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Photosynthesis Productivity Improvement Efficiency and Yield in Salt Soils

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ABSTRACT

The article provides data on how to increase the growth and development of cotton, yield, photosynthesis productivity, restore soil fertility, reduce salinity, pH of the alkaline environment in saline, arid zones of the Bukhara oasis. In the 6th variant, when using "Carbon dioxide forming a utility model" during the plowing period and after 1-2 irrigations in cotton, the exhaust gas introduced under the soil turned out to be the most effective, due to this, the formed carbonic acid normalized the balance of soil microorganisms, reduced salinity by 52.09%, neutralized alkalinity after washing salts from pH=8.1 (in control) to 6-var. pH = 7.5 converted hard-to-reach phosphorus into digestible forms for plants, leaf area increased by 0.6805 m^2/ plant, dry weight- 320 g, net photosynthesis productivity- 10.4 g/ m^2, additional yield- 15.7q / ha, weight of one bolls- 7.4g, weight 1000pcs. cotton seeds-140g, fiber length-37.5 mm, fiber yield-39%. Profitability- 34-40%.

Keywords: Carbonic acid forming a utility model", pH neutralization, Desalination," Leaf surface, Dry weight, Photosynthesis productivity, Yield, Profitability

INTRODUCTION

The process of photosynthesis for life on Earth is not only of great importance, but, one might say, decisive. Energy is needed to carry out any process in nature. On Earth, it is taken from the Sun. Sunlight is captured by plants and converted into the energy of chemical bonds of organic compounds. This transformation is photosynthesis.

The rest of the organisms on Earth (with the exception of some bacteria) use the organic matter of plants to obtain energy for their lives.

During photosynthesis, oxygen is released. Oxygen is essential for the process of respiration. During respiration, the reverse process of photosynthesis takes place. Organic substances are oxidized, destroyed, and energy is released that can be used for various life processes. Thanks to oxygen respiration, the living world has received the possibility of a wide and complex development. And oxygen in the atmosphere was formed due to plants and the process of photosynthesis.

During photosynthesis, carbon dioxide is absorbed from the atmosphere. Carbon dioxide is released during respiration.

All organic matter contains the chemical element carbon. It is plants that bind it into organic substances (glucose), receiving it from inorganic substances (carbon dioxide). And they do it in the process of photosynthesis. In the future, "travelling" through food chains, carbon passes from one organic compound to another. Ultimately, with the death of organisms and their decomposition, carbon again passes into inorganic substances.

For humanity, the process of photosynthesis is also of great importance. Coal, peat, oil, natural gas are the remains of plants and other living organisms that have accumulated over hundreds of millions of years. They serve as a source of additional energy for us, which allows civilization to develop.

There are a number of negative environmental factors that lead to a deterioration in the process of photosynthesis, including increased soil salinity, high air temperature, low water, evaporation of moisture from the soil, a breath of warm temperature wind, excess or lack of light, less than normal light, etc. - others factors.

The Republic of Uzbekistan is located in the center of the Eurasian continent in the Aral Sea basin. More than 70% of the country's territory is occupied by semi-deserts and deserts, including the largest desert in Central Asia - Kyzylkum. The total population of the country is about thirty-five million people, of which about 49% live in regions prone to drought [1-3]; [4-7].

As a result of one of the world's largest environmental disasters - the drying up of the Aral Sea, over 60% of the coastal areas of Central Asia have become practically unsuitable for use for agriculture and other activities. At the same time, 75 million tons of salt are annually distributed to other parts of Central Asia and beyond. This, in turn, accelerates the processes of salinization

and desertification in the Central Asian countries as a whole, especially in the lands of the Aral Sea region on the territory of Uzbekistan, where, in addition, a new Aralkum desert has formed in the northeast and south of the region with an area of 5.5 million hectares [1-3]; [4-7].

In the lower reaches of the Amudarya River (on the territory of the Khorezm region and the Republic of Karakalpakstan, including the Bukhara region), about 91% of irrigated lands are classified with varying degrees of soil salinity, desertification and degradation of agro ecosystems are observed [1-3]; [4-7].

Geobotanical research on 5.3 million hectares of pastures in the Aral Sea region showed that 2.4 million hectares of land are degraded. Based on the results of the research, proposals were developed for the restoration of these territories [1-3]; [4-7].

Combating soil salinization, melioration and revival of agricultural ecosystems, mitigation and adaptation to climate change through innovative approaches and technologies, the introduction of the so-called "climate-smart agriculture" and the integration of all this through the national "Agricultural Development Strategy until 2030" - are our top priorities for the long term [1-3]; [4-7].

Bukhara region is located in a semi-desert zone. The climate is sharply continental.

Over the past 10 years, the maximum air temperature has reached from 45°C to 53°C, the minimum air temperature has been -17-26°C, and the prolonged blow of hot summer winds adversely affects the growth and development of crops and yields.

Therefore, according to its geographical position, the Bukhara oasis is located close to the Aralya Bay region and belongs to the regions of the Republic of Uzbekistan with extreme conditions.

Today, the population is growing at a very fast pace and in order to provide the existing population of the Republic of Uzbekistan with more than 36.2 million people with food, clothing, technical and industrial goods, as well as for the harmonious development of the future young generation in all aspects, scientists need to develop and implement a science-based form comprehensively effective and simultaneous use of water-resource-saving, innovative microbioagrotechnologies, which are one of the first and most important tasks, advanced science and achievements.

Soil salinization is one of the extreme factors, spread over very large areas, both in Uzbekistan and around the world. An increased concentration of toxic salts disrupts the balance in the soil microbial community, the photosynthetic process, and as a result, the balance of plant nutrition, especially phosphorus and potassium, is disturbed.

At present, a very urgent problem of agriculture is the problem of increasing the fertility of degraded soils, the productivity of photosynthesis and the productivity of agricultural crops when it is cultivated on saline, phosphated soils.

For normal growth and photosynthesis productivity, cotton and other crops must receive sufficient phosphorus, applied at the right time and in the right form, to complete their production cycle without reducing yields.

Phosphorus is essential for the growth and development of all crops. In plants, phosphorus is part of nucleic acids, phospholipids, and a number of coenzymes. Therefore, sufficient provision of plants with this element is necessary for the normal course of photosynthesis, respiration, energy accumulation and transfer, cell division and growth. In particular, phosphorus accelerates the maturation of plants, which can significantly increase the efficiency of water use [8-10]; [11-14]; [15- 19].

For soil desalinization, the necessary reaction occurs only at a sufficiently high content of carbon dioxide in the soil. In saline soils of the Bukhara region, the Republic of Uzbekistan, it is just lacking.

The dissolution of inorganic phosphates - with the help of carbon dioxide - results - producers of organic acids and a decrease in the alkaline pH of the soil [8-11].

In connection with the above data, the most effective way to restore the fertility of degraded - saline, phosphated and polluted soils under cotton is the use of tractor waste (exhaust gas) with the help of carbon dioxide forming a "useful model" of the arable and sub arable soil layer.

The formation of carbon dioxide in the arable and sub arable layer can be an objective indicator of the intensity of decomposition of soil organic matter and makes it possible to characterize one of the most important aspects of the biological circulation of substances.

The influence of various stress factors such as soil salinity, abnormal heat (garmsel), drought (water deficit) depending on the degree of leafiness of cotton, the accumulation of dry mass, the productivity of photosynthesis is low or high, there will be a decrease or increase from the amount of accumulated dry mass and leaf area.

Usually, with a small leaf area, the activity of photosynthesis decreases due to a decrease in the assimilation surface, and with a large leaf area, productivity decreases due to a lack of light at the required level.

The cotton leaf is the main photosynthetic organ of the plant, and increasing or decreasing its surface area increases or decreases the productivity of photosynthesis [20, 21], [22, 23], [24-27].

Also, the leaf is an important organ of the plant, serving for the implementation of transpiration and biosynthesis of a number of organic compounds, including the synthesis of phytohormones (auxin, gibberellin, abscisic acid, cytokinin) [27, 28, 29].

According to the interpretation of Abdullaev K.A., Karimov H.Kh. the surface of a plant leaf directly depends on its variety, the quality of agrotechnical measures carried out in it, the

mechanical composition of the soil, the degree of fertility and salinity, water availability, illumination, plant density used in various norms and periods of mineral nutrition and affects the change in the value of photosynthesis productivity [20-22], [23, 24].

Therefore, achieving an acceptable level of foliage on saline, arid soils is one of the important issues of growing cotton [25-27], [28-30], [31, 32], [33-35].

In the growth, development and accumulation of fruit elements, the assimilation surface formed by their leaves is of great importance.

The yield value is closely related to the leaf area, and it is said that in order to obtain a quality crop from agricultural crops, depending on the type of crop, the leaf area should be 45-60 thousand m^2/ha. [22-24], [28, 32].

From many years of field experiments and literature data, it is known that, for the normal origin of the process of photosynthesis productivity, plants should have, only with moderate observance of soil composition, nutrition, air temperature, humidity and pH of the soil environment, illumination, water-air aeration. And in general, all the factors necessary for all plants will be enough, then the photosynthetic process is going well and you can grow a high yield of crops. In order to increase the productivity of photosynthesis and obtain a high and high-quality cotton crop on saline and global desiccation soils of the Bukhara region of the Republic of Uzbekistan, it is very relevant to use the new technology of the “Useful Model” installation for introducing tractor waste into the arable and subsurface soil layer during plowing and during the growing season before irrigation and after 1-2-irrigation cultivation.

The essence of the new technology lies in the fact that when using the “Utility Model” installation, introducing tractor waste (exhaust gas) under the soil (during the plowing period and during cultivation), neutralize and desalt the soil in order to restore soil fertility, the number of microorganisms and the laws of equilibrium. To increase the productivity of photosynthesis, the yield and quality of cotton and other agricultural crops, in conditions of arid, global temperatures, and saline, phosphated soils.

The objects of the study were high air puffs, droughts, saline, phosphated soils, the Bukhara Scientific Experimental Station of selection, seed production and cultivation of cotton agro technology, the "Utility Model" for the introduction of tractor exhaust, the cotton variety "Bukhara-8" and the productivity of photosynthesis.

RESEARCH METHODS

Experimental experiments were carried out according to the methodology adopted in UzSRIBSPATCG "Methodology for conducting field research [36]. Methodology of agrochemical, agrophysical and microbiological studies of field cotton areas [37]. These yield results were dispersively analyzed according to the method of B. Dospekhov "Methodology of field experience" [38]. The leaf surface, biomass and productivity of photosynthesis were determined during the growing season of cotton: with the appearance of 2-4 true leaves; budding; flowering; and maturation according to Tretyakov's method [32].

A study to study the effectiveness of carbon dioxide forming the "Useful Model" when applied under the soil (during the plowing period and during cultivation) was carried out in the scientific experimental farm of the UzSRIBSPATCG of the Bukhara region in the Republic of Uzbekistan. In order to reduce salinity and restore soil fertility, increase the assimilable form of phosphorus in plants, and ultimately improve leaf area, dry weight and photosynthesis productivity, yield and fiber quality. The soil is meadow-alluvial, saline. The depth of groundwater was 2.0-2.5 m above sea level. In the experiment, 8 variants were studied. The experiment was repeated three times. The size of each plot was 2592m^2.

All agro technical measures on the experimental fields were carried out according to the plan developed by the experimental farm. The scheme of experience is given in table.1.

According to the generally accepted methodology developed by the scientists of UzSRIBSPATCG, field germination and seed germination energy, phenological records and observations of the growth and development of cotton were determined.

Soil samples were taken in two periods: in spring (at the beginning) and in autumn (at the end of the growing season) at horizons 0-30; 30-60; 70-100 cm of soil layers for agrochemical, microbiological and reclamation analyses.

Table 1: Scheme of experience

№	Experience options	Terms of application of the "Utility Model"		
		During plowing	Before watering the culti vation	After watering cultivation
1	Absolute control (no fertilizer)	"Utility model" is not used		
2	Control (against the background of N-250, P-175, K-100 kg/ha)	"Utility model" is not used		
3	Control (P_2O_5 is not applied), during the plowing period and after 1-2 irrigations of cotton with cultivation, exhaust gas is introduced under the soil	+	-	+
4	Only during the plowing period, the introduction of exhaust gas into the soil	+	-	-
5	During the period of plowing and before the 1st-2nd irrigation of cotton with cultivation, the introduction of the soil into the arable layer of the exhaust gas	+	+	-
6	During the plowing period and after the 1st-2nd irrigation of cotton with cultivation, exhaust gas is introduced under the soil	+	-	+
7	During the growing season and before the 1st-2nd irrigation of cotton with cultivation, exhaust gas is introduced under the soil	-	+	-
8	During the growing season, after the 1st-2nd irrigation of cotton with cultivation, exhaust gas is introduced under the soil	-	-	+

At the end of the growing season, manual collections and counts were carried out to determine the yield of plants. The quality of the fiber was determined in the laboratory "SIFAT", the oil content of the seeds was determined by the method of extraction with petroleum ether on a Soxhlet apparatus.

RESULTS AND DISCUSSION

The main indicators of the photosynthetic activity of plants are: leaf area, photosynthetic potential, net productivity of photosynthesis and utilization rate of photosynthetic active radiation. The leaf area value is composed of the leaf area of individual plants and depends to varying degrees on the growing season, growing weather conditions, crop variety, plant density, nutrient availability, soil type and degree of salinity, etc. [21], [9-11], [33-35].

The classic of the Russian soil scientist, academician Antipov-Karataev [39] in the 20th century, on the basis of whose works many ways of improving saline soils were developed, wrote in a scientific work: “if there is enough calcium carbonate in the soil, salinization may not occur, since in the process of exchange reactions, it displaces harmful ions.

Salinity inhibits the entry of phosphorus into cotton plants through the root system, since phosphorus is found in soils in the form of water-insoluble tricalcium phosphate - $Ca_3 (PO_4)_2$. [9-11], [12, 17], [29,40].

And in order to increase the leaf canopy, dry weight and productivity of photosynthesis and ultimately obtain a high and high-quality yield, it is necessary to need digestible forms of phosphorus. Chloride and sulfate salts inhibit the uptake of phosphorus by plants, since under the influence of salinity, the solubility of phosphorus decreases, which requires additional application of phosphorus fertilizers. On a global scale, the efficiency and digestibility of phosphate fertilizers is approximately 10-25%.

The role of phosphorus in plant life is due to its influence on the development of the cotton root system, which in turn performs the main function in transporting nutrients, maintaining metabolic processes and strength in a growing plant.

Phosphorus is an integral part of DNA and RNA. Phosphate fertilizers increase the resistance of plants to adverse conditions, and also improve the physical condition of the plant as a whole. Participates in the regulation of plant respiration, accelerates the germination and ripening of seeds. It is an indispensable element for the formation of buds and seeds, and supports the process of photosynthesis [8], [9-11].

Everyone knows that saline soils are poor in organic matter.

The bacteria involved in the production of carbon dioxide sharply reduce their activity, they have nothing to eat. How can it be extracted? Of course, it can only be extracted with carbonic acid. For the formation of carbonic acid under the soil, we will need water and carbon dioxide. CO_2 is found in abundance in tractor waste, i.e., in the exhaust gas.

If we use the "Useful Model" to introduce tractor waste under the soil of cotton during the plowing period and during cultivation, then we get the following chemical reaction: $H_2O + CO_2 = H_2CO_3^-$ and with such a reaction you can get carbonic acid! [9-11].

Carbonic acid is very weak in chemical properties. When interacting with a base and acids, it forms medium and acidic salts.

If saline soils are saturated with carbonic acid, then toxic ions will turn into harmless salts. If there is enough carbonic acid in the soil, then the process of desalinization will begin in the soil, i.e., soil neutralization reactions take place. When the pH of the soil environment is closer to seven, then it will be very favorable for the growth and development of crops.

Saturation of saline soil with exhaust (carbon dioxide) gas can be achieved using a utility model. Samples were periodically taken from the subject and from the control variant. We determined the degree of salinity and pH of the soil of the experimental plot - it decreased by 30-60 percent, and in the fall on the control (2) variant, the pH was equal to - 8.6-9.1; (and in the spring of the 2nd variant, after washing, they were 8.0-8.1) in the experimental (5-6) variant, the pH decreased to 7.5-7.6, i.e., 1.1-1.0 (for 3 years) below the control.

It was thought that only the process of soil desalinization could not give such excellent results. We know that, according to physiology, the enrichment of above-ground air with carbon dioxide increases the yield of most crops - due to increased photosynthesis. But here there is a different picture; carbon dioxide is given into the soil. When the NPK was analyzed before and after the introduction of the exhaust gas under the soil, some questions came to light.

We annually apply many thousands of tons of phosphorus fertilizers to the cotton field, but cotton (on saline soils) does not absorb all the phosphorus (on the strength of 15 to 25%), once it enters the soil, a significant part of it turns into sparingly soluble secondary phosphates. The roots of cotton plants will need only dissolved forms of phosphorus. From year to year, phosphorus accumulates in the soil, and lies in it useless for plants. Phosphoric acid is highly soluble in carbonic acid. Therefore, phosphates accumulated in the soil as a result of the applied phosphate fertilizers are better dissolved in water saturated with carbon dioxide.

In non-saline soils rich in humus, beneficial bacteria live a full-blooded life and actively release carbon dioxide. The gas combines with water, forming carbonic acid; the hardly soluble phosphorus is transferred to an available state for plants. And on saline soils, carbonic acid is produced much less, while a significant part goes to combat harmful salts.

The amount of CO, CO_2 released by the soil is determined by biological indicators (the rate of growth and development of plants and activates the vital activity of free-living microorganisms, respiration of the roots).

The composition of (tractor waste) fuel for the engine, in addition to hydrogen and carbon, also includes Cr, Ca, S, Fe and Si in smaller quantities. Engine oil contains Ca, P and Zn. The thermal efficiency of the engine determines the chemical composition of the exhaust, which depends on

the brand of fuel, engine speed, load size, operating temperature and injection characteristics. The composition of the exhaust is also affected by fuel additives [8, 9-11].

Heavy metals that are toxic to humans are converted into additional nutrients that can be assimilated by crops as micronutrients. In other words, tractor waste can become a source of providing plants with microelements.

When using "Carbon dioxide forming a useful model" in arable and sub arable layers on saline, degraded soils in three growing seasons, applied annual mineral (phosphorus and potash) fertilizers, hardly soluble forms are transferred to an accessible state for plants.

The availability of nitrogen oxide from the exhaust system is increased through several steps. Initially, an increase in the concentration of carbon dioxide in the soil activates the activity of free-living microorganisms involved in the production of amino acids.

If the culture absorbs nitrogen in the form of nitrates, then it is 2 times more efficient at capturing carbon dioxide compared to using ammonia. Exhaust gas activates the work of soil bacteria, which forms a positive interaction.

During the operation of a diesel engine, carbon particles are formed in a unique cylindrical shape - carbon nanotubes.

Adding carbon nanotubes like this to tomato seeds allows the crop to maintain water uptake, which encourages germination, according to a study from the University of Arkansas. With this treatment, the seeds germinated 2 times faster than untreated [8].

Nitrogen from the exhaust is used faster than it is applied with ammonia forms of fertilizer or urea. The ability of soil microorganisms to bind nitrogen is often limited by the deficiency of organic matter [8-10]; [11, 12].

The main benefits of nitrate exhaust nutrition are:

- Acceleration of metabolic processes and the preservation of hydrogen in the roots;
- More carbon dioxide in the soil;
- An increase in the concentration of copper in the culture tissues;
- Activation of the growth of crops that respond positively to sodium, especially with insufficient potassium supply, in such crop's sodium improves the water balance;
- Decreased chloride uptake by cultures that do not tolerate sodium;
- In plant tissues, the pH level rises, which helps to protect them from pathogens and improve the absorption of nitrates [8].

Moreover, the moisture in the exhaust, during cooling, is able to condense in the seeds, activating their germination [8-10]; [11, 12].

It has now been scientifically proven that the number of live bacteria, parasites or fungi on seeds treated with waste [8].

Table 2: Spring state of the sum of mobile forms of nutrients in the soil of the experimental field, mg/kg

Location of the selected soil sample	soil layer, cm	Amounts of mobile forms NPK, mg/kg		
		N- NH_4	P_2O_5	K_2O
Bukhara Scientific Experimental Station	0-30	14.2	11.6	107
	30-70	10.5	9.8	101
	70-100	7.4	7.4	104

The state of the sum of gross forms of nutrients in the spring at the beginning of the experiment in layers 0-30; 30-70 and 70-100 cm in soils, respectively, were: nitrogen - 0.041-0.048-0.032%; phosphorus - 0.132-0.116-0.099%; potassium-0.584-0.615-0.665% (see Table 3).

Table 3: Spring state sum of gross forms of nutrients, %

Location of the selected soil sample	soil layer, cm	Humus, %	Amount of C in humus, %	Number of gross form N P K			
				N- NH_4, %	P_2O_5, %	K_2O, %	C/ N
Bukhara Scientific Experimental Station	0-30	1.73	1.01	0.041	0.132	0.584	24.5
	30-70	1.55	0.90	0.048	0.116	0.615	18.8
	70-100	1.05	0.61	0.032	0.099	0.665	19.1

The autumn sums of mobile and gross forms of nutrients in the soil of the experimental field are given in tables 4-5.

Table 4: Autumn state of the sum of mobile forms of nutrients in the soil of the experimental field, mg/kg (09/08/2020)

	Options	soil layer, cm	number of mobile forms N P K, mg/kg		
			N- NH_4	P_2O_5	K_2O
2	Background control (N-250, P-175, K-100 kg/ha)	30-50	9,8	6,2	100
3	Control (P_2O_5 is not applied), during the plowing period and after 1-2 irrigation of cotton with cultivation, exhaust gas is introduced under the soil	0-30	10,9	8,4	104
		30-50	12,6	6,4	119
		60-100	9,9	7,4	108
4	Exhaust gas is introduced under the soil only during the plowing period	0-30	10,1	7,8	103
		30-50	11,8	6,0	115
		60-100	9,5	7,1	105
5	During the plowing period and before the 1st- 2nd irrigation of cotton with cultivation, exhaust gas is introduced under the soil	0-30	11,1	9,2	106
		30-50	13,4	7.1	123
		60-100	10,2	7,5	115
6	During the plowing period and after the 1st-2nd irrigation of cotton with cultivation, exhaust gas is introduced under the soil	0-30	11,3	9,4	107
		30-50	13,5	7.5	125
		60-100	10,4	7,6	116
7	During the growing season, exhaust gas is introduced under the soil with cultivation until the 1st-2nd irrigation of cotton	0-30	10,9	8,4	104
		30-50	12,6	6,0	119
		60-100	9,9	7,4	108
8		0-30	8,8	7,0	113

	During the growing season, exhaust gas is introduced under the soil with cultivation after the 1st-2nd irrigation of cotton	30-50	9,3	5,4	107
		60-100	7,4	10,4	116

Analyzing Table 4 by the end of the growing season, it can be seen that the dynamics of the NPK content in the soil layers was different depending on the period of exhaust gases application. In the control variant, the amount of NPK in a 30-50-cm soil layer was 9.8-6.2-100 mg/kg, and during plowing and during the growing season with cultivation, after 1-2 irrigations of tractor exhaust introduced into the soil in 6 -th variant, in mobile forms, the amount of NPK by layers, respectively, was: 13.5-7.5-125 mg/kg. The difference in the indicators of mobile forms of the amount of NPK between the 2nd and 6th options, respectively, was: -3.7-1.3-25 mg/kg more than the 2nd control.

However, the results of the table show that in the 6th variant, despite receiving an additional yield, the amount of NPK in the mobile form accumulated in the soil more than the control one.

One of the main reasons for this situation is that, depending on how many times and for what period the tractor waste was brought under the soil, due to the creation of favorable conditions, the successful occurrence of the neutralization reaction and other biochemical processes in the soil, the accumulation of the number of mobile forms of nutrients increased over time. by converting harmful salts into harmless ones in the soil. Additional digestible forms of macro and microelements were formed in the soil, as a result, we can say that by analyzing the data, due to the creation of favorable conditions for plants and soil, the cotton yield and the amount of NPK in the mobile form in the soil increased.

It was noted that the application of fertilizers, irrigation, the number of shoots and the ongoing agrotechnical activities were the same in all options. There is a significant difference between the yield indicators obtained from them, due to the improved absorption of fertilizers by plants in option -6 compared to the control option.

Therefore, these indicators indicate that mineral fertilizers applied during the growing season and secondary phosphates, which have not been absorbed for many years, react with the presence of exhaust gases sent to the soil and turning into an easily absorbed form by the plant. And in the end, we can say that this leads to an increase in the productivity of photosynthesis, dry weight and, to an increase in productivity and its quality.

Also, the obtained research results prove that carbon dioxide simultaneously reduces the level of soil salinity in saline lands and converts phosphorus fertilizers into phosphorus that is easily digestible for plants.

The results of three-year (2020-2022) studies of agrochemical analyzes show that at the beginning of the growing season, mobile forms of NPK on 3-4-5-6-7-8 variants were, respectively: the amount of nitrogen (0-30cm in the soil layer) -17.0 -17.3-17.4-17.5-16.4-16.8 mg/kg; (30-50cm in the soil layer) -14.4-14.4-14.6-14.5-14.2-14.4 mg/kg.

Table 5: Autumn state of the sum of gross forms of nutrients in the soil of the experimental field, % (September 8, 2020)

Options	soil layer, cm	Humus, %	Gross forms of nutrients		
			$N\text{-}NH_4$, %	P_2O_5, %	K_2O_3, %
2. Background control (N-250, P-175, K-100 kg/ha)	30-50	1.05	0.020	0.165	0.294
3. Control (P_2O_5 is not applied), during the plowing period and after 1-2 irrigation of cotton with cultivation, exhaust gas is introduced under the soil	0-30	0.91	0.035	0.173	0.365
	30-50	0.63	0.032	0.182	0.455
	60-100	0.90	0.027	0.161	0.515
4. Exhaust gas is introduced under the soil only during the plowing period	0-30	0.90	0.032	0.170	0.350
	30-50	0.60	0.030	0.180	0.415
	60-100	0.65	0.025	0.159	0.485
5. During the plowing period and before the 1st- 2nd irrigation of cotton with cultivation, exhaust gas is introduced under the soil	0-30	1.13	0.040	0.183	0.365
	30-50	0.93	0.034	0.192	0.455
	60-100	0.73	0.029	0.171	0.615
6. During the plowing period and after the 1st-2nd irrigation of cotton with cultivation, exhaust gas is introduced under the soil	0-30	1.15	0.041	0. 204	0.606
	30-50	0.99	0.035	0.292	0.471
	60-100	1.02	0.033	0.182	0.441
7. During the growing season, exhaust gas is introduced under the soil with cultivation until the 1st-2nd irrigation of cotton	0-30	0.83	0.040	0.163	0.315
	30-50	0.93	0.032	0.192	0.471
	60-100	0.73	0.035	0.182	0.441
8. During the growing season, exhaust gas is introduced under the soil with cultivation after the 1st-2nd irrigation of cotton	0-30	1.12	0.040	0.204	0.600
	30-50	0.89	0.034	0.292	0.455
	60-100	1.02	0.029	0.171	0.615

The amount of phosphorus (0-30cm in the soil layer) -22.2-22.2-22.4-23.1-22.3-22.8 mg/kg; (30-50 cm in the soil layer) -20.3-20.3-20.7-21.4-18.8-19.2 mg/kg.

The amount of potassium-210-211-213-218-212-216mg/kg; (30-50cm in soil layer) -197-199-204-209-200-208mg/kg. At that time, against the background of the mineral fertilizer of the control (2) variant, these indicators in the 0-30 cm layer were: nitrogen-14.7 mg/kg; phosphorus-18.9 mg/kg; potassium-199 mg/kg. And in a layer of 30-50 cm of soil, mobile forms of NPK were respectively: 12.2-13.9-193 mg/kg.

At the end of the growing season, the mobile forms of NPK according to 3-4-5-6-7-8 variants were respectively: (0-30 cm in the soil layer) the amount of nitrogen-12.5-12.7-12.9-12.9 12.9-10.9 mg/kg; (30-50 cm in the soil layer) -13.1-13.1-13.4-14.5-13.6-11.3 mg/kg; the amount of

phosphorus (0-30 cm in the soil layer) -16.3-16.3-16.1-16.6-16.1-15.3 mg / kg; (30-50 cm in the soil layer) - 11.2-11.0-13.5-14.4-14.1-13.9-13.8 mg/kg; the amount of potassium (0-30cm in the soil layer) -184-186-195-202-175-194 mg/kg; (30-50 cm in the soil layer) -188-190-199-210-190-198 mg / kg.

If we compare the data obtained with the 3-variant to the 2-(control) variant on the content of the mobile form of phosphorus in the soil, at the beginning and end of the growing season, then we get more interesting data. Although we did not contribute (third year) to the 3rd var. the annual rate of phosphorus fertilizers for the growth and development of cotton, the amount of mobile forms of phosphorus at the beginning and end of the growing season (0-30 cm and 30-50 cm in the soil layer) was 22.2, -20.3 mg/kg; 17.3-15.3 mg/kg. In the control variant at the beginning and end of the growing season in these soil layers were, respectively: 18.9-13.4 mg/kg; 13.9-10.0 mg/kg, i.e. the difference between the variants was 3.3-6.9 mg/kg (at the beginning of the growing season), 3.4-5.3 mg/kg (at the end of the growing season) was higher than the control variant.

These indicators are explained as follows: when plowing and cultivating with the help of the “Utility Model” installation for collecting tractor waste introduced under the soil, a sufficient amount of carbonic acid is formed. Hardly soluble secondary phosphates that accumulate from year to year, which lie useless under the soil, dissolve in carbonic acid and turn into an accessible form of phosphorus for plants.

Therefore, without applying phosphorus fertilizers to cotton, we can use the secondary phosphates that are stored in the soil (they are converted into an assimilable form of phosphorus with the help of carbonic acid) and get high and high-quality yields. By saving phosphate fertilizers, reducing soil salinity, improving nutrition with macro and microelements, the yield and quality of the fiber increase. As a result, the cost is reduced and economic efficiency is increased.

And on the other hand, since the property of carbonic acid is weak, when interacting with a base and acids, it forms medium and acidic salts (neutralization reactions occur). Due to the neutralization process, toxic ions turn into harmless ones for plants, i.e. The pH of the soil environment is desalinated, the structure and granularity of the soil improves. Fertility is restored. The number of beneficial microorganisms is increasing. The balance of distribution of macro and microelements by the plant improves. Such an environment provides favorable conditions for the plants, and will eventually lead to increased canopy, dry weight, and photosynthesis productivity[9-11].

Among the options studied, the best option turned out to be (during the plowing period and during the growing season after watering the introduction of tractor waste under the soil) - option 6.

On the absolute control variant (the third year without fertilizers), the mobile forms of NPK in the layers of 0-30 and 30-50 cm of soil at the beginning of the growing season were,

respectively: 12.1-15.7-193 mg/kg; 9.8-11.7-186 mg/kg; and at the end of the growing season they were respectively: 9.9-12.3-187 mg/kg; 8.7-10.6-179 mg/kg.

Thus, the tests showed that the introduction of exhaust gases into the soil affected the agrochemical state of the soil (the number of qualitatively sown seeds increased on saline soils, the concentration of nitrate nitrogen in the soil stabilized, and microbiological activity improved).

At the same time, despite all the advantages of this technology and its widespread use in a number of countries, this issue has not been studied sufficiently.

The great world soil scientist V.V. Dokuchaev [40] said that: "salt licks are an inevitable evil, they must be studied and learned to manage them, then they will work for us."

In order to reduce the degree of soil salinity and to obtain a higher and higher quality yield every year, the content of harmful salts in the soil layers was analyzed using agrochemical analyzes. Tables 6-7-8-9 provide information on the spring and autumn state of the content of harmful salts in soil horizons.

Table 6: Spring state of the amount of easily soluble harmful salts and dense residue in the soil of the experimental field before the experiment (April 22, 2020)

soil layer, cm	After washing the salts, the indication pHmeter (spring)	Dense residues,%	The content of harmful soluble ions, in percent,(%)						Total amount of ions
			HCO_3^-	$C1^-$	$SO4^{-2}$	Ca^{+2}	Mg^{+2}	Na^++K^+	
0-30	7.8	0.964	0.009	0.080	0.551	0.195	0.033	0.033	0.901
30-70	7.9	1.110	0.012	0.085	0.715	0.215	0.045	0.063	1.135
70-100	7.9	1.380	0.012	0.055	0.633	0.195	0.033	0.057	0.985

According to the results of the analysis, the amount of soluble harmful ions in the soil of the experimental field before sowing (in the state after washing with salts) in layers 0-30; 30-70 cm of soil; the number of HCO_3^-, Cl^- and SO_4^{2-} ions in layers of 70-100 cm is respectively: 0.009-0.012-0.012; 0.080-0.085-0.055; and 0.5541-0.715-0.633%, and the total amount of ions by soil layers was respectively: 0.901-1.135-0.985, which indicates the degree of soil salinity above average.

Table 7: Autumn state of the amount of easily soluble harmful salts and dense residue in the soil of the experimental field after the experiment (September 8, 2020)

	horizons, cm	soil pH (autumn)	Dense residues,%	The content of harmful soluble ions, in percent,(%)						Total amo unt of ions
				HCO_3^-	$C1^-$	$SO4^{-2}$	Ca^{+2}	Mg^{+2}	Na^++K^+	
2	0-30	8,0	0.992	0.009	0.090	0.588	0.210	0.037	0.054	0,988
	30-50	8.1	1.245	0.006	0.130	0.604	0.235	0.050	0.087	1,112
3	0-30	7.7	0.750	0.008	0.030	0.470	0.180	0.006	0.032	0.714
	30-50	7.7	0.730	0.008	0.025	0.468	0.190	0.006	0.012	0.709

	60-100	7.8	0.317	0.006	0.030	0.172	0.060	0.006	0.023	0.297
	0-30	7.7	0.765	0.009	0.040	0.493	0.170	0.007	0.035	0.754
4	30-50	7.7	0.730	0.007	0.070	0.438	0.160	0.007	0.015	0.697
	60-100	7.8	0.405	0.007	0.025	0.219	0.060	0.007	0.016	0.334
	0-30	7.6	0.750	0.009	0.030	0.475	0.150	0.006	0.032	0.702
5	30-50	7.7	0.725	0.009	0.025	0.468	0.140	0.006	0.012	0.660
	60-100	7.8	0.315	0.006	0.030	0.172	0.060	0.006	0.023	0.297
	0-30	7.6	0.610	0.008	0.020	0.345	0.170	0.006	0.025	0.546
6	30-50	7.5	0.615	0.009	0.020	0.350	0.160	0.006	0.009	0,672
	60-100	7.8	0.310	0.007	0.020	0.171	0.060	0.007	0.011	0.329
7	0-30	7.7	0.718	0.009	0.030	0.438	0.185	0.006	0.030	0.693
	30-50	7.7	0.740	0.009	0.027	0.479	0.193	0.006	0.012	0.726
	60-100	7.8	0.312	0.006	0.030	0.224	0.155	0.006	0.020	0.441
	0-30	7.6	0.715	0.008	0.022	0.451	0.173	0.006	0.025	0.685
8	30-50	7.7	0.727	0.009	0.022	0.457	0.191	0.006	0.009	0,694
	60-100	7.8	0.319	0.007	0.029	0.223	0.061	0.007	0.011	0.338

After salt washing, the pH of the alkaline environment of the soil in the arable and subsurface soil layers in the control variant was 8.0-8.1, and by the end of the growing season, depending on the application of the utility model, in options 5-6, in different soil layers were pH = 7.5-7.6 to 7.7-7.8.

Table 8: Spring state of the amount of easily soluble harmful ions in the soil of the experimental field before the study (April 22, 2020)

Soil layer, cm	The content of easily soluble harmful ions, in milligram equivalent								total amount of harmful ions
	HCO_3^-	$C1^-$	$SO4^{-2}$	total anions	Ca^{+2}	Mg^{+2}	Na^++K^+	total cations	
0-30	0.148	2.256	11.461	13.864	9.750	2.713	1.436	13.899	27,763
30-70	0.197	2.397	14.872	17.466	10.750	3.699	2.741	17.190	34,656
70-100	0.197	1.551	13.166	14.914	9.750	2.713	2.480	14.942	29,856

According to the results of table 7, it can be seen that in the process of neutralization, compared with the control (pH=8.0-8.1) version of the experiment, pH decreased by 0.3-0.4-0.5-0.6. These data are presented in table 7.

Tables 8-9 show data on the spring-autumn state of the amount of easily soluble harmful ions in the soil of the experimental field before and after the study.

Analyzing the data in Table 8, the spring state (after washing) the amount of soluble harmful ions in the soil (0-30, 30-70, 70-100 cm) layers where the experiment was carried out, the highest content of soluble harmful ions was observed in 30-70 cm soil layers . $C1^-$, SO_4^{-2} ions and the total number of anions and the sum of anions and cations, respectively, were: 2.397-14.872-17.466-34.656 milligram equivalent.

Usually, in the experimental plots, the degree of salinity increases every year from spring to the end of the growing season (autumn). And on the test options, where "Carbon dioxide forming a useful model" was applied to the soil, secondary salinization was not observed in these options.

Table 9: Autumn state of the amount of easily soluble harmful ions in the soil of the experimental field after the study (September 8, 2020)

Layer options, cm		The content of easily soluble harmful ions, in milligram equivalent								
		HCO_3^-	$C1^-$	$SO4^{-2}$	total anions	Ca^{+2}	Mg^{+2}	Na^++K^+	total cations	total amount of harmful ions
2	0-30	0.148	2.256	11.461	13.864	9.750	2.713	1.436	13.899	27,763
	30-70	0.197	2.397	14.872	17.466	10.750	3.699	2.741	17.190	34,656
	70-100	0.197	1.551	13.166	14.914	9.750	2.713	2.480	14.942	29,856
3	0-30	0.148	0.846	8.780	9.774	8.000	0.393	1.292	9.685	19.459
	30-70	0.144	0.705	8.634	9.483	8.500	0.393	0.422	9.315	18.798
	70-100	0.168	0.746	3.578	4.492	3.000	0.493	1.001	4.494	8.986
4	0-30	0.144	0.574	8.294	9.012	9.500	0.393	0.988	10.881	19.893
	30-70	0.148	0.464	9.230	9.842	10.000	0.860	0.360	11.220	21.062
	70-100	0.197	0.746	9.398	10.341	11.000	0.786	0.479	12.265	23.265
5	0-30	0.148	0.564	9.294	10.006	10.100	0.490	0.888	10.478	21.484
	30-70	0.148	0.564	9.330	10.042	10.000	0.760	0.360	10.120	21.162
	70-100	0.177	0.746	9.198	10.121	10.500	0.786	0.479	10.765	21.886
6	0-30	0.148	0.526	8.080	8.754	8.000	0.393	0.392	8.785	17.539
	30-70	0.148	0.505	7.734	8.387	7.500	0.393	0.322	8.215	16.602
	70-100	0.098	0.646	3.578	4.322	3.000	0.493	0.901	4.394	8.716

If you look at the content of soluble harmful salts in gram-equivalent terms, then the experimental field shows that this field is saline. On such soils, the possibility of obtaining high and high-quality crop yields is limited.

By the end of the growing season in the 5th and 6th variants, where the “carbon dioxide-forming utility model” was used, the content of $C1^-$, SO_4^{-2}, the sum of the number of anions and the total number of harmful ions in layers 0-30; 30-70 cm of soil, compared with the control, the differences in the 6-variant were respectively less: ($C1^-$) - 1.751-1.892 mg. Eq; (SO_4^{-2}) 3.381-7.138 m. Eq; (sum of anions) - 5.110-9.077 mEq; (sum of cations) -5.114-8.979 mEq; (total amount of harmful ions) – 10.224-18.054m. Eq; also in the 5th variant, these indicators were correspondingly less by: ($C1^-$)-1.692 - 1.833 m.Eq; (SO_4^{-2}) - 2.167 - 5.442 mg. Eq; (sum of anions) -3.858-7.424 mg. Eq; (sum of cations) – 3.421-7.07 mg. Eq; (total number of ions) - 6.601-13.494 m.Eq.

In the 6th variant, in the layer (30-70 cm), compared with the 2nd control variant, soils were desalinated by 52.09%, i.e., the total harmful ions decreased by (34.656-16.602 =) 18.054 m.Eq. The results of the analyzes can be seen in Table 9.

Thus, based on the results of chemical analysis, it can be concluded that in options 5-6 used during the plowing period and before and after 1-2-irrigation cultivations of the utility model that emits carbon dioxide, harmful anions and cations soluble in the soil react with carbon dioxide and neutralize its environment, due to the process of neutralization of harmful salts for plants turning into harmless and additional sources of mineral salt, creates a favorable environment for their growth and development, which leads to an increase in crop elements, activation of capillary roots, an increase in dry weight, photosynthesis productivity.

Also, on saline lands, the coefficient of absorption of mineral fertilizers by plants is somewhat lower compared to crops on non-saline lands, and for these reasons, mineral and organic fertilizers are used relatively more on such lands. Phosphorus fertilizers applied annually to the soil are not absorbed by the plant and lie uselessly in the soil in the form of secondary phosphates. Phosphorus salts are known to be highly soluble in carbonic acid. It is enough for them to react with each other to turn into easily digestible phosphorus.

The constant application of mineral fertilizers and the use of pesticides in saline soil cause chemical changes that disrupt the content of mobile forms of nutrients in soils, which contributes to the development of degradation processes such as dehumification, soil compaction, violation of the ratio of nutrients, etc., ultimately soil is polluted and its fertility is also reduced. All these negative phenomena lead to a violation of the balance of nutrients. The number of useful soil microorganisms decreases, the cation-anion composition of the soil absorbing complex changes, which changes the reaction of the soil environment to alkaline (pH = 8-10), which disrupts the absorption of macro- and microelements by plants.

The data obtained indicate that the use of exhaust gas under the soil was observed in 3-4-5-6-7-8-options, which led to a decrease in alkaline pH among soils, the degree of salinity and an increase in biodiversity, an improvement in the balance of the soil microbial community (ammonifiers , phosphorus mobilizing, oligonitrophils, butyric acid bacteria, phases I and II nitrifiers, etc.) beneficial microorganisms. Among the options studied, the 5-6 options turned out to be the best (during the plowing period and before and after 1-2 irrigations of cotton with the cultivation of introducing tractor waste under the soil).

Depending on the degree of influencing various stress factors (salinization, abnormal heat, cold, water deficit, etc.), there will be a decrease or increase in the productivity of the degree of cotton foliage, accumulation of dry matter, low or high productivity of photosynthesis, depending on the accumulated amount of dry matter. matter at the expense of area.

In the growth, development and accumulation of fruit elements in plants, the assimilation surface formed by their leaves is of great importance [21,22], [23,24.].

The amount of yield is closely related to the leaf area, and scientists say that in order to obtain a quality crop from crops, depending on the type of crop, there should be a leaf area of 45-60 thousand m^2/ha. [21-24]; [32].

In order to determine on saline and arid soils what effect the carbon dioxide-forming useful model has on the leaf surface, the accumulation of dry matter and the productivity of photosynthesis, at a plant density of 80-90 thousand bushes / ha, in cotton varieties Bukhara-8 in all variants, plant samples and analyzed during the growing season: with the appearance of 2-4 true leaves, budding, flowering, maturation of the plant.

The obtained 3-year scientific data show that using a utility model that produces carbon dioxide in the arable layer, depending on the growing season of cotton, as well as on how many times it is applied and how much carbon dioxide is formed in the soil, according to the experimental options, the yield and productivity indicators were differently.

Due to the formation of carbon dioxide, CO, N_2O and other heavy metals in the exhaust of the tractor, the number of beneficial microorganisms under the soil increases, biochemical, aerobic-anaerobic, humifying, nitrifying processes are activated, the balance of distribution of macro-microelements in plants normalizes the growth and development of plants and creates a favorable environment for more formation of reproductive products. That is, therefore, with an increase in the number of leaves in one plant, an increase in the leaf surface area and the productivity of photosynthesis are observed. In studies, the accumulation and formation of a large amount of biomass was observed in the phases of flowering and fruiting of the plant.

During the plowing period and during the vegetation of plants, when introducing tractor waste (exhaust gas) in the subsurface layer with the help of a utility model, it neutralized the saline pH of the alkaline environment of the soil. Thanks to the process of neutralization, toxic salts for plants were turned into harmless additional nutrients.

In addition, we know that phosphoric acids dissolve well in carbonic acid, therefore, phosphate fertilizers that have been in the form of secondary phosphates for many years are converted into an easily digestible form by the plant, and waste gases harmful to humans and animals: CO, CO_2, N_2O, produced by the engine of the internal tractor combustion, enter the soil as a result of activation of various biochemical, aerobic-anaerobic processes of humification, nitrification.

This affects the acceleration of seed germination, but also improves metabolism in the early stages of plant development and accelerates the ripening of cotton bolls, leads to an increase in enzyme activity and, as a result, has a positive effect on increasing biomass and yield [8; 9-11].

Figure 1 shows data on the impact of the application of the "utility model of desalination and restoration of soil fertility" on the change in leaf area during the growing season of cotton on saline soils.

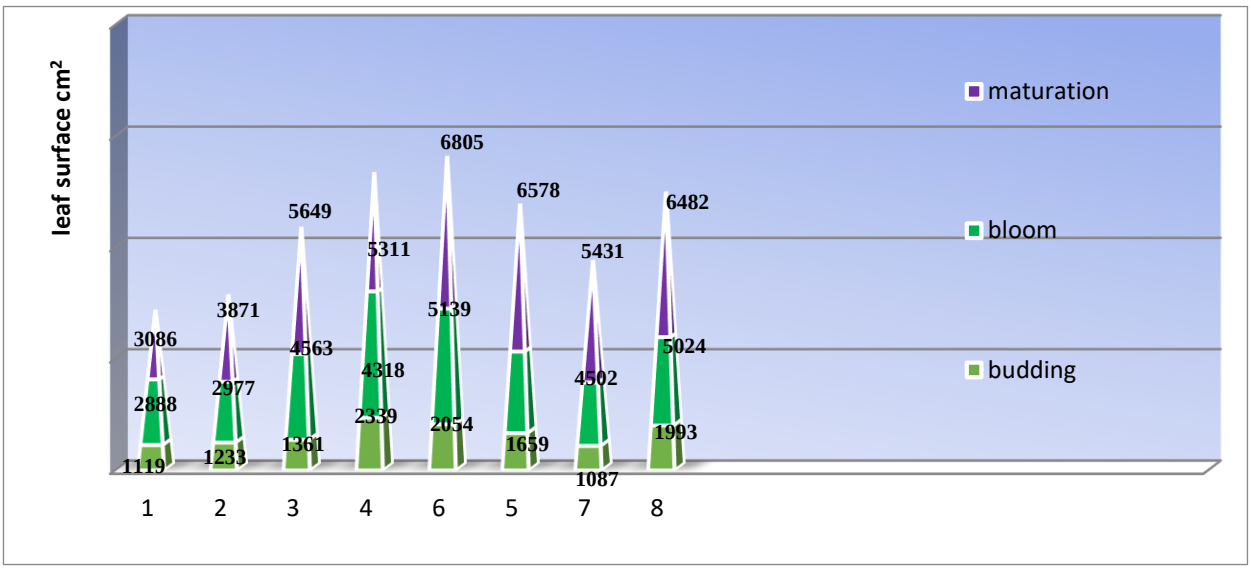


Figure 1: The impact of the application of the "useful model of desalination and restoration of soil fertility" on the change in leaf area during the growing season of cotton on saline lands.

In the research, actually recognizing that the leaves of plants carry out the process of photosynthesis, determined the leaf area, dry weight and productivity of photosynthesis during the vegetation period of cotton with the appearance of 2-4 true leaves, budding, flowering and ripening, which with the help of the "carbon dioxide-forming utility model" introduced exhaust gases in the arable and subsoil layers of the soil during plowing and before and after 1-2 irrigation cultivations, indicates that, depending on the amount of emissions introduced under the soil, the leaf surface and its biomass changed differently in all variants.

The increase in the leaf plate and the accumulation of dry matter is one of the most important indicators of the cotton yield and the successful completion of the processes of its growth and development, that is, all these processes lead to an increase in the productivity of photosynthesis.

Studies have shown that with an increase in the leaf surface area and dry matter of one plant bush, the yield increases.

Normally, a plant breaks down organic matter into inorganic matter by inhaling carbon dioxide under the action of sunlight during photosynthesis. The more carbon dioxide, the more productive the process of photosynthesis.

To find out how the “Carbon Dioxide Utility Model” affects the accumulation of plant dry matter, canopy and root development, as well as the growth and development of cotton, it was used during the plowing period and in the pre-irrigation and post-irrigation cultivation of cotton by introducing exhaust gases under the soil .

Under the conditions of a saline and long-term high-temperature dry wind in the initial phase of growth and development of cotton variety Bukhara-8 (during the appearance of 2-4 true

leaves), the dry weight of cotton in all variants ranged from 1.0-1.2 g to 1.6 g , leaf surface - 38.1 to 90.6 cm^2.

Among the tested variants, the highest indicators were observed in the 5th-6th variant, where during the plowing period, before and after 1-2 cultivation irrigations, trakroor exhausts were introduced under the soil. At the same time, compared with 1-2 control options, the differences in dry weight and leaf surface, respectively, were: 0.6 - 0.4 g; 21.1-52.5 cm^2; 0.1g; 47.9 cm^2 above the control.

According to the results of the study, the accumulation of dry matter and the development of the root system differed depending on the rate and duration of the use of exhaust gas. The largest amount of dry matter mass and the development of the root system was observed during the years of study on the 5-6th variant, i.e. with the use of exhaust gas under the soil before and after irrigation cultivation, the indicators of dry matter per bush, respectively, amounted to: 310-320 g /plant. In the control variant, this figure was 157.0 g/plant. In options 5-6, the weight of one box was 7.2-7.4 g. In the control variant, this indicator was 7.0 g.

The development of the root system was higher in the experimental variants compared to the control, and in the experiments there was a thickening of the active lateral (1-2-3, etc. of the 5th ordinal) roots. In option 6, where the utility model was used, the height of one plant was 135 cm, the number of mature bolls was 26, the root length was 34 cm. In the control variant, these parameters were respectively: 118 cm, 14 pcs. boxes and 32 cm.

The thickening of the lateral active roots in the underground part of the earth indicates that as a result of thawing with the help of carbon dioxide of phosphate fertilizers lying underground for many years, the plant converts phosphorus into an easily digestible form, due to the fact that the lateral roots of the plant use fertile nutrients from it, enlargement occurs. lateral roots and accumulation of cotton fruit elements. Also, due to the presence of carbon dioxide, the growth of beneficial living microorganisms and other microbiological processes in the soil increased, and the development of roots under the soil improved compared to the control variant. Ultimately, this led to an increase in productivity, the restoration of the laws of balance.

Table 10: Influence of the Utility Model desalinating and increasing soil fertility on the leaf surface, dry weight and photosynthesis productivity in the conditions of saline lands and global warming (per plant, on average over 3 years)

№	Experience options	Dry weight(dw_1), in the period with the appearance of 2-4 true leaves, g	Dry weight (dw_2) during ripening, g	Dry weight(dw_2-dw_1) growth over 90 days	leaf surface, m^2		Net productivity of photosynthesis, g/m^2
					At the beginning of the growing season (Ls_1)	At the end of the growing season (Ls_2)	
1	Absolute control (no fertilizer)	1.0	120	119.0	0.00381	0.3086	8.4

2	Background control(N-250, P-175, K-100 kg/ha)	1.2	157	155.8	0.00437	0.3871	8.8
3	Control (P2O5 is not applied), during the plowing period and after 1-2 irrigation of cotton with cultivation, exhaust gas is introduced under the soil	1.3	250	248.7	0.00497	0.5649	9.7
4	Exhaust gas is introduced under the soil only during the plowing period	1.4	232	230.6	0.00386	0.5311	9.6
5	During the plowing period and before the 1st-2nd irrigation of cotton with cultivation, exhaust gas is introduced under the soil	1.1	310	308.9	0.00662	0.6578	10.2
6	During the plowing period and after the 1st-2nd irrigation of cotton with cultivation, exhaust gas is introduced under the soil	1.6	320	318.4	0.00683	0.6805	10.4
7	During the growing season,	1.3	245	243.7	0.00566	0.5431	9.9

	exhaust gas is introduced under the soil with cultivation until the 1st-2nd irrigation of cotton						
8	During the growing season, exhaust gas is introduced under the soil with cultivation after the 1st-2nd irrigation of cotton	1.6	300	298.4	0.00633	0.6482	10.1
(Least significant difference) LSD_{05} = 0.15 g/m^2; (Error percentage) Er = 4.5 %							

In the ripening phase, the indicators of dry weight, leaf surface and net productivity of photosynthesis in 3-4-5-6-7-8 variants were respectively: 250-232-310-320-245-300g; 0.5649-0.5311-0.6578-0.6805-0.5431-0.6482 m^2; 9.7-9.6-10.2 - 10.4-9.9-10.1 g/m^2.

According to the analysis of scientific data, depending on when and how many times the tractor exhaust was applied during the vegetation phase, there is a difference in leaf area and biomass accumulation compared to control options.

Among the tested variants, where exhaust gases introduced under the soil, i.e. in variants 5-6, leaf area, dry weight and net photosynthesis productivity were high. Leafiness and dry weight from a cotton bush are relatively reduced in the remaining 3-4-8-7 variants, and the net productivity of photosynthesis was also relatively low.

In the 6th variant, the largest leaf area (0.6805 m^2), dry weight gain (320 g/plant), photosynthesis productivity (10.4 g/m^2) were observed.

Thanks to the optimal application of the utility model, exhaust gases under the soil were due to the successful course of the neutralization reaction and biochemical processes, soils were desalinated, fertility was restored, the balance of distribution of macro and microelements among plants, wind and air exchange conditions were improved. The number of beneficial microorganisms has increased, as a result of which the productivity of photosynthesis, the yield and quality of raw cotton have increased.

In table. 10 and Figure 2 show the average three-year scientific results of the "desalination and soil restoration utility model" on increase in leaf area, dry matter accumulation and net photosynthetic productivity during the growing season of plants by test options.

This is due to the fact that when using exhaust gases at optimal times using a utility model that produces carbon dioxide, various harmful gases for humans contained in exhaust gases (CO, CO_2, N_2O) in saline soils react with ions in the soil to form harmless acidic salts (nutrients), due to which it spreads through the root to the cotton leaf and accelerates the activity of the membrane membranes that make up the leaf cell. It allows you to distribute the metabolism evenly, as a result, the process of photosynthesis is accelerated, and instead of a high accumulation of organic matter, more dry matter accumulates in cotton.

In our studies, the above theoretical and practical three-year results confirmed their validity. Usually, if we take into account that the process of photosynthesis accelerates from morning to the middle of the day, then it is observed that the amount of sunlight falling on a plant on a slope ($30\text{-}40^0$) increases in an area with a large number and area of leaves [27, 29] the accumulation of dry mass, the duration of the assimilation period, plant growth, the yield and net productivity of photosynthesis primarily depend on exogenous (its salinity, lack of water, mineral nutrition, light, heat, etc.) factors, which are influenced from outside.

Depending on the use of the useful device, as well as the duration of its use on saline soils, the weight of one bolls, the percentage of opening of the bolls, the quality of the crop, and the profitability varied in different ways.

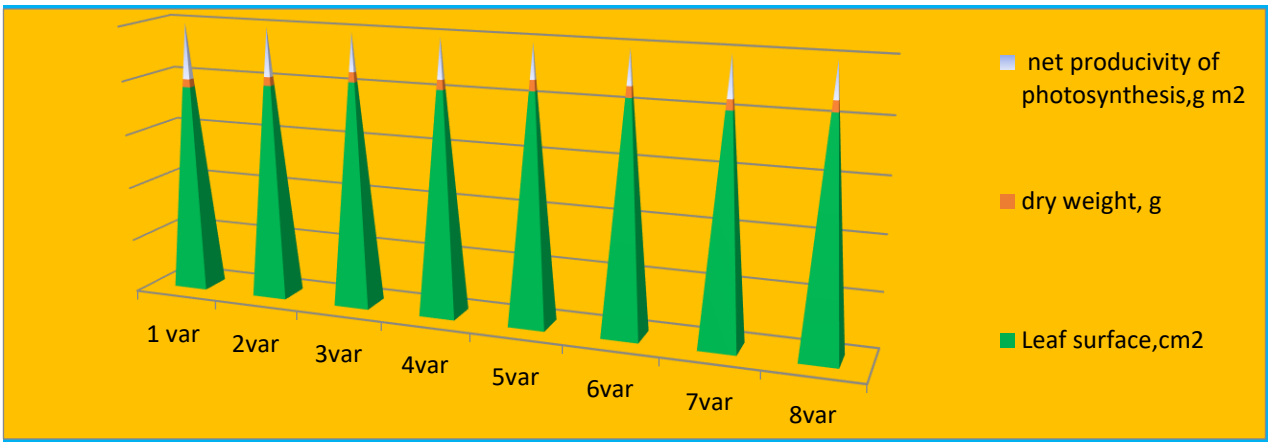


Figure 2: Effect on leaf area, dry matter accumulation and photosynthesis productivity when applying "Carbonic acid forming utility model" on saline soils.

Before each harvest, 100 cotton bolls were selected from each plot of the experiment I and III repetitions and the average weight of one cotton boll was determined. The cotton harvest was determined by manual collection from each option completely.

According to the calculation results for the options, the weight of the 1st harvest in the research year was as follows:

The largest weight of the 1st harvest was observed in options 5-6 and amounted to 37.02 - 40.03 c/ha, respectively. In the control variant, this indicator was 28.7 c/ha, in the 3-4-7-8 variant, respectively, they were: 36.2-34.1-36.0-35.2 c/ha. Compared to the control, the weight of the 1st harvest in 5-6 variants was proportional to the following: +10.8 c/ha; +15.70 c/ha - crop additives.

The highest positive results for the 2nd harvest were obtained for options 5-6, respectively: 9.48-11.37 c/ha of cotton. On the control variant, it was grown only from two harvests - 35.7 c/ha; on the 5th - 46.5 c /ha; on the 6th - 51.4 c/ha. The rest of the yield options were average.

The results obtained show that the productivity indicators of options 5-6, where the useful model was used, during the plowing period and during the vegetation of cotton plants before and after 1-2 cultivation irrigations, were higher than the control variant by +10.8 c/ha; +15.70 c/ha.

In these variants, an increase in the weight of cotton from one boll and the number of bolls per bush was observed (respectively: 0.2 - 0.4 g; 9.4 - 12.0 pcs.).

As a result, in these variants, the mass of 1-2 harvests was higher, which led to an increase in yield compared to the control variant. In options 5-6 (1.0 mm; 0.7-0.8%), they showed higher quality indicators, i.e. fiber length and fiber yield.

In the course of the research, it was also found that depending on when and in what period the utility model was used, there was a change in the leaf surface, the accumulation of large amounts of dry matter and the net productivity of photosynthesis, the yield and its quality increased to one degree or another.

Among the tested options, the most positive results were noted in the 6th option, compared with the control option, the degree of soil desalinization by -52.09%, the pH of the alkaline medium decreased to -7.5. According to the results of 3 years of scientific research, leaf area increased by *0.6805 m^2/ plant*, dry weight -320 g, net photosynthesis productivity -10.4 g/m^2, additional yield 15.7 c/ha, weight of one bolls -7.4 g, weight 1000 pcs., cottonseed-140g, fiber length-37.5mm, fiber yield -39%. profitability increased by- 34-40%.

CONCLUSION

Based on the studied three-year data, it can be concluded that on saline soils, when using the “utility model that forms carbonic acid”, during the plowing period and after 1-2 irrigated cotton crops, applied under the soil turned out to be the most effective, due to the exhaust gas formed under the soil carbon dioxide normalized the balance of soil microorganisms, reduced salinity, neutralized soil alkalinity (pH=8.1 control, pH=7.5). Among the tested variants, the most positive results were noted on the 6th variant, compared with the control variant. In this variant, the degree of soil desalinization decreased by -52.09%. The transfer of hard-to-reach phosphorus into easily digestible forms for plants, the leaf area increased by 0.6805. m^2/plant, dry weight per - 320g, net productivity of photosynthesis -10.4g/m^2, additional yield -15.7

q/ha. The mass of one box increased by 7.4 g, the mass is 1000 pieces. cotton - 140g, fiber length - 37.5 mm, fiber yield - 39%, profitability - 34-40%.

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