PHOTOSYNTHETIC ACTIVITY OF CROPS FODDER BEET DEPENDING ON CULTIVAR CHARACTERISTICS IN THE CONDITIONS OF FOREST-STEPPE OF WESTERN

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The article presents the results of studies of high-performance varieties and hybrids of fodder beet (Beta vulgaris crassa), plant growth and development in terms of western forest-steppe. It is defined leaf surface area, photosynthetic capacity and net productivity of photosynthesis of fodder beet, dependent on the varietal characteristics.

Keywords: *fodder beet, variety, hybrid, leaf area, photosynthetic potential, net photosynthetic productivity.*

Fodder beet is important for increasing of production of juicy fodder for animals. For a wide cultivation of root crops and effective use of the biological potential of the variety and climatic conditions of the western forest-steppe it is important scientific justification of growing technology elements, selection for yield and quality varieties, and so on.

In the technology of fodder beet it is taken into account the whole range of farming practices, which should provide an intense accumulation of organic matter and the rapid growth of leaf surface [1]. Solar radiation is the best used by fodder beet plants in mid-summer. Under steppes of western Ukraine it occurs during the phase of the second pair of true leaves, closing and opening plants in line [6]. The density of plants is important and essential to plant fodder beet , which should be optimal because thickness of crops leads to greater density of plants and leaf weight, according to the misuse of the photosynthetic apparatus and mutual shading of leaves [1, 4]. This worsens aeration and blowing of thickened crops,

hampered access of CO_2 to the leaf mass of plants. Therefore, the above factors improve the conditions of photosynthesis [5].

It should also be noted that the optimum lighting of fodder beet is a prerequisite for plant growth and development and the formation of reproductive organs, because leaves receive the maximum amount of light energy and provide them with additional content, thereby increasing the total area of leaf mass [7, 2]. The rate of photosynthesis is reduced in a phase of opening lines of fodder beet crops [6].

The most important indicator of photosynthetic activity of plants fodder beet, which ultimately determines the productivity of crops, is the area of the leaf surface (ALS), photosynthetic capacity (PC), the net efficiency of photosynthesis (NEP) and its economic efficiency.

Scientists observed that productivity growth processes in fodder beet is achieved by increasing the assimilation surface, namely by asymilants formed during photosynthetic activity of leaves is an active formation of roots [7]. Thus the biosynthesis of proteins and chlorophyll provide supporting effect on the functional activity of mature leaves, setting the stage for intense photosynthesis [8]. Conditions of plants developing and conditions of supply form the harvest. The optimal value of leaf surface must be achieved before the end of vegetative growth, at the beginning of mass forming of roots. Where the photosynthetic surface reaches maximum development before this period, as a result of mutual shading of large leaves turn yellow in the lower tier, they dry up and assimilation surface decreases, which leads to a significant reduction in yield [2].

Purpose and objectives. To set the duration of phenological phases of plant growth and development and yield of fodder beet depending on the varietal characteristics in terms of western forest-steppe.

Materials and methods research. Experimental studies were conducted during 2010-2013 in the field rotation.

The climatic conditions of the western forest-steppe are characterized by a sufficient amount of heat, but unstable moisture. Significant increase in

temperature was observed during March-April and April-May. The summer period is characterized by high and constant temperatures in July - up to 20°C, in August - 22-23°C. Warm period is within 230-265 days, and during the active growing season (temperature above 10°C) ranges from 155 to 170 days. The sum of active temperatures is 2300-2750°C, the SCC is 1,3-2,0, annual rainfall ranges from 498-675 mm in the west - to 790 mm, with an average temperature 7,8°C.

Sowing of fodder beet was conducted on the 15-18 of April by wide-row method of sowing with the width of 45 cm. Studied varieties: Kyivsky (control), Galytsky, Dniester, Adra; hybrids: Krakus, Solidar, Katsper. The total land area was – 45,0 m^2, accounting – 25,2 m^2.

Research results. Results of experimental studies suggest that leaf surface per unit area in the initial phases of plant growth between varieties is not very different, and its values were within 1,14-1,71 thousand m^2 / ha (Table 1).

According to research results, the rate of growth of leaf surface of plants of different varieties during the growing season defined clearly by varietal characteristics and phases of growth. The highest rates of leaf surface in phase of closing lines were obtained from the following varieties of fodder beet as Galytsky – 68,99 thousand m^2 / ha, hybrid Katsper – 62,21 thousand m^2 / ha, Kyivsky (control) – 62,01 thousand m^2 / ha, hybrid Solidar – 59,01 thousand m^2 / ha and hybrid Krakus – 56,94 thousand m^2 / ha. Varieties Dniester – 53,49 thousand m^2 / ha and Adra – 44,99 thousand m^2 / ha had slightly lower indicator of leaf surface.

Table 1

Influence of varieties on the area of leaf surface of plants, fodder beet, thousand m^2/ha (average over 2010-2013)

Variety	Formation of the second pair of leaves	Closing of lines	Technical ripeness
Kyivsky (control)	1,60	62,01	25,06
Galytsky	1,71	68,99	26,32
Dniester	1,41	53,49	21,37
Adra	1,14	44,99	20,94
Krakus	1,49	56,94	21,06
Solidar	1,49	59,01	22,32
Katsper	1,65	62,21	25,15

The same pattern has been noted by us and the phase of technical ripeness. Varieties of fodder beet of Kyivsky (control), Galytsky, hybrid Katsper formed bigger leaf surface area, resulting in a longer growing season. Change of leaf surface in ontogeny in all variants of the experiment expressed as a direct correlation.

The development of assimilative surface is also influenced by weather conditions during the growing season. In 2010 and 2013 the surface area of assimilation was lower compared to the 2011-12 years. This is due to the fact that summer was droughty in those years. Moisture was insufficient, rain fell a little. Thus, in 2011, high rates of leaf surface in phase of closing lines are marked in varieties Galytsky – 67,09 thousand m^2 / ha and Galytsky – 61,17 thousand m^2 / ha, in hybrids Katsper and Solidar – 61,12 thousand m^2 / ha and 60,00 thousand m^2 / ha, respectively. The maximum area of leaf surface was formed in all varieties and hybrids of fodder beet in 2012. In this year high rates of leaf surface in phase of closing lines were marked in a variety of Galytsky – 74,75, hybrid Katsper – 65,84, Galytsky, Kyivsky – 65,61 and hybrid Solidar – 62,81 thousand m^2 / ha. Low rates of leaf surface area are marked in a variety of Adra – 49,12 thousand m^2 / ha.

To determine the yield of crops and fodder beet performance evaluation, it is necessary to have indicators that characterize the possible total area of the leaf surface of plants growing season. Therefore, the unit of measurement of photosynthetic activity of plants in crops is considered 1 m^2 of leaves per day and expressed m^2 × days / ha (PC) [6, 2].

According to experimental results, it was found that the dynamics of photosynthetic potential of fodder beet varieties is similar to that which is formed by leaf surface area (Table. 2).

Table 2

Photosynthetic potential of fodder beet depending on variety, mln. m^2 × days / ha (average for 2010-2013)

Variety	Phases of of growth and development		
	Formation of the second pair of leaves	Closing of lines	Technical ripeness
Kyivsky (control)	0,027	1,926	2,999
Galytsky	0,033	2,311	3,321
Dniester	0,027	1,899	2,440
Adra	0,023	1,600	2,401
Krakus	0,026	1,903	2,301
Solidar	0,029	2,419	2,862
Katsper	0,027	2,111	2,900

As the results of studies on the average performance during the years of the photosynthetic capacity increase from appearing sprouts to the closure of plants in a row, as of the closing lines to technical ripeness. The maximum values during the technical ripeness of roots – 3,321 mln.m^2 × days / ha was formed in a variety of Galytsky, varieties of Adra and hybrid Krakus had lower values of photosynthetic capacity – 2,301 and 2,401 million m^2 × days / ha, respectively.

Limit of leaf surface area and photosynthetic capacity have upper and lower indicators, and transition causes a decrease of net photosynthesis productivity [4].

The results of the study found that the average years of research on the net maximum photosynthetic productivity (NEP) of plants of fodder beets are 6,90 – 6,77 g / m ^{2} per day in phase of closing lines (Table. 3).

Table 3

Net photosynthetic productivity of fodder beet varieties, g / m ^{2} per day (average for 2010-2013)

Variety	Closing of lines	Technical ripeness
Kyivsky (control)	6,77	3,86
Galytsky	6,59	3,71
Dniester	6,53	3,54
Adra	5,99	3,59
Krakus	6,42	3,67
Solidar	6,88	3,74
Katsper	6,90	3,83

Net photosynthetic performance as an indicator of the effectiveness of the assimilation of leaf surface of fodder beet in field experiment is maximum in the phase of closing lines – 7,24 g / m ^{2} per day, it is seen in a variety of Kyivsky (control) in 2011. The lowest net photosynthetic performance is observed in a variety of Adra - in 2010 in the phase of closing lines net productivity of photosynthesis was 6,0 g / m ^{2} per day and in 2012 only 5,61 g / m ^{2} per day. In the future, the net performance of the tested varieties and hybrids in the period from the closing lines to technical ripeness decreased. Kyivsky (control) over four years of research had 3,86 g / m ^{2} per day. In Galician grade 3,71 g / m ^{2} per day. Hybrids Krakus, Solidar, Katsper had 3,67; 3,74; 3,83 g / m ^{2} per day, respectively.

Conclusions. It is determined during the performance of the net productivity of photosynthesis, depending on the varietal characteristics and phases of plant growth and development of fodder beet.

As a result, the highest level of net photosynthesis productivity was noted in Kyivsky variety, hybrids Katsper and Solidar that was in a phase of technical ripeness – 3,86; 3,83 and 3,74 g / m ^{2} per day, respectively. This was due to the size of leaf surface area.

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ФОТОСИНТЕТИЧЕСКАЯ ДЕЯТЕЛЬНОСТЬ ПОСЕВОВ СВЕКЛЫ КОРМОВОЙ В ЗАВИСИМОСТИ ОТ СОРТОВЫХ ОСОБЕННОСТЕЙ В УСЛОВИЯХ ЗАПАДНОЙ ЛЕСОСТЕПИ

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Рассмотрены результаты исследований высокопродуктивных сортов и гибридов свеклы кормовой (Beta vulgaris crassa), рост и развитие растений в условиях западной Лесостепи. Определена площадь листовой поверхности,

фотосинтетический потенциал и чистая продуктивность фотосинтеза свеклы кормовой, которые зависели от сортовых особенностей.

Ключевые слова: *свекла кормовая, сорт, гибрид, листовая поверхность, фотосинтетический потенциал, чистая продуктивность фотосинтеза.*

ФОТОСИНТЕТИЧНА ДІЯЛЬНІСТЬ ПОСІВІВ БУРЯКА КОРМОВОГО ЗАЛЕЖНО ВІД СОРТОВИХ ОСОБЛИВОСТЕЙ В УМОВАХ ЗАХІДНОГО ЛІСОСТЕПУ

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Розглянуто результати досліджень високопродуктивних сортів і гібридів буряка кормового (Beta vulgaris crassa), ріст та розвиток рослин в умовах західного Лісостепу. Визначена площа його листкової поверхні, фотосинтетичний потенціал та чиста продуктивність фотосинтезу буряка кормового, що залежали від сортових особливостей.

Ключові слова: *буряк кормовий, сорт, гібрид, листкова поверхня, фотосинтетичний потенціал, чиста продуктивність фотосинтезу*