YIELD AND QUALITY OF ROUND PEPPER FRUITS - INFLUENCE OF CALCIUM NITRATE AND BIOSTIMULANTS

PRODUCȚIA ȘI CALITATEA FRUCTELOR DE ARDEI GOGOȘAR - INFLUENȚA NITRATULUI DE CALCIU ȘI A BIOSTIMULATORILOR

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Abstract.
The study aims to investigate the effect of using calcium nitrate, simple or combined with different biostimulants on the quantity and quality of round pepper fruits (Capsicum annuum L. var. grossum). The biological material used consisted of the cultivar "Asteroid 204". Three foliar treatments were applied, from fruit setting, with calcium nitrate alone or in combination with three seaweed-based biostimulants (Agrocean B, E-Dalgin and Kelpak), two based on microorganism inoculum (Triptolemus HV and Albit), and three mixed bistimulants (Sprintene, Kinactiv Fruit and Rerum). The mass of a fruit, the number of fruits per plant and the yield were determined, and for the assessment of quality - the firmness and thickness of the pulp, the total dry matter content, the total soluble solids, and the level of titratable acidity. The combined use of calcium nitrate with various biostimulants, such as Kelpak, Sprintene, Kinactiv Fruit or Rerum, increases production and improves some quality traits.
Key words: biostimulatori, calitatea fructelor, *Capsicum annuum*, producție

Rezumat.
Studiul are ca scop investigarea efectului utilizării azotatului de calciu, simplu sau combinat cu diferiți biostimulatori asupra cantității și calității fructelor de ardei gogoșar (Capsicum annuum L. var. grossum). Materialul biologic utilizat a constat în cultivarul "Asteroid 204". S-au aplicat trei tratamente foliare, de la formarea fructelor, cu nitrat de calciu singur și în combinație cu trei biostimulatori pe bază de alge marine (Agrocean B, E-Dalgin și Kelpak), doi pe bază de inocul de microorganisme (Triptolemus HV și Albit), și trei bistimulatori micști (Sprintene, Kinactiv Fruit și Rerum). Au fost determinate masa medie a unui fruct, numărul de fructe pe plantă și producția, iar pentru aprecierea calității - fermitatea și grosimea pulpei, conținutul de substanță uscată totală, totalul solidelor solubile, și nivelul acidității titrabile. Utilizarea

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combinată a nitratului de calciu cu diferiți biostimulatori, precum Kelpak, Sprintene, Kinactiv Fruit sau Rerum determină creșterea producției și îmbunătățirea unor caractere calitative.
Cuvinte cheie: biostimulants, *Capsicum annuum*, fruit quality, yield

INTRODUCTION

In recent years, a clear trend has been observed to reduce the application of mineral fertilizers in agriculture, especially those nutrients applied to the soil, such as nitrogen (N), phosphorus (P) and potassium (K) [Jin *et al*., 2022]. In parallel, foliar fertilization has become a method used to supplement macro- and micronutrients, as well as to administer plant hormones, stimulants and other beneficial substances to plants. Although foliar spraying cannot replace soil fertilization, it can be used as an additional strategy within sustainable agricultural practices [Kannan, 2010]. Foliar spray application is a crop management strategy, helping to maximize agricultural yields [Ciucu-Paraschiv and Hoza, 2022a; Ciucu-Paraschiv *et al*., 2023; Januszkiewicz *et al.,* 2025; Panayotov, 2004; Zong *et al.,* 2011], as well as increasing drought tolerance and improving the quality of agricultural crops [Botella *et al.,* 2017; Ciucu-Paraschiv and Hoza, 2021; Ciucu-Paraschiv and Hoza, 2022b; Fageria *et al.,* 2009; Stoica *et al.,* 2024]. The response of plants to foliar fertilization depends on the species cultivated, the form and concentration of the fertilizer, as well as the frequency and timing of application, depending on the stage of plant development. Kuepper [2003] and Lovatt [1999] have pointed out that foliar fertilization is becoming increasingly widespread in modern agriculture, due to its increased efficiency and ecological advantages compared to soil fertilization. Nutrient uptake through foliage can occur much more rapidly compared to soil nutrition [Fernández and Eichert, 2009; Kannan, 2010; Lester *et al.,* 2006; Weinbaum, 1988].

Round pepper (*Capsicum annuum* L.) is a very popular horticultural plant in Romania, due to its economic importance and the nutritional value of its fruits. Pepper is a valuable source of bioactive nutrients, including vitamin C, carotenoids (provitamin A) and phenolic compounds, which contribute to its nutritional profile and antioxidant activity [Abu-Zahra, 2011]. Production is carried out both in open fields and in greenhouses. Agricultural management practices play a fundamental role in the development of this crop. Recently, interest in foliar fertilization of peppers has increased, which is supported by several studies [Baloch *et al.,* 2008; López *et al.,* 2013; Maheswari and Haripriya, 2008; Rubio *et al.,* 2009]. Panayotov [2004] analyzed various doses of foliar fertilizer to evaluate the effects on vegetative growth and pepper production.

Calcium nitrate is an important source of calcium, which can be applied both by fertigation and foliar application to peppers, with a role in reducing the risk of fruits suffering from apical rot, a metabolic defect that can often occur in pepper fruits [Buczkowska *et al*., 2016; Marcelis and Ho, 1999].

Agriculture has increasingly turned to the use of inoculants of microorganisms and seaweed extracts for a sustainable and environmentally friendly approach. Biostimulants with beneficial microorganisms, such as *Trichoderma*, have an antimicrobial effect on diseases caused by bacteria and fungi [Drobek *et al.,* 2019]. These can be combined with fertilizers and contribute to pepper fruits growth and quality, promoting root development, nutrient absorption and resistance to abiotic and biotic factors [Duan *et al.,* 2023; Toader *et al.,* 2022]. Production can increase up to 30% after *Trichoderma* treatments [Benítez *et al.,* 2004]. Although they are mainly used for soil treatments, some studies indicate the potential for their use as foliar treatments on peppers [Saxena *et al.,* 2016].

Seaweed extracts, rich in nutrients, amino acids, vitamins and growth hormones, stimulate plant development and have been used in agriculture for a long time [Crouch and Van Staden, 1993]. They act as biofertilizers or biostimulants, due to their ability to fix carbon dioxide and nutrients [Piwowar and Harasym, 2020]. Brown macroalgae species, richer in essential elements for growth, are the most used [Pereira, 2021]. Studies indicate positive responses of pepper to seaweed treatments, with increases in fruit yield [Salazar-Salazar *et al.,* 2022]. However, research on the effects of seaweed on pepper is limited and requires further study.

Also, given the interest in increasing the nutritional value of foods, the purpose of this work was to examine the effect of calcium nitrate, administered with or without other nutrients, on the quality of pepper fruits and their yield.

MATERIAL AND METHOD

The present experience was carried out in 2025, within the Research and Development Institute for Vegetable and Flower Growing Vidra, between May and September 2025.

The biological material consisted of seedlings of round pepper, cultivar Asteroid 204. It is the variety with the highest demand for seed, among the varieties for which RDIVFG Vidra is the author and maintainer. It is a semi-early variety of bell pepper, with large fruits that have a round, flattened shape, with 3-4 lobes, of a glossy dark red color at physiological and technological maturity (which coincide with this variety of pepper). The seedling was produced in the greenhouses of the institute.

The seedling was planted on 23th May, on ground mulched with black polyethylene film, with a distance of 70 cm between rows and 25 cm between plants in a row. Irrigation was done by drip. Treatments applied for diseases and pests were done the same, regardless of the experimental variant. Weed control was done by two manual and three mechanized weedings.

Foliar treatments were applied to the vegetation, depending on the experimental variant studied. Foliar treatments were carried out with simple calcium nitrate or combined with biostimulants of different types. Products available on the market, from several categories of preparations, were used as biostimulant preparations. Three biostimulant products based on seaweed (Agrocean B, E-Dalgin and Kelpak), two based on microorganism inoculum (Triptolemus HV and Albit), and three mixed bistimulants (Sprintene, Kinactiv Fruit and Rerum) were used. Their chemical composition is presented in table form (Table 1).

Three foliar treatments were applied with the prepared solutions, starting with the moment when the first fruit reached the typical size of the variety (BBCH 71). The treatments were applied at 14-day intervals. The solutions and treatments applied on each variant were the following:

V1 = untreated control;
V2 = pepper treated with calcium nitrate (5 g/L);
V3 = pepper treated with calcium nitrate (5 g/L) and Agrocean B (2 ml/L);
V4 = pepper treated with calcium nitrate (5 g/L) and E-Dalgin (2 ml/L);
V5 = pepper treated with calcium nitrate (5 g/L) and Kelpak (2 ml/L);
V6 = pepper treated with calcium nitrate (5 g/L) and Triptolemus HV (2 ml/L);
V7 = pepper treated with calcium nitrate (5 g/L) and Albit (2 ml/L);
V8 = pepper treated with calcium nitrate (5 g/L) and Sprintene (2 ml/L);
V9 = pepper treated with calcium nitrate (5 g/L) and Kinactiv Fruit (2 ml/L);
V10 = pepper treated with calcium nitrate (5 g/L) and Rerum (2 ml/L).

Table 1

Products used for the preparation of treatment solutions and their chemical composition

Product	Chemical composition
Calcinit	Total nitrogen – 15.5% (from nitric nitrogen NO_2 - 14.4% and ammoniacal nitrogen NH4 1.1%); calcium oxide CaO 26.5%
Agrocean B	60% *Laminaria digitata* extract *Laminaria digitata* concentrate - 597.72 g/L; N – 6.0% (w/w), P_2O_5 – 5.0% (w/w), K_2O – 5.0% (w/w), B – 2.5% (w/w), MgO – 5.0% (w/w)
E-Dalgin	Pure extract of *Ascophyllum nodosum*
Kelpak	Pure extract of *Ecklonia maxima*
Triptolemus HV	Mycorrhiza content: 0.1%; Rhizosphere bacteria content: 1 x 10^5 CFU/g; *Trichoderma* spp. content: 1.2 x 10^8 CFU/g
Albit	Poly-beta-hydroxybutyric acid; natural biopolymer synthesized from soil bacteria: *Bacillus magaterium* and *Aureofaciens pseudomonas*, min. 0.62 %; N - min. 7.5 %; P - min. 6 %; K - min. 4.5 %; Mg - min. 0.6 %; S - min. 2.7 %
Sprintene	Mn 1%, Zn 1%, organic matter 80%
Kinactiv Fruit	Free amino acids 4% (w/w), P_2O_5 – 12,0% (w/w), K_2O – 16,0% (w/w), B – 0,5% (w/w), Mo –0,05% (w/w), Cu – 0,002% (w/w), Fe – 0,2% (w/w), Mn 0,01% (w/w), Zn 0,002% (w/w)
Rerum	N - 0,5%; P - 0,5%; K - 0,5%; Fe - 0,15%; Zn - 0,075%; Mn - 0,075%; Cu - 0,075%; B - 0,03%; Co - 0,015%; Mo - 0,015%; ASFAC BCO-4 - 20%; Amino acids - 20%; MgO - 0,15%

At round pepper, technological ripening coincides with physiological ripening. The fruits were harvested at their specific color, a glossy dark red. As they were harvested, the fruits were counted and weighed, and the following measurements were made: the average number of fruits per plant (pieces), the average weight of a fruit (g) and the production per hectare (t/ha).

To evaluate the quality of the fruits, a series of analyses were carried out aimed at determining some essential physicochemical properties, as follows: average fruit weight, fruit firmness, pH and titratable acidity, total dry matter (DW) and total soluble solids (TSS) content. Each parameter was determined in triplicate for each fertilization variant. The force required to pierce the pepper fruit was measured at three locations: near the stem end, the center, and the top of the fruit. The three firmness measurements were averaged to obtain a single firmness value for each fruit. Firmness was measured using a Force Gauge PCE-FM 200 with a 6.5 mm probe; values were expressed in Newtons (N). The total dry matter (DW) content was expressed as a percentage (%), determined by the gravimetric method by drying 10 g of fruit tissue at 105°C to constant weight, according to Krełowska-Kułas [1993]. For the determination of total soluble substances (TSS), a portable digital refractometer (Model: HI96800, Hanna Instruments, USA) was used, and the results were reported in % Brix according to PN-90/A-75101/02. The pH of each juice sample was measured with the EUTECH Cyberscan pH 11 electronic pH meter (Singapore), using a glass electrode. Statistical analysis of all data was performed using SPSS software, version 20.0 (SPSS Inc., Chicago, IL, USA). Results are presented as mean ± standard error (SE) and were discussed by one-way ANOVA. Statistically significant differences were considered at the $p < 0.05$ level.

RESULTS AND DISCUSSIONS

The cultivar Asteroid 204 recorded an average yield of 48.82 ± 1.69 t/ha (range 42.38–69.65 t/ha) and 5.50 ± 0.47 fruits/plant (minimum 4.20 and maximum 6.38 fruits/plant). The average fruit weight was 168.46 ± 20.68 g (range 130.66–219.12 g). The average BER was 7.50 ± 3.42% (range 2.99–14.22%). The coefficients of variation indicate high variability for BER (45.6%), whereas the average fruit weight showed the lowest variability (12.28%). From the ANOVA results, foliar treatments significantly influenced yield, the number of fruits per plant, and BER, with effect sizes of 52.6%, 60.4%, and 85.2%, respectively. By contrast, the average fruit weight (g) was not significantly affected by the foliar treatments (Table 2).

Table 2

Effect of the fertilization variant on productivity parameters (yield, fruits per plant, average fruit weight) of the round pepper cultivar Asteroid 204

Evaluated component		Yield (t/ha)	Fruits/plant	Fruit weight (g)	BER (%)
Fertilization technique	Sig.	* (p=0.044)	* (p=0.011)	n.s. (p=0.203)	*** (p=0.000)
	Effect size (%)	52.6	60.4	38.2	85.2

*Significance letters and symbols refer to treatment effects. n.s. = non-significant; * = significant ($p \leq 0.05$); ** = highly significant ($p \leq 0.01$); *** = very significant ($p \leq 0.001$).

For all other quality characteristics, average values of the coefficients of variation were recorded mostly lower than those of the productivity parameters (from

5.16% to 14.42%). The ANOVA analysis revealed a very significant effect on the quality parameters: juice pH, TSS content (% Brix) and DW content (%) with effect size values of 79.50%, 30.10% (juice pH) and 21.8% (TSS content – % Brix). Pulp thickness (mm) was significantly influenced by the treatments applied; in this case, the effect size of the foliar treatments was only 8.30% (Tables 3 to 5).

Table 3

Effect of the fertilization variant on quality parameters (average weight, firmness, pH, TSS, DW and pulp thickness) of round pepper, cultivar Asteroid 204

Evaluated component		Firmness (N)	Juice pH	TSS content (% Brix	DW content (%)	Pulp thickness (mm)
Fertilization technique	Sig.	n.s. (p=0.086)	*** (p=0.000)	*** (p=0.000)	*** (p=0.000)	* (p=0.020)
	Effect size	12.7	30.1	21.8	79.5	8.30

Significance letters and symbols indicate the effects of treatments: n.s. = nonsignificant; * = p 0.05; ** = p ≤ 0.01; *** = p ≤ 0.001.

Table 4

Statistical descriptors (mean, median, standard deviation, coefficient of variation, minimum, and maximum) for the productivity parameters (yield, fruits per plant, average fruit weight)

Statistical descriptors	Yield (t/ha)	Fruits/ plant	Fruit weight (g)	BER (%)
Mean	52.46	5.22	168.46	7.50
Median	50.17	5.10	168.68	6.65
Std. deviation	7.85	0.66	20.68	3.42
Var. coeff.	14.96	12.64	12.28	45.6
Minimum	42.38	4.20	130.66	2.99
Maximum	69.65	6.38	219.12	14.22

Table 5

Statistical descriptors (mean, median, standard deviation, coefficient of variation, minimum, and maximum) for the quality parameters, firmness, juice pH, total soluble solids (TSS) content, dry weight (DW) content, and pulp thickness of the round pepper cultivar "Asteroid 204"

Statistical descriptors	Firmness (N)	Juice pH	TSS content (% Brix)	DW content (%)	Pulp thickness (mm)
Mean	25.45	5.04	7.35	7.65	6.85
Median	25.25	5.02	7.50	7.49	6.79
Std. deviation	1.95	0.26	1.06	0.84	0.95
Var. coeff.	7.66	5.16	14.42	10.98	13.87
Minimum	22.17	4.58	3,60	6.08	4.87
Maximum	32.09	6.91	9.20	9.15	9.89

The yield varied significantly following the treatments applied, with values ranging between a minimum of 44.86 t/ha and a maximum of 61.69 t/ha (Table 6). The highest yield was obtained in the case of the variant in which treatments with calcium nitrate + Sprintene product were used, with a value of 61.69 t/ha. The effect of this treatment was significantly higher both compared to the untreated variant (V1), and compared to some treated variants (V2 – treated with calcium nitrate; V3 – treated with calcium nitrate + Agrocean B; V7 – treated with calcium nitrate + Albit). Compared to the untreated variant, the increase was 37.52%.

With a yield that was not significantly lower than the best treatment, the combined treatment with calcium nitrate + Kelpak led to a significant increase compared to the variant in which no foliar treatments were used, with an increase of 33.33%, meaning an increase of 14.95 t/ha. This variant also differed significantly from the variant treated with calcium nitrate + Agrocean B. These results are consistent with some previous studies (Constantin et al., 2024), which indicate an increase in production determined by calcium nitrate + Kelpak treatments in round pepper.

Another variant that led to a significant increase in fruit yield was variant V10, in which treatments with calcium nitrate + Rerum were used. Compared to the untreated variant, this variant led to a 31.23% increase, meaning an increase of 14.01 t/ha.

Table 6

Influence of foliar treatments on fruit yield

Variant	Treatment	Yield (t/ha)	Fruits/ plant	Fruit weight (g)	BER (%)
V1	untreated	44.86 ± 3.09^{c}	5.02 ± 0.36^{bc}	150.04 ± 21.53^{b}	12.95 ± 0.74^{a}
V2	calcium nitrate (5 g/L)	48.82 ± 1.69^{bc}	5.50 ± 0.47^{abc}	149.04 ± 15.92^{b}	7.17 ± 2.93^{bcd}
V3	calcium nitrate (5 g/L) + Agrocean B (2 ml/L)	45.94 ± 4.43^{c}	4.60 ± 0.39^{c}	167.91 ± 29.06^{ab}	9.07 ± 1.02^{b}
V4	calcium nitrate (5 g/L) + E-Dalgin (2 ml/L	51.08 ± 8.41^{abc}	5.20 ± 0.64^{abc}	163.42 ± 13.06^{ab}	4.51 ± 1.35^{d}
V5	calcium nitrate (5 g/L) + Kelpak (2 ml/L)	59.81 ± 11.75^{ab}	5.96 ± 0.55^{ab}	166.27 ± 19.94^{ab}	6.38 ± 2.03^{bcd}
V6	calcium nitrate (5 g/L) + Triptolemus HV (2 ml/L)	50.89 ± 4.83^{abc}	5.15 ± 0.72^{abc}	166.35 ± 23.79^{ab}	4.37 ± 0.13^{d}
V7	calcium nitrate (5 g/L) + Albit (2 ml/L)	48.83 ± 4.00^{bc}	4.56 ± 0.33^{c}	179.09 ± 18.56^{ab}	13.01 ± 1.06^{a}
V8	calcium nitrate (5 g/L) + Sprintene (2 ml/L)	61.69 ± 5.75^{a}	6.08 ± 0.38^{a}	169.18 ± 10.22^{ab}	4.53 ± 1.65^{d}
V9	calcium nitrate (5 g/L) + Kinactiv Fruit (2 ml/L)	53.82 ± 6.03^{abc}	4.69 ± 0.18^{c}	191.85 ± 24.93^{a}	5.25 ± 1.48^{cd}
V10	calcium nitrate (5 g/L) + Rerum (2 ml/L)	58.87 ± 8.57^{ab}	5.40 ± 0.68^{abc}	181.47 ± 7.93^{ab}	7.71 ± 1.75^{bc}

*Duncan test: Significant differences ($p \le 0.05$) are indicated by mean values in a column that do not share the same letter (a, b, c).

The amount of **fruit/plant** was also significantly influenced by the treatments applied.

The highest fruit/plant yields were obtained for the variants treated with calcium nitrate + Sprintene (6.08 fruits/plant) and calcium nitrate + Kelpak (5.96

fruits/plant). However, only the variant treated with calcium nitrate + Sprintene (V8) led to significant differences compared to the untreated variant (V1), which yielded an average of 5.02 fruits/plant.

The other treatment options did not determine significant differences compared to the untreated option, in terms of the number of fruits/plant.

Some treatment variants led to a decrease in the number of fruits/plant compared to the untreated variant, but without being significantly different. This is the case of variants V3 (calcium nitrate + Agrocean B), V7 (calcium nitrate + Albit) and V9 (calcium nitrate + Kinactiv Fruit).

The fruit weight was significantly influenced and varied between 149.04 g and 191.84 g. The largest fruits were obtained in the case of the calcium nitrate + Kinactiv Fruit treatment, this being the only variant that determined significant increases in fruit mass, compared to the variant in which no treatments were used. The fruits were larger by a percentage of 27.86%, meaning an average of 41.8 g more. This variant also led to a significant difference compared to the variant treated with calcium nitrate (V2).

The percentage of fruits affected by blossom end rot had an average value between 4.37 and 13.01%. Except for the treatments with calcium nitrate + Albit (V7), all experimental variants led to a decrease in the percentage of affected fruits. The lowest percentage of affected fruits was obtained in the case of using the treatments with calcium nitrate + Triptolemus (V6), followed by the variants to which foliar treatments with calcium nitrate + E-Dalgin (V4) and with calcium nitrate + Sprintene (V8) were applied. These values led to a decrease in the percentage from 12.95% to 4.37-4.53%.

The firmness. The consistency and texture of the pulp contribute to the stability of the products against external pressures. In the case of red bell pepper, these characteristics are influenced by both the stage of maturity and the cultivation conditions [Jovicich *et al*., 2005; Pohrib and Petrache, 2011]. Research indicated that the water potential of the fruit at the time of harvest was greater in green peppers compared to red peppers, and that firmness diminished as the fruit changed color [Biles *et al*., 1993]. The firmness of the fruits varied between a minimum of 24.04 N obtained in the case of variant V3 (calcium nitrate + Agrocean B) and 26.69 N, in the case of variant V8 (calcium nitrate + Sprintene) (Table 7).

The applied foliar treatments did not lead to significant differences compared to the variant in which no foliar treatments were applied. In contrast, the treatments with calcium nitrate + Sprintene (V8) led to significant differences compared to the variants in which treatments were applied with calcium nitrate + Agrocean B (V3 – 24.04 N), with calcium nitrate (V2 - 24.68 N), with calcium nitrate + E-Dalgin (V4 - 25.02 N), and, respectively, with calcium nitrate + Kelpak (V5 - 25.70 N). At the same time, the treatments with calcium nitrate + Kinactiv Fruit (V9) or Rerum (V10) significantly increased the firmness of round pepper fruits compared to the treatments used with calcium nitrate + Agrocean B.

Table 7

Influence of foliar treatments on fruit quality

Variant	Treatment	Firmness (N)	Juice pH	TSS content (% Brix)	DW content (%)	Pulp thickness (mm)
V1	untreated	25.25±2.60^{abc}	4.96±0.11^{bc}	7.31±0.78^{bc}	7.24±0.20^{cde}	6.95±0.96^{abc}
V2	calcium nitrate (5 g/L)	24.68±1.23^{bc}	5.18±0.10^{b}	7.40±0.90^{bc}	7.72±0.36^{bcd}	6.65±0.81^{c}
V3	calcium nitrate (5 g/L) + Agrocean B (2 ml/L)	24.04±1.30^{c}	4.97±0.17^{bc}	6.91±1.42^{cd}	7.02±0.26^{de}	6.60±0.99^{c}
V4	calcium nitrate (5 g/L) + E-Dalgin (2 ml/L	25.02±1.85^{bc}	5.16±0.09^{b}	6.28±1.42^{d}	6.41±0.41^{e}	6.86±0.56^{a}
V5	calcium nitrate (5 g/L) + Kelpak (2 ml/L)	25.70±1.86a^{bc}	4.96±0.16^{bc}	7.70±0.73^{ab}	8.24±0.29^{ab}	6.94±0.98^{bc}
V6	calcium nitrate (5 g/L) + Triptolemus HV (2 ml/L)	25.55±1.93^{abc}	4.97±0.07^{bc}	7.30±1.01^{bc}	7.24±0.22^{cde}	6.74±1.06^{c}
V7	calcium nitrate (5 g/L) + Albit (2 ml/L)	25.47±2.25^{abc}	5.16±0.09^{b}	7.24±0.86^{bc}	7.15±0.80^{de}	6.79±0.95^{abc}
V8	calcium nitrate (5 g/L) + Sprintene (2 ml/L)	26.69±1.88^{a}	4.99±0.09^{bc}	7.51±0.69^{bc}	8.03±0.68^{abc}	6.59±0.95^{c}
V9	calcium nitrate (5 g/L) + Kinactiv Fruit (2 ml/L)	26.12±1.81^{ab}	4.89±0.08^{c}	8.18±0.60^{a}	8.78±0.36^{a}	7.49±0.89^{abc}
V10	calcium nitrate (5 g/L) + Rerum (2 ml/L)	26.03±2.18^{ab}	5.41±0.65^{a}	7.63±0.81^{abc}	8.70±0.56^{a}	7.42±0.81^{ab}

*Duncan test: Significant differences ($p \leq 0.05$) are indicated by mean values in a column that do not share the same letter (a, b, c).

The pH of the juice from red bell peppers can vary depending on several factors such as the stage of maturity, cultivation conditions, and treatment methods [Pohrib and Petrache, 2011]. Typically, the pH of red bell pepper juice ranges from approximately 4.5 to 5.5 [Jovicich *et al*., 2005]. In our study, the juice pH ranged from 4.89 (V9 – calcium nitrate + Kinactiv Fruit) to 5.41 (V10 – calcium nitrate + Rerum). The only treatment variant that resulted in significant differences compared to the untreated variant was V10, which used treatments with calcium nitrate + Rerum, increasing the pH value of the pepper juice by 9.07% (from 4.96 to 5.41). This treatment also led to significant increases in pH compared to all other foliar treatments. pH plays an important role in maintaining the texture of peppers. A significant loss ($P \leq 0.05$) of firmness in red bell peppers was observed when the pH dropped below 3.4 [Papageorge *et al*., 2003].

The total soluble solids. Carbohydrates in vegetables and fruits are represented by monosaccharides (such as glucose, fructose, and sorbose), disaccharides (like sucrose), and polysaccharides (including cellulose, starch, and pectins). Sweet-tasting products contain significant amounts of monosaccharides. Soluble carbohydrates, along with acids and tannins, play a significant role in shaping the flavor of vegetables and fruits. Carbohydrates, along with organic acids, are the main source of energy for respiration [Gherghi, 1994]. The TSS content in round pepper fruits. varied significantly with values ranging from 6.28% Brix (in the case of variant V4 – calcium nitrate + E-Dalgin) to 8.18% Brix (in the case of V9 – calcium nitrate + Kinactiv Fruit). Compared to the variant in which no foliar treatments were applied (V1), variant V4 (calcium nitrate + E-Dalgin) determined a significant decrease in the TSS, from 7.31% Brix to 6.28% Brix. In oposite, variant V9 led to a significant increase from 7.31% Brix to 8.18% Brix. The other experimental variants did not determine significant differences compared to the non-foliar treated variant, even if a slight increase in TSS was observed in the case of treatments applied with calcium nitrate (V2) or in combination with Kelpak (V5), with Sprintene (V8) or with Rerum (V10). At the same time, variant V9 determined a significant increase in the TSS compared to the foliar treated variants V2 (calcium nitrate), V3 (calcium nitrate + Agrocean B), V4 (calcium nitrate + E-Dalgin), V6 (calcium nitrate + Triptolemus HV), V7 (calcium nitrate + Albit) and V8 (calcium nitrate + Sprintene).

The total dry matter content in peppers is an important parameter that reflects the overall quality and nutritional value of the fruit. Higher DW content is often associated with improved taste, texture, and processing qualities. Research has shown that factors such as variety, cultivation conditions, and maturity at harvest can significantly influence the DW of peppers [Kader, 1995]. Studies have reported that the DW content in bell peppers can range from 6% to 10%, depending on these factors [Sezen *et al*., 2006]. Additionally, higher dry matter levels have been correlated with better shelf life and increased resistance to post-harvest decay [Kader, 2002].

The DW varied significantly with values ranging from 6.41 (V4 – calcium nitrate + E-Dalgin) to 8.78% (V8 – calcium nitrate + Kinactiv Fruit). The highest values were obtained in the cases of variants treated with calcium nitrate + Kinactiv Fruit (V9), calcium nitrate + Rerum (V10), and calcium nitrate + Kelpak (V5). The rest of the experimental variants did not lead to significant changes in DW.

The pulp thickness ranged between 6.59 mm (calcium nitrate + Sprintene) and 7.49 mm (calcium nitrate + Kinactiv Fruit). Foliar treatments did not determine significant differences compared to the untreated variant, but there were differences between treatments. The treatments with calcium nitrate + Kinactiv Fruit (V9) determined significant increases in pulp thickness compared to variants V2 (calcium nitrate), V3 (calcium nitrate + Agrocean B), V6 (calcium nitrate + Triptolemus HV), V7 (calcium nitrate + Albit) and V8 (calcium nitrate + Sprintene). The conclusions of previous research [Tadesse *et al.*, 2002] show that the thickness of the bell pepper pericarp increases with the age of the fruit and is positively correlated with its firmness [Rahman *et al.*, 2014].

The strength of the correlations in Fig.1 indicates that the treatment variant was associated with a significant increase in yield ($r = 0.506$, $p < 0.01$). While this suggests a positive association, confirming the magnitude and practical significance of the effect would require additional testing to identify the optimal dose or conditions of the treatment. A positive correlation was found between the treatments applied and fruit firmness ($r = 0.270$, $p < 0.01$), as well as between the treatments and TSS ($r = 0.241$, $p < 0.01$) and DW ($r = 0.567$, $p < 0.01$), indicating a positive impact of the treatments on these properties. There is a positive association, of low intensity, between foliar treatments and fruit pulp thickness ($r = 0.158$, $p < 0.05$). This association is statistically significant, though modest in strength.

An inverse relationship was observed between the treatments and the occurrence of BER, but the strength of this correlation was not statistically significant ($p > 0.05$).

		Treatment	Yield (t/ha)	Fruit/ plant	BER (%)	Firmness (N)	TSS (% Brix)	DW (%)	Pulp thickness (mm)
Treatment	Pearson Correlation	1	0.506**	0.065	-0.310	0.270**	0.241**	0.567**	0.158*
	Sig. (2-tailed)		0.000	0.734	0.096	0.003	0.002	0.001	0.016
Yield (t/ha)	Pearson Correlation		1	0.639**	-0.445*	0.238	0.123	0.422*	0.285
	Sig. (2-tailed)			0.000	0.014	0.205	0.516	0.020	0.126
Fruit/plant	Pearson Correlation			1	-0.381*	0.350	0.027	0.142	0.128
	Sig. (2-tailed)				0.038	0.058	0.887	0.455	0.499
BER	Pearson Correlation				1	-0.102	0.097	-0.181	0.094
	Sig. (2-tailed)					0.591	0.610	0.340	0.620
Firmness (N)	Pearson Correlation					1	0.158	0.229	0.047
	Sig. (2-tailed)						0.087	0.223	0.613
TSS (% Brix)	Pearson Correlation						1	0.659**	0.184*
	Sig. (2-tailed)							0.000	0.023
DW (%)	Pearson Correlation							1	0.458*
	Sig. (2-tailed)								0.011
Pulp thickness (mm)	Pearson Correlation								1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Fig. 1. Correlation matrix between evaluated component

There is a significant positive correlation between total fruit production and the number of fruits per plant ($r = 0.639$, $p < 0.01$). The relationship between yield and the number of fruits per plant is strong. Both yield and the number of fruits per plant are significantly negatively correlated with the incidence of BER.

A very strong positive interdependent relationship was identified between TSS and DW ($r = 0.659$, $p < 0.01$). The thickness of the fruit pulp is inversely related to DW ($r = -0.458$, $p < 0.05$).

CONCLUSIONS

The synergy between calcium nitrate and biostimulants is associated with increased yield and improvement of certain qualitative traits of the crop.

The results support the hypothesis that blossom end rot is also a nutritional problem. The incidence of the phenomenon decreased following the application of calcium nitrate in combination with various biostimulants, with the exception of the combination of calcium nitrate with Albit.

In round pepper, among the tested biostimulants, Kelpak, Sprintene, Kinactiv Fruit, and Rerum are recommended both for increasing yield and for optimizing certain qualitative characteristics.

Favorable results were also observed for the combination of calcium nitrate with Triptolemus HV, though less evident.

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