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# Factors Affecting the Productivity of Cereals

## Abstract

Autumn cereal sowing is preferred in all regions of Azerbaijan. Several factors influence the productivity of autumn cereals. These include: sowing time, seeding rate, irrigation, diseases, pests, and harvesting time. By carrying out all agrotechnical measures on time and combating diseases and pests effectively, it is possible to obtain high yields. Increasing the production of wheat is great importance in providing the rapidly increasing population in our country with agricultural products. In fact, one of the most important field crops in people's nutrition is wheat. Split, macarons and starch obtained from wheat flour are used in food for people, and the leaves and stem of the wheat plant are used in paper-cardboard industry and it is used for feeding animals. This study aimed to determine to the investigations carried out the factors affecting agricultural production and the relative importance of each factor in increasing the production level. The general objective of the study is to estimate crop production efficiency, determine production flexibility, and measure the effect of a factor on production wheat plant.

***Keywords:*** *cereal, sowing, irrigation, pests, diseases, chemical control*

## Introduction

The decline in biodiversity has led to a continuous increase in plant monoeciousness, which in turn has led to genetic depression, the spread of epidemic diseases, and a sharp decrease in adaptation to climatic conditions and productivity (Aliyev, 2014). According to FAOSTAT (2020), wheat is a highly productive, easily stored, and highly adaptable crop that has been cultivated in a variety of climates. From its most primitive form to the varieties currently cultivated, these and other desirable traits have been selected and developed by human societies since ancient times.

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It is thought that the domestication of wheat occurred around 10,000 years ago in the Fertile Crescent, a region in the Middle East considered the cradle of Western and Middle Eastern civilizations, and that it spread throughout the world through early farmers, adapting the domesticated populations to different environments (Seyidaliyev, Gurbanov, Mammadova, 2014).

More than 70% of agricultural land worldwide is used to cultivate cereal crops. In Azerbaijan, cereals are cultivated on an area of 900,000 hectares, of which 600,000 hectares are allocated to autumn cereals. The morphological structure of cereal plants includes the root, stem, leaf, flower, and grain (Mammadov, Ismayilov, 2012). Cereal crops have fibrous root systems that do not penetrate deep soil layers. Depending on the variety, the stems can range from 40 cm to 1.5 meters in height. The leaves are narrow and ribbon-like; the flowers form in spikes and are self-pollinating, where grains develop (Ahmadov, Musayev, 2005; Valiyeva, 2024).

Cereals occupy a prime position in the diet composition of all human beings, with rice, wheat, and maize being the major staple cereals with more than 70% share among all the food grains. Cereals are products obtained from several grain crops (Grain production, 2017; Yusifov, 2011).

Cereal grains can be classified based on their structure as either naked or hulled. Corn, rye, and wheat are considered naked grains. The structure of naked grains includes the fruit and seed coat, aleurone layer, endosperm, and embryo (Seyidaliyev, 2014). Hulled grains are surrounded by floral bracts and include barley, emmer, millet, and rice.

**Research**

The cultivation and production of cereals form the foundation of crop farming and are vital for the development of agriculture. In Azerbaijan, the main cultivated wheat varieties include Garagylchyg, Garabagh wheat, Sevinj, Mirbashir 50, Tartar, Mugan, Aran, Nurjahan, yellow wheat, Gurgani, and white wheat. Based on sowing time, cereals are categorized as either autumn or spring crops, with autumn cereals being more prevalent in Azerbaijani farming (Gurbanov, 2017).

The factors affecting the growth, development, and productivity of autumn cereals are divided into two categories (Devendra, 2021): 1. Uncontrollable factors: annual precipitation, temperature, floods, solar radiation, winter frosts, etc., which are beyond human control. 2. Controllable factors: sowing time, seeding rate, irrigation timing and method, fertilizer application timing and rate, pest and disease control—these are influenced by human activity (Jafarov, 2024; 2001).

Cereal crops play a crucial role in ensuring food security in our country (Seyidaliyev, Huseynov, 2020). These crops are cultivated under both irrigated and rainfed conditions across all regions, including mountainous areas. Regardless of the growing conditions, one of the key factors affecting cereal productivity is sowing time. Early sowing leads to early germination, tillering, and stem elongation, which makes the plants vulnerable to cold weather and may cause yield loss. Late sowing may also result in poor germination due to cold, leading to weaker plant development. Therefore, sowing should be carried out when the air temperature drops to +5–6°C to ensure proper tillering and winter resistance. For optimal results, sowing depth should be 8–10 cm in rainfed conditions and 5–7 cm in irrigated areas.

Another crucial factor influencing cereal yield is the seeding rate. It is essential to use high-quality certified seeds. To protect seeds from diseases, they must be treated before sowing (Khalilova, 2016). The seeding rate should be determined based on laboratory tests of seed germination and purity. It also varies depending on soil-climatic conditions and the crop variety. For example, soft wheat requires 4–5 million seeds per hectare, durum wheat 3–4 million, and barley around 3 million seeds per hectare.

**Proper Calculation of Sowing Norms in Grain Crops and Its Impact on Yield**

Proper calculation of the sowing rate in grain crops significantly affects high productivity. If the amount of seed sown is below the norm, sparse emergence occurs in the field, resulting in fewer plants and fewer productive stems per plant, ultimately leading to lower yields. On the other hand, if seeds are sown excessively, the field becomes overcrowded, reducing the nutrient area available per plant and

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limiting sunlight exposure. In densely sown fields, plants develop poorly and do not receive adequate nutrients. Moreover, such dense sowings promote rapid development of diseases and pests. Therefore, in winter grain crops, special attention should be given to sowing norms. These crops are vulnerable to unfavorable environmental conditions during winter and may grow weakly or even perish. That's why they require special care.

After sowing, grain seeds should be irrigated — this initial irrigation is called "sowing irrigation." Generally, grains are irrigated using the furrow method. Irrigation is especially important in winter grain crops. When precipitation is low in winter, irrigation becomes essential. Proper and timely irrigation increases productivity in grain fields. In early spring, applying nitrogen fertilizers to winter grains that have emerged from winter dormancy is crucial (Seyidaliyev, 2016). During winter, protein levels in winter grains increase, helping the plants withstand cold conditions. However, in spring, this protein hinders the formation of productive stems, so nitrogen fertilization is necessary. Fertilization plays a vital role in achieving high yields in winter grains. Applying mineral fertilizers promotes normal growth and development of the crops and enhances their resistance to diseases, pests, drought, and frost.

During the spring months, before the formation of spikes, top-dressing fertilizers should be applied. Early fertilization increases the number and formation of spikelets in the spike, laying the foundation for higher yields. Even if sowing irrigation is performed, if winter is dry, further irrigation becomes necessary. The timing of irrigation affects productivity. Depending on rainfall during the growing season, grain fields may need irrigation 3–5 times. In general, the moisture level of fields sown with winter grains should not drop below 70–75%.

During the tillering stage, a large amount of sugar accumulates in the nodes and leaves, enhancing cold resistance. Well-tillered crops in autumn absorb moisture and nutrients quickly in early spring, grow rapidly, and become resistant to spring drought.

The application of mineral fertilizers plays a significant role in achieving high-quality and high-yield winter grains. It is known that the application of fertilizers depends on the previous crop, soil structure, and composition. Applying mineral fertilizers supports the healthy growth and development of grains, increases their resistance to adverse conditions, and improves soil fertility, structure, and physical, chemical, and biological properties, which in turn boosts crop yield and quality (Gasimov, Aliyeva, Tahirli, Abduyeva-Ismayilova, 2010).

In cultivating winter grains, especially wheat, barley, and rice, the use of MAP (Mono-Ammonium Phosphate) fertilizer is recommended. MAP contains 11% nitrogen, 48–55% phosphorus, 2% CaO, and 0.5% MgO — all of which dissolve easily in water. Before applying this fertilizer, a soil test should be conducted, and MAP should be applied if these nutrients are deficient. MAP enhances root system development and strengthens plant roots, boosts flowering, and ultimately increases yield.

The quality of harvested grains depends on their genotype, growing conditions, and agrotechnical methods. With proper agrotechnology, healthy seeds with high quality indicators can be obtained. Healthier seeds lead to fewer diseases and pests in the field.

Global atmospheric changes have caused some diseases, particularly rust, to spread rapidly in winter grains. Mild winters, high early spring rainfall, and sudden temperature increases lead to the spread of rust diseases. The most dangerous diseases in cereals are yellow and brown rust, loose smut, covered smut, and powdery mildew. Yellow rust, caused by Puccinia striiformis West., affects leaves, spikes, and sometimes the grains. It causes yellow linear spots on the leaves, where uredospores mature and spread via wind, infecting healthy plants. These spores destroy chlorophyll and cause leaf drop, reducing productivity.

Loose smut is caused by Ustilago tritici, which damages mainly wheat grains. Inside the grains, black dusty masses (chlamydospores) form, which can remain viable for up to 5 years and survive in

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soil or on seeds through winter. The spores infect the spikes during flowering, destroying the developing grains (Valiyeva, 2024).

Covered smut, caused by Tilletia caries, is transmitted by wind and insects. It forms dense masses inside the grains, reducing their quality. Powdery mildew is caused by Erysiphe graminis and is seen in barley, wheat, rye, and triticale. It can infect leaves, stems, and even flowers. This disease spreads rapidly when humidity exceeds 80% and the air is cool. Root rot is caused by Fusarium graminearum, affecting all plant organs. Infected grains are light, white, and have low germination ability. To increase resistance, phosphorus-potassium fertilizers are recommended before sowing and nitrogen fertilizers after emergence.

To prevent these diseases, the following measures should be taken:

1. Crop rotation; 2. Field weeding; 3. Seed treatment (Tiram, Vitavax 75% preparations); 4. Field spraying with chemical agents.

In the experimental nursery at ADAU, we observed the spread of rust disease in soft wheat varieties such as Nurcahan and ADAU 100. Initially, we sprayed the fields with the fungicide Decotan. We monitored the field every 3 days and noticed the disease was progressing. Then we treated the field with Ridomil. Three days after application, further monitoring showed no disease progression. Ridomil also proved effective against other diseases.

Timely harvesting is essential for preserving yield. If harvesting is done too early, the grain moisture is high, leading to surface wrinkling as the grains dry, which can cause molding and spoilage during storage. If harvesting is delayed, grains begin to fall from the spikes, leading to yield loss. Therefore, special attention should be paid to timely harvesting.

To determine whether cereals are ready for harvest:

1. All plants in the field should be completely yellow.
2. Grains in the spike should be completely dry and not crushable by hand.
3. All vegetative organs (stem, leaves, spikes) should be completely dry.
4. When crushed, grains should fall easily from the spike.
5. Spikes across the field should be uniformly dry.
6. Even if dry, grains should be spread out post-harvest for additional drying.
7. Well-dried grains should be bagged and stored in dry warehouses.
8. Storage areas must be regularly ventilated.

## Conclusion

The soil and climate conditions in our republic are different, the crops sometimes remain undeveloped and sometimes are completely destroyed due to the cold weather in winter. Accordingly, the demand of crops (wheat, barley, etc.) according to soil and climate conditions should be valued in a timely manner and properly. As a result, the number of plants destroyed in the winter season decreases, the plant develops well and the productivity is high. It is more important to practice the positioned team in line with other requested managers. Rotary crops should be applied properly so that, unlike other agricultural fields, the productivity is high and the productivity of the land is increased.

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