

UOT: 628.31.631.85

V.I. Jafarov

e-mail: vcdiv@rambler.ru

Ministry of Science and Education Republic of Azerbaijan Institute of Soil Science and Agrochemistry, Baku, Azerbaijan Republic

THE EFFECT OF USING OF ORGANIC AND MINERAL ORIGIN RAW MATERIALS IN AGRICULTURE ON SOIL FERTILITY

Summary. *The presented work relates to ecology, chemical technology, in particular, methods for the production of fertilizers from sewage sludge and agriculture.*

The scale of production activity increases with population growth, so the problem of optimizing the interaction between man and nature is relevant and its solution is of great importance in improving the environment. Wastewater is one of the by-products of anthropogenic activities. When it is cleaned, a precipitate (sludge) is formed. The volume and the toxicity of sludge are, of course, increasing due to urban growth and the intensification of industrial production. About 25-30 kg of dry sediment is formed per person per year in European countries.

There is no single rational and environmentally safe, currently tested technology for sludge disposal in our republic, and its appearance is unlikely to be created shortly since the sediments of different treatment facilities have different physicochemical and biological properties, as well as entirely different qualitative and quantitative compositions of elements.

Purifying and disposing of such waste (sludge) is a serious environmental problem. The main principles of its solution are a set of environmental and economic interests of society, environmentally safe disposal and use of sludge, and their involvement in the economic cycle. The problem of using waste for fertilizer has various aspects and it is inseparable from the problem of soil fertility and ecology.

The exceptional importance of organic matter in increasing soil fertility has long been known. In this regard, application of organic-mineral complexes that affect the productivity and quality of plants, determination of effective fertilizer norms and application of new technologies are an urgent issue and are of great theoretical and practical importance.

The fertility of the soil is very dependent on the intensity of the biological processes taking place in it. Sufficient moisture, organic matter and a favorable reaction of the soil solution are required for the activity of microorganisms in the soil.

He worked on the technology of organic-mineral complex preparation and applied it under agricultural plants (cotton) in order to achieve the set goal in the direction of solving this issue.

Key words: *Soil; cotton; organic-mineral complex; fertilizer; fertility.*

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Introduction

Cotton farms buy thousands of tons of mineral fertilizers, herbicides and other substances every year in order to achieve high yields. At the same time, the state and municipalities spend a large amount of money on land reclamation.

Application of scientific achievements and advanced practices to production will allow to achieve positive results in the development of cotton farming [4].

In this regard, using of alternative possibilities (volcanic mud, igneous shale, domestic and sewage waste, etc.) raw materials for the preparation of organic-mineral complexes based on modern technology has become a priority issue today [2].

Natural minerals of non-ore origin, widely distributed in our republic, wastes of various purposes, etc. the expansion of the potassium-phosphorus-nitrogen fertilizer raw material base, including the fertilization of low-fertile soils and the improvement of the ecological environment, is the main goal of the research.

Object and methods of the research

Field researches were carried out in the territory of Azadkend municipality, Saatli region, in 5 variants and 4 replicates, and the area of each plot was 100 m². BO-440 white golden cotton variety was used in field experiments.

Ammonium salt (33.4%), phosphorus-amaphos (51%), potassium-potassium sulfate (52%) and organic-mineral complexes were applied as nitrogen fertilizers.

Soil agrochemical analysis in soil samples taken, pH in potentiometer, granulometric composition – N.A. Kachinski, absorbed ammonia (N-NH₄) – D.P. Konev, nitrate nitrogen (N-NO₃) – Grandval-Lyaju, total humus – I.V. Tyurin, total nitrogen, total phosphorus – K.E. Ginzburg and G.M. Sheglova, free phosphorus – M.P. Machigin, total potassium – P.K. Smith, exchangeable potassium – P.V. Protosov was determined in a flame photometer with water.

The agrotechnical care of the plants was carried out in accordance with the agrotechnical rules adopted for the region.

Analysis and discussion

Chemicalization was the basis of agricultural intensification all over the world in the second half of the last century. As a result of this, a high yield was obtained, but later this process created great problems from an environmental point of view.

In this regard, using of organic fertilizers in the production of agricultural products has become one of the priority issues.

P.B. Zamanov pointed out that there are up to 40 different wastes that can be used as organic fertilizers and that have a reserve of 22 million tons and showed that these wastes are collected in different places every year and cause environmental pollution [3, 14, 15].

Preparation and application of such waste as organic fertilizer is very favorable for farms both economically and ecologically.

It has been determined by the conducted researches that various local organic wastes can be used as organic fertilizers. These organic wastes increase the nutrients in the soil and have a positive effect on the productivity of agricultural plants [11, 12].

By carrying out laboratory research (chemical, radioactive, microbiological, etc.) of minerals with a rich organic-chemical composition, as well as domestic and industrial wastes, which are available in our country, the complex fertilizer preparation technology is applied in the relevant farms, and at this time, the hydro-physical properties of the soil, at the same time, it is very important to solve applied science-based issues, such as determining the effect on the nutritional regime, development, and productivity of plants [7, 9].

Tillage methods have a great role in the cultivation of agricultural products, as well as in increasing efficiency in farming. It is clear from scientific studies and experiments that minimizing the main cultivation of the soil has positive results [1, 10].

In order for cultivated plants to grow and develop normally and produce high yields, they must be well provided with the life factors (water, light, air, food). Of these life factors, water and food are mainly paid for by land. Therefore, improving the water-physical properties of the soil is one of the important issues.

The fact that the soil structure in the planting layer has a favorable structure for the plant, preservation of moisture in the soil, and at the same time improves the exchange of nutrients, which is considered one of the main factors that directly affect productivity.

In the areas of our republic where irrigated agriculture is spread, soil degradation, decrease in fertility, and deterioration of water physical properties of soils have taken a more intensive form [5, 13].

It is necessary to improve the physical-mechanical and agrochemical indicators of those soils, and at the same time to regulate the humus balance in order to get a planned high yield from agricultural plants.

Application of organic fertilizers is important for improving soil structure and increasing fertility (figure 1).

It is clear from the conducted multi-year researches that a part of the mineral fertilizers given to the soil is exchanged or is washed into the deep layers of the soil in the form of various compounds. This process varies depending on soil and climate conditions [6, 8].

In order to study leaching losses when fertilizers are applied, lysimeter pots (50x50 cm) were placed under the cotton plant in the 0-60 cm layer of meadow-grey soil in the research area, and samples of water filtered from the lysimeters were taken and analyzed in the characteristic development phases.

Table 1. Nutrient leaching under the cotton plant in meadow-grey soils, mg/l

Water content	Control variant	NPK	Organic-mineral complex
Roughness	42,86	37,24	41,81
pH	7,4	7,5	7,6
Sodium Na ⁺	293,56	371,30	174,53
Potassium K ⁺	24,16	157,45	34,41
Calcium Ca ²⁺	731,59	239,67	659,51
Magnesium Mg ²⁺	75,44	303,19	106,08
Iron Fe ³⁺	2,91	305,50	66,34
Sulfate SO ₄ ²⁻	1299,70	191,76	182,28
Carbonate CO ₃ ²⁻	1388,01	681,48	1312,85
Chloride Cl ⁻	299,71	606,30	119,66
Silicon Si	3,01	1504,01	307,52
Aluminum Al	1,97	370,83	79,67
Dry residue	4100	4700	3100



Figure 1 (a-d). Examples of the use of raw materials of organo-mineral origin in agriculture

The experimental soils were poorly supplied with nutrients in forms assimilated by plants.

PH in filtered water samples is close to neutral as can be seen from the table (Table 1). It ranges from 7,5 to 7,6. The amount of leached chlorine (Cl) and sulfate ions did not exceed the permissible limit.

In recent years, the cultivation of cotton as a monoculture in our republic, the non-application of crop rotation, the one-sided application of mineral fertilizers, the use of organic fertilizers in very small quantities, and the violation of the hydro-physical and biological properties of the soil have led to a decrease in their natural fertility in various degrees.

M.P. Babayev, E.A. Gurbanov and others have shown that long-term irrigation, recultivation cultivation along with the application of organic fertilizers improves the structure of grassland and grassland wetlands in Central Asian conditions [2, 5].

It is clear from the above that the application of organic fertilizers together with mineral fertilizers plays an important role in obtaining a high and stable yield from agricultural crops.

Studying of the agro-chemical and granulometric composition of the soils where agricultural plants are grown allows determining the agronomic and economic efficiency of the fertilizers applied to these soils.

In this regard, some granulometric composition of the irrigated sandy loam soils of the experimental area was also studied (Table 2).

Table 2. Granulometric composition of experiment field irrigated meadow-grey soils, %

Variants	Depth cm	Size of fractions, mm						
		1,0-0,25	0,25-0,05	0,05-0,01	0,01-0,005	0,005-0,001	< 0,001	< 0,01
Control	0-50	0,27	17,33	15,20	4,32	24,68	38,20	67,20
Sand	0-50	-	18,08	16,12	6,36	26,60	32,84	65,80
Organic-mineral complex	0-50	0,28	18,48	22,20	3,88	22,56	32,60	59,04

As can be seen from the results of the analysis, the sub-crop layers of the irrigated loam-gray soils ($AU^I_a + AU^{II} = 0.50$ cm) had a medium clay granulometric composition, and the granulometric composition was relatively lighter (< 0,59%) in the organic-mineral complex has been done.

Result

1. The researched meadow-grey soils are medium granular soils. Application of organic and mineral complex in this type of soil affects the soil structure to a certain extent and improves its capacity, as a result of which the root system of the plant develops better and can absorb nutrients better.

2. During the research, while analyzing the water samples filtered from the lysimeters placed under the cotton plant in the irrigated meadow-grey soils, it was found that pH is close to neutral. It ranges from 7.5 to 7.6. The amount of leached chlorine (Cl) and sulfate ions did not exceed the permissible limit.

3. As can be seen from the results of the analysis, the sub-crop layers of irrigated loamy-gray soils ($AU^I_a + AU^{II} = 0.50$ cm) had a medium clay granulometric content, and the granulometric content was relatively lighter (< 0,59%) in the organic-mineral complex was observed.

REFERENCES

1. Babayev, A.H., & Osmanova, S.A. (2016). Effect of soil cultivation and fertilizers on the degree of soil fragmentation under irrigation conditions. *Agrarian science of Azerbaijan*, 5, 20-31.
2. Alosmanov, M.S., Aliyev, A.A., Mammadov, M.I., Jabbarova, Z.A., Jafarov, V.I., Abbasov, O.R., Baloglanov, E.E., Alosmanova, V.M., Yolchuyeva, U.C., & Gafarova, O.O. (2022). Effect of organic-mineral complexes prepared on the basis of local raw materials and wastes on the development of cotton plants against the background of mineral fertilizers. In *Proceedings of the virtual international scientific-practical conference on "Current problems of modern agricultural and biological sciences: global challenges and innovations"* (pp. 225-229). Agricultural Research Institute of the Ministry of Agriculture of the Republic of Azerbaijan. Baku.
3. Aliyev, Ad.A., Abbasov, O.R. (2016). Igneous shales of Azerbaijan and their fields of application. *Earth and man.*, 6, 45-51.

4. Aliyev, Ad.A., & Abbasov, O.R. (2019). Mineralogical and geochemical proxies for the Middle Eocene oil shales from the foothills of the Greater Caucasus, Azerbaijan: Implications for depositional environments and paleoclimate. *Mineralia Slovaca*, 157-174.
5. Babayev, M.P., Gurbanova, E.A., Ramazanova, F.M., & Najafova, S.I. (2022). Lands of the Republic of Azerbaijan. Baku: "MSV Nashr" LLC. P. 63-66.
6. Hasanov, Y.C. (2011). Agrophysical properties of natural and anthropogenic soils of Ujar support station. In *Azerbaijan Reclamation and Water Management Open Joint-Stock Company AzHveM EIB Scientific Works* (Vol. XXXI, pp. 168-172). Baku, Science.
7. Movsumov, Z.R. (1978). Nitrogen in agriculture in Azerbaijan. Baku.
8. Mammadov, G.S. (2007). The basics of soil science and soil geography. Baku: Science publishing house. P. 361-366.
9. Mangrich, A., Tessaro, L., Dos Anjos, A., et al. (2001). A slow-release K⁺ fertilizer from residues of the Brazilian oil-shale industry: synthesis of calcilite-type structures. *Env. Geol.*, 40, 1030-1036.
10. Mammedov, M.I., & Mammedova, S.A. (2021). Wagging joint application of mineral fertilizers with bentonite to the soil in order to prevent the loss of nutrients and the transition of their digestible forms. *Agrochemical Bulletin*, 54-59.
11. Turbas, E. (1992). Use of oil-shale ashes as a lime fertilizer in Estonia. *Oil Shale*, 9 (4), 301-309.
12. Taghiyev, R.A. (1986). Some issues of improving the technological quality of cotton fiber. *Agricultural science news*, 2, 19-22.
13. Zeynalov, S.B. (1997). The effect of various organic wastes on the productivity of corn in the conditions of meadow-forest soils. *Agrarian science of Azerbaijan*, 1-2, 31-33.
14. Zamanov, P.B. (n.d.). Effectiveness of organic fertilizers obtained from the recycling of common waste in Azerbaijan in agriculture. *A collection of works on soil science and agrochemistry*, 23 (1-2), 283-288.
15. Retrieved from <https://www.stat.gov.az>

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В.І. Джафаров

ВПЛИВ ВИКОРИСТАННЯ СИРОВИНИ ОРГАНО-МІНЕРАЛЬНОГО ПОХОДЖЕННЯ НА РОДЮЧІСТЬ ҐРУНТІВ У СІЛЬСЬКОМУ ГОСПОДАРСТВІ

Анотація. Представлена робота стосується екології та хімічної технології, зокрема, способів виробництва добрив з осадів стічних вод та сільського господарства.

Масштаби виробничої діяльності збільшуються із зростанням населення, тому проблема оптимізації взаємодії людини і природи є актуальною і її вирішення має велике значення в поліпшенні навколишнього середовища. Стічні води є одним із побічних продуктів антропогенної діяльності. При їх очищенні утворюються осади (шлам). Обсяг і токсичність шламу, звичайно, зростає через зростання міст і інтенсифікацію промислового виробництва. За рік у європейських країнах утворюється близько 25-30 кг сухих осадів у розрахунку на одну людину.

Єдиної раціональної та екологічно безпечної, апробованої на сьогоднішній день технології утилізації осадів в нашій республіці немає, та й навряд чи буде створено найближчим часом, оскільки відкладення різних очисних споруд мають різні фізико-хімічні та біологічні властивості, а також абсолютно різні якісні та кількісні складові.

Очищення та утилізація таких відходів (осадів) є серйозною екологічною проблемою. Основними принципами її вирішення є сукупність еколого-економічних інтересів суспільства, екологічно безпечна утилізація та використання, залучення їх до господарського кругообігу. Проблема використання відходів на добрива має різні аспекти і невіддільна від проблеми родючості ґрунту та екології.

Виключне значення органічних речовин у підвищенні родючості ґрунту відомо давно. У зв'язку з цим застосування орґано-мінеральних комплексів, які впливають на

продуктивність і якість рослин, визначення ефективних норм удобрення та застосування нових технологій є актуальним питанням і має важливе теоретичне та практичне значення.

Родючість ґрунту дуже залежить від інтенсивності біологічних процесів, що в ньому відбуваються. Для життєдіяльності мікроорганізмів у ґрунті необхідні достатня кількість вологи, органічних речовин і сприятлива реакція ґрунтового розчину.

Для досягнення поставленої мети у напрямку вирішення цього питання розроблена технологія приготування органо-мінерального комплексу та застосування його для удобрення сільськогосподарських культур (бавовна).

Ключові слова: ґрунт; бавовна; органо-мінеральний комплекс; добриво; родючість.

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Джафаров В.І.

Міністерство науки та освіти Азербайджанської Республіки, Інститут ґрунтознавства та агрохімії

Адреса робоча: AZ1073 Азербайджан, м. Баку, вул. М. Рагіма, 5

e-mail: vcdiv@rambler.ru