

Puławy, 31.07.2024 r.

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A summary of the doctoral dissertation entitled: "*Yield and selected physiological indices of maize (Zea mays L.) grown for grain in crop rotation and monoculture*" prepared under the supervision of prof. dr hab. Jerzy Książak.

Keywords: corn, cultivation method, monoculture, crop rotation, photosynthesis, transpiration, water use efficiency (WUE), chlorophyll fluorescence, leaf greenness index (SPAD), productivity indices.

The aim of the study was to determine the effect of different soil cultivation methods (plow, simplified and direct seeding) under corn cultivated in monoculture and crop rotation on grain yield, yield structure elements and morphological features of plants. Assessment of the effect of different soil cultivation methods under corn cultivated in monoculture on selected physiological indices (photosynthesis and transpiration intensity), relative chlorophyll content in leaves and leaf cover area compared to corn cultivated in crop rotation. Determination of corn productivity indices depending on the soil cultivation method. The research hypothesis assumed that yield, plant morphological features, gas exchange parameters, leaf chlorophyll content index, leaf area index and productivity depend on soil moisture conditions, which is the effect of the tillage system.

The research was carried out in 2017-2019 at RZD Grabów in the Mazowieckie voivodeship on a static field experiment (established in 2004) with maize cultivation in monoculture and crop rotation (spring barley - winter wheat - maize). The experiment was established using the split-block method on a lessive soil developed from light clay classified as a very good rye complex. In the cultivation of maize in monoculture, three methods of preparing the soil for sowing were used: zero tillage (direct seeding), full tillage (ploughing), and simplified tillage (12-15 cm grubber). In the object with full cultivation, after harvesting

the cobs, the maize straw was ploughed in in autumn after being shredded, and with simplified cultivation, a grubber was used. On the other hand, in the object without mechanical cultivation, the straw (after prior shredding) remained on the surface of the field.

The method of cultivation considered in the study had a significant impact on the growth, development and yield of maize, especially in combination with weather conditions. In 2018, characterized by the most favorable weather conditions, maize was characterized by the highest intensity of photosynthesis and transpiration. In drier years (2017 and 2019), which were characterized by water shortages and unfavorable rainfall distribution, maize grown in monoculture and direct seeding was characterized by a higher intensity of photosynthesis than in rotation, which indicates the beneficial effect of conservation cultivation systems on the level of soil moisture. The highest water use efficiency (WUE) was recorded in the drier 2019, and the lowest in 2017. Moreover, in the years characterized by the greatest water shortages, higher SPAD index values were observed for maize grown in monoculture and direct seeding, in 2017 by 7.6% (statistically significant differences), in 2019 by 13.0% (trend), compared to that grown in rotation. In 2018, when more favorable weather conditions were recorded, a significantly higher SPAD index (by 9.6%) was noted for maize grown in rotation, compared to that grown in monoculture with direct seeding.

The effect of the tillage system on the average leaf area index of maize (LAI) was insignificant. In 2018, the highest leaf area ratio index (LAR) was recorded for maize grown in monoculture and direct seeding, and the lowest in rotation, while in the dry year 2019, the highest value of this index was noted for plants grown in rotation. Higher values of the leaf weight ratio index (LWR) were recorded in more favorable conditions for maize cultivation in 2018, compared to 2019. In addition, the highest leaf unit productivity index (ULR) in 2018 was characterized by maize cultivated in rotation, and in 2019 - cultivated with the use of simplified systems.

The development of the maize root system in early development stages (BBCH 12-32) depended primarily on the method of cultivation, but also on weather conditions, especially moisture. Both in 2018 and 2019, maize in the 9-leaf stage cultivated in the simplified system developed a root with the largest surface area, length and diameter. The mass and volume of the root in the more favourable 2018 were the highest in maize cultivated in rotation, while in the dryer 2019 these parameters had the highest values in maize sown in monoculture in direct seeding. The method of cultivation significantly influenced the accumulation of biomass and the formation of above-ground organs (stem and leaves). In both years of the study up to the 1st node phase (BBCH 31), the highest height, dry mass of stem and leaves and leaf area were

developed by plants cultivated using the plough system, in 2018 in the crop rotation, and in 2019 in the crop rotation and monoculture.

The highest corn grain yield was obtained in 2018, which was characterized by more favorable weather conditions during the vegetation period. In the first and third year of the study, the method of cultivation significantly affected the corn grain yield. In 2017, the grain yield of corn grown in monoculture in direct seeding and simplified tillage was higher, by 32.9% and 12.2%, respectively, and in 2019 – by 36.0% and 30.7% compared to crop rotation. In a wetter year (2018), corn yielded at a similar level on all sites (on average 12.8 t ha⁻¹). Corn grain grown in monoculture and direct seeding was characterized by higher moisture than from sites where plough tillage was used. In 2017, significantly higher cob weight and number of grains per cob were observed in corn cultivated in a simplified system, by 30.5% and 25.6%, respectively, and in a zero tillage system, by 46.3% and 37.3%, respectively, compared to crop rotation. A similar trend of changes, but not statistically confirmed, was shown in 2019, while in 2018 the differences were insignificant. Thousand grain weight was significantly different only in 2017, the largest grains were produced by corn cultivated in monoculture in simplified tillage and with direct seeding, and significantly smaller in systems with plough cultivation.

The obtained research results showed that corn cultivation in a long-term monoculture does not lead to a decrease in grain yield compared to crop rotation. The use of simplifications in maize cultivation is justified because it translates into better yields in years with unfavourable weather conditions, while in favourable years it does not lead to a significant decrease in grain yield compared to plough systems. The increase in dry periods during the growing seasons in Poland observed in recent years encourages the promotion of simplified systems.

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