The response of winter wheat to different agronomic factors

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Summary

This dissertation presents the results of a small-area field experiment with winter wheat, conducted in the Agricultural Experiment Station in Bałcyny ("Bałcyny" Ltd., 53°40′N,19°50′E). The experiment had a 2^{1} x 3^{4-1} design with two replications, and five agronomic factors were tested. The experimental variables were as follows: winter wheat cultivar (hybrid cv. Hybery, open-pollinated cv. Artist), sowing date (optimal, delayed by 10 days, delayed by 20 days), seeding rate (200, 300, 400 kernels/m^{-2}), nitrogen rate (90, 150, 180 kg N ha^{-1}) and disease control method (seed dressing, seed dressing + one fungicide treatment, seed dressing + two fungicide treatments).

The effects of selected agronomic factors on the technological quality of grain and production efficiency of two cultivars of winter wheat, hybrid cv. Hybery and open-pollinated cv. Artist, were determined in the study. Production technologies were selected for both cultivars to obtain high stable grain yields (best choice) and low yields (worst choice). In the next step, their influence on grain quality classification was evaluated, and agricultural inputs and economic efficiency were determined for each technology.

It was found that winter wheat yields were significantly affected by weather conditions. The grain yields of hybrid cv. Hybery and open-pollinated cv. Artist grown on soil of good wheat complex (according to the Polish soil quality classification system) were comparable. Yield variability across years of the study was also similar in both cultivars. No significant differences were found in winter wheat yields in response to different sowing dates. In terms of absolute values, early sowing in September was preferable to sowing on 10 or 15 October. In each growing season, the hybrid cv. Hybery produced higher yields when the sowing date was optimal or delayed by 10 days. Such a response was noted in the open-pollinated cv. Artist only in the season characterized by low yields, whereas no significant differences were observed in the remaining years of the study. The applied seeding rates (200, 300, 400 kernels m^{-2}) significantly modified the grain yields of winter wheat. A significant increase in grain yields was noted in the hybrid cv. Hybery and open-pollinated cv. Artist at a seeding rate of 300 kernels/m^{-2}. The applied nitrogen rates had no significant effect on the grain yields of winter wheat. Grain yields tended to increase when the nitrogen rate was increased from 90 to 150 kg ha^{-1}, but a further increase in nitrogen rate (by 30 kg ha^{-1}) did not induce a considerable yield increment. A nitrogen rate of 150 or 180 kg ha^{-1} exerted the greatest yield-forming effect on winter wheat cv. Hybery in all growing seasons. In winter wheat cv. Artist, in the season characterized by low yields, a nitrogen rate of 90 kg ha^{-1} had a beneficial influence on grain yields. Disease control methods (seed dressing, one or two fungicide treatments during the growing season) had no significant effect on the grain yields of winter wheat. The analyzed cultivars tended to produce higher yields in response to full fungicide control (two treatments). The main components of the production technologies ensuring the highest and

stable grain yields of winter wheat cv. Hybery were the optimal sowing date (20 or 25 September), a seeding rate of 300 kernels/m^{-2}, a nitrogen rate of 150 kg ha^{-1} and full control of fungal diseases (seed dressing + two fungicide treatments during the growing season). The open-pollinated cv. Artist produced the highest grain yields under the production technology involving a seeding rate of 300 kernels/m^{-2} and a nitrogen rate of 150 kg ha^{-1}; this cultivar positively responded to delayed sowing (30 September or 5 October) and a low level of fungal disease control (only seed dressing). The technological quality of grain was lower in the hybrid cv. Hybery, mostly due to significantly lower grain vitreousness, lower sedimentation value, and a lower content of protein and wet gluten in grain. In most cases, individual agronomic factors exerted a minor and non-significant effect on the technological quality of winter wheat grain. Only grain vitreousness was affected by sowing date and nitrogen rate in cv. Hybery, and softening of dough was affected by sowing date in both cultivars. Under the compared production technologies, the technological quality of grain in cv. Hybery was not satisfactory in any year of the study, and grain was always classified to group C (fodder). Its processing suitability was low due to too low protein content, low sedimentation value and low baking volume of bread. The grain of cv. Artist was classified to group B (bread) only in the 2017–2018 growing season under the production technology characterized by low levels of all agronomic factors. Under the market conditions of 2021, selected technologies ensuring high and low grain yields required higher inputs in winter wheat cv. Hybery than cv. Artist due to a considerable share of seeds in overall costs. The analyzed technologies resulted in lower income, higher unit cost and lower efficiency ratio in cv. Hybery. The achieved economic results were satisfactory in both winter wheat cultivars, regardless of grain production technology. In both cultivars, the technologies ensuring high grain yields were more economically viable.

Key words: winter wheat, hybrid cultivar, sowing date, seeding rate, nitrogen rate, disease control, grain yield and quality, economic efficiency