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ECONOMIC EFFICIENCY OF WINTER TRITICALE GRAIN PRODUCTION

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Abstract. The aim of this research has been to assess and compare the economic efficiency of production technologies used to grow a semi-dwarf winter triticale cultivar Gniewko. The method based on the standard gross margin (SGM) was used for the economic evaluation of the two production technology differentiated costs level. The analyzed material consisted of results achieved during a three-year field experiment located at the Experimental Station in Bałcyny near Ostróda. Technologies with the highest and lowest average yields were selected for comparisons. The compared technologies differed from each other in the rate of nitrogen fertilization and fungicides. The more intensive winter triticale technology in field trial, the greater the financial values of winter triticale yield as well as direct costs and direct surplus. The direct costs analysis references to the positive verification of the research hypothesis. The increase of the direct surplus value, which accounted 25.2%, was recorded when the intensity of cultivation increased. Increasing inputs for winter triticale production up to the level of intensive technology in trial conditions was economically justifiable.

Key words: direct costs, winter triticale, technology level

INTRODUCTION

Winter triticale belongs to crops distinguishable by a very large potential yielding capacity. In intensive farming, the main objective is to maximize yields and profit, paying little or no attention to possible damage caused by the application of commercial means of production [Kuś 1999]. The social need for the decrease in the chemical use of the agriculture and its environmental impacts is growing [Takăcs-György 2007]. However, high prices of production means and limited financial resources force producers to turn to less intensive technologies, which nonetheless ensure high economic efficiency of production.

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The actual production process on a farm depends on technical and budget conditions, which are the reflection of various combinations of production factors as well as relationships between these factors and the volumes of production they help to achieve [Klepacki 1997, Krasowicz and Kuś 1998, Niezgoda 1998].

Economic efficiency is expressed by the ratio between the value of inputs and the value of the outputs obtained owing to the said inputs. Economic efficiency is closely connected to technical-economic effectiveness, which represents the ratio between quantities of used materials and the amount of produced goods. It is justified to state that production processes have reached an optimal efficiency when they bring about best effects under given conditions in terms of production output and economic results [Kołoszko-Chomentowska 2006]. An economic assessment of the efficiency of the technology applied on a farm enables the farmer to make good decisions [Krasowicz 2004].

The profitability of triticale cultivation depends on the intensity of applied technologies. The latter is conditioned i.a. by the intensity of crop protection [Jaśkiewicz 2009]. Falger and Jaworski [2001] claim that the main purpose of plant protection treatments is to ensure the achievement of yield, which is a product of the genetic potential of a cultivated variety and other factors such as fertilization, cultivation or weather and soil conditions. An application of a plant protection method – its level or selection of a pesticide – is conditioned by the envisioned threats on a given plantation and the financial capacity of the farm.

One of the most important aspects of crop production is the level of fertilization. Quantities of applied fertilizers are directly connected to the efficiency of fertilization. In any farming system, fertilization is an extremely important element of agronomic practice, which to a large extent conditions the production output. Any effort undertaken to improve the efficiency of using fertilizer components is highly valuable and desirable because it can lower the costs while improving the quality of products [Skarżyńska 2006].

According to Jaśkiewicz [2002] and Podolska et al. [2002], nitrogen fertilization is particularly worth attention because this macronutrient has the strongest influence on the level of yields produced by cereals.

The research hypothesis assumes that increasing the level of the means of production, mainly mineral fertilization and fungicides protection, from the lowest to the highest yield technology, achieve a higher grain yield ensures the higher economic effectiveness of land, one of the basic productive factors.

MATERIAL AND METHODS

The analysis was based on three-year field trials with the semi-dwarf winter triticale cultivar called Gniewko. The trial was conducted in 2009–2011 at the Experimental Station in Bałcyny near Ostróda. A two-factorial experiment was established with the split-plot method (4 replications) on proper grey-brown podsolic soil, classified as good wheat complex. The soil tillage treatments were carried out according to the generally accepted agronomic recommendations. The preceding crop was winter oilseed rape. Phosphorus in a dose of 70 kg·ha^{-1} P_2O_5 as triple superphosphate (46%) and potassium consisting of 90 kg·ha^{-1} K_2O as potassium salt (60%) were applied in a single treatment before sowing.

Weed control, in both technologies, comprised a single treatment in autumn, composed of the herbicides Boxer 800 EC 2 l·ha^{-1} (active ingredient *prosulfocarb*), Glean 75 WG 5 g·ha^{-1} (active ingredient *chlorsulfuron*) and Legato 500 SC 0.5 l·ha^{-1} (active ingredient *diflufenican*). The lowest yield technology comprised the following mineral fertilization regime: 30 kg N·ha^{-1} (in the form of ammonium nitrate 34%), seed dressing with Baytan Universal 094 FS (active ingredient *triadimenol* + *imazalil* + *fuberidazole*) and top dressing with Input 460 EC (at BBCH 31 phase) in the amount 1 l·ha^{-1} (active ingredient *spiroksamine* 300 g·ha^{-1} + *prothioconazole* 160 g·ha^{-1}). The highest yield

Table 1. Production value and direct costs of the winter triticale production

Specification	The intensity level of technology	
	the lowest yield	the highest yield
Grain yield (t·ha^{-1})	7.33	9.96
Production value (PLN·ha^{-1})	6 304	8 566
Directs costs (PLN·ha^{-1}), including:	1 237	1 788
mineral fertilizers	643	1 105
grain sowing	283	283
plant protection products, including:	312	401
seed dressing	39	39
fungicides	156	245
herbicides	117	117

Table 2. Economic evaluation of the winter triticale production

Specification	The intensity of technology level	
	the lowest yield	the highest yield
Direct surplus (PLN·ha^{-1})	5 066	6 777
Direct surplus of product (PLN·t^{-1})	691.1	680.4
Direct costs per 1 PLN direct surplus (PLN)	0.24	0.26
Direct profitabilty index (–)	5.09	4.79
Direct surplus of production value (%)	80.4	79.1
Crop yield counterbalancing direct costs (t·ha^{-1})	1.43	2.07

Table 3. Structure of the winter triticale direct costs production

Specification	The intensity of technology level (%)	
	the lowest yield	the highest yield
Directs costs, including:	100.0	100.0
mineral fertilizers	51.9	61.8
grain sowing	22.8	15.8
plant protection products, including:	25.3	22.4
seed dressing	3.2	2.2
fungicides	12.6	13.7
herbicides	9.5	6.5

technology included mineral fertilization in the amount of 150 kg N·ha^{-1} (divided into 90 + 60 in the form of ammonium nitrate 34%), seed dressing with Baytan Universal 094 FS (active ingredient *triadimenol* + *imazalil* + *fuberidazole*), top dressing with Input 460 EC (at BBCH 31 phase) in the amount of 1 l·ha^{-1} (active ingredient *spiroksamine* 300 g·ha^{-1} + *prothioconazole* 160 g·ha^{-1}) and the preparation Prosaro 250 EC (at BBCH 58 phase) in a dose of 0.6 l·ha^{-1} (active ingredient *tebuconazole* 75 g·ha^{-1} + *prothioconazole* 75 g·ha^{-1}).

The calculations were made on three-year average yields of winter triticale grain. The economic efficiency of winter triticale grain production was assessed for the highest and the lowest yield in the experiment, using a quartile as a statistical instrument.

Many researches [e.g. Harasim 1989, Krasowicz 1999, Jaśkiewicz 2009] turn to a simplified calculation method, broadly used in agriculture economics, to perform an assessment of the economic efficiency of a production technology. This method considers only direct costs calculated from the products of prices of particular materials and applied doses (seeds, mineral fertilizers and pesticides). However, Krasowicz [2007] observes that the profitability of production on a farm level is also dependent on indirect costs, typically disconnected from the level of yields. Costs of commercial means of production (seeds, mineral fertilizers, pesticides) were same as market prices in the first quarter of 2013.

The basic measure of efficiency used in this analysis was value of direct surplus. Among the most important economic assessment components is the obtained the highest value of this index [Ziętara 2002, Artyszak and Kucińska 2005]. Also, a synthetic measure of economic efficiency of production was used, in the meaning of direct profitability index achieved as the ratio of production value to direct costs incurred by generating this production.

As the data were processed electronically, sums of components may differ from the given values. For the sake of clarity, some of the discussed data were rounded up to integers.

RESULTS OF THE ANALYSIS AND DISCUSSION

Under the experimental conditions, the level of winter triticale yields was high, ranging between 7.33 and 9.96 t·ha^{-1}. The highest yield technology ensured a 35.9% higher grain yield than the lowest yield technology (Table 1). However, it also incurred 30.8% higher direct costs. Despite much higher direct costs, direct surplus was 33.8% higher than in the lowest yield technology (Table 2). Contrary results were reported by Grabiński et al. [2008]. From their calculations of direct surplus, it was concluded that the highest direct surplus was achieved when production means applied to production of winter triticale were used modestly (still ensuring a relatively high yield). However, as the production became more intensive, the level of direct surplus declined. Similar results demonstrated Nieróbca et al. [2008]. Higher direct surplus values in winter triticale production in the research were obtained under moderately intensive and economical technologies.

On the other hand, the direct costs per 1 PLN direct surplus, was slightly better (about 8.3%) in the lowest yield technology (0.24). Augustyńska-Grzymek [2007] reported that the best farms which produced winter triticale obtained average 0.31. In our experiment, the difference between the two technologies in the direct surplus per 1 ton of product and direct surplus in percentage value of production were at a similar level but to the advantage of the lowest yield technology.

Special role is attributed to the relation of the production value to direct costs allocated to its attainment. This relationship is known as the direct profitability index. In our study, this index was high and similar in both technologies (5.09 in the lowest and 4.79 in the highest yield technology). The higher value of this index obtained Nachtman [2009]. Ecological production winter triticale allowed to achived 8.7. Nasalski et al. [2008] calculated an analogous index for winter wheat grown in a conventional system within the range of 1.2 and 1.8. On the other hand, Jaśkiewicz [2006] implies a higher value of this index in a technology with a lower level of nitrogen fertilization.

The return of the direct costs in the lowest yield technology appeared at a unit yield of 1.43 tons. In the highest yield technology, the costs were paid back when the yield of grain reached 2.07 tons.

Having analyzed the structure of direct costs expended on winter triticale production, it should be concluded that mineral fertilization had the highest contribution to costs in both technologies, varying from 51.9 to 61.8% of direct costs (Table 3). Literature verifies that mineral fertilization is the most costly element of agronomic practice and may even exceed 60% of the total production inputs [Dopka 2004]. Domska et al. [2001] claim that the level of fertilization, especially nitrogen nutrition, is a dominant component among production inputs in cultivation of cereal crops. Seeds were the second most expensive item in the category of direct costs. In both technologies, the cost was identical, but its contribution to the costs structure varied from 15.8% in the highest yield technology to 22.8% in the lowest yield technology. Among the plant protection chemicals, fungicides were most expensive.

CONCLUSIONS

Costs are an important element of profitability accounting, and the knowledge of their constituents as well as interactions both between particular costs and within the sphere of income and profit may be useful for the producer to make correct decision. Agricultural practice is continuously searching for new ways to improve the efficiency of production. It is possible either by maximizing the volume of production or minimizing the costs of obtaining a given quantity of produce. Higher yields typically require higher costs, and the key point is to keep the cost increase below or – at the most – equal with the production volume increment. It makes no sense to expend additional inputs which will not be paid off by an adequately high yield. Hence, implementation of new technologies and production means should always be carefully analyzed in the context of costs and gains.

The profitability calculation made for winter triticale has revealed differences in the economic efficiency of the analyzed production technologies. The compared technologies were demonstrably different in direct surplus value. The highest yield technology in field trial was evidently more competitive, where mentioned parameter was 25.2% higher. The index illustrating the direct profitability was similar in both technologies, equal 4.79 and 5.09. For obvious reasons (higher direct production costs), the yield in the highest yield technology was higher than the lowest yield technology (by 35.9%). The analysis of direct costs clearly shows that mineral fertilization is responsible for the highest share of costs in both technologies.

An increase in yield induced by the more intensive production system completely covered the increase in the total costs. Economically, the intensification of winter triticale is feasible and profitable. An increase in the value of production is higher than the due increase in the costs. However, it is worth remembering that production profitability (apart from volumes of yields achieved) depends on prices for grain and their relationship with the costs of production means.

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EKONOMICZNA EFEKTYWNOŚĆ PRODUKCJI ZIARNA PSZENŻYTA OZIMEGO

Streszczenie. Celem badań była ocena i porównanie sprawności ekonomicznej technologii produkcji półkarłowego pszenżyta ozimego odmiany Gniewko. Do oceny ekonomicznej technologii produkcji pszenżyta ozimego wykorzystano metodę opartą na standardowej nadwyżce bezpośredniej (SGM). Materiał badawczy stanowiły wyniki trzyletniego doświadczenia polowego zlokalizowanego w Zakładzie Produkcyjno-Doświadczalnym w Bałcynach k. Ostródy. Do oceny wytypowano technologie największych i najmniejszych średnich plonów. Porównywane technologie produkcji różniły się wielkością dawki nawożenia azotem oraz poziomem ochrony fungicydowej. Wykazano, że im intensywniejsza technologia produkcji, tym większa wartość produkcji pszenżyta ozimego, wyższe koszty bezpośrednie oraz zysk bezpośredni. Analiza kosztów bezpośrednich wskazuje na pozytywną weryfikację hipotezy badawczej. Wzrost intensywności technologii skutkował większą nadwyżką bezpośrednią (o 25,2%). Wyższe koszty ponoszone na wzrost intensywności technologii produkcji pszenżyta ozimego w warunkach doświadczalnych są ekonomicznie uzasadnione.

Słowa kluczowe: koszty bezpośrednie, pszenżyto ozime, poziom technologii

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