Technologies for the formation of high-quality turf spaces

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Abstract. The aim of the work was to determine the influence of mineral nutrition on the growth, development and quality of lawn grasses of a football field in the southern regions of Russia. The experiment was carried out on the site of the VGAFK training ground (Volgograd). Water-soluble fertilizers were used: foliar dressing; instant: Urea + Potassium Magnesia, Fertika. The composition of the sown grass mixture: Lolium perenne variety Vesuvius (20 %), Lolium perenne variety Eurocurdus (20 %), Festuca rubra variety Dorianna (20 %), Poa pratensis variety Markus (20 %), Poa pratensis variety Limousine (20 %). Lawn quality was assessed using two methods: A.A. Lapteva and NTEP (National Turfgrass Evaluation Program). The frequency of mowing the lawn will vary depending on light conditions, soil temperature and humidity. But there is a clear dependence on additional mineral nutrition. When applying fertilizers, mowing the lawn should be done every 5-7 days. Without additional mineral nutrition, the haircut should be done once every 7-12 days. It is important that when cutting, 1/3 of the leaf surface is cut off. Recommendations of technological solutions for decompaction of the root layer of the soil of the lawn space, which occur due to intense loads, are presented. It was revealed that the use of the studied water-soluble and instant fertilizers in the conditions of the south of Russia reduces the weediness of the lawn, increases its projective cover and the productivity of shoots of lawn grasses, and increases the breaking load. At the same time, the lawn coverings that are most aligned in height are noted. As a result, the quality and decorativeness of the lawn improve.

1. Introduction
The lawn is a decorative and functional element of the landscape and consists of densely growing perennial grasses. The underground and aboveground parts of the lawn cover form a densely overgrown herbage, interacting with each other and the environment. The demand for turf coverings, especially sports ones, is growing every year around the world. The sports turf must be resistant to mechanical stress, be used for many years during all sports seasons, as it is intended for active sports. The turf of sports lawns must be strong, dense, resistant to mechanical damage.

The nature and intensity of nutrition of lawn grasses are determined by the sum of environmental factors, conditions of agrotechnical care and operation of the field. Their need for elements of mineral nutrition plays an important role. At the same time, the lack of one element cannot be compensated for by the excess of another [1]. Hence, there is a demand for products that allow you to get the maximum possible effect with minimal effort and time [2-5]. And, despite the fact that there are a large number of different drugs and a range of technical devices for the care of the state of the grass on sports lawn areas (golf, football and other fields), this problem remains urgent. The modern sports lawn...
maintenance system requires renewal of preparations to protect the natural turf from diseases, pests and weeds, since the sports lawn requires constant and timely care so that the field does not lose its playing characteristics [6-9].

2. Materials and methods
The aim of the work was to determine the influence of mineral nutrition on the growth, development and quality of lawn grasses of a football field in the southern regions of Russia. The experiment was carried out at the site of the VGAFK training ground prepared for the 2018 FIFA World Cup. The football field is located in the central region of Volgograd. Field area 9322 m²: width – 79 m², length – 118 m². The composition of the sown grass mixture: *Lolium perenne* variety Vesuvius (20 %), *Lolium perenne* variety Eurocurdus (20 %), *Festuca rubra* variety Dorianna (20 %), *Poa pratensis* variety Markus (20 %), *Poa pratensis* variety Limousine (20 %). We used water-soluble fertilizers: foliar dressing (Izagri Azot, Izagri Vita, Izagri Potassium, Biodux); instant: Urea + Potassium Magnesia, Fertika. Control - without the use of fertilizers. The calculation of the need for lawn grasses in mineral fertilizers for the growing season was determined according to the chemical and granulometric analysis of the soil and the removal of nutrients. Fertilizers were applied using a fertilizer spreader according to the schedule: Fertika (spring-autumn), Urea in combination with Potassium-magnesia and a complex of foliar dressing (summer-autumn).

Lawn quality was assessed using two methods: A.A. Lapteva and NTEP (National Turfgrass Evaluation Program). Evaluation of the productivity of shoots was carried out in August – a period of high decorativeness of the lawn. According to the NTEP method, which is the main method for evaluating lawn grasses in 30 countries of the world (USA, Great Britain, Germany, etc.), the quality of the lawn was determined by the measure of aesthetics and functional application. In this experiment, the decorativeness of the herbage was evaluated on a 5-point scale. The criteria for assessing the quality of the lawn were:

- regrowth (mm) of lawn grasses during the entire growing season;
- evenness in height;
- deviation from the norm (40 H / m²) of the breaking load indicator, determined using a structure (imitating the spikes of football players) with a dynamometer;
- presence of weeds.

The assessment of the decorativeness and quality of the lawn was also carried out according to the method of A.A. Laptev. At the same time, the productivity of shoot formation (pcs / m²) and projective cover (%) were assessed on a 5-point scale. Lawn quality was defined as: unsatisfactory, fair, good and excellent.

Based on the experience, a graph was drawn up for the dynamics of lawn growth. It makes it possible to understand the optimal moment of mowing the grass mixture.

Recommendations for technological solutions for decompression of the root layer of the soil of the lawn space, which occur due to intense loads, and for bringing the grain size composition of the soil to the optimum are presented.

3. Results and Discussion
As a result of the studies, it was found that all fertilizers have a positive effect on the growth, development, strength and decorativeness of sports lawns, tables 1 and 2. Lawn grasses withstand the greatest breaking load when using Fertika fertilizer and a complex of Urea and Potassium of Magnesia. Treatment of the lawn space with these preparations has a better effect on the growth of grass stand, reduces weediness, improves evenness in height, improves the productivity of shoots, and increases the projective cover. As a result, the treatment of a sports turf with Fertika fertilizers and a complex of Urea and Potassium of magnesia gives the highest assessment in terms of decorativeness and quality of grass stand.
Table 1. Criteria for evaluating the application of fertilizers on the lawn according to the NTEP method (on a 5-point scale)

| Fertilizers          | Regrowth (mm) | Evenness in height | Breaking load, H/m² | Presence of weeds | Assessment of decorativeness of herbage |
|---------------------|---------------|--------------------|---------------------|-------------------|----------------------------------------|
| foliar dressing     | 20.9          | good               | 45                  | average           | 4                                      |
| Urea + Potassium Magnesia | 28.0        | excellent          | 50                  | weak              | 5                                      |
| Fertika             | 22.5          | good               | 60                  | weak              | 5                                      |
| control             | 15.9          | satisfactorily     | 44                  | strong            | 4                                      |

Table 2. Criteria for evaluating the use of fertilizers on the lawn by the method of A.A. Laptev

| Fertilizers          | Projective cover % | Shoot productivity scores * | Lawn quality |
|---------------------|---------------------|-----------------------------|--------------|
| foliar dressing     | 90                  | 4                           | good         |
| Urea + Potassium Magnesia | 100        | 5                           | excellent    |
| Fertika             | 100                 | 4                           | excellent    |
| control             | 80                  | 4                           | good         |

* - on a 5-point scale

According to many recommendations, the lawn should be mowed when the grass stand reaches a height of 10-15 cm. The frequency of mowing the lawn varies depending on the illumination, soil temperature and humidity [10-13]. When treating the lawn space with foliar subcrustations, the complex Urea + Potassium Magnesia, Fertika, the growth of herbage from the last mowing is accelerated compared to the control, Figure 1. In this regard, when applying fertilizers, mowing the lawn should be carried out every 5-7 days. Without additional mineral nutrition, the haircut should be done once every 7-12 days. The lawn should be mowed regularly. It is important that 1/3 of the leaf surface is cut off when cutting. Haircut recommendations are given at an average daily temperature of t > 10°C.

Figure 1. Change in the growth of lawn grass from the last mowing, centimeters.
Intensive use of lawn grass, the load of lawn care equipment, the compacting effect of irrigation and precipitation are the cause of overcompaction of the root layer of the soil. As a result, the air regime of the soil worsens, and water permeability decreases. This leads to the development of a superficial root system and a deterioration in the absorption of nutrients. Aeration contributes to the decompaction of the root layer and the improvement of the water-air properties of the soil. This technological operation is carried out by machines by vertical piercing with needles or hollow tubes (replaceable working organs) of the vegetation layer to a depth of 8-20 cm. The number of holes is up to 500 pcs/m² (Fig. 2).

![Figure 2. Lawn aeration machine (a) and schematic aeration process (b).](image)

When piercing the lawn, holes are formed and the root layer of the soil is partially compacted. The depth of the holes to be made must be controlled and the depth of the working bodies must be regulated. One of the most effective methods of loosening is hollow tube aeration (Fig. 3).

![Figure 3. Lawn aeration with hollow tubes (a) and post-aeration coring machine (b).](image)

The technological operation is carried out at a temperature of 15-28 °C on a wet lawn in sunny weather. This allows for improved core collection. Simultaneously with the collection of cores, sand is introduced and embedded. After the work has been completed, the load on the lawn is eliminated for two weeks.

During the operation of the lawn, the process of migration of large soil particles down the profile and siltation of the upper horizon occurs. To bring the granulometric composition of the soil to the optimum, it is necessary after aeration to apply coarse sand at the rate of 30-35 m³ to a standard football field (Fig. 4). At the same time, in order to avoid getting a thermal burn by herbs, the air temperature should not exceed +28 °C. The sand is covered with a mesh harrow and then watered abundantly. Up to 180 m³ are brought onto the football field per year.
4. Conclusion
The use of the studied water-soluble and instant fertilizers in the south of Russia reduces the weediness of the lawn, increases its projective coverage and the productivity of shoots of lawn grasses, and increases the breaking load. At the same time, the lawn coverings that are most even in height are noted. As a result, the quality and decorativeness of the lawn improves. The greatest decorativeness and stability of the lawn grasses of the football field are at the application of Fertika fertilizer and the complex of Urea and Potassium of magnesia. Fertilized lawn areas should be mowed 3-5 days earlier than unfertilized ones.

Intensive use of lawn grass, the load of lawn care equipment, the compacting effect of irrigation and precipitation are the cause of overconsolidation of the root layer of the soil. To prevent this process, it is recommended to carry out aeration with machines by vertical piercing of the vegetation layer to a depth of 8-20 cm. After aeration, it is necessary to add coarse-grained sand at the rate of 30-35 m³.

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