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PHOTOSYNTHETIC ACTIVITY AND PRODUCTIVITY OF POTATO ON SOIL FERTILITY DIFFERENT IN THE STEPPE VOLGA

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ABSTRACT

The efficiency of the use of the calculated doses of fertilizers for the planned harvest early varieties of potatoes Luck. As a result of studies of the dynamics of formation of the leaf surface area of potato leaf photosynthetic capacity utilization of PAR on gray forest soils of forest-steppe of the Middle Volga revealed its dependence on mineral nutrition level. Revealed their impact on productivity and quality of potato tubers. Maximum leaf area of agrocenosis varieties Luck formed in the flowering stage and the highest value of 46.8 thousand. M2 / ha achieved at the highest mineral nutrition background. Better graphics leaf area growth differed agrocenosis potatoes on the background, designed to harvest the tubers of 40 t / ha, which allowed the formation of a high yield in the experiments.

Fertilization and increase their doses increased the amount of photosynthetic potential (PP) in interphase periods and during the period of vegetation Luck potato varieties. On the control without fertilizer application amount of photosynthetic potential was - 2.173.000 m2 / ha × days. Fertilization based on the yield of 25 t / ha of tubers has increased the rate of 1.16 times, and the highest power background designed for the harvest of 40 t / ha in 1.65 times. For every thousand OP units formed from 7.2 kg to 10.8 kg control of potato tubers on the background of fertilizer application per crop of 35 tons / ha.

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On the control without fertilizers, crop dry phytomass was 5.02 t / ha, and the highest yield of 11.87 t / ha was formed at the highest background fertilizer, designed for the harvest of 40 t / ha. In natural fertility formed tuber yield of 14.4 t / ha. Fertilizing of planned crops in doses calculated cash-balance method on the tuber yield of 25-40 t / ha provided formation 24.5-36.2 t / ha or 91.0-98.0% of the plan. As the level of the planned harvest the probability of obtaining reduced from 2.0 to 9.0%. More starch (14.7%) contained the potato tubers with options where fertilizers were calculated on the yield of 25 t / ha of tubers. A further increase in mineral nutrition reduced starch content in tubers. The amount of nitrates in tubers from all experimental variants was below the MRL. Increasing doses of fertilizers increased their content of 1.24 - 1.73 times (without fertilizer 41 mg / kg wet weight).

Keywords: Sheet surface photosynthetic potential (FP), potatoes, yield, dry substance, starch, vitamin C, nitrates.

INTRODUCTION

Formation yields of agricultural crops are a time-dependent process flow and the result of which is determined by a complex interaction of plants with environmental conditions. The task of obtaining high and stable yields is reduced to optimize the conditions of the environment to the needs of the plants. The main factors determining the level and quality of the harvest for Agricultural a crop, including potatoes, is suitable for the photosynthetic activity of the combination of light, heat, water and nutrients. Main principles and provisions of the modern theory of productivity reflected in the fundamental works of many scientists **(**2.7.8.9**).** They are based on the theory of photosynthetic productivity, considering it necessary to create crops that provide the most efficient energy absorption of photosynthetically active radiation (PAR), the formation of organic matter and optimum use of them in the process of metabolism, transport, growth and organogenesis. It is known that not the entire amount of incoming PAR is used by plants. The maximum possible utilization rate of photosynthesis of solar radiation energy absorbed by crops is about 20%. Actual use of the absorbed and especially the energy incident on the crops (linking it to the biomass harvest), an average of 0.5-1.5% **(**7**).** Increase the utilization of solar radiation on photosynthesis can be achieved by activation of the process (selection of varieties and plants with a high intensity of photosynthesis, the improvement of mineral nutrition, moisture, ensuring the carbon dioxide and other crops.), a change in crop structure and its optical density. Surface area photosynthetic crop primarily determined by the area of the leaves and the main organ of photosynthesis **(**10.3**).** On leaves, accounting for 80-90% of all the

absorbed solar radiation and sowing 60-95% of organic matter produced by photosynthesis **(**1**).** The most favorable for obtaining high yields of this type is a sheet surface growth dynamics, as quickly as possible when it reaches the area size of 40-50 thousand. M2 / ha, and then stored for a long time as possible in the active state at this level, and finally decreases considerably or completely dies, giving the plastic material on the formation of tubers. Further increases in leaf area results in reduction of crop accumulation per unit leaf area (on the lower net photosynthesis efficiency) In connection with the fact that associated with the leaf area of the optical density seeding **(**5.14**).** Consequently, the leaf area and crop dimensions in net photosynthesis productivity are the main factors determining the level of plant biomass yield. Indicators optimal leaf area per 1 hectare of crop size and maximum daily increments of dry matter for the different varieties of plants and cannot be the same, they vary depending on climate and weather. This is due to differences in light curves of different plants, uneven structure and the optical density of planting, the level of mutual oppression of plants or leaves the individual layers. Thus, optimal for the type of plants and planting will have the leaf area, which corresponds to the maximum daily increase in the harvest. Therefore, methods of farming should be aimed at creating conditions of plant life, which would contribute to the ability to quickly form an optimum leaf surface seeding and conservation of leaves, if possible, in an active state for a long time, ie, provide a high photosynthetic potential crop. Hence, the number coming to FAR crops can provide significantly greater yields than they receive at present. The factors that provide an optimal course of the growth of leaf area and yields, moisture and mineral nutrients **(**5.7.14.15.**).** PAR resources can only be realized in the presence of water. However, even if the water for intensive production process is sufficient, not always PAR used at maximum efficiency. To use phased array with maximum efficiency it is necessary to plant and culture in general have been able to absorb most of the incident on the crop PAR. Crops of potatoes, thick corn and grain crops is passed around 10-15% of the total integrated radiation **(**10.12.13.**)**. 20-25% from the rest of the radiation is reflected and absorbed by 60-70%. In the area of PAR said plants and crops absorb radiation at the highest level: only about 5-8% of it is reflected and passed 1-2%. Thus, crops absorbed 90-94% PAR **(**11**).** Water exchange takes place between the root system and the soil. Foliar supply of water through the leaves occurs by natural rainfall and irrigation. But for the process of photosynthesis, a comparatively small amount of water. The role of water in plant life is actually much broader and is in addition to photosynthesis, water also provides a swelling of the protoplasm, and transpiration through plants regulates heat mode **(**11**).** With a lack of moisture, solar radiation can be even

detrimental factor for plants. The best plants for water is such a mode in which the maximum increase in the period before he plants have approximately the same number of available moisture as much as possible can evaporate. Therefore, each level corresponds to a radiation inflow transpiriruemoy optimum amount of water, and consequently precipitation. Then we have the equality and radiation devices and transpiration tool **(**6**).** In crops with optimal water regime of crops proportional influx of total radiation during the growing season. The same applies to the need for mineral elements. If crops are provided with water, but will not meet their needs in the mineral nutrition, it cannot form an optimal structure of crops and the optical density or biological yield insufficient percentage will take economic valuable portion of the crop (grain, tubers, etc.). Cultural practices that are aimed at improving the productivity, yield positive results if they provide rapid development and the achievement of the optimum size of crop leaf area, increase the productivity of the leaves, keep them in an active state may long period of time, promote the best use of the products of photosynthesis, first to improved growth and feed conductive organs (leaves, roots, stems), and then the growth of economically valuable organs that constitute the main crop of plants. So, the level of formation of crops depends on soil and climatic conditions of the biology of plants and the level of applied agricultural technology.

CONDITION, MATERIALS AND METHODS

Investigations were carried out on experimental fields of the University of Kazan in a suburban area of the Republic of Tatarstan. Gray, forest soil, medium, pilot area is flat. Power arable layer of 26-28 cm, the pH of salt extract 5.6, humus content by Tyurin 3.42-3.52%, hydrolysable nitrogen 131-136, 147-154 mobile phosphorus and exchangeable K 179-184 mg / kg of soil. The total area of the plot accounting 72.0 60.0 m2. Repeated experience of three times. The predecessor of winter rye. Planting depth of 8-10 cm. Planting was carried out tubers middle fraction (60-65 g). For planting seed tubers used first reproduction. Driving experience one-way number 1 included options: 1 - without fertilization (control); 2 - Calculation of fertilizer to 25 tons of tubers from one hectare; 3 - Calculation of fertilizer to 30 tons of tubers from one hectare; 4 - calculation of fertilizer to 35 tons of tubers from one hectare; 5 - calculation of fertilizer to 40 tons of tubers from 1 ha. In the second experiment to study the mode of irrigation fertilizer expect to receive 40 tons of tubers from 1 ha. Planting is carried out when the soil temperature 6-7 0C. During the growing season in all phases of development of plants collected plant samples of 15 pieces from each variant of the

experiment. The area of leaves, photosynthetic potential (PP), was calculated by the **Nichiporovich (1961).** Potato Harvest cleaned.

Analysis and discussion of the results of the study: the basis for the formation of a crop photosynthetic activity of plants. The major importance is the value of the assimilating surface of plants. The size and dynamics of leaf area are affected by numerous agronomic, climatic and biological factors. These study the dynamics of leaf area showed that the fertilizer had a significant impact on the amount of leaf area and their livelihoods during the growing season. At all-time accounting fertilized embodiments it was higher than the control with no fertilizer (Table. 1). If this phase germination rate was low, then it is the phase of formation of buds depending on the background power 2.6-3.1 fold increase compared to the previous phase and the control without use of fertilizers embodiment, sheet surface was 27.4 thousand. m2 / ha.

Table 1. The area of leaves of potato varieties depending on Luck food background, thousand m2 / ha, 2011-2013

The level of the planned yield, t / ha	phase of development				
	seedling	budding	flowering	the beginning of wilting of foliage	cleaning
without fertilizers	10.5	27.4	29.6	23.7	14.3
25	11.1	30.2	34.1	28.5	15.2
30	11.7	33.9	37.9	33.8	16.7
35	12.3	37.2	41.5	36.9	18.9
40	12.5	39.8	46.8	40.5	22.7

Leaf area, reached its maximum size at the end of flowering phase power regardless of the background. In an embodiment without fertilizer maximum leaf area reached 29.6 thousand. M2 / ha. When fertilizer based on productivity 25 t / ha tuber is increased 1.15 times, against 40 m / m - 1.58 times compared with the control without fertilization. By cleaning was significant leaf death and reducing the active surface. Determination results indicate a major role of fertilizers photosynthetic productivity indicators. With increasing power increased background collection of dry matter per unit area. Thus, in an embodiment without fertilizer dry biomass yield was 5.02 t / ha, and at a second level, the crop it was - 2.64, in the third -

4.85, while the fourth - 5.54, when the fifth 6.85 t / ha higher. A similar pattern was observed for average daily gain of dry biomass, where the difference between the extremes was 2.36 times (Table. 2). The most important factor in the production process is the photosynthetic potential (PP) sowing. It reflects the intensity of work assimilating surface, as for interphase periods or for the entire growing season. The photosynthetic capacity at the beginning of the growing season turned out to be insignificant, but as the leaf area growth it increases and reaches a maximum value at the end of the potato growing season. In the embodiment, the amount of control of the photosynthetic capacity of the plants during the growing season was 2173 thousand. M x 2days/a. Fertilization based on the receipt of harvest tubers 25 t / ha increased the amount of AF to 347 thousand m 2 x days / ha, against the backdrop of 40 t / ha to 1402 thousand units, that is, with an increase in the background Power, the figure regularly increased.

Table 2. Indicators of potato varieties planted productivity Luck depending on food background, 2011-2013

The level of planned yield, t/ha	The yield of dry biomass, t/ha	The amount of FC during the growing season, thousand m 2 x days per ha	PSR, kg of tubers per 1 thousand units of FP	The utilization of HEADLIGHTS, %
without fertilizers	5.02	2173	7.2	1.05
25	7.66	2520	10.2	1.60
30	9.87	2910	10.2	2.07
35	10.56	3196	10.8	2.21
40	11.87	3575	10.5	2.48

The results of the point to the major role of fertilizers photosynthetic productivity indicators. With increasing power increased background collection of dry matter per unit area. Thus, in an embodiment without fertilizer dry biomass yield was 5.02 t / ha, and at a second level, the crop it was - 2.64, in the third - 4.85, while the fourth - 5.54, when the fifth 6 85 t / ha higher. A similar pattern was observed for average daily gain of dry biomass, where the difference between the extremes was 2.36 times. The productivity of work leaves (BPD) - a tuber yield on the 1000 OP units - shows the "work" of the photosynthetic potential of the

growing season. Its value is changed on the options and the experience was highest (10.8 kg) on the background of fertilizer application, designed for the formation of tuber crop 35 t / ha. In an embodiment without fertilizer per thousand plants OP units 7.2 kg of tubers formed in the second and third - fifth and 10.2 - 10.5 kg. The utilization factor of photosynthetically active radiation (PAR) is also dependent on the background diet. As you increase it naturally increased and the utilization rate of PAR. In the embodiment where fertilizers were applied per tuber yield 40 t / ha, and its value was 2.48%, which is 1.43% higher than the control. Studies have shown that fertilization of potatoes can significantly improve its yield (Table. 3).On Board the natural fertility, tuber yield without fertilizer was 14.4 tons per 1 ha. Adding fertilizer based on the yield of 25 t / ha increased the yield to 24.5 t / ha, which is 98.0% of the plan, in the third embodiment with respect to 30 t / ha was obtained 28.5 t / ha or 95.0 % in the fourth - 33.0 t / ha or 92.8% in the fifth 36.2 or 91.0%.

Table 3. yield Luck potato varieties depending on food background, t / ha, 2011-2013**.**

The level of planned yield, t/ha	Yield, t/ha				Deviation from the program	
	2011 г	2012 г	2013 г	average	t/ha	%
without fertilizers	14.8	12.7	15.6	14.4	-	-
25	24.6	22.5	26.3	24.5	- 0.5	- 2.0
30	28.4	25.6	31.4	28.5	- 1.5	- 3.5
35	31.7	29.8	36.4	33.0	- 2.0	- 5.7
40	35.2	32.6	40.8	36.2	- 3.8	- 9.5
HCP_{05}						

Data of laboratory studies have shown that a balanced diet, even with an increase in food background had no significant effect on the starch content in the tubers. Thus in the embodiment the control contained 14.4% tuber starch. In a second embodiment, where the fertilizer was made, based on the yield of 25 t / ha 14.7% tubers contain starch. In a third embodiment, which were made to 30 t / ha of manure and fertilizers balanced diet, little changed starch content relative to the control? When making higher doses of fertilizer backgrounds designed for the formation of the tuber crop 35 and 40 t / ha, a decrease of starch in the 0.6-1.0 per cent (Table. 4).

Table 4. indicators of quality varieties of potatoes Luck depending on food background, %, 2011-2013

The level of planned yield, t/ha	The starch content, %	Vitamin C, mg%	Protein content, %	Nitrate content, mg/kg	The taste score
without fertilizers	14.4	18.7	2.87	41.3	3.8
25	14.7	19.0	3.12	50.6	4.0
30	14.1	19.2	3.48	59.5	4.5
35	13.8	18.9	3.28	66.4	3.9
40	13.4	18.3	3.21	70.5	3.7

Collection of starch per unit area increases with increasing yields. If the control version, it was found to be 2.00 t / ha, while the fertilizer based on the yield of 25 t / ha, it increased by 1.61 t / ha, against a capacity of 30 t / ha of tubers - 2.02 t / ha. The fourth and fifth embodiments increase starch yield was 3.00 t / ha as compared to the control without fertilizer. The data from our experiments indicate that fertilizer per 40 tons / ha led to a reduction of vitamin C in potatoes 0.4 mg%. Fertilizers designed for yields of 25-35 t / ha provided a boost the vitamin C content in tubers. An important factor determining the nitrate accumulation in tubers is the use of mineral and organic nitrogen fertilizers. Our experienced in all versions of nitrate content in tubers is lower than the MPC. However, with the increase in insertion fertilization rates the amount increased in the tubers. In the tubers with the control group of nitrates contained 41 mg / kg. If fertilization, as increasing their number increased doses of 10 mg / kg calculated on the background on the yield of 25 t / ha to 30 mg / kg against the background of 40 t / ha. A significant influence on the yield of marketable tubers at harvest had made fertilizer. With an increase in their standards declining proportion of small tubers, and large (over 100 g), on the contrary, increased. Without fertilizer application, it was equal to 80.49%, and with increasing marketability background food crops increased by 4.33-11.45%. Manure and nutrients to the fat, calculated on the yield of 40 t / ha of tubers, reduced the share of small tubers from 19.61 to 8.06%, and large (over 100 g) increased from 29.93 to 40.71%.

CONCLUSION

Maximum leaf area agrocenosis varieties Luck highest value (46.8 thousand. M2 / ha) reached at the highest fertilizer background. Better graphics leaf area growth differed agrocenosis potatoes on the background, calculated on the tuber yield of 40 t / ha, which allowed the formation of a high yield in the experiments. According to the natural fertility of gray forest soils formed yields early potato varieties Luck 14.4 t / ha. Fertilizing of planned crops in doses calculated cash-balance method on the tuber yield of 25-40 t / ha provided formation 24.5-36.2 t / ha or 91.0-98.0% of the plan. As the level of the planned harvest the probability of obtaining reduced from 2.0 to 9.0%. The photosynthetic potential (FP) during the growing season of potato varieties Luck was in the first variant without fertilizers 2.173. The second 2.520, third 2.910, in the fourth 3.196 and fifth 3.575 million. M2 / ha of days, that is, with an increase in standards of AF fertilizers increased respectively 0.347-1402 million units per thousand formed OP units from 7.2 to 10.8 kg of potatoes. The starch content varied from a few of fertilizers. The maximum starch content (14.7%) reached the second embodiment; when the fertilizer based on yield of 25 t / ha tubers. A further increase in the background is some of its decline. The nitrate content in all variants of the experiment was below the MRL. However, with increasing standards of fertilizers increased the content in 1.24 - 1.73 times (without fertilizer - 41 mg / kg wet weight).

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