previous crop, and the winter pea cultivar used in the experiment was Frosen. This cultivar is characterized by high lodging resistance, frost tolerance down to -18°C , and high yield potential. Sowing density was of 90-100 germinating seeds/ m^2 , corresponding to a seeding rate of 200 kg/ha. Sowing was carried out on 14th November 2025. The crop management practices included shallow disc harrowing immediately after harvesting the preceding crop during the second half of July. Seedbed preparation was performed using a Tiger cultivator (Gruber) at a depth of 15-18 cm before sowing. Disease and pest control consisted of a single application of the insecticide-fungicide Bioprotekt at a rate of 0.5 L/ha during the second half of April, when the presence of the major pests and diseases was detected in the crop. The treatment targeted anthracnose (*Ascochyta pisi*), pea moth (*Cydia nigricana*), and pea weevil (*Bruchus pisorum*), which are among the most common and economically important biotic constraints affecting pea production. Throughout the growing season, numerous observations and measurements were performed. This paper present the results obtained at harvest, including plant height, number of nodes/stem, leaflets/ stem, number of pods/plant, and plant density at harvest (plants/ m^2). The experimental data were analyzed by calculating treatment means of variants and replications.



Figure 3. Organic autumn pea experiment (2025, Adamclisi, Experimental Field)

RESULTS AND DISCUSSIONS

Height of pea plants. The tallest plants were recorded in V7 (Effective Microorganisms), with a mean height of 83.53 cm, representing an increase of 6.00 cm (7.74%) compared to the control variant (77.53 cm). This was followed by V2 (Dolomite of Baita), which reached 82.27 cm, an increase of 4.74 cm (6.11%) over the control. Intermediate values were observed for V4 (Granulated vermicompost) and V5 (Blackjak biostimulant), both producing an average plant height of 80.90 cm, corresponding to an increase of 3.37 cm (4.35%) relative to the control. The Aminotop N (V8) treatment resulted in a modest increase to 78.27 cm, which is 0.74 cm (0.95%) higher than the control. In contrast, Bio-Ceres NPK (V3) showed a plant height (77.43 cm) similar to the control, while Biohumus + Etamin (V6) produced the shortest plants (76.87 cm), 0.66 cm (0.85%) lower than the control. Overall, the treatments based on Effective Microorganisms (EM) and Dolomite of Baita had the most pronounced positive effect on plant height, whereas Bio-Ceres NPK and Biohumus Etamin did not improve plant height under the conditions of this experiment (Figure 4).

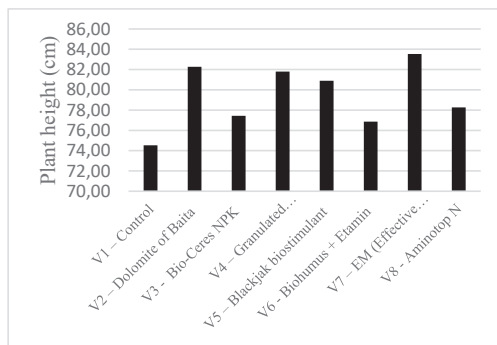


Figure 4. Plants height at harvesting (cm)

Number of nodes/stem. The average number of nodes per stem ranged from 7.63 nodes/stem (V3 - Bio-Ceres NPK) to 12.57 nodes/plant (V5 - Blackjak biostimulant). Compared to the control (10.87 nodes/stem), the highest values were recorded for V5 - Blackjak biostimulant (12.57 nodes/stem) and V7 - Effective Microorganisms (12.30 nodes/stem), whereas V3 - Bio-Ceres NPK showed the lowest value (Figure 5).

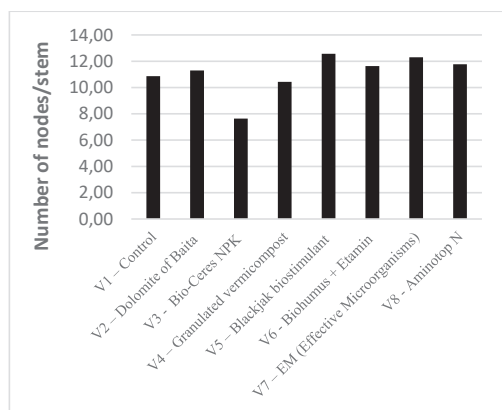


Figure 5. Number of nodes/stem

Number of folioles/plant. Number of folioles per plant ranged from 15.27 folioles/plant in V3 - Bio-Ceres NPK to 25.13 folioles/plant in V5 - Blackjak biostimulant. Compared with the control (21.73 folioles/plant), the higher values were recorded for V5 - Blackjak biostimulant (25.13 folioles/plant), V7 - Effective Microorganisms (24.60 folioles/plants), V8 - Aminotop N (23.53 folioles/plant), V6 - Biohumus + Etamin (23.27 folioles/plant), and V2 - Dolomite of Baita (22.60 folioles/plant). The lowest value was observed in V3 - Bio-Ceres NPK (15.27 folioles/plant). These results indicate that most treatments increased the number of leaves per plant compared to the control, whereas Bio-Ceres NPK reduced this parameter under the experimental conditions (Figure 6).

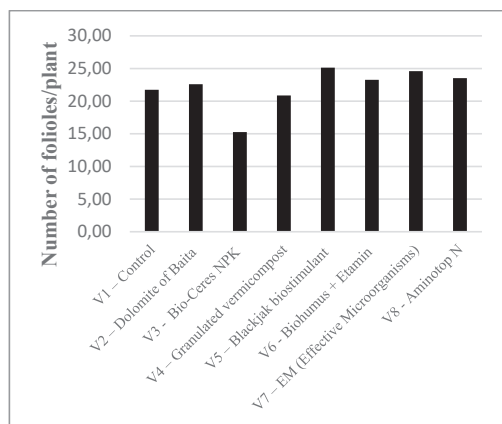


Figure 6. Number of folioles/plant

Number of pods/plant. As shown in Figure 7, the average number of pods per plant ranged from 7.33 in V7 - Effective Microorganisms to 10.43 in V5 - Blackjak biostimulant. Compared to the control variant (8.40 pods/plant), V5 - Blackjak biostimulant recorded the highest average value, while V7 - Effective Microorganisms showed the lowest value. The remaining treatments produced values close to the control, varying between 7.93 and 8.53 pods/plant. The treatments showed only moderate variation in this parameter, with Blackjak biostimulant producing the highest average response under the experimental conditions (Figure 7).

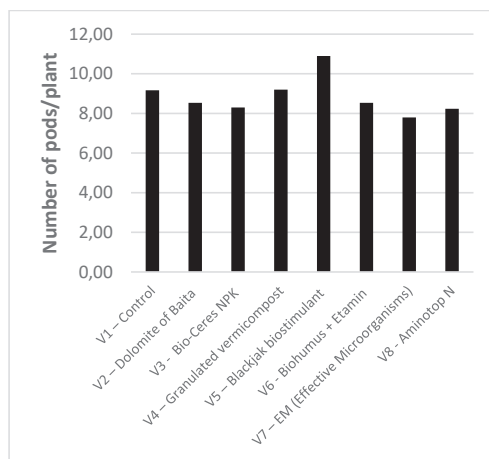


Figure 7. Number of pods/plant

Plant density at harvesting (plants/m²). The highest average plant density was obtained with Biohumus + Etamin (V6), followed by Blackjak biostimulant (V5) and Effective Microorganisms (V7). Harvestable plant density ranged from 55.33 plants/m² in the untreated control variant (V1) to 81.33 plants/m² in V6 - Biohumus + Etamin. Compared to the control, all treatments increased the harvestable plant density, with the highest values recorded for V6 - Biohumus + Etamin (81.33 plants/m), V5 - Blackjak liquid biostimulant (80.33 plants/m²), and V7 - Effective Microorganisms (79.33 plants/m²). These results suggest that the application of biostimulants and biofertilizers improved plant establishment and survival until harvest under the experimental conditions (Figure 8).

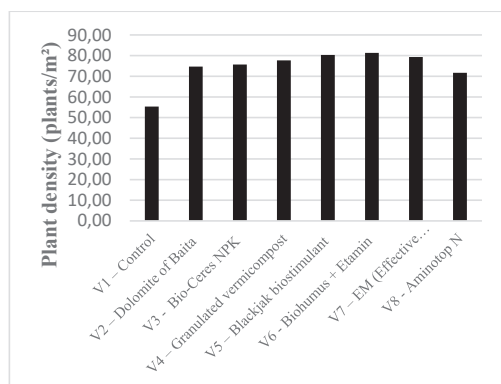


Figure 8. Plant density at harvesting (plants/m²)

Grain mass/plant. Grain mass per plant ranged from 3.25 g in V3 (Bio-Ceres NPK) to 3.80 g in V6 (Biohumus + Etamin). Compared to the control (3.70 g), the highest values were recorded for V6 (Biohumus + Etamin) and V7 (Effective Microorganisms), whereas the lowest value was observed in V3 (Bio-Ceres NPK). Overall, most treatments produced grain mass values comparable to or slightly higher than the control, except for Bio-Ceres NPK and Aminotop N (Figure 9).

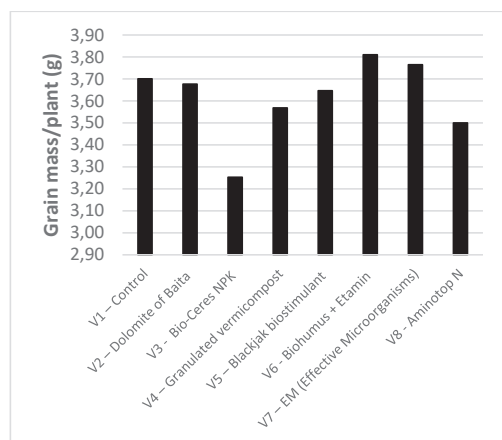


Figure 9. Grain mass/plant (g)

CONCLUSIONS

The application of the tested biostimulants and biofertilizers influenced the vegetative growth of pea plants and grain mass/plant. Although numerical differences were observed among treatments, not all measured parameters were significantly affected.

Plant height was not significantly influenced by the applied treatments indicating that none of the products substantially altered stem elongation under the experimental conditions.

Similarly, the number of pods per plant did not differ significantly among treatments, suggesting that pod formation was relatively stable regardless of the applied treatment.

In contrast, the number of nodes per stem was significantly affected by the treatments. The Blackjak liquid biostimulant (V5) produced the highest mean number of nodes, whereas Bio-Ceres NPK (V3) recorded the lowest value, indicating that these products differed in their influence on vegetative development.

The number of folioles per plant was generally higher in plants treated with Blackjak liquid biostimulant, Biohumus + Etamin, and Effective Microorganisms, while Bio-Ceres NPK consistently resulted in lower values. Harvestable plant density was also improved by all treatments compared with the untreated control, with the highest plant density recorded for Biohumus + Etamin (V6), followed by Blackjak liquid biostimulant (V5) and Effective Microorganisms (V7).

Overall, the treatments based on Blackjak liquid biostimulant, Biohumus + Etamin, and Effective Microorganisms showed the most consistent positive effects across the evaluated parameters. Conversely, Bio-Ceres NPK generally resulted in lower values for several vegetative traits, indicating a less favorable response under the conditions of this experiment.

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