SECTION 7.
AGRICULTURAL SCIENCES AND FOODSTUFFS

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LARGE-DROP APPLICATION OF LIQUID COMPLEX MINERAL FERTILIZER UAN (UREA-AMMONIUM MIXTURE) IN WINTER WHEAT CROPS IN EASTERN UKRAINE

Abstract. *In the times of globalization and market relations, the question of increasing production volumes arises. Given the fact that land resources and arable land are limited, the question arises of increasing yield and obtaining more grain from the same cultivated area. To achieve this goal, first of all, it is necessary to understand the climatic and soil characteristics of the areas and the possibility of applying fertilizers at different stages of plant development. Depending on the phenological phase of winter wheat development, the use of some fertilizers and aggregates becomes impossible, such as the application of liquid fertilizers with an injector at the flag leaf stage, or the use of a mineral fertilizer spreader at the stage of completion of tillering, when the land is covered with vegetation quite densely or completely covered. One of the key points in crop formation, which cannot be regulated in the conditions of most arable lands in Ukraine, is the limit of moisture, both precipitation and moisture in the soil. Therefore, another equally principal factor is the composition and form of fertilizer. The type of aggregate that can be used, the uniformity of application, the speed of application, the requirements for air humidity (urea, for example, begins to melt at high humidity, which makes it impossible to apply it with a planter or spreader), the level of moisture in/on the soil (the distribution of the active substance in the soil and its loss due to evaporation directly depends on this factor). For the same experiment, urea-ammonium mixture (UAN) was used as the second spring top dressing. Based on the results of the study, different application doses were selected and analyzed, best doses were selected and introduced into the general fertilizing system of the enterprise.*

Introduction. Ukraine is well known in the world as a country that exports grain, seeds, oil to various parts of the world. Thus, according to statistics, in 2021 Ukraine became the world leader in sunflower production and took first place in the world ranking of exporters of sunflower and sunflower oil, third place in the export of rapeseed, fourth in the export of corn and fifth in the export of wheat. In general, Ukrainian wheat exports cover 9% of world exports [1, 2]. The main consumer countries of Ukrainian wheat are the countries of Africa, the Arabian Peninsula, Turkey and the countries of the European Union [2]. The total volume of exported wheat for 2021 was almost 21 million tons. The total area occupied by winter wheat crops was 23.7% of the total amount of arable land [2]. This means that wheat occupies a major place in the economy of our country, as well as in the lives of millions of people outside its borders.

According to previously conducted research [3, 4] there is a direct relationship between the vegetative above-ground mass of the plant and the yield, and therefore, in order to obtain high yields of winter wheat, it is necessary to ensure the growth and development of the leaf surface

and a high level of chlorophyll in the leaf. It is well known fact, that chlorophyll is a photosynthetic element that takes part in the process of photosynthesis, the process of primary formation of organic substances in plants. Due to this green pigment, plants absorb carbon from the environment and accumulate it in dry mass [5]. Also, Priplavko's research on the use of chelating compounds analyzed the direct dependence of yield formation on the total surface area of the leaves [6]. Vegetative mass is an indicator of the ratio of available nutrients as sufficient or deficient. Based on the level of development of the green mass and the level of chlorophyll in the leaves, it is possible to calculate the plant's need for nutrients at each stage of development.

According to the international classification, winter wheat has nine macro stages of development: germination, seedling development, tillering, ear development, steam elongation, earing, flowering, ripening, dying. Depending on which phenological phases the plants fertilizing method is changing, it affects the processes that are characteristic of this phase. So, for example, the first top dressing in spring on frozen-melted soil, depending on the type of nitrogen, stimulates the spring growth of green mass, the development of seedlings or promote vegetation. The effectiveness of nitrogen fertilizer depends not only on its form, but also on the technological process of its application and weather conditions. When applying ammonium nitrate with a spreader on frozen-melted soil, the problem arises, firstly, of nitrogen loss due to the volatility of the nitrate, and secondly, the plant has not yet recovered its vegetation and cannot consume the nitrate form of nitrogen, which again leads to losses. If the first top dressing is carried out with ammonium sulfate after frost and taking into account the long form of nitrogen (ammonium) and low average daily temperatures (for the transition of nitrogen from ammonium to nitrate at an average daily temperature of +5ºC it takes about 6 weeks), then this nitrogen will not satisfy the early needs of the plant. That is why it was proposed to use liquid mineral fertilizer UAN as a second top dressing in the spring, at the recovery vegetation stage, at the onset of spring vegetation.

UAN is a mixture of ammonium nitrate, urea and water combined by an endothermic process. In its composition, UAN has 3 forms of nitrogen: nitrate (NO3-) — 25%, ammonium (NH4+) — 25%, amide (NH2-) — 50%. When nitrogen is absorbed by the plant through the root system, nitrogen must go into the nitrate form. The nitrate form of nitrogen is available for assimilation by the plant, and therefore begins to work immediately. Ammonium is first converted into nitrate form, and then absorbed by the plant. The amide form of nitrogen is the longest form of nitrogen, it first turns into the ammonium form, and only then into the nitrate form. Due to the liquid form, uniform and quick application is achieved, while part of the fertilizer falls on the plant and is absorbed through the leaf surface.

Method and experiment. Experiments were conducted during 2018-2020, in production crops in the fields of Stanychno-Luhanskiy district of Luhansk region, which belongs to the Steppe zone. Climate with pronounced cold winter (-15-25ºC) and hot summer (+30+35ºC, with characteristic dry hot winds in June-July). The fields are located on a marl plateau with deep groundwater. The mechanical composition of the soil is characterized as chestnut chernozem, sandy in places, with a high level of calcium. By nutrient composition, without obvious nutrient deficiency. According to the pH level, they are neutral.

UAN-32 fertilizer (32 units of active substance per 100 kg of fertilizer) was applied using a field sprayer with a 24-meter sweep width [7], nozzles for 5 holes without spraying, which large drops of UAN are provided, which do not leave burns on the leaf surface, and when hit on the soil in a large spot seep deep and dissolve in soil moisture. Fertilization was carried out in the spring, at the recovery vegetation stage, as soon as the temperature reached the mark for the restoration of spring vegetation.

This method of applying liquid fertilizers has both advantages and disadvantages, which are listed in Table 1.

Table 1

Advantages and disadvantages of the different method of introduction of UAN

Factor/ type of equipment	**Presence of moisture in a top layer of soil**	**absent moisture in a soil in depth on 2-3 cm**	**work productivity (according to quantity of covered hectares per day)**	**soil aeration**
sprayer	+	-	+	-
injector	+	+	-	+

On one hand, if the weather factors are unfavorable (winds, insufficient accumulation of moisture in winter, as it was in 2020, a sharp rise of temperature in the spring) the sprayer is not best method of application. On other hand, in optimal agrometeorological conditions and in the presence of large sown areas, the use of injection method may be impractical and replaced by a more optimal type of equipment.

In order to conducted experiments on the accounting of the effectiveness of fertilizing with UAN in large drops, it was carried out by the method of control strips with the following parameters, listed in Table 2:

Table 2

Application dose of UAN fertilizer in kg, l, kg of active substance per hectare

UAN-32 quantity / №of plots	kg/ha	L/ha	active ingredient N kg/ha
1	100	76	32
2	150	115	48
3	200	153	64
4	250	192	80
5	300	230	96

Application was made in longitudinal parallel strips with a width of 24 meters, control has 150 kg/ha of ammonium sulfate in physical weight without UAN.

Based on the results of the research, data on the effect of such fertilizing on the growth and development of winter wheat were collected and analyzed. Application of UAN fertilizer has a positive effect on the development of winter wheat on the development and growth of winter wheat in the spring and gives a significant increase in yield. Comparative results are shown in Table 3.

Table 3

Average result for 3 years

UAN/ha	Quantity of stem million/ha	Quantity of ears up to harvesting million/ha	Yield centner/ha
Control	3,5	3	24,2
100	4,3	3,5	30,3
150	4,7	3,9	35,1
200	4,9	4,5	39,7
250	5,2	4,6	47,1
300	5,4	4,6	47,2

Conclusion and discussion.

Large-drop application of UAN mineral fertilizer has a direct economic benefit for enterprises, the cost mechanism is much lower than the benefit obtained from fertilizing even at small doses. The first sign of the positive effect of fertilizing is an increase in the level of chlorophyll in the leaves and active plant development, the second sign is an increase in the number of stems, and the third sign is an increase in yield. The largest average yield increase was 23 c/ha, and the average indicator between the dose of 250-300 kg of UAN per hectare is almost the same. In our opinion, this is connected on the one hand with the moisture limit, and on the other hand with insufficient nutrition at the stage from the flag leaf to the filling of the grain. As a rule, the lower rows of the ear remained unformed, the grains were not formed and had from 2 to 3 grains in a pod. The indicator of the number of stems reflects, firstly, the impulse in the formation of stems, and secondly, the number of productive stem that formed an ear. The number of dead stems was from 400 to 800 thousand per hectare.

Fertilizing with long nitrogen at the tillering stage has a significant effect on the development of the green mass (leaf surface area) of winter wheat, and at the next stage on the establishment and formation of the ear. Research on fertilizing at later stages was also studied, the results of which are highlighted in previous works. An open question stays for further research on the ratio of water molecules to nitrogen molecules, for calculations of possible assimilation of nitrogen by plants for more efficient application of fertilizers and reduction of the impact of nitrates on ecology.

References:

1. Ukraine-Factsheet-April2022.pdf (usda.gov)
2. Експорт-імпорт окремих видів товарів за країнами світу (ukrstat.gov.ua)
3. Дудкіна О., Каплун А. (2010) Урожай формує листя. *Пропозиція*. (6), 20-22.
4. Носатовский А. И. (1965). Пшеница (биология). Москва: Колос.
5. Злобін Ю.А. Курс фізіології і біохімії рослин / Злобін Ю.А. – Суми: Університетська книга, 2004. – 463 с
6. Приплавко С. О., Гавій В. М., Суховєєв О. В., Суховєєв В. В. (2012). Вплив похідних фенілантранілової кислоти на ріст листків, сумарний вміст хлорофілу А і В та врожайність озимої пшениці. *ВІСНИК ДОНЕЦЬКОГО НАЦІОНАЛЬНОГО УНІВЕРСИТЕТУ, Сер. А: Природничі науки*. (1), 192-195.
7. Доспехов Б. А. (1985). Методика полевого опыта. Москва: Агропромиздат.