«Сейфуллин оқулары – 18(2): « XXI ғасыр ғылымы – трансформация дәуірі» халықаралық ғылыми - практикалық конференция материалдары = Материалы международной научно-практической конференции «Сейфуллинские чтения – 18(2): «Наука XXI века – эпоха трансформации » - 2022.- Т.III. Ч.I. – P.23-27

SCIENTIFIC FOUNDATIONS OF AGRICULTURAL PLANTS FARMING AND THEIR REGULATION

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In order to obtain high yields of agricultural crops and increase soil fertility, it is necessary to conduct agriculture based on the achievements of agronomic science, technology and best practices. To this end, it is necessary to thoroughly and comprehensively study the requirements of plants for growth factors and their influence on soil fertility conditions. It is necessary to develop the most effective ways to satisfy plants in the necessary living conditions.

Explaining the tasks of agriculture, K. A. Timiryazev wrote "... a cultivated plant and the requirement imposed by it is the fundamental scientific task of agriculture" [1].

For the life of a green plant, factors such as light, heat, water, air and nutrients are necessary. In the absence of any of them, the plant dies.

For many years, scientists have been trying to establish the relationship and interaction of plants with individual growth factors. In the experiments, both one of the factors was quantitatively changed, without changing the others, and several. Based on these studies, the following laws of agriculture were formulated: minimum, optimum, maximum, equivalence, irreplaceability and interaction of plant growth and development factors.

The law of the minimum was formulated by Liebig. He argued that the yield of plants depends on a factor that is at a minimum. When it is eliminated, the yield increases, but until another factor is at a minimum. For clarity, this law is depicted in the form of a "Dobenek barrel", which consists of rivets of various heights (Pic.1).

The yield is compared with the water level in the barrel, which cannot be higher than the lowest riveting, since when others increase, water will inevitably flow through the lowest riveting. In the picture, the water level is limited by a rivet indicating nitrogen (a factor that is at a minimum). With an increase in this factor, phosphorus will be in the minimum of the main nutrients.

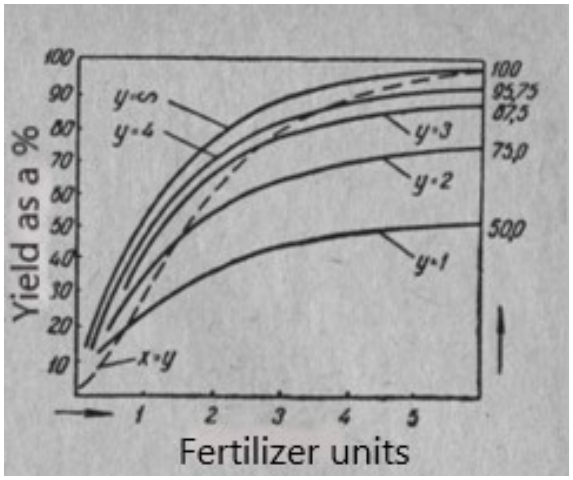
The law of the minimum reads as follows: "The productivity of the field is directly dependent on the necessary component of plant food contained in the soil in the smallest amount".

(Pic.1) Dobenek 's barrel

Later, this law received the following mathematical expression: V = A-X, where Y is the yield, X is the amount of nutrients, and A is the proportionality coefficient for this type of fertilizer.

Influenced by the criticism of the supporters of the “law” of decreasing soil fertility, Liebig began to recognize the decreasing effect of subsequent identical dosages of fertilizers applied to the soil. His new position was consistent with the experiments of Gelrigel and other researchers (Pic.2)

In Gelrigel’s vegetation experiments, the highest yields of barley were obtained at soil moisture content of 60% of the total moisture capacity. In the absence of water and its maximum content, the yield was zero. The results of these experiments were mistakenly used by some researchers to prove the existence of a “law” of decreasing soil fertility and only on the basis that they allegedly confirm the attenuation of the effect of successive identical dosages of the factor. In fact, this experience confirms the existence of the laws of minimum, optimum and maximum.



(Pic.2) Curves of crop yield changes depending on changes in factor x and y (x-fertilizer units,y-yield)

Liebscher at the end of the XIX century made additions to the Liebig minimum law. Their essence boils down to the following: “The plant with the greater productivity can use the vegetation factor that is at a minimum, the more

other factors are at an optimum". Thus, studies have established the dependence of the effect of the factor, which is at a relative minimum, on the presence of others and their dosages.

Valuable research on the study of plant requirements for growth conditions was carried out by the German scientist Mitscherlich (1910-1911). Based on numerous experiments, he came to the conclusion that the height of the crop is determined by the total amount of active plant growth factors.

He expressed his results of research on the effectiveness of fertilizers with the formula:

$$\frac{dy}{dx} = C(A-V)$$

(Table- 1) The Mitscherlich formula

Where V is the harvest; X is the intensity of the tested factor; A is a conditional constant that denotes the highest yield, taking one or another value, depending on the availability of plants with all factors; C is the coefficient of action of the variable factor X (Table 1)..

This formula is clearly characterized by the curves of Pic. 2. Solid lines depict the change in yield with a sequential quantitative change of two factors (x and y). The yield curves have a sigmoidal shape.

Similar results were obtained in the experiments of Seelhorst and Tucker with oats, Russell with tomatoes and Lundergord on the assimilation of carbon dioxide by sugar beet leaves (S. A. Vorobyov). Studies of the P. A. Kostychev Reclamation Experimental Station also deserve attention. In the experiments of the station, the influence of two changing factors (humidity and fertilizers) on the yield of spring wheat was studied separately and jointly. Their results are shown in Pic.3 (humidity is expressed as a percentage of total moisture capacity).

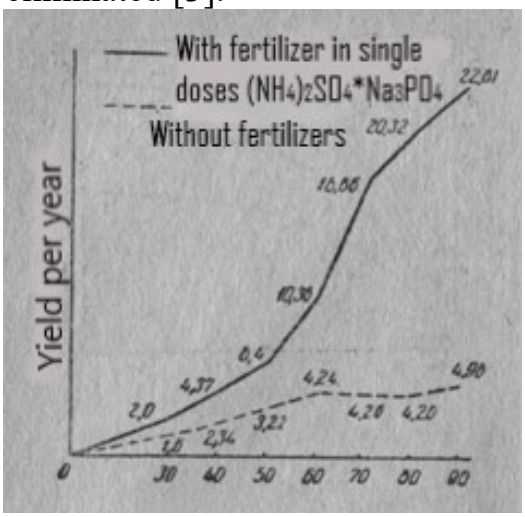
In the following years, Soviet and foreign scientists conducted numerous studies with simultaneous changes in three factors. It is established that the yield of plants depends on the combined action of many factors, and the limitations of Liebig's minimum law are shown [2].

Thus, the existence of laws of equivalence, irreplaceability and interaction of plant growth factors was proved.

The more fully plants are provided with life factors, the better they grow and develop. With a lack or excess of one of the factors, the normal growth and development of plants is disrupted. The best conditions for plant life are created with an optimal combination of the necessary factors. Therefore, in order to obtain a high crop yield, it is necessary to give plants all the necessary living conditions at the same time and in various optimal combinations throughout the entire period of their growth and development.

The greatest effect is observed when, when growing cultivated plants, the missing or excess factor is primarily affected. For example, there is not enough air in the soil to get a high yield, although other necessary factors for plants are in

sufficient quantity. In this case, soil aeration should be improved. However, the provision of plants with all the main growth factors does not completely eliminate the law of the minimum. Continuous crop growth is possible only when the limiting factor is constantly eliminated [3].



(Pic.3) Wheat yield depending on soil moisture and fertilizers.

Achievements of plant physiology, microbiology, soil science, agrochemistry and other related sciences are of great importance for agriculture. Major research in the field of plant physiology, including photosynthesis, belongs to K. A. Timiryazev.

In the process of photosynthesis, inorganic substances turn into organic ones, and the plant mass grows, in which large reserves of “canned” energy are concentrated. So, one gram of carbohydrates when burned releases about four large calories, and one gram of fat — up to ten. It was found that the blue rays of the solar spectrum affect the formation of proteins and organic acids, and yellow-red — carbohydrates [4].

This scientific research is not only of theoretical interest, but also of great practical importance, especially when cultivating vegetable crops in closed ground.

Numerous studies have revealed that the intensity of photosynthesis depends on the concentration of carbon dioxide, light, temperature, water regime, nutrients, etc.

In agriculture, there are known techniques that allow to improve the use of sunlight to some extent. These include the direction of the rows of sowing from north to south, timely thinning of plants and the fight against weeds shading crops, etc.

The achievements of microbiology have a significant impact on the development of agriculture. Numerous studies by Soviet and foreign scientists have established that the number of microorganisms and their activity largely depend on the content of organic matter in the soil. It gives them food and energy.

Theoretical issues of microbiology are closely linked with practice. For example, various microorganisms are currently widely used in production to mobilize nutrients in the soil contained in a form inaccessible to plants.

Of great importance for agriculture is the study of soil cover with the compilation of soil maps and cartograms. Soil maps and cartograms are necessary

in order to use the land rationally, apply fertilizers correctly, establish the depth of plowing, introduce crop rotation, improve the physical, biological and agrochemical properties of the soil. During the soil survey, excessively moistened lands are also identified, on which reclamation and hydraulic engineering works are carried out. The main method of regulating the water regime of swampy soils is closed drainage.

In order to increase the effectiveness of agrotechnical techniques, it is necessary to carry them out correctly and in combination. It must be remembered that each agrotechnical technique can affect both one and several factors of plant life. In fact, they are intertwined with each other, and if one of the factors is reduced or increased, it can hinder or strengthen the influence of others.

Thus, D. N. Pryanishnikov found that with sufficient mineral nutrition, the transpiration coefficient of the plant significantly decreases:

Soil moisture (as a percentage % of total moisture capacity)	20	40	60	80
Evaporated units of water per unit of dry matter:				
Without fertilizers	444	402	483	505
With fertilizers	282	334	372	409

(Table 2) 1)soil moisture 2)without fertilizers 3)with fertilizers

These data show the complete dependence of two factors: water and fertilizers. With the same amount of water on a fertilized background, the plant uses it more productively [3].

Agrotechnical techniques should be applied taking into account the characteristics of the zone, each farm, the state of the field and the cultivated crop, since different factors will be of leading importance in different conditions. As a result, thanks to the research and experiments of scientists, we are moving forward in agriculture. Thus, we increase the yield, but also save our land resources. This is one of the most important topics for the world at the moment, getting resources with little damage to our Land.

References

1 К.А.Тимирязев “Земледелие и физиология растений”, Изд. ЛИТРЕС, 2010.
2 Либих, Ю. Химия в приложении к земледелию и физиологии растений / Ю. Либих. – Москва : Государственное издательство колхозной и совхозной литературы "Сельхозгиз", 1936. – 401 с. – (Классики естествознания). – Режим доступа: по подписке. – URL: https://biblioclub.ru/index.php?page=book&id=134215.
3 https://www.webofscience.com/wos/woscc/full-record/WOS:000454632200030?SID=EUW1ED0FDCXoVKYIyiUuA8QZHU8pI
4 К.А.Тимирязев “Космическая роль растения”, Изд. ЕЁ Медиа, 2012.