UDC 633.522:631.5:581.4 https://doi.org/10.21498/2518-1017.22.1.2026.357577

The influence of ionic form of silicon on the formation of elementary fibre cells in *Cannabis sativa* L.

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Purpose. To establish the peculiarities of the fibrous layer structure and the degree of variability of the traits of the primary and secondary bast fibre cells in industrial hemp (*Cannabis sativa* L.) varieties under the influence of exogenous silicon and the possibilities of using it to improve fibre quality. **Methods.** Plants of the 'Afina' and 'Hlukhivski 51' varieties, grown in an area of 30 × 5 cm, were studied. During the vegetation period, the plants were treated twice or three times with an aqueous solution of $K_2SiO_3 \cdot 5H_2O$ at concentrations of 2.5 g/L and 5.0 g/L, respectively, at the BBCH development phases 15, 51 and 65. The control variants used distilled water instead of the silicon solution. For the anatomical analysis, transverse sections of bark and wood were taken from the stems at the level of the IV internode (with a diameter of 9.5 mm) and examined using light microscopy. **Results.** In hemp plants under the influence of silicon, the thickness of the bast fibre layer increased, as can be seen from the analysis of transverse stem sections. For the 'Afina' variety, the secondary fiber layer thickness increased from 105 µm in the control group to 138 µm in the treated group. For the 'Hlukhivski 51' variety, it increased from 163 µm to 230 µm with triple treatment using a 0.5 g/L $K_2SiO_3 \cdot 5H_2O$ solution. This increase in fiber layer thickness was mainly due to secondary fibers, i.e., silicon activates cambium activity, the secondary generative tissue. The lengths and widths of the primary fibre cells were 40.2 and 25.9 µm for the 'Afina' variety and 57.0 and 40.2 µm for the 'Hlukhivski 51' variety. The lengths and widths of the secondary fibre cells were 25.1 and 15.5 µm and 33.4 and 16.5 µm, respectively. The increase in cell sizes was due to a decrease in the channel size and an increase in the thickness of the secondary walls. These changed from 6.5 to 12.5 µm and from 16.5 to 19.7 µm in primary bast fibre cells and from 5.5 to 7.2 µm and from 6.0 to 7.6 µm in secondary bast fibre cells in the 'Afina' and 'Hlukhivski 51' varieties, respectively. An increase in the proportion of isodiametric and oval-shaped cells with a convex contour, as well as cells with a small channel, was observed, indicating a structural rearrangement of fibrous formations. **Conclusions.** To increase the total fibre content of hemp stems, it is advisable to treat the plants with a silicon (Si) solution during the period of intensive secondary fibre accumulation, and to obtain higher-quality fibre, during the period of intensive primary fibre accumulation.

Keywords: *hemp; stem anatomy; histology of transverse sections; bast; fibre quality characteristics; potassium metasilicate.*

Introduction

Hemp (*Cannabis sativa* L.) is one of the oldest fibre crops, traditionally used in the textile, pulp and paper, and biocomposite industries. The crop's main economic value is determined by the presence of bast fibres in the phloem of the stem bark. These fibres are formed by elongated sclerenchyma cells with multilayered secondary cell walls that are enriched with cellulose and lignin. Primary fibres are formed in the early stages of ontogenesis from primary meristematic tissues and are characterised by their considerable length, whereas secondary fibres are formed later due to cambial activity. The ratio of primary and secondary fibres determines the quality and strength of the fibrous

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raw material. To increase fibre content and improve its quality, various breeding methods and techniques [1], as well as agrotechnical measures such as different fertilisation systems and the application of microelements, are widely employed [2].

One such microelement may be silicon (Si), which is present in plants in quantities equivalent to macronutrients such as calcium, magnesium and phosphorus. In perennial grasses, silicon often contains more than any other inorganic component. However, with the exception of diatom algae and horsetails, silicon is considered a facultative element for plants [3].

Consequently, silicon is often omitted from nutrient solution prescriptions and neglected in most plant physiology studies, despite plants grown in ordinary nutrient media without silicon often being structurally weaker, exhibiting growth, development, viability and reproductive anomalies, and being more susceptible to abiotic stresses such as metal toxicity. They are also more vulnerable to pathogenic organisms and herbivorous animals, ranging from phytophagous insects to mammals [3]. Thus, there is compelling evidence that silicon should be included in the list of elements with an important impact on plant life [3].

Plants primarily absorb silicon in the form of silicic acid ions (Si^{32-}), which are transported via apoplastic and symplastic pathways involving specific membrane transporters. In recent years, there has been growing interest in the role of silicon in cell wall formation, particularly in fibre (bast) crops such as hemp, and in its effect on fibre quality [3, 4]. It should be noted that improving the fibre's quality characteristics (particularly length, linear density, flexibility and strength) is a key objective in breeding and cultivating this crop.

It has been established that hemp can actively absorb and accumulate silicon in various plant organs [5]. Using molecular genetic and microscopic methods, a family of aquaporin proteins has been identified in *Cannabis sativa* L., some of which form membrane channels that are potentially involved in silicon transport. It has been demonstrated that silicon (Si) accumulates in the cell walls of certain tissues, particularly the bast fibres of the stem, suggesting its potential role in the development and modification of fibre cells [5].

The cells of hemp primary fibres are characterised by a thick secondary cell wall that is rich in cellulose and hemicellulose, and a relatively low lignin content. Silicon can be deposited in the apoplast in the form of amorphous silica ($SiO_2 \cdot H_2O$), which can either form an additional structural component of the cell wall or interact with its polysaccharide matrix [4, 6–9]. This interaction increases the mechanical strength of the cells, stabilises the walls and changes their elastic properties, which is particularly important for fibrous tissues [4, 6–9]. The cell wall of bast fibre cells consists of two main structural parts: the primary layer (P) and the secondary layer (S), which forms during cell wall thickening and consists of three layers: the outer layer (S_1), the middle layer (S_2), and the inner layer (S_3). The layers S_1, S_2 and S_3 differ significantly in thickness. S_1 and S_3 are thin, whereas S_2 is thick and constitutes most of the cell wall. Silicon specifically promotes the thickening of layers S_2 and S_3 and reduces microporosity [4, 9]. It stimulates cambium cell division and the intensity of secondary fibre differentiation, resulting in the formation of more uniform fibrous layers [4, 10]. At the ultrastructural level, a reduction in cell lumen size, increased homogeneity of the secondary layers and strengthening of the middle lamella are observed. These changes improve the mechanical properties of the fibre, meaning this element plays a key role in the formation of the anatomical structure of hemp fibres, ensuring they are strong, homogeneous and technologically valuable [11].

Experimental studies on hemp confirm that exogenous silicon application can influence the morphometric parameters of bast fibers. In particular, under conditions of heavy metal (Cd, Zn) exposure, which impair the biosynthesis of cellulose and lignin at the cell wall level [12], silicon (2 mM), through chelation, complex formation, stimulation of antioxidant systems, and regulation of the expression of heavy metal ion transport genes [10], mitigates the negative impact of stress on the development of elementary fiber cells, promoting an increase in their diameter and the preservation of cell wall integrity, which indicates the protective and structurally modulating role of Si in the differentiation process of elementary fibers [13, 14].

The effect of silicon on fibre formation is likely to extend beyond its structural function. According to the literature, silicon (Si) may indirectly influence the expression of genes associated with the synthesis of cell wall components, the activity of enzymes in the cellulase complex and the phytohormonal regulation of cell growth [4, 6, 15, 16]. These effects are particularly evident under abiotic stress, when silicon enhances the stability of growth processes and reduces tissue damage [4, 6, 15, 16]. Salinity is one of the most common abiotic stress factors affecting various biochemical and physiological processes in plants. It inhibits growth and signifi-

cantly reduces productivity. Therefore, silicon (Si) is proposed as one of the most effective methods for enhancing tolerance to salt stress in various plant species [17]. For instance, silicon treatment alleviated salt stress symptoms in old cannabis leaves where the xylem tissue contained wider-lumen vessels [15].

Thus, the available literature suggests that silicon plays a role in the formation of primary fibre cells by accumulating in cell walls, thereby strengthening their structure and indirectly regulating differentiation processes. However, the impact of varying silicon concentrations on the anatomy and physical-mechanical properties of hemp fibres requires further targeted research. The significant differences observed in the structure, size and arrangement of cells within the primary and secondary fibre elements and layers of different cannabis genotypes [18] suggest that varieties that differ significantly in fibre content and intended agricultural use should be included in studies investigating the effects of silicon.

The study aims to determine the anatomical characteristics of the fibrous layer, as well as the degree of variation in the cellular features of primary and secondary bast fibres, in a cross-section of the stem of industrial hemp varieties under the influence of exogenous silicon. The study also aims to assess the potential of using silicon to improve fibre quality.

Materials and methods

Studies conducted in 2024–2025 utilised the industrial hemp varieties 'Afina' and 'Hlukhivski 51'. The former is a seed-oil variety with excellent suitability for mechanised harvesting due to its relatively short stature. During the study period, it was characterised by a total fibre content of 22.1%, according to competitive variety testing data. The second variety is intended for fibre and bioenergy use, characterised by vigorous growth and high stem yield, with an average total fibre content of 36.3%.

Plants of the specified varieties were grown in a nursery with four replicates and a planting area of 30 × 5 cm using the hole-sowing method, according to the methodology described in [19]. The plants were treated two or three times at development stages 15, 51 and 65 on the BBCH scale (Biologische Bundesanstalt, Bundessortenamt und Chemische Industrie) [20] by spraying with an aqueous solution of potassium metasilicate pentahydrate ($K_2SiO_3 \cdot 5H_2O$) at concentrations of 2.5 or 5.0 g/L, with an application rate of 0.2 L/m². The control treatment involved spraying with distilled water.

For the anatomical analysis, typical cannabis stems were collected at the BBCS 65 stage [20]. Two- to three-centimetre sections of bark containing a portion of wood were cut from the stems of living cannabis plants at the level of the fourth internode. These sections were placed in vials containing a mixture of distilled water, ethanol and glycerol (in equal parts) and cross-sections were prepared using a microtome. Temporary anatomical preparations were then made. The anatomical analysis of the fibrous structures of the hemp stems was performed using a light microscope at magnifications of 600x, 300x and 150x. Morphometric measurements were taken using an eyepiece micrometer. Ten measurements were taken from 20 stems of each variant.

A statistical analysis of the data was performed by calculating the mean and standard error of the sample mean, as well as the significance level of the difference, using a Student's t-test.

Results and discussion

Treating plants with potassium silicate affected the formation of the bast fibre layer in the cross-section of the hemp stems of both varieties studied. However, changes in the thickness of the primary fibre layer were minor and, in most cases, statistically insignificant. In plants of the medium-fibre variety 'Afina', for example, the thickness of the primary fibre layer ranged from 165 ± 3.80 µm in the control group to 173 ± 3.42 µm after three treatments with 5.0 g/L Si, showing no significant difference from the control group. A similar trend was observed for the high-fibre variety 'Hlukhivski 51', where the maximum value for this trait, 230 ± 4.06 µm, was obtained after one treatment (a threefold application of 5.0 g/L).

By contrast, the thickness of the secondary bast fibre layer increased significantly with an increase in the number of treatments and the concentration of the active ingredient. In 'Afina' plants, it increased from 105 ± 2.12 µm (control) to 138 ± 4.08 µm (threefold treatment at 0.5 g/L, $p < 0.001$), i.e. by 31.4%. This pattern was more pronounced in plants of the 'Hlukhivski 51' variety: increasing from 163 ± 3.25 µm (control) to 230 ± 5.51 µm ($p < 0.001$) – a 41.1% increase. Thus, the increase in total fibre layer thickness mainly occurs due to the formation of secondary fibres, with silicon largely activating the secondary meristem – the cambium (Table 1).

Silicon also had a significant effect on the anatomical structure of primary bast fibre cells.

Table 1

The thickness of the layers of hemp bast fibres in a cross-section of the stem in the control group and under the influence of silicon (with a stem diameter of 9.5 mm at the fourth internode)

Variant	Thickness of fiber layer, µm	
	primary	secondary
'Afina'		
Control	165 ± 3.80	105 ± 2.12
2-time, 2.5 g/l	166 ± 3.21	114 ± 3.03 *
3-time, 2.5 g/l	170 ± 4.49	122 ± 2.59 ***
2-time, 5.0 g/l	171 ± 5.18	129 ± 2.60 ***
3-time, 5.0 g/l	173 ± 3.42	138 ± 4.08 ***
'Hlukhivski 51'		
Control	218 ± 4.83	163 ± 3.25
2-time, 2.5 g/l	222 ± 6.40	186 ± 3.75 ***
3-time, 2.5 g/l	220 ± 4.44	195 ± 3.85 ***
2-time, 5.0 g/l	224 ± 5.57	213 ± 7.00 ***
3-time, 5.0 g/l	230 ± 4.06 *	230 ± 5.51 ***

Note: the difference compared to the control group is statistically significant according to Student's t-test at a significance level of: * – 0.05. ** – 0.01. *** – 0.001.

In the 'Afina' variety of plant, the length of primary bast fibre cells increased from 36.4 ± 0.36 µm (control) to 40.2 ± 0.48 µm (after three treatments with 5.0 g/L Si, $p < 0.001$), while the width increased from 22.0 ± 0.30 µm to 25.9 ± 0.36 µm ($p < 0.001$). A similar trend was observed in 'Hlukhivski 51' plants, where cell length increased from 52.0 ± 0.45 µm to 57.0 ± 0.97 µm and width from 35.8 ± 0.58 µm to 40.2 ± 0.83 µm.

Another notable feature was the qualitative reorganization of cellular structures. In the 'Afina' variety of plant, the proportion of isodiametric cells (cells close to being round or regular polyhedra) and oval cells with convex outlines was 96.0% in the control group. In the Si-treated variants, this proportion increased to between 98.5% and 98.8%.

A mature bast fibre consists of a primary layer, a secondary layer made up of multiple layers, and a canal that was previously filled with cytoplasm. These canals are classified as punctate, slit-like or hollow. Within the same fibrous layer, one, two or all three types of canal may be present [18]. The shape of the canal usually resembles the outer contour of the cell's cross-section as a whole. This is because the sheath of the elementary fibre gradually thickens in uniform, concentric layers. The canal of a mature elementary fibre cell is always hollow as the cytoplasm is gradually used up to thicken the sheath [18]. The size of the canal is primarily determined by the thickness of the cell membrane. As the membrane thickens, the canal narrows. Small canals are generally punctate or slit-like, corresponding to the isodiametric shape of the cell. In contrast, large canals are narrow- or wide-lumen, corresponding to the oval shape of the cell. An irregular cell shape results in a correspondingly irregular channel shape, although there may be exceptions [18].

In the control group, the proportion of cells with small punctate or slit-like pores was 50.5%, increasing to 71.0–80.9% following Si treatment. In 'Hlukhivski 51' plants, the proportion of correctly shaped cells increased to 98.5–99.4% under the influence of silicon, compared to 97.3% in the control group. Meanwhile, the proportion of cells with small canals increased to 80.5–99.1%, compared to 75.5% in the control group. The effect on the shape of the cell channels of elementary bast fibres was particularly

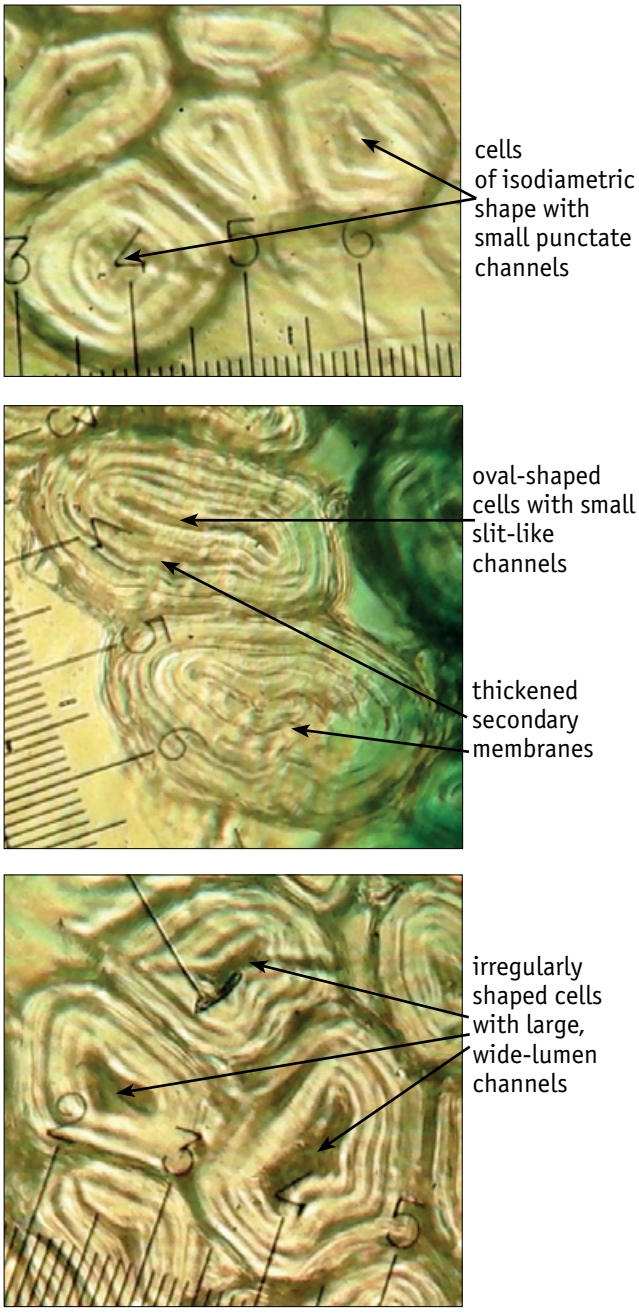

Fig. 1. Cells of elementary hemp bast fibers

noticeable in plants of the low-fibre 'Afina' variety, which has a greater proportion of large narrow- or wide-lumen channels (Fig. 1).

At the same time, the thickness of the secondary cell wall increased significantly: for the 'Afina' variety, it increased from 6.5 ± 0.11 μm to 12.5 ± 0.22 μm ($p < 0.001$); for the 'Hlukhivski 51' variety, it increased from 16.5 ± 0.35 μm to 19.7 ± 0.38 μm ($p < 0.001$) (Table 2).

Thus, the increase in cell size did not occur due to expansion of the canal, but rather through intensive thickening of the secondary cell walls. This is important in terms of forming the fibre's physical and mechanical properties. Thickening the cell walls of elementary bast fibres makes them stiffer and improves the mechanical strength of the tissues. The rigid wall can also withstand turgor pressure better during intensive growth.

The studies conducted revealed a clear effect of silicon on the cells of secondary bast fibres. In 'Afina' hemp plants, cell length increased from 22.3 ± 0.33 μm to 25.1 ± 0.37 μm ($p < 0.001$), and cell width increased from 13.3 ± 0.26 μm to 15.5 ± 0.30 μm ($p < 0.001$). The thickness of the secondary wall increased from 5.5 ± 0.10 to 7.2 ± 0.19 μm. Similar patterns were observed for the 'Hlukhivski 51' variety, with cell length reaching 33.4 ± 0.66 μm and cell width reaching 16.5 ± 0.32 μm ($p < 0.001$). The maximum secondary cell wall thickness values (7.6 ± 0.22 μm) were significantly higher than the control values (6.0 ± 0.12 μm).

The proportion of cells with small, isodiametric and oval canals also increased. This indicates that the fibre's structure is being reorganised towards an increase in secondary cell wall density and a reduction in lumen size. In plants of the 'Afina' variety in the control group, the proportion of cells with a regular shape was 92.5%. This increased to 95.5% with a two-time treatment of 2.5 g/L, 98.1% with a three-time

Table 2

Changes in the anatomical characteristics of primary bast fiber cells in hemp on a transverse section of the stem under the influence of Si

Variant	Cell size, μm		Share of cells, %		Thickness of secondary cell walls, μm
	length	width	isodiametric and oval shape with convex contour	with small lumen (point or slit-like)	
'Afina'					
Control	36.4 ± 0.36	22.0 ± 0.30	96.0	50.5	6.5 ± 0.11
2-time, 2.5 g/l	38.1 ± 0.44 **	24.1 ± 0.26 ***	98.5	71.0	11.4 ± 0.23 ***
3-time, 2.5 g/l	38.5 ± 0.67 **	24.8 ± 0.51 ***	98.4	72.2	11.8 ± 0.14 ***
2-time, 5.0 g/l	39.1 ± 0.40 ***	25.2 ± 0.25 ***	98.7	72.3	12.1 ± 0.15 ***
3-time, 5.0 g/l	40.2 ± 0.48 ***	25.9 ± 0.36 ***	98.8	80.9	12.5 ± 0.22 ***
'Hlukhivski 51'					
Control	52.0 ± 0.45	35.8 ± 0.58	97.3	75.5	16.5 ± 0.35
2-time, 2.5 g/l	54.4 ± 0.83 *	36.9 ± 0.53	98.5	80.5	18.0 ± 0.20 ***
3-time, 2.5 g/l	55.9 ± 0.87 ***	37.8 ± 0.43 *	98.5	94.6	18.5 ± 0.21 ***
2-time, 5.0 g/l	56.0 ± 0.66 ***	37.8 ± 0.44 *	98.9	96.7	18.4 ± 0.36 ***
3-time, 5.0 g/l	57.0 ± 0.97 ***	40.2 ± 0.83 **	99.4	99.1	19.7 ± 0.38 ***

Note: significantly different from the control group according to Student's t-test at the following significance levels: * 0.05, ** 0.01, *** 0.001.

Table 3

Changes in the anatomical characteristics of secondary bast fibres in cannabis on a cross-section of the stem under the influence of Si

Variant	Cell size, μm		Share of cells, %		Thickness of secondary cell walls, μm
	length	width	isodiametric and oval shape with convex contour	with small lumen (point or slit-like)	
'Afina'					
Control	22.3 ± 0.33	13.3 ± 0.26	92.5	48.8	5.5 ± 0.10
2-time, 2.5 g/l	22.5 ± 0.34	14.0 ± 0.21 *	95.5	52.4	6.1 ± 0.12 ***
3-time, 2.5 g/l	24.8 ± 0.49 ***	14.5 ± 0.30 **	98.1	66.6	6.4 ± 0.20 ***
2-time, 5.0 g/l	24.6 ± 0.50 ***	14.6 ± 0.28 **	98.6	70.3	6.6 ± 0.13 ***
3-time, 5.0 g/l	25.1 ± 0.37 ***	15.5 ± 0.30 ***	98.9	77.9	7.2 ± 0.19 ***
'Hlukhivski 51'					
Control	28.0 ± 0.46	14.1 ± 0.22	97.0	65.5	6.0 ± 0.12
2-time, 2.5 g/l	29.4 ± 0.43 *	14.8 ± 0.38	98.1	71.1	7.0 ± 0.14 ***
3-time, 2.5 g/l	30.2 ± 0.45 **	16.0 ± 0.30 ***	98.5	84.2	7.2 ± 0.16 ***
2-time, 5.0 g/l	32.3 ± 0.46 ***	16.0 ± 0.24 ***	99.0	88.7	7.3 ± 0.18 ***
3-time, 5.0 g/l	33.4 ± 0.66 ***	16.5 ± 0.32 ***	99.6	90.2	7.6 ± 0.22 ***

Note: significantly different from the control group according to Student's t-test at the following significance levels: * 0.05, ** 0.01, *** 0.001.

treatment of 2.5 g/L, 98.6% with a two-time treatment of 5.0 g/L, and 98.9% with a three-time treatment of 5.0 g/L Si. For plants of the 'Hlukhivski 51' variety, this trait was recorded at 97.0% (control), 98.1%, 98.5%, 99.0%, and 99.6%, respectively. The proportion of cells with small punctate or slit-like channels across the experimental variants was 48.8% (control), 52.4%, 66.6%, 70.3% and 77.9% for plants of the 'Afina' variety, and 65.5% (control), 71.1%, 84.2%, 88.7% and 90.2% for plants of the 'Hlukhivski 51' variety (Table 3).

Given that high-quality hemp fibre is characterised by properly formed individual bast fibres that are oval or isodiametric in shape with rounded contours (no sharp angles), small canals (point-like or slit-like), thick secondary sheaths with moderately sparse layering and compact fibre bundles [18], the results obtained indicate a dual effect of silicon. On the one hand, silicon stimulates cambial activity and the formation of secondary fibres, ensuring an increase in the total content and thickness of the bast fibre layer. However, an increase in the amount of secondary and total fibre, as well as cell size, may be accompanied by a decrease in technological quality. Conversely, improving fibre quality – intensive accumulation of primary fibre (stimulation of procambium activity), formation of isodiametric and oval-shaped cells with a convex contour and narrow canal, and thick secondary walls – is possible if processing occurs in the early stages of ontogenesis, during the period of intensive primary fibre formation.

Conclusions

The thickness of the bast fibre layer on the cross-section of the stem, the size of the elementary bast fibre cells and the thickness of their secondary walls increased under the influence of silicon in various varieties of cultivated hemp plants used for different economic purposes. The fibre layer mainly thickened due to secondary fibres, i.e. silicon activates the secondary generative tissue, the cambium. Cell sizes increased due to a reduction in canal size and thickening of the secondary walls. An increase in the proportion of isodiametric and oval-shaped cells with a convex contour, as well as cells with a small canal, was observed, which indicates a structural reorganization of the fibre. To increase the total fibre content in the stems, it is advisable to carry out silicon treatment during the period of intensive secondary fibre accumulation, and to obtain higher-quality fibre, during the period of intensive primary fibre accumulation.

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УДК 633.522:631.5:581.4

Міщенко С. В.[1,2*], Лавриненко Ю. О.[3], Марченко Т. Ю.[3], Кириченко Г. І.[2] Вплив Силіцію на формування клітин елементарних волокон *Cannabis sativa* L. *Plant Varieties Studying and Protection*. 2026. Т. 22, № 1, С. 4–10. https://doi.org/10.21498/2518-1017.22.1.2026.357577

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Мета. Встановити особливості будови волокнистого шару, ступінь мінливості ознак клітин первинних і вторинних луб'яних волокон стебла у сортів промислових конопель (*Cannabis sativa* L.) за впливу Силіцію екзогенного походження та визначити можливості його використання для поліпшення якісних характеристик волокна. **Методи.** Досліджували рослини сортів 'Афіна' та 'Глухівські 51', вирощені на площі живлення 30 × 5 см. Протягом вегетації їх обробляли двічі або тричі водним розчином $K_2SiO_3 \cdot 5H_2O$ з концентрацією 2,5 чи 5,0 г/л, у фазах розвитку ВВСН 15, 51 і 65 відповідно. Контролем слугували варіанти досліду, в яких замість Силіцію використовували дистильовану воду. Для анатомічного аналізу зі стебел робили поперечні зрізи кори та деревини на рівні IV міжвузля (діаметр – 9,5 мм) й вивчали їх методом світлової мікроскопії. **Результати.** За результатами аналізу поперечного зрізу стебла встановлено, що в рослин конопель під впливом Силіцію збільшувалася товщина шару луб'яних волокон. Зокрема, в сорту 'Афіна' товщина вторинного шару волокон зростала зі 105 мкм у контрольному варіанті до 138 мкм для дослідних рослин, а в 'Глухівські 51' – зі 163 до 230 мкм за умови триразової обробки розчином $K_2SiO_3 \cdot 5H_2O$ з концентрацією 0,5 г/л. Товщина шару збільшувалася переважно завдяки вторинному волокну, тобто Силіцій активізував діяльність камбію, вторинної твірної тканини. Довжина й ширина клітин первинних волокон становили 40,2 та 25,9 мкм для рослин сорту 'Афіна' й 57,0 та 40,2 мкм для 'Глухівські 51'; вторинних волокон – 25,1 та 15,5 мкм і 33,4 та 16,5 мкм відповідно. Зменшення каналу й потовщення вторинних оболонок зумовило збільшення розмірів клітин первинних луб'яних волокон у сортів 'Афіна' та 'Глухівські 51' з 6,5 до 12,5 мкм і з 16,5 до 19,7 мкм відповідно; вторинних – з 5,5 до 7,2 мкм і з 6,0 до 7,6 мкм відповідно. Виявлено зростання частки клітин ізодіаметричної й овальної форми з опуклим контуром та клітин із малим каналом, що свідчить про структурну перебудову волокнистих утворень. **Висновки.** Для збільшення вмісту загального волокна у стеблах конопель обробку рослин розчином Si доцільно проводити в період інтенсивного накопичення вторинного волокна, а для отримання волокна вищої якості – під час інтенсивного накопичення первинного волокна.

Ключові слова: *коноплі; стебло; анатомія; тканини; гістологія поперечного зрізу; луб; якість волокнопродукції; калій метасилікат.*

Надійшла / Received 02.02.2026
Прийнято до друку / Accepted 22.02.2026
Опубліковано онлайн / Published online 30.03.2026