Scientific Papers. Series A. Agronomy, Vol. LXIX, No. 1, 2026
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

EFFECTS ON WINTER OILSEED RAPE YIELD OF SOME BIOSTIMULATORS APPLIED IN THE SPRING

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Abstract

In the actual context of climate change which is a global challenge for agriculture, there is a need for new solutions and strategies to minimize the negative impact of stress factors during the growing season of winter oilseed rape. The use of biostimulators is one of the solutions, and therefore, their use has become an important component of crop technology. Starting from these aspects, the aim of the performed research was to identify the effects of the spring application of some biostimulators on grain yield at winter oilseed rape in the specific growing conditions of South Romania. In this respect, research was performed in the years 2023, 2024, and 2025, in field experiments under rainfed conditions having the following experimental variants: v1 - no biostimulator treatment, which was taken as the control variant; v2 - Cropmax biostimulator, applied at a rate of 1 l/ha; v3 - Aminosol biostimulator, applied at a rate of 1 l/ha; v4 - Algamax Fluid biostimulator, applied at a rate of 1.5 l/ha. The obtained results showed that using biostimulators in winter oilseed rape cultivation represents a way to increase the grain yield regardless of the climatic conditions. The yield increase due to the biostimulator application is more consistent the more favorable the year is from a climatic point of view.

Key words*: winter oilseed rape, biostimulator, spring application, grain yield.*

INTRODUCTION

Oilseed rape (*Brassica napus* L.) is one of the most important oil crops in the word, with an increasing cultivated area and production over the last 60 years (according to FAOSTAT database), ranking third in the world oil production, after palm oil and soybean oil. In Europe, it is widely cultivated in temperate and cool continental regions, this being particularly valued for its healthy, high-quality oil and its high oil content in seeds (Kaya et al., 2026). Oilseed rape was introduced into cultivation in Romania in the 1840s-1850s, the cultivated areas and the obtained yields registering significant variations over time, the cultivated area starting to increase significantly after 1996 (Ion, 2021) reaching 800,000 ha in 2025 (INS, 2026).

Optimal conditions for plant growth and development are key to increasing winter oilseed rape yields (Dubis et al., 2018), these conditions being achievable through cultivation technology. Indeed, agricultural technology is transforming the way we farm, offering solutions to the many challenges facing the agricultural industry today (Yanog, 2024).

The main problem in the technology of growing winter oilseed rape comes down to overcoming adverse consequences in the early and late development of plants, which leads to the failure of the sown areas or unsatisfactory yields with low quality indicators (Mihaylov, 2024).

It seems highly probable that boosting natural plant defense strategies by applying biostimulators will help to solve an old problem of poor yield in plant cultivation, by provoking their better growth and development even under suboptimal environmental conditions (Posmyk and Szafranska, 2016).

Biostimulators are substances applied to plants, intended to improve their status by helping them to grow and develop well and to go well through periods of stress (Adam et al., 2025). Also, the biostimulator application increase the agronomic effectiveness of fertilization (Nowak et al., 2021). Practically, they contain a bioactive substance that improves plant growth, increases nutritional efficiency and tolerance to abiotic stress, improves plant protection against

pathogens and improves plant traits and yield quality (Bulgari et al., 2019; Calvo et al., 2014; du Jardin, 2015; Hayat et al., 2012; Kolomazník et al., 2012; Kumar & Aloke, 2020; Petrova et al., 2023; Ruzzi et al., 2024; Sikorska et al., 2018; van Oosten et al., 2017; Xu and Geelen, 2018).

According to Regulation (EU) 2019/1009 of the European Parliament and of the Council, a plant biostimulator shall be an EU fertilizing product the function of which is to stimulate plant nutrition processes independently of the product's nutrient content with the sole aim of improving one or more of the following characteristics of the plant or the plant rhizosphere: nutrient use efficiency, tolerance to abiotic stress, quality traits, or availability of confined nutrients in the soil or rhizosphere.

Biostimulators are based mainly on the following bioactive substance: humic substances, seaweed extracts, hydrolysed proteins and amino acids, plant extracts, inorganic compounds, beneficial microorganisms, chitosan and other biopolymers (Grammenou et al., 2023).

Many scientific studies have demonstrated the potential of various categories of biostimulants to improve crop production and to ameliorate abiotic stresses such as drought and soil salinity (Calvo et al., 2014). Improving the effects of abiotic stress is the most commonly mentioned benefit of using biostimulants (Rouphael et al., 2017; Yakhin et al., 2017).

The current agricultural system is in search of new strategies to achieve a more sustainable production while keeping or even increasing crop yield and quality, in this scenario, the application of biostimulants being a potent solution (Ancín et al., 2024). Biostimulators have been identified as one of the most important agronomic factors that scientists have been looking for in a range of natural sources over the last few decades (Yaseena and Takacs-Hajosa, 2022). Although biostimulators were initially designed as a helpful tool mainly in organic farming, they are now used in all cropping systems (organic, conventional, and integrated) in the open field and protected cultivation (Ruzzi et al., 2024).

Biostimulators are increasingly integrated into production systems with the goal of modifying physiological processes within the plants (Yakhin et al., 2017), their application being an important part of intensive agriculture (Petrova et al., 2023). While these products have long been staples of farming systems, the growing demand for sustainable and innovative solutions has created new opportunities for biostimulants (Starr et al., 2026). Indeed, the use of natural growth stimulants is becoming an increasingly common practice in agriculture (Sikorska et al., 2018).

It is clear there is a need for new solutions and strategies to minimize the negative impact of stress factors during the growing season of the winter oilseed rape, the use of biostimulators being one of the solutions. On the other hand, although biostimulants have shown great potential, there is still much to learn about how they work and how to maximize their benefits taking into account their effectiveness depends on crop type, dose, and timing (Carillo et al., 2025). Starting from this idea, the aim of the performed research was to identify the effects of the spring application of some biostimulators on grain yield at winter oilseed rape in the specific growing conditions of South Romania

MATERIALS AND METHODS

Research was performed in the years 2023, 2024, and 2025, in field experiments under rainfed conditions located in South Romania (about 30 km northeast of Bucharest). The experiments were organized as macro-plots with 3 replications, having the following experimental variants:

- V1 - no biostimulator treatment, which was taken as the control variant;
- V2 - Cropmax biostimulator, applied at a rate of 1 l/ha;
- V3 - Aminosol biostimulator, applied at a rate of 1 l/ha;
- V4 - Algamax Fluid biostimulator, applied at a rate of 1.5 l/ha.

Cropmax is a plant biostimulator with a combination of macronutrients, micronutrients, amino acids, vitamins, polysaccharides, enzymes, and other substances.

Aminosol is a plant biostimulator based of amino acids and peptides produced by enzymatic hydrolysis of animal protein.

Algamax Fluid is a plant biostimulator with bioactive compounds (carbohydrates, amino

acids, macronutrients and micronutrients) extracted from *Ascophyllum nodosum*.

In all experimental years, the biostimulators were applied in the BBCH 31 phase (one visibly extended internode) of the oilseed rape plants.

The preceding crop was winter wheat in all experimental years. Tillage consisted of a passage after harvesting the preceding crop with the cultivator Tiger 3 MT at a depth of 30 cm. The seedbed was prepared before sowing by a passage with a cultivator.

In autumn, before seedbed preparation, the complex fertilizer 20:20:0 + 13S was applied in a rate of 300 kg/ha for all the experimental variants, which provided 60 kg/ha of nitrogen, 60 kg/ha of phosphorus, and 39 kg/ha of sulphur. Early in the spring, 143.5 kg/ha of Urea (46% nitrogen content) was applied, assuring a nitrogen rate of 66 kg/ha. In the BBCH 50 phase (flower buds present, still enclosed by leaves) of the oilseed rape plants, 126 kg/ha of CAN (Calcium Ammonium Nitrate, with 27% nitrogen content, respectively 13.5% NH_4^+ and 13.5% NO_3^-, plus 7% CaO, and 5% MgO) was applied, this providing a nitrogen rate of 34 kg/ha. In total, the nitrogen rate was 160 kg/ha (60 kg in autumn, before seedbed preparation + 66 kg early in the spring + 34 kg in the BBCH 50 phase).

The macro-plots had 0.333 ha for each replication, which means 1 ha for each experimental variant and 4 ha in total for the experimental field.

The oilseed rape hybrid used in the experimental field was PT298 (a mid-early hybrid with high yielding potential). The sowing was performed as follows: on 20th of August in 2022; on 11th of September in 2023; on 4th of September in 2024. In all experimental years, the sowing density was 50 germinating seeds per square meter.

In autumn, one herbicide was applied to control monocotyledonous weeds and one insecticide was applied to control pests. In the years 2023 and 2024, one herbicide was applied also in spring to control monocotyledonous weeds and one herbicide to control dicotyledonous weeds.

Pest control was carried out by applying three insecticides in the spring of 2023 and four insecticides in 2024 and 2025.

Disease control was carried out by applying two fungicides in the spring of 2023 and 2024 and three fungicides in 2025.

The harvest of macro-plots on replications for each experimental variant was done using a harvester machine, and after that, the grains were weighed. The seed moisture content was determined using a Portable Moisture Analyser. The grain yield was calculated per hectare and it was expressed in kg reported at 9% moisture content.

The soil where the field experiments were located each year is cambic chernozem. According to the physical plot where the field experiment was located each year, pH varies between 5.77 and 5.96, the organic matter content between 2.25% and 2.65%, and the nitrogen index between 1.82 and 2.15.

From a climatic point of view, the experimental years were characterized as follows for winter oilseed rape: the year 2025 was the most favourable, with good rainfall in the previous autumn and a large amount of precipitation (130.3 mm) in May, during the period of grain setting and filling; the year 2023 comes second as favourability, with high amount of rainfall in April, May, and June, and with not so high temperatures; the year 2024 was the least favourable, with high temperatures in spring and less rainfall.

RESULTS AND DISCUSSIONS

In all the experimental years, all the experimented biostimulators determined higher grain yields compared to control variant (with no biostimulator) (Table 1 and Figure 1). Also in all the experimental years, the highest grain yields were registered for the biostimulator Algamax Fluid, but while the difference compared to control variant was not statistically significant in the year 2023, this was significant in 2024 and very significant in 2025 (Table 1).

In the year 2023, no biostimulator treatment registered differences statistically significant compared to control variant. In the year 2024, only the treatment with the biostimulator Algamax Fuid registered a difference statistically significant compared to control variant, but in the years 2025 all the three experimented biostimulators registered differences statistically as being very significant compared to control variant (Table 1).

Compared to control variant, the experimented biostimualtors determined differences from

33 to 186 kg/ha in the year 2023, from 53 to 345 kg/ha in the year 2024, and from 665 to 756 kg/ha in the year 2025 (Table 1).

The biostimulator Algamax Fuid had the smallest coefficient of variation between years (10.21%) of all the three biostimulators taken into experience. The highest coefficient of variation between years (13.3%) was registered for the biostimulator Cropmax. The control variant with no biostimulator applied registered a smaller coefficient of variation (7.63%) compared to the variants treated with biostimulators (Table 1). This suggest that, compared to the untreated variant, the use of biostimulators induces a higher variation of the grain yield from year to years, according to the climatic favorability of the year.

The highest grain yields, but also the highest differences to control variant were registered in the favorable climatic year 2025. The climatic favorability of the year 2025 made the oilseed rape plants to make maximum use of the biostimulator products. In less favorable climatic conditions of the years 2023 and 2024, the effects determined by the biostimulator products were less consistent. However, it stood out the biostimulator Algamax Fuid based on extracts from *Ascophyllum nodosum* in the worst climate year 2024 with a consistent difference compared to control variant of 345 kg/ha (Table 1).

Table 1. Grain yield and coefficient of variation between years (2023-2025) at oilseed rape treated with biostimulators

Experimental variants	2023		2024		2025		Coefficient of variation between years (%)
	Yield (kg/ha)	Difference to control (kg/ha)	Yield (kg/ha)	Difference to control (kg/ha)	Yield (kg/ha)	Difference to control (kg/ha)	
Control – no biostimulator	3672	0	3107	0	3670	0	7.63
Cropmax	3814	142	3184	77	4424	754 ***	13.30
Aminosol	3705	33	3160	53	4335	665 ***	12.86
Algamax Fluid	3858	186	3452	345 *	4426	756 ***	10.21
$DL_{5\%}$		*262.82*		*279.52*		*251.92*	
$DL_{1\%}$		*382.38*		*406.67*		*366.53*	
$DL_{0.1\%}$		*574.55*		*611.04*		*550.72*	

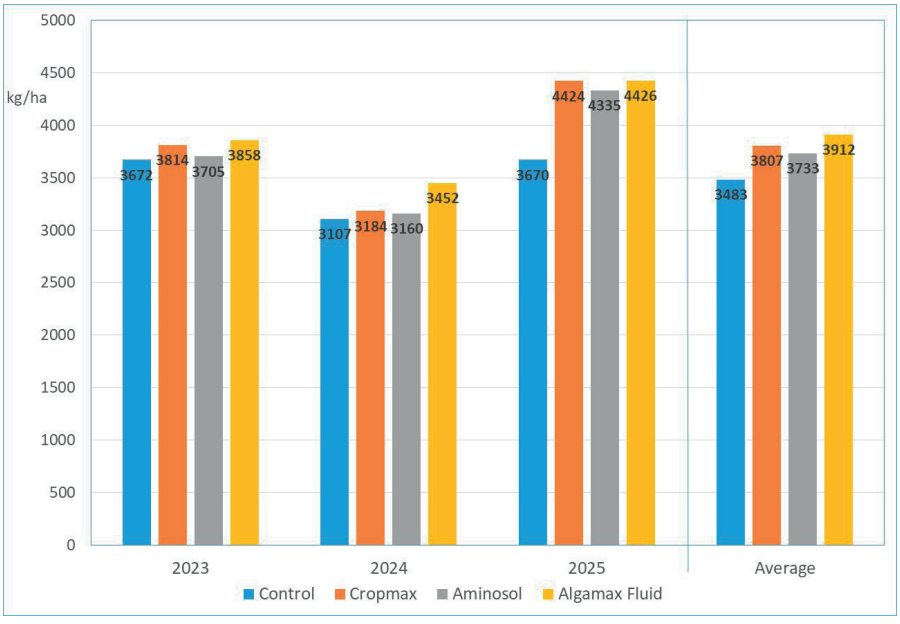

Figure 1. Grain yield at oilseed rape treated with biostimulators, in 2023-2025 period

As average values for the three experimental years, Algamax Fuid determined a difference compared to the control variant of 429 kg/ha, Cropmax determined a difference compared to the control variant of 324 kg/ha, and Aminosol determined a difference compared to the control variant of 250 kg/ha (Figure 1).

CONCLUSIONS

The obtained results showed that using biostimulators in winter oilseed rape cultivation represents a way to increase the grain yield regardless of the climatic conditions.

Compared to the untreated variant, the use of biostimulators induces a higher variation of the grain yield from year to years, according to the climatic favorability of the year. Practically, the yield increase due to the biostimulator application is more consistent the more favorable the year is from a climatic point of view.

Among the experimented biostimulators, it stood out the biostimulator Algamax Fuid based on extracts from *Ascophyllum nodosum* with the highest grain yields and with a consistent difference compared to control variant in the worst climate year 2024.

REFERENCES

Adam, L., Hermeziu, M., Ion, V. (2025). Effects of some biostimulators at two potato cultivars cultivated at different plant densities. *Scientific Papers. Series A. Agronomy, Vol. LXVIII*, No. 1, 235–245.

Ancín, M., Soba, D., Picazo, P.J., Gámez, A.L., Le Page, J.-F., Houdusse, D. et al. (2024). Optimizing oilseed rape growth: Exploring the effect of foliar biostimulants on the interplay among metabolism, phenology, and yield. *Physiologia Plantarum, 176*(5), e14561.

Bulgari, R., Franzoni, G., Ferrante, A. (2019). Biostimulants application in horticultural crops under abiotic stress conditions. *Agronomy, 9*, 306.

Calvo, P., Nelson, L., Kloepper, J.W. (2014). Agricultural uses of plant biostimulans. *Plant Soil, 383*, 3–41.

Carillo, P., Avice, J.-C., Vasconcelos, M.W., du Jardin, P. and Brown, P.H. (2025). Biostimulants in Agriculture: Editorial. *Physiologia Plantarum, 177*, e70046.

Du Jardin, P. (2015). Plant biostimulants: definition, concept, main categories and regulation. *Sci. Hortic. 196*, 3–14.

Dubis, B., Reich, M., Jankowski, K.J. (2018). The influence of biostimulators on winter oilseed rape. Sborník z konference "Prosperující olejniny", 4.-6.12, 61–62.

FAOSTAT, https://www.fao.org/faostat/en/#data.

Grammenou, A., Petropoulos, S., Thalassinos, G., Rinklebe, J., Shaheen, S., Antoniadis, V. (2023). Biostimulants in the Soil–Plant Interface: Agro-environmental Implications – A Review. *Earth Systems and Environment, 7*, 583–600.

Hayat, S., Hayat, Q., Alyemeni, M.N., Wani, A.S., Pichtel, J., Ahmad, A. (2012). Role of proline under changing environments: a review. *Plant Sign. Behav. 7*(11), 1456–1466.

INS (2026). Producția vegetală la principalele culturi în anul 2025 (Vegetal production of the main crops in 2025). Institutul Național de Statistică, București.

Ion, V. (2021). Rapița (*Oilseed rape*). In: Ion, V., Bășa, A.G. (Ed.), *Fitotehnie – Plante oleaginoase (Phytotechnics – Oil Crops)*, Editura Ex Terra Aurum, București, pp. 208-357.

Kaya, M.D., Ergin, N., Kulan, E.G., Yaman, E. (2026). Evaluation of foliar-applied biostimulants and nutrients for enhancing drought tolerance in canola (*Brassica napus* L.). *Chilean Journal of Agricultural Research, 86*(5), 832–844.

Kolomazník, K., Pecha, J., Friebrová, V., Janáčová D., Vašek, V. (2012). Diffusion of biostimulators into plant tissues. *Heat and Mass Transfer, 48*(9), 1505–1512.

Kumar, H.D., Aloke, P. (2020). Role of Biostimulant Formulations in Crop Production: An Overview. *International Journal of Agricultural Sciences and Veterinary Medicine, 8*(2), 38–46.

Mihaylov, B. (2024). Response of winter canola (*Brassica napus* L.) to treatment with growth regulators and biostimulators - A review. *Scientific Papers. Series A. Agronomy, Vol. LXVII, No. 1*, 544-553.

Nowak, R., Szczepanek, M., Błaszczyk, K. (2021). Effect of biostimulant application on winter oilseed rape yield under different NPK and S fertilization. *Acta Sci. Pol. Agricultura, 20*(4), 171–180.

Petrova, I., Ivanova, S., Stoyanova, S., Mincheva, R., Pavlova, M. (2023). Infuence of biostimulants and humic extracts treatment on the fatty acid profle of the spring oilseed rape variety. *Agricultural Science and Technology, 15*(1), 52–59.

Posmyk, M.M., Szafranska, K. (2016) Biostimulators: A New Trend towards Solving an Old Problem. *Front. Plant Sci. 7*: 748.

Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003.

Rouphael, Y., Colla, G., Giordano, M., El-Nakhel, C., Kyriacou, M.C., De Pascale, S. (2017). Foliar applications of a legume-derived protein hydrolysate elicit dose dependent increases of growth, leaf mineral composition, yield and fruit quality in two greenhouse tomato cultivars. *Scientia Horticulturae, 226*, 353–360.

Ruzzi, M., Colla, G., Rouphael, Y. (2024). Editorial: Biostimulants in agriculture II: towards a sustainable future. *Front. Plant Sci. 15*, 1427283.

Sikorska, A., Gugała, M., Zarzecka, K. (2018). Response of winter rapeseed to biostimulator application and

sowing method. Part II. Seed yield components. *Acta Sci. Pol. Agricultura, 17*(4), 215–223.

Starr, M., Unruh-Snyder, L., Gatiboni, L., Jayaratne, K. (2026). Biostimulants in Modern Agriculture: A Comprehensive Review with Emphasis on Protein Hydrolysates. *Phyton-International Journal of Experimental Botany, 95*(4), 2.

Van Oosten, M.J., Pepe, O., DE Pascale, S., Silletti, S., Maggio, M. (2017). The role of biostimulants and bioeffectors as alleviators of abiotic stress in crop plants. *Chem. Biol. Tehnol. Agric., 4:5*, 1–12.

Yanog, H. (2024). Agricultural Technology: Transforming the Future of Farming. *African Journal of Food Science and Technology, 15*(9), 01–02.

Yakhin, O.I., Lubyanov, A.A., Yakhin, I.A., Brown, P.H. (2017). Biostimulants in Plant Science: A Global Perspective. *Front. Plant Sci., 7*, 2049.

Yaseena, A.A., Takacs-Hajosa, M. (2022). The effect of plant biostimulants on the macronutrient content and ion ratio of several lettuce (*Lactuca sativa* L.) cultivars grown in a plastic house. *South African Journal of Botany, 147*, 223–230.

Xu, L., Geelen, D. (2018). Developing Biostimulants from Agro-Food and Industrial By-Products. *Frontiers in Plant Science, 9*. 1567.