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Cover Crops as a Tool for Improving the Nutritional Properties and Antioxidant Activity of Kernel Sweet Corn

Biljana Šević[1*], Željko Dolijanović[2], Marija Bajagić[3], Vera Rajičić[4], Ivan Tupajić[1], Vojin Cvijanović[5], Jelena Stojiljković[1]

[1]Institute for Vegetable Crops Smederevska Palanka, Smederevska Palanka, Serbia
[2]University of Belgrade, Faculty of Agriculture, Belgrade, Serbia
[3]University of Bijeljina, Faculty of Agriculture, Bijeljina, Bosnia and Herzegovina
[4]University of Niš, Faculty of Agriculture, Kruševac, Serbia
[5]Institute for Science Application in Agriculture, Belgrade, Serbia
[*]Corresponding author. E-mail: bsevic@institut-palanka.rs

ABSTRACT

The aim of the work was to examine the influence of cover crops with the application of microbiological fertilizer on the nutritional properties and antioxidant activity of sweet corn as a response to the resulting climate changes. In the two-year research results (2014-2016), significant differences were found in the content of phenol, vitamin C, glutathione and protein. The average phenol content in the grain in the first examined year varied from 317.21 μg g^{-1} to 574.40 μg g^{-1}, while in the second year it was measured from 842.98 μg g^{-1} to 1825.13 μg g^{-1}. Common vetch (1777.02 μg g^{-1}) and winter fodder pea (1251.68 μg g^{-1}) showed the best results among cover crops, while microbiological fertilizers had no statistically significant effect. The average content of vitamin C was higher in the first year, especially in common vetch (30.80%) and the mixture of vetch with winter oats (32.56%) with the application of fertilizers. Winter forage kale showed superiority in terms of glutathione content, with average values from 1543.31 mmol g^{-1} to 1619.58 mmol g^{-1}. A significant difference in glutathione content was observed in the second year in the mixture of common vetch and oats with fertilizer (1561.01 mmol g^{-1}), compared to the same variety without fertilizer (762.40 mmol g^{-1}). Common vetch as a cover crop showed an advantage in kernel protein content (11.68%), as well as a mixture of winter fodder peas and oats (11.64%). These results indicate the potential of cover crops to improve the nutritional quality of sweet corn.

Keywords: sustainable agriculture, phenolics, vitamin C, glutathione, protein.

INTRODUCTION

Interest in the concept of sustainable agriculture in the context of conservation and management of natural resources has grown significantly during the last ten years of the last and twenty years of this century (Dolijanović et al., 2018; Stojiljković et al., 2021). Soil, as a dynamic environment, is one of the key elements of crop production and a basic prerequisite for achieving high and stable yields (Rajičić et al., 2024; Sidahmed et al., 2025). Cover crops and the application of microbiological fertilizers play a significant role in improving the sustainability of agricultural production. They include various soil maintenance measures under vegetation, including winter cover crops, green manuring in summer, live mulches or catch crops, as well as sowing forage plants behind the main crop. Microorganisms, including biological fertilizers, play a key role in crop productivity, maintaining soil fertility, stimulating plant growth and productivity, plant defense and stress tolerance, increasing uptake and accumulation of N, P, Fe, Mn, Zn and Cu in plant tissues, enhancing antioxidants and photosynthetic pigments (Maris et al., 2021). Biological measures influence the preservation and increase of the level of organic matter in the soil (Jacobs et al., 2022), improve its physical properties, such as structure and water regime (Momirović et. al., 2015). Also, they enable the accumulation of nitrogen through

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legumes, stimulate the microbiological activity of the soil and suppress weeds (Janošević, 2021; Petcu et al., 2022). The strategy of transitioning agricultural production from high-investment systems to sustainable cultivation systems is a priority, whereby certain combinations of crops may be more suitable for sustainable production in different environmental conditions (Revilla et al., 2021; Bajagić et al., 2023). Legume cover crops, according to numerous studies, improve soil quality, creating more favorable conditions for the growth, development and yield of the main crops (Elsalahy et al., 2019; Kocira et al., 2020). By encouraging the development of conservation tillage systems, cover crops are recognized as key factors in providing nitrogen to cultivated crops. The highest values of vitamin C come from production when winter fodder kale and winter fodder peas were used as a cover crop (Šević et al., 2024). Sweet corn (*Zea mays* L. var. *saccharata* Sturt) has a kernel with high nutritional value, a thin pericarp, a sweet taste, and an endosperm with a delicate texture (Yang et al., 2021; Filiz et al., 2024). The kernel is full of sugars that are in optimal balance with amino acids, minerals and vitamins of the B group, and in addition, it is a good source of fiber (Tupajić et al., 2024). The highest values of vitamin C come from production when winter fodder kale and winter fodder peas were used as a cover crop (Šević et al., 2024). At the optimal stage of maturity, sweet corn contains 5-6% sugar, 10-11% starch, 3% water-soluble polysaccharides, 70% water, as well as a moderate level of protein and vitamins (Murmu et al., 2016). The goal of the research was to determine the connection between the production system (application of different cover crops and microbiological fertilizer) and the nutritional quality of sweet corn grains and the level of antioxidant capacity.

MATERIAL AND METHODS

Experimental design and location

The research lasted two years (2014-15 and 2015-16) and was aimed at studying the effects of growing cover crops and the application of microbiological fertilizers on the chemical properties of hybrid sweet corn grains. It was conducted in the experimental field of the Maize Institute "Zemun Polje", Belgrade, Republic of Serbia (geographical coordinates 44°52'N, 20°20'E), at an altitude of 110 meters. The experimental trial was set up according to a split-plot design in 4 replications.

Plant material and sowing cover crops

In the experiment, 4 types of cover plants were grown: common vetch (*Vicia sativa* L., Fabaceae), winter fodder pea (*Pisum sativum* L., Fabaceae), winter oats (*Avena sativa* L., Poaceae) and winter fodder kale (*Brassica oleracea* L. *convar. acephala*, Brassicaceae). Also, two varieties with mixtures were included in the test: common vetch + winter oats and winter fodder peas + winter oats, as well as a control plot, which was not covered with plants. Cover crops were sown by hand in autumn, in the first half of November, depending on weather conditions. Each basic plot had an area of 17.5 m². The amount of seed for sowing is adapted to the specifics of the plant species, sowing time and cultivation goals, in order to achieve the optimal number of plants per area. The sowing rate was: 120 kg ha^{-1} for common vetch (sowing depth 5 cm), 160 kg ha^{-1} for winter oats (3 cm depth), 15 kg ha^{-1} for winter fodder kale (3 cm depth) and 150 kg ha^{-1} for winter fodder peas (4 cm depth).

Agrotechnical measures and topdressing

Preparing the soil for sowing in the fall involved deep plowing and pre-sowing preparation, with the simultaneous introduction of basic fertilizers. Before sowing, soil samples were taken from depths of 0-20 cm and 20-40 cm for agrochemical analysis. Fertilization was done in the fall and monopotassium phosphate (MKP 0:52:34) was applied, while nitrogen was added in the spring, together with the sowing of the main crop as a plant supplement in the form of a single nitrogen fertilizer Urea. The amount of N was 120 kg ha^{-1} N for the variant with oats and the control plot, 80 kg ha^{-1} N for leguminous crops and 90 kg ha^{-1} of pure nitrogen for the variants with the mixture. The remaining 40 and 30 kg ha^{-1} N, respectively, are considered to be provided by nitrogen fixation.

Fertilization treatments

In the spring of the following year, after plowing the cover crops, liquid microbiological fertilizer UNIKER (10 l ha^{-1}), which contains proteolytic and cellulolytic bacteria (*Bacillus megaterium*, *Bacillus licheniformis*, *Bacillus pumilus*, minimum 106 cm^{-3} per strain) was applied to the soil. This fertilizer had the role of stimulating the decomposition of plant residues and contributing to the increase of soil fertility. It was applied to half of each elementary plot.

Sowing main crops, harvesting and kernel analyses

The main crop, a sweet corn hybrid (ZPSC 421su, FAO group 400), was sown by hand in the third decade of May and grown in a natural water regime. The sowing density was 65.000 plants per hectare (distance 70 x 22 cm). Each year after harvesting at milk maturity (22-25 after fertilization), the kernels were manually separated, and then an average sample of 500 g of fresh kernels was formed. To analyze the chemical properties of the grain, after extraction with 5% trichloroacetic acid, glutathione (GSH) was determined by spectrophotometric method on a Biochrom Libra S22 UV/Vis device (Biochrom, UK), according to the procedure described in Sari-Gorla et al. (1993). Soluble phenols were measured spectrophotometrically, after extraction with doubly distilled water, and were expressed as µg of 3-hydroxy-4-methoxycinnamic acid per gram of dry matter, according to Simić et al. (2004). Vitamin C was quantified by iodometric titration according to Rikovski et al. (1989). The kernel protein content was measured on an infrared analyzer.

Soil characteristics

The experimental field of the Maize Research Institute "Zemun Polje", where experimental research was carried out, is characterized by specific characteristics, both climate and soil (Table 1).

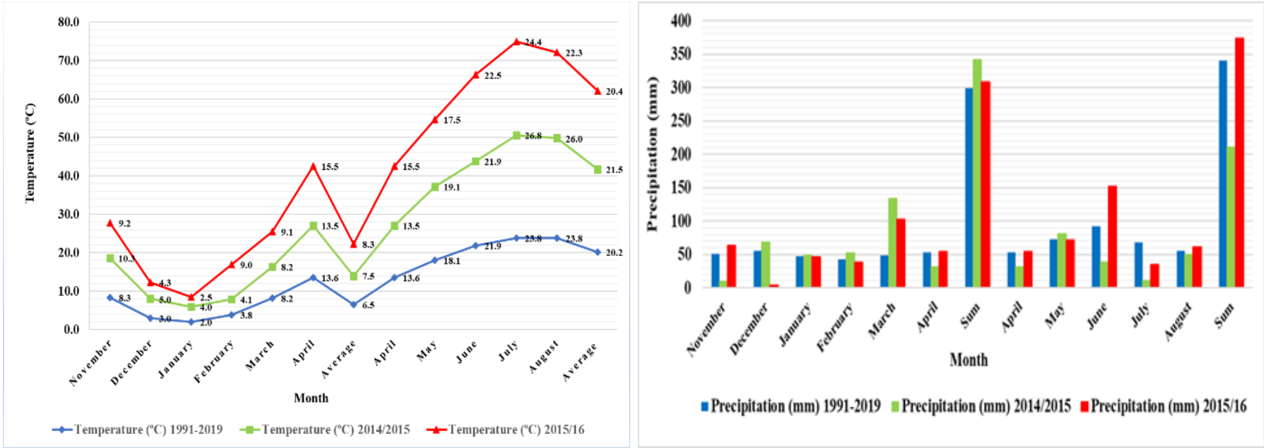
Table 1. Basic agrochemical properties of the soil of the studied locality (Zemun Polje, Serbia)

Depth (cm)	N sum (kg ha^{-1})	NH_4 (kg ha^{-1})	NO_3 (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	Humidity (%)	P_2O_5 ppm (mg kg^{-1})	K_2O (ppm)	pH H_2O	pH nKCl
0-20	44.37	1.82	42.55	25.96	280.42	10.72	29.73	150.75	7.05	7.04
20-40	21.66	0.70	20.96	33.19	298.47	11.16	38.01	160.45		

The chemical reaction of the soil is neutral (Ah horizon) to weakly alkaline, and with increasing depth it is increasingly basic (pH in water 7.05 and pH in KCl 7.04). The total N content is 44.37 kg ha^{-1} in the 0-20 depth and 21.66 in the 20-40 cm depth. The soil contains 29.73 or 38.01 mg of available P per 100 g of soil and 150.75 or 160.45 mg of K per 100 g of soil.

Meteorological conditions

Average monthly air temperatures for the period 1991-2019 year, as well as for the research period 2014-2016. Figure 1a show that there was variation between years in their values. April 2015 was at the level of the multi-year average, while in 2016 the temperature rose by 1ºC. There are also differences in the amount and distribution of precipitation. During April 2015, the amount of precipitation amounted to only 30.7 mm, while in the same period in 2016, it amounted to 53.9 mm, which is at the level of the multi-year average (Figure 1b). During the month of May, when the sowing was done, in 2015 the temperature rose by 1ºC, and in 2016 the temperatures were lower by 0.6ºC, the precipitation for the same period was at the level of a multi-year period, which had a positive effect on the germination and sprouting of the main crop. June 2015 was at the level of the multi-year average, with 21.9ºC, while in 2016 the air temperature was 0.6ºC higher. June 2015 was marked by significantly lower amounts of precipitation, which negatively affected the growth and development of plants.



(a) **(b)**

Figure 1. Average monthly air temperatures (ºC) (a) and the distribution precipitation (mm) (b) during the experimental periods (2014-2016) and multi-year averages (1991-2019) in Belgrade (Serbia) location.

During June 2015, the amount of precipitation was only 38.6 mm, while for the same period in 2016 it was 152.2 mm, which is 60.2 mm more than the multi-year average. During July 2015, an increase in temperature was recorded (26.8ºC), which is 3 degrees higher compared to the multi-year period and 2.4ºC, compared to the same period in 2016 (24.4ºC). The period with an insufficient amount of precipitation in 2015 continued in July, when only 10.6 mm fell, while 35 mm of rain fell in 2016 (67.9 mm during the multi-year average). The trend of high temperatures in 2015 continued during August (26.0ºC), which is 2.2ºC higher compared to the multi-year average. In 2016, during August, the recorded temperature was 22.3ºC. During August, higher amounts of precipitation were recorded compared to the multi-year average (55.0 mm) in 2016 (60.8 mm), while in 2015, in the same period, the amount of precipitation was 49.5 mm. Based on the recorded mean monthly air temperatures and monthly precipitation, it can be concluded that the year 2015 is extremely unfavorable for plant production, especially for the production of sweet corn.

Statistical data processing

Statistical data analysis was done with the help of IBM SPSS Statistics software, version 26.0. The first factor was the year of production (A), the second factor was cover crops (B), while the third factor was treatment - microbiological fertilizer (C). To compare mean values between treatments, the Tukey's test (HSD - Honestly Significant Difference) was performed. Minitab Statistical Software (Trial version) used for Pearson's correlation analysis was conducted to determine the relationship between the studied traits, as well as for visualising the relative importance of different factors affecting the variables and their interactions. The results are presented tabularly and graphically.

RESULTS AND DISCUSSION

In recent years, much attention has been paid to phytonutrients and antioxidants in the fruit of cultivated plants due to their positive effects on human health. The results of this research provide significant insight into the influence of cover crops, microbiological fertilization and climatic conditions on the content of phenol, vitamin C, glutathione and protein in sweet corn kernels (Table 2).

Table 2. Results of testing the influence of observed factors on chemical properties of kernel sweer corn (F test)

Source	Phenolics	Vitamin C	Glutathione	Protein
Year (A)	15917787.68**	3.755ns	1499998.17**	16.94**
Cover crops (B)	175675.17**	35.95**	323308.089**	0.63ns
Treatment (C)	585.34**	169.04**	32065.75**	1.90ns
A x B	233346.54**	19.25**	290659.47**	0.10ns
A x C	344555.82**	231.87**	276131.78**	0.19ns
B x C	41888.62**	8.60**	118720.85**	0.36ns
A x B x C	49324.55**	5.01**	184676.80**	0.80ns

Note: ** - High significant at $p<0.01$ probability level; ns - Non significant at $p>0.05$ level.

Content phenolics

An interval plot (Figure 2a) for the phenolics variable is shown in blue dots, which represent the mean value of phenolic content for each specific combination of cover crops and treatments with and without fertilization. Lines extending above and below each point represent the 95% confidence interval for the mean. In this case, the lines are invisible, which indicates a certainty (95%) that the actual mean value of the phenolic content for that combination is within that interval. The wider the interval, the greater the variability of those combined factors. In a study conducted on 10 different genotypes of corn with different grain colors, they stated that the higher content of phenolic compounds in corn kernels contributes to their higher antioxidant activity (Žilić et al., 2012). Confidence intervals were calculated based on the standard deviation of the data for each individual combination of factors, the variability within each group was take into account. The average values of phenol content in kernel sweet corn in the first year of research range from 317.21 μg g^{-1} to 574.40 μg g^{-1}, while in the second year those values are significantly higher (842.98 μg g^{-1} to 1825.13 μg g^{-1}), which can be clearly seen in the figure. The year factor (A) had a statistically very significant influence on the obtained average values, while the influence of the application of microbiological fertilizer (C) was much smaller (Figure 2b). Common vetch (1777.02 μg g^{-1}) and winter fodder pea (1251.68 μg g^{-1}) showed an advantage compared to other treatments. Application of microbiological fertilizer had an effect on increasing the content of phenolic compounds in kernel sweet corn (Dragičević et al., 2021). The positive effect of cover crops on the phenolic content of sweet corn can be explained by the ability of cover crops to increase plant stress tolerance. In general, analyzing the impact of cover crops (B) did not show significant differences and their significant effect was absent, even with interactions (AB, BC, ABC). The second year of the research was more favorable to the main crop in terms of climatic factors (average daily air temperature and amount and distribution of precipitation) during the growing season. In the case of the control variant, a significantly lower phenol content was measured in the control variant in the first year of the year, which emphasizes the influence of the age factor (Figure 2c). Parallel lines (Figure 2d) suggest that there are no significant interactions between the factors, while their intersection shows that there is an interaction. A certain treatment can significantly increase the phenolic content in one year, but its effect is absent in the second year. A visual representation of the complex analysis of phenolic content is clearly provided, allowing to compare the influence of different years on this variable, the choice of cover crop and the effectiveness of fertilization treatments. The year factor showed a statistically very significant effect, while cover crops and their interactions had a limited effect, which suggests that climatic factors are dominant in determining the phenolic content.

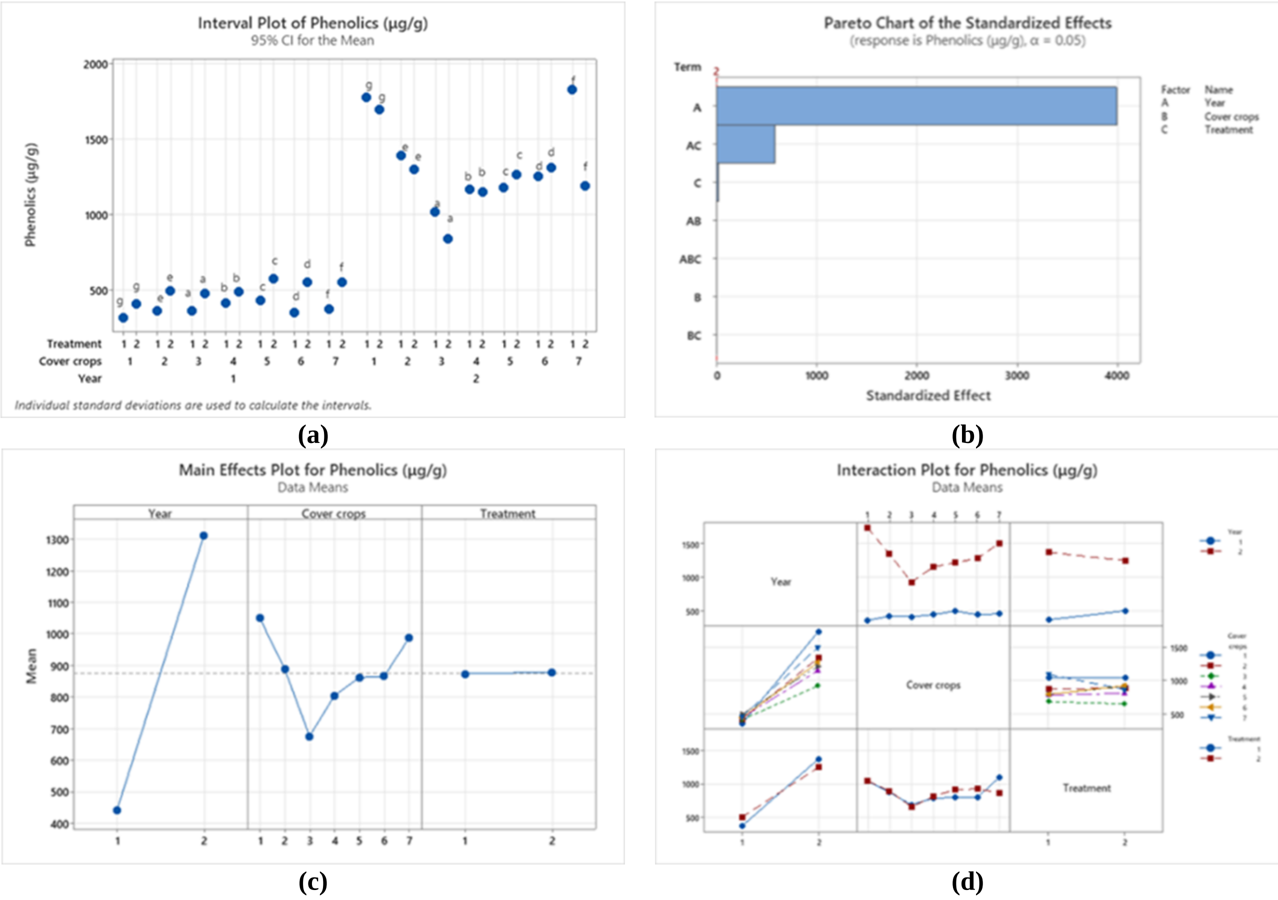


Figure 2. Interval Plot of variable phenolics with a level of significance 0.05 (a), Pareto Chart of the Standardized Effect (b), Main Effects Plot (c) and Interaction Plot (d) for phenolics (µg/g).
Year (A): 1 - (2014/2015); 2 - (2015/2016); Cover crops (B): 1 - common vetch (1), winter oats (2), winter fodder kale (3), mixtures of winter fodder peas + winter oats (4) and common vetch + winter oats (5), winter fodder peas (6) and control (7); Treatment (C): 1 - with microbiological fertilizer, 2 - without with microbiological fertilizer.
Year x Cover crops (AB), Year x Treatment (AC), Cover crops x Treatment (BC), Year x Cover crops x Treatment (ABC).

Content vitamin C

The average content of vitamin C and its dynamics depending on the year, cover crops and application of fertilization are shown with a simultaneous assessment of uncertainty (confidence interval) and a statistical comparison between different combinations of factors. In the first year of research, higher average values of vitamin C were measured in sweet corn grains, which ranged between 30.80% (common vetch) and 32.56% (mixture of common vetch + winter oats) in the treatment with fertilization (Figure 3a). Longer lines on the figure indicate greater data variability for that combination. The influence of microbial fertilizers on the nutritional quality of the product was also established through the increase of vitamin C content in tomato fruit (Ochoa-Velasco et al., 2016). Factors observed individually and in mutual interactions showed statistically significant differences between the achieved values. The greatest effect (Figure 3b) on the average content of vitamin C was shown by the interaction of factor AC and the effect of factor C. The same influence of the factor was manifested in the interaction of AB and individually observed factor B. The cover crop winter fodder kale showed an advantage in the achieved results compared to other cover crops, especially common vetch and winter oats (Figure 3c). The obtained results are in agreement with the research results (Dragičević et al., 2016), where it was determined that the highest values of vitamin C come from production with winter fodder kale and winter fodder peas. The average content of vitamin C changes through different levels of factors in both years of the study (Figure 3d).

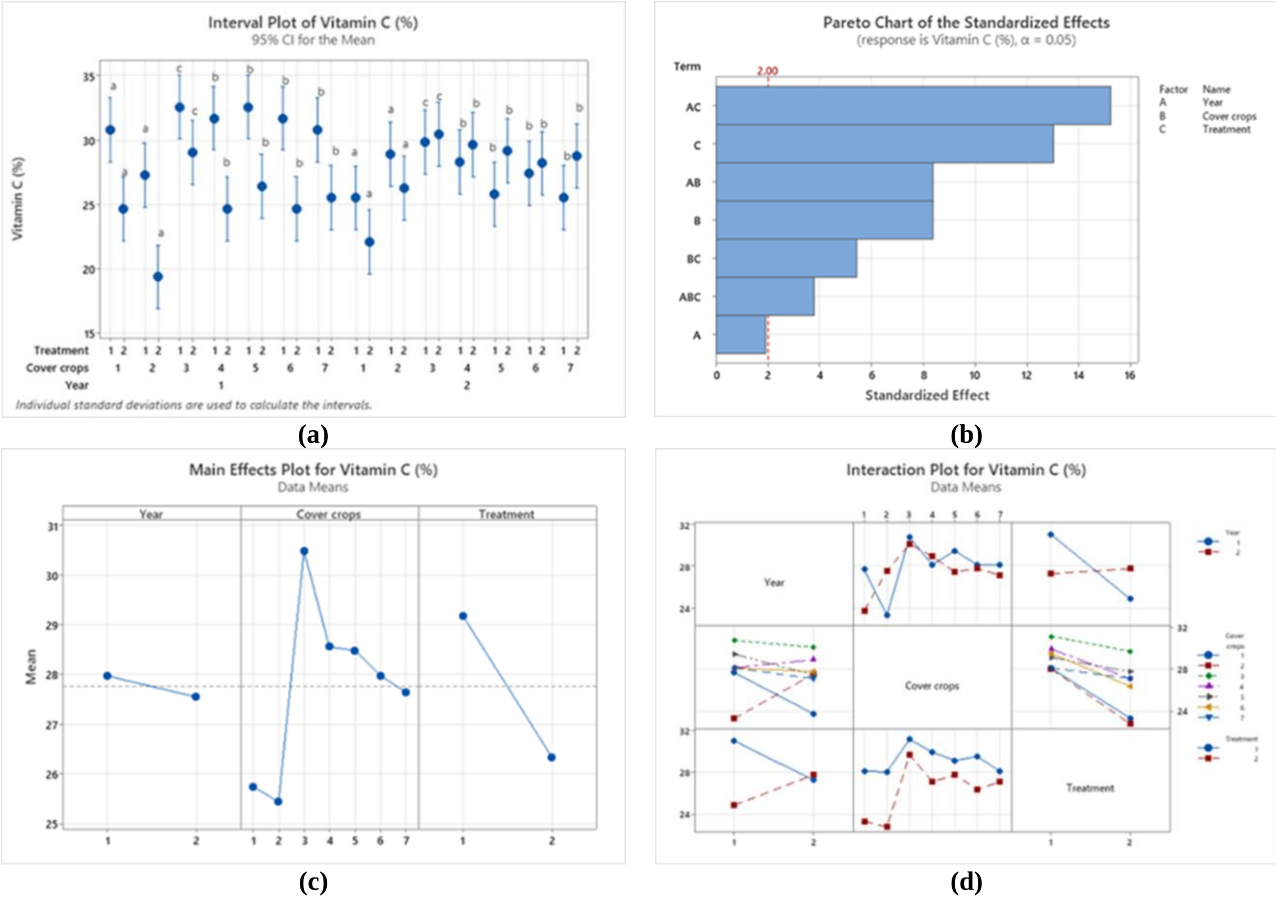


Figure 3. Interval Plot of variable vitamin C with a level of significance 0.05 (a), Pareto Chart of the Standardized Effect (b), Main Effects Plot (c) and Interaction Plot (d) for vitamin C (%).
Year (A): 1 - (2014/2015); 2 - (2015/2016); Cover crops (B): 1 - common vetch (1), winter oats (2), winter fodder kale (3), mixtures of winter fodder peas + winter oats (4) and common vetch + winter oats (5), winter fodder peas (6) and control (7); Treatment (C): 1 - with microbiological fertilizer, 2 - without with microbiological fertilizer.
Year x Cover crops (AB), Year x Treatment (AC), Cover crops x Treatment (BC), Year x Cover crops x Treatment (ABC).

Crossing lines show the interaction between the factors, while parallel lines show the absence of interaction. Year as a factor had the smallest effect on this variable. Vitamin C content showed the opposite trend, with higher values in the first year (30.80-32.56% in treatments with fertilization) compared to the second year. The interaction of year factor and microbiological fertilizer (AC) had the greatest effect on this variable, which indicates that the application of microbiological fertilizer can improve nutrient absorption under specific conditions. The cover crop winter fodder kale stood out in particular, which resulted in a higher content of vitamin C compared to common vetch or winter oats. This may be a consequence of the higher biomass of fodder kale, the decomposition of which enriches the soil with organic matter and nutrients. However, the lower performance of winter oats (19.36% vitamin C without fertilization in the first year) indicates the limitations of certain cover crops in improving grain quality.

Content glutathione (GSH)

Plants are exposed to various stressful conditions and biotic stresses include significant losses in yield and grain quality, where the role of glutathione in increasing their resistance is emphasized (Wang et al., 2025). Glutathione levels vary depending on the observed factors (Figure 4). Confidence intervals provide insight into the precision of estimated mean values for this variable (Figure 4a). Very narrow intervals indicate greater precision and certainty (95%). Average values range from 762.40 mmol g^{-1}

to 1898.56 mmol g^{-1}. The highest values were measured in the mixture of common vetch and winter oats in the second year without the application of microbiological fertilizer. The results of the research are in agreement with the results (Dragicevic et al., 2021), where in the research on the influence of cover crops on the content of glutathione in the kernel of sweet corn, the lowest value was determined in the variant with common vetch and winter oats, with the application of microbiological fertilizer, while the highest values were also in this variant, but in the first year.

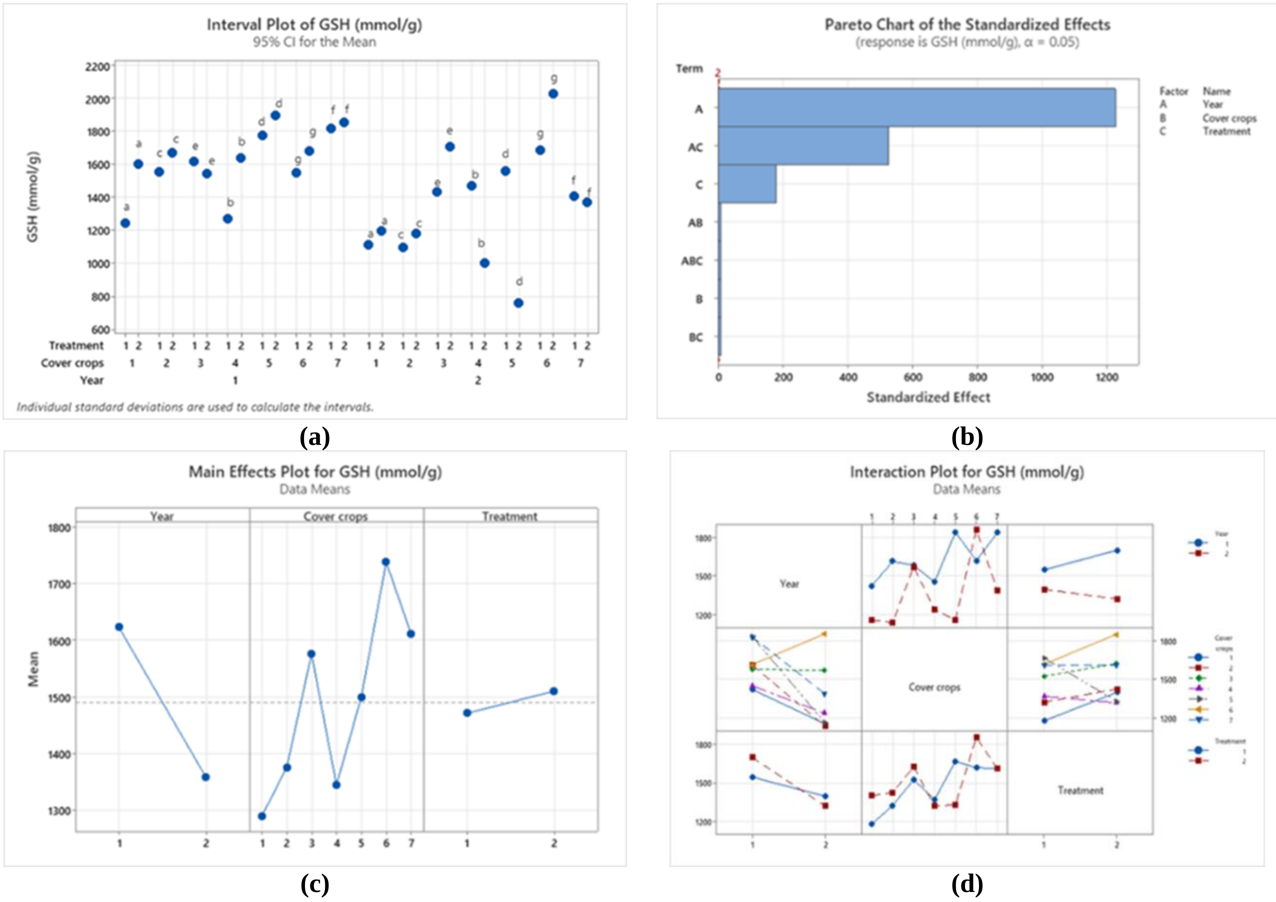
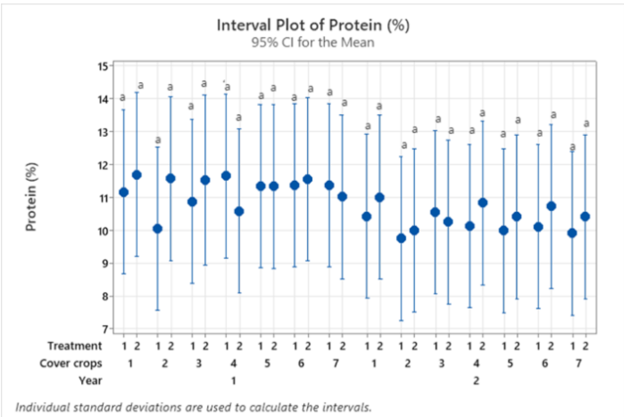


Figure 4. Interval Plot of variable GSH (glutathione) with a level of significance 0.05 (a), Pareto Chart of the Standardized Effect (b), Main Effects Plot (c) and Interaction Plot (d) for GSH (mmol/g).
Year (A): 1 - (2014/2015); 2 - (2015/2016); Cover crops (B): 1 - common vetch (1), winter oats (2), winter fodder kale (3), mixtures of winter fodder peas + winter oats (4) and common vetch + winter oats (5), winter fodder peas (6) and control (7); Treatment (C): 1 - with microbiological fertilizer, 2 - without with microbiological fertilizer.
Year x Cover crops (AB), Year x Treatment (AC), Cover crops x Treatment (BC), Year x Cover crops x Treatment (ABC).

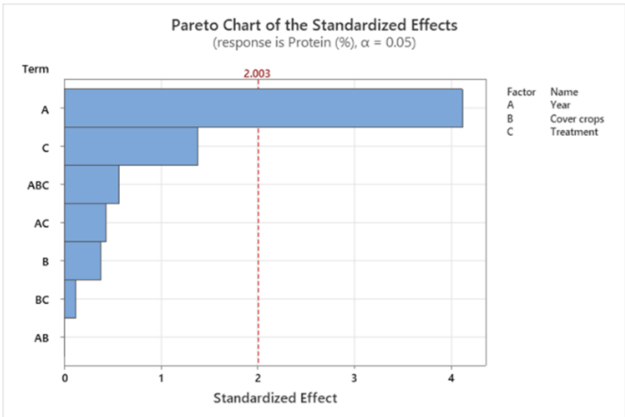
The strong effect of the year factor is clearly emphasized, which showed statistically very significant differences in the obtained values (Figure 4b). The research years differ especially in the amount and distribution of precipitation during the vegetation period of cover crops, which further affected the amount of above-ground biomass formed, which was plowed immediately before sweet corn sowing. A significant difference is noticeable in the level of glutathione in the second year of research in the mixture of common vetch and winter oats, in the variant with the application of microbiological fertilizer it doubled to 1561.01 mmol g^{-1} compared to the first year, while in the variant without application the content is 762.40 mmol g^{-1} (Figure 4c). The observed results were also achieved on the variants with winter fodder kale (1619.58 mmol g^{-1} and 1543.31 mmol g^{-1}). Also, the application of microbiological fertilizer had an effect on the higher content of total glutathione in the varieties with winter fodder kale and mixtures of legumes and winter oats in the research (Janošević, 2021). The interreaction of the factors year x cover crop x treatment did not show significant statistical differences (Figure 4d), as well as the interaction of year x cover crop, year x treatment. Of the individual factor analyses, cover crops had the smallest effects on this variable. The level of glutathione in the experiment with cover crops and organic fertilizers was mostly influenced by mulch (straw) and winter fodder peas, because the application of organic fertilizers significantly affected the amount of available forms of N, which play a significant role in the accumulation of this type of protein (Dragicevic et al., 2021).

Content protein

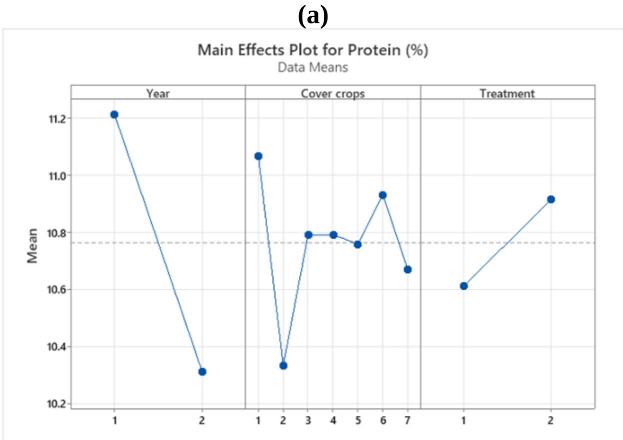
Average protein values and confidence intervals for different treatment combinations are visually shown (Figure 5a). It is strongly suggested that there are no statistically significant differences in the average protein percentage between the analyzed treatments. In the first year, the highest protein content (11.68%) was measured on the variant with common vetch without microbiological fertilizer, then on the variant with a mixture of winter fodder peas and oats (11.64%) with the application of fertilizer. In the second year, common vetch as a cover crop also showed an advantage (11.00%).



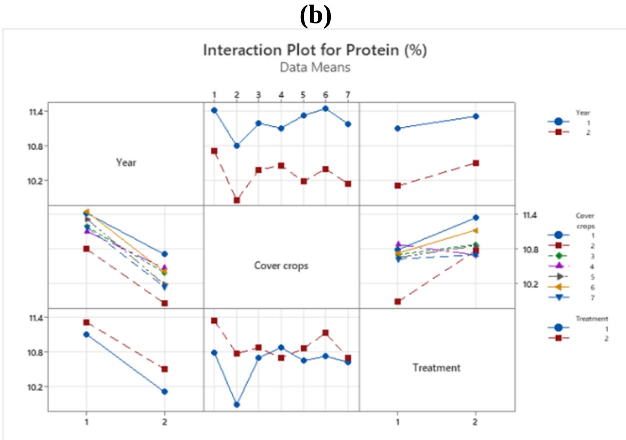
(a)



(b)



(c)



(d)

Figure 5. Interval Plot of variable protein with a level of significance 0.05 (a), Pareto Chart of the Standardized Effect (b), Main Effects Plot (c) and Interaction Plot (d) for protein (%).
Year (A): 1 - (2014/2015); 2 - (2015/2016); Cover crops (B): 1 - common vetch (1), winter oats (2), winter fodder kale (3), mixtures of winter fodder peas + winter oats (4) and common vetch + winter oats (5), winter fodder peas (6) and control (7); Treatment (C): 1 - with microbiological fertilizer, 2 - without with microbiological fertilizer.
Year x Cover crops (AB), Year x Treatment (AC), Cover crops x Treatment (BC), Year x Cover crops x Treatment (ABC).

The age factor had a significant impact (Figures 5b, 5c), in contrast to other factors that had no impact on the results of this parameter (Figure 5d). The highest protein content in the kernel sweet corn was obtained in the variant of winter fodder kale, common vetch and mulching with straw (Dragičević et al., 2016), which is a consequence of the positive impact of soil N enrichment by leguminous crops (Idikut et al., 2009). The advantage of cover crops and the application of microbiological fertilizer on the protein content in the kernel sweet corn, especially in dry years accompanied by high air temperatures in the summer months (Janošević et al., 2017; Dolijanović et al., 2018).

The highest protein content in the kernel sweet corn was obtained by plowing the biomass of cover crops, especially red date, while a positive effect on the content of starch, oil and protein was shown by sowing red date in the sweet corn crop (Yeganehpoor et al., 2015). In addition to increasing kernel yield, one of the main goals of plant breeders is to improve their nutritional quality, especially due to the increased demand for plant proteins, the popularity of organic and vegan diets, and health reasons (Urošević et al., 2023). The average protein content in corn grains in the first year was 1.50% lower compared to the same in the second year, which was less favorable in terms of rainfall and temperature (Lalević et al., 2019). The protein content in soybeans, in addition to variety specificity, is largely dependent on environmental factors (Popović et al., 2012), and this research confirmed that the crucial influence was the year factor, i.e. the climatic conditions during the growing season.

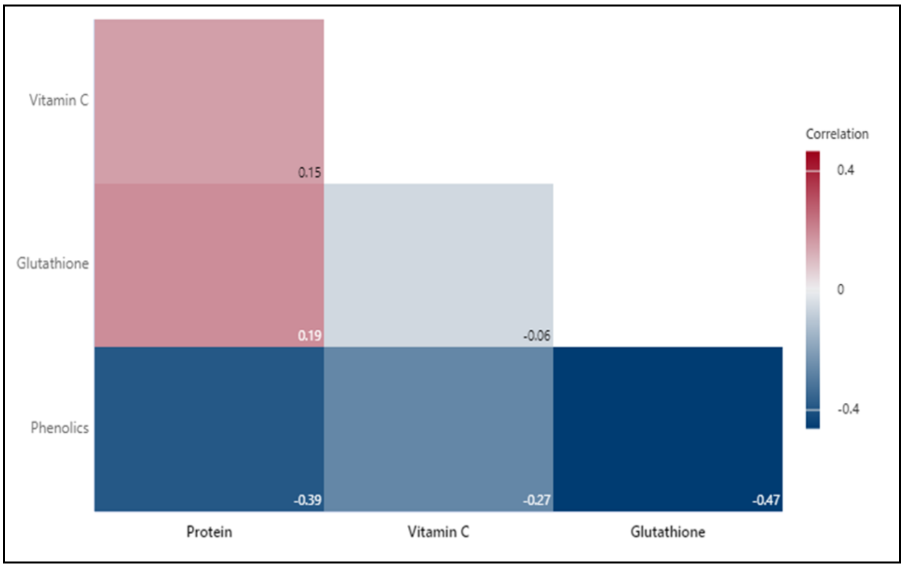


Figure 6. Correlation coefficient between the studied parameters (vitamin C, phenolics, glutathione, protein). Correlation is significant at the 0.01 level** and 0.05 level*.

The degree of connection between the tested traits was determined by the correlation coefficient (Figure 6). A negative medium-weak relationship was established between phenol and glutathione (r = -0.47**), phenol and protein (r = -0.39**) and between phenol and vitamin C (r = -0.27*). Also, a negative but very weak relationship was established between the content of vitamin C and glutathione (r = -0.06). The negative correlation between phenols, vitamin C, glutathione and proteins reflects complex biological interactions in the biosynthesis of these compounds. Increased synthesis of one antioxidant can reduce the concentration of others due to limited plant resources. Positive but very weak correlations were found between protein and glutathione (r = 0.19) and protein and vitamin C (r = 0.15).

CONCLUSIONS

The potential of cover crops with the optimization of microbiological fertilizer application is reflected in the improvement of the quality of corn grains with specific properties, which is confirmed by the results of this research. It emphasizes the importance of integrating sustainable practices in agriculture, which provide a basis for further research aimed at improving the nutritional quality of the main crop. The effectiveness of cover crops was highlighted, including in the conditions of a semiarid climate, and the advantage in the content of test components was shown by used of common vetch, oyimi fodder kale and a mixture of winter fodder peas and winter oats. With the goal of ecologically safe and high-quality products for human consumption, cover crops as a tool for improving the system of growing sweet corn fully meet the criteria, which are based on the principles of sustainable agriculture.

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