

INFLUENCE OF SOWING SYSTEMS AND APPLICATION RATES OF MINERAL AND ORGANIC FERTILIZERS ON THE FORMATION OF THE LEAF CANOPY OF SUNFLOWER

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Abstract: This article presents a cross-sectional analysis of factors applied during the experimental period to determine their influence on the growth, development, and yield formation of sunflower plants. Special attention was paid to the effect of different sowing systems and varying application rates of mineral and organic fertilizers on the formation of the leaf canopy, which plays a key role in photosynthetic activity and productivity.

Keywords: sunflower, vegetable oil, yield, growth stages, vermicompost, flowering, fertility

Introduction

Currently, there is a growing trend in the production of major oilseed crops due to the increasing global demand for vegetable oil. Owing to its high nutritional and dietary value, vegetable oil is increasingly replacing animal fats in human consumption. According to FAO data, sunflower is cultivated on an area of 25.6 million hectares worldwide, with an average yield of 19.3 t/ha and a total production of 51.5 million tons.

Ukraine accounts for 15.0 million tons (30%) of global sunflower oil production, followed by Russia with 12.7 million tons (24%), the European Union with 9.7 million tons (18.5%), Argentina with 3.8 million tons (7%), and Turkey with 1.8 million tons (6%). In addition, approximately half a million tons of sunflower are produced annually in countries such as the USA, South Africa, and Australia. Thus, major sunflower producers are present on all continents of the world.

Aim of the Study

The aim of this research was to study the influence of mineral and organic fertilizers on the growth, development, and yield of sunflower plants cultivated under the soil and climatic conditions of the Fergana region, as well as to develop agrotechnological elements for the production of environmentally friendly products.

Objectives of the Study

The objectives of the study included:

determining the effect of application rates of mineral and organic fertilizers, as well as different types of organic fertilizers, on the agrophysical and agrochemical properties of soil during sunflower cultivation;

assessing their impact on plant growth and development;

evaluating dry matter accumulation and photosynthetic productivity;

analyzing seed set and yield component losses;

determining seed yield and oil quality of sunflower.

Materials and Methods

Field observations on plant growth, development, yield formation, as well as calculations and analyses were carried out in accordance with the Methodology for Conducting Field Experiments adopted by UzPITI.

The leaf surface of agricultural crops is the main photosynthetically active area and plays a decisive role in plant growth and development. As leaf area increases, photosynthetic activity intensifies, leading to accelerated synthesis of organic matter and accumulation of nutrients. Leaf area size varies depending on crop species, varietal characteristics, and the level of nutrient and water availability (Evans, 2013).

Leaf age, position, and structural characteristics are important factors determining functional efficiency. A leaf area index (LAI) of approximately 3–5 is considered optimal for high photosynthetic efficiency (Sinclair & Muchow, 1999).

Excessive vegetative growth may restrict assimilate translocation to reproductive organs and result in yield reduction. Therefore, agronomic practices should aim to ensure optimal leaf development. Both direct and inverse relationships exist between leaf area and yield, and yield improvement can be achieved by maintaining photosynthetic activity of leaves for a prolonged period (Tagoev & Makhkamov, 2017).

Based on the above, leaf area is considered a key factor influencing the growth and development of agricultural crops.

Results and Discussion

A cross-sectional analysis of experimental variants was conducted to assess the influence of the studied factors on sunflower growth, development, and yield parameters. Seed placement schemes included 70×20–1 and 70×25–1.

In variants 1–2–3 sown at a spacing of 70×30–1 and supplied with mineral fertilizers at a rate of N150P105K150 kg/ha, the leaf area in the phase of the first pair of leaves was 257.0, 229.4, and 205.7 m²/ha, respectively. During the formation of the third pair of leaves, leaf area increased to 2961.2, 2609.7, and 2311.5 m²/ha. At the capitulum formation stage, values reached 23,900.4, 21,442.1, and 19,212.1 m²/ha. During flowering, the maximum leaf area was observed at 33,302.4, 29,442.6, and 26,195.6 m²/ha. Subsequently, leaf area declined during seed filling and full maturity stages.

In variants 4–5–6, where mineral fertilization (N150P105K150 kg/ha) was supplemented with farmyard manure at rates of 10, 15, and 20 t/ha, leaf area increased further across all growth stages compared to mineral fertilization alone.

The highest leaf area values were recorded in variants 25–26–27, where mineral fertilizers at a higher rate (N210P145K210 kg/ha) were combined with vermicompost at 5, 10, and 15 t/ha. In these treatments, leaf area during flowering reached 41,172.2, 38,920.5, and 36,614.9 m²/ha, respectively, followed by a gradual decrease toward physiological maturity.

In contrast, variants 7–8–9, which received mineral fertilizers (N150P105K150 kg/ha) supplemented with lower rates of vermicompost, exhibited comparatively lower leaf area values throughout the growing season.

Overall, the results indicate that increasing fertilizer application rates significantly enhances leaf area development, particularly when mineral fertilizers are combined with organic amendments.

Conclusion

The findings demonstrate that sowing systems, mineral fertilizer rates, and organic fertilizer application rates have a significant effect on the formation of the sunflower leaf canopy. An increase in mineral fertilizer rates leads to an expansion of leaf area; however, the combined application of mineral and organic fertilizers exerts a more pronounced positive effect on leaf

surface development. This synergistic interaction contributes to improved photosynthetic activity and creates favorable conditions for higher yield formation.

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