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ECONOMIC ASSESMENT OF CULTIVATION OF TRITICALE AND PEA MIXTURES GROWN FOR FODDER SEEDS

Summary

The aim of the study was to assess from economic point of view a triticale with pea mixture cultivation in ecological production system. Field experiments carried out in the years 2014-2016 in a split-plot design, in 4 replications. The mixtures differentiated of percentage of pea (40, 60, 80%) were compared. The highest production value was obtained from the cultivation of a mixture of triticale with a 40% share of legume crop (2282 zl·ha^{-1}), which was the result of a higher yield level of this mixture. The lowest production value was obtained from growing the mixture with the highest (80%) share of pea (2091 zl·ha^{-1}). The highest level of direct costs was generated by the mixture of triticale with the highest percentage of pea. The highest level of direct surplus was ensured by the mixture with the 40% share of pea. This ratio was higher than the surplus obtained from cultivation of the mixture with 40 and 60% share of legumes by respectively: 7 and 30%.
***Key words**: pea, spring triticale, cereal-legume mixtures, gross margin, direct costs*

OCENA EKONOMICZNA UPRAWY MIESZANEK PSZENŻYTA Z GROCHEM UPRAWIANYCH NA NASIONA

Streszczenie

Celem badań była ocena ekonomiczna uprawy mieszanki grochu z pszenżytem jarym o zróżnicowanym udziale nasion komponentów przy wysiewie, w ekologicznym systemie gospodarowania. Doświadczenia polowe przeprowadzono w latach 2014-2016 w układzie split-plot, w 4 powtórzeniach, na glebie kompleksu żytniego dobrego. Porównywano mieszanki grochu z pszenżytem jarym o zróżnicowanym udziale rośliny strączkowej (40, 60 i 80%). Najwyższą wartość produkcji uzyskano z uprawy mieszanki pszenżyta z 40% udziałem rośliny strączkowej, co było efektem wyższego poziomu plonu tej mieszanki. Natomiast najniższą wartość produkcji uzyskano z uprawy mieszanki z najwyższym (80%) udziałem grochu. Największy poziom kosztów bezpośrednich generowała mieszanka pszenżyta z najwyższym udziałem rośliny strączkowej, co wynikało z wyższego udziału kosztów materiału siewnego przeznaczonego do uprawy tej mieszanki. Najwyższy poziom nadwyżki bezpośredniej, określającej poziom pokrycia kosztów bezpośrednich wartością produkcji (bez dopłat) zapewniła uprawa mieszanki z najniższym udziałem grochu (1745 zł·ha^{-1}). Wskaźnik ten był wyższy od nadwyżki uzyskanej z uprawy mieszanki z 40 i 60% udziałem rośliny strączkowej odpowiednio o: 7 i 30%.
***Słowa kluczowe**: groch siewny, pszenżyto jare, mieszaki zbożowo-strączkowe, nadwyżka bezpośrednia, koszty bezpośrednie*

1. Introduction

Growing in mixtures with cereals is one of the methods of increasing the efficiency of the legumes yielding. Mixed sowing has a positive effect on the soil and its sanitary status, as a result of which they are a very good forecrop for many plant species grown on the farm [16, 21]. According to Sobkiewicz and Podgórska [20], plants growing in mixed fields tend to make better use of the production space than the same crops in single-species sowing. In the years with unfavorable weather conditions, the low yield of legume seeds is to a large extent compensated by cereal grain yield [18]. It can be assumed that the profitability of this type of sowing, due to the higher yields of seeds [15], will be higher than pure sowings. Mixtures improve soil moisture and its microbiological conditions, which results in greater production potential [2].

Economic and environmental benefits resulting from simultaneous cultivation of cereals with legumes constantly arouse interest in this way of cultivation all over the world. However, due to the fact that research is conducted under different environmental conditions, its results are often contradictory. Agrocenosis, which consists of two species of plants, generates additional interactions that shape various end-effects of such cultivation [18]. The aim of the study was economic assessment of triticale with pea mixture in ecological production system.

2. Material and methods

The source material of the study included the results of a field experiments carried out in the years 2014-2016 at the Advisory Agricultural Center in Szepietowo (Podlaskie province), [52°52'11"N 22°32'27" E] in a split-plot design, in 4 replications. For the comparative analysis, fodder peas variety Klif (with bipinnate leaves) seed mixtures were used with spring triticale of Milewo variety with a varied share of leguminous plants: 40, 60, 80% of the weight of sown seeds. The experiment was carried out on the soil of a good rye complex, class IVb. The content of available nutrients were in range (mg·100 kg-1 soil): phosphorus 6.2-6.4; potassium 6.1-6.9 and magnesium 5.0-5.6. Soil pH, as determined in 1 N KCl, was 5.2-5.4.

The basic evaluation criteria used at work were: production value, direct costs and direct surplus [1, 19]. The production value was determined on the basis of the yield ob-

tained from the area of 1 ha. The amount of inputs of production means was determined based on actual seed material consumption. The costs of production means were determined on the basis of purchase prices, and the value of production was determined according to the average purchase price of grain [9]. In the economic assessment, only direct costs were taken into account, while the direct surplus was calculated as the difference between the value of the production obtained and the direct costs incurred. Direct payments for growing the cereal-legume mixture were also included. The production value balancing the direct costs expressed in the amount of grain necessary to cover these costs was calculated. The analysis was carried out in current prices from 2015. In order to reduce the impact of weather conditions, the assessment of the profitability of growing the cereal-legume mixture was based on the average value of yields from the analyzed years.

3. Results and discussion

Yield level is usually one of the basic factors determining the economic efficiency of production of a crop. An important element determining the profitability of production is related to the amount of expenditures incurred and the resulting costs.

The level of yielding of mixtures was influenced by the pea percentage in the matter of sown seeds, which in turn translated into the value of production, economic efficiency, including the profitability of production. The highest level of yield was obtained from mixtures with a 40% share of pea (Fig. 1). Increasing the share of lupine seeds in sowing mixtures resulted in a decrease in the level of their yield (Fig. 1). The increase in the share of pea seeds in the sown mixture to 60 and 80% resulted in a reduction of their yield by 9% compared to the yield obtained at the lowest share of legume. This dependence was observed by other authors for mixtures of cereal with peas [11, 12, 13]. From the studies of Borowiecki and Księżak [6], in which the increase in the share of peas in mixtures while reducing the density of sowing spring cereals led to a decrease in the yield level of the mixtures.

The level of profitability of growing native legumes depends on many factors, but first of all on the value of production calculated as the product of the price and yields, as well as the relation of the obtained production value to the incurred production costs [10].

The analysis showed that the highest production value determined on the basis of the yield and sales price of seeds was obtained from growing triticale with a 40% share of leguminous crop (2282 zl·ha^{-1}), which was the result of a higher yield of this mixture (Table 1). The lowest value of production was obtained from growing the mixture with the highest (80%) share of peas (2091 zl·ha^{-1}) and was lower by 9 and 8% than the value of production obtained from growing the mixture with 40 and 60% share of pea. This diversity primarily resulted from the yield obtained. The obtained results were similar to the studies of Gugała et al. [8] and Bojarszczuk and Podleśny [4] who proved that sales prices, high productivity and incurred costs determine the profitability of production.

Table 1. Production value and direct costs of production of seeds of pea with spring triticale mixtures depending on the share of legume in mixture

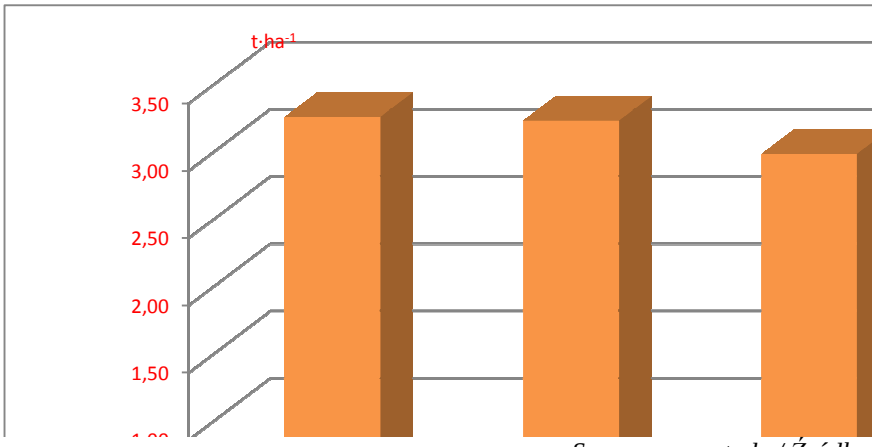
Tab. 1. Wartość produkcji i koszty bezpośrednie produkcji nasion mieszanki grochu siewnego z pszenżytem jarym w zależności od udziału rośliny strączkowej w mieszance

Specification	Share of pea in mixture (%)			Mean
	40	60	80	
Production value (zl·ha^{-1})	2282	2263	2091	2212
Direct costs (zl·ha^{-1})	537	645	752	645
seeds material	285	393	500	393
fuel	252	252	252	252
Share in direct costs (%)				
seeds material	53	61	67	60
fuel	47	39	33	40
Direct costs of production (zl·t^{-1})	165	200	252	205

Source: own study / Źródło: opracowanie własne

An important element of the profitability of production is connected with direct costs reflecting valuable consumption and costs of means of production, such as: seeds, mineral fertilizers, plant protection chemicals. The level of direct costs related to the cultivation of peas and its mixtures with spring triticale varied depending on the proportion of legume contained in these mixtures.

Analyzing the results of own research, it was found that the highest level of direct costs was generated by the cultivation of a triticale mixture with 80% share of peas. Their level resulted from the higher level of seed costs of leguminous plants.



Source: own study / Źródło: opracowanie własne

Fig. 1. Yield of cereal-legume mixtures depending on the share of pea in mixture

Rys. 1. Poziom plonowania mieszanek zbożowo-strączkowych w zależności od udziału grochu (t·ha^{-1})

Table 2. Economic results of cultivation of pea with spring triticale mixtures depending on the share of legume in mixture
Tab. 2. Wyniki finansowe uprawy grochu siewnego w mieszance z pszenżytem jarym w zależności od udziału rośliny strączkowej w masie wysiewu mieszanki

Specification	Share of pea in mixture (%)			Mean
	40	60	80	
Gross margin (zl·ha^{-1})	1745	1619	1338	1567
Gross margin per 1 t of grain (zl)	535	501	448	496
Gross margin per 1 zloty of direct costs	3.25	2.51	1.78	2.51
Direct payment (zl·ha^{-1})	888	888	888	888
Area payment	454	454	454	454
Payment for greening	304	304	304	304
Payment for seeds material	130	130	130	130
Gross margin with direct payment (zl·ha^{-1})	2633	2507	2226	2455
Share of direct payment in gross margin (%)	17.2	18.1	20,4	19.0
Crop balancing direct costs (t)	0.77	0.92	1,07	0.92

Source: own study / Źródło: opracowanie własne

The costs of seed material in growing the mixture with the highest percentage of peas were higher than in the crop mixture with 40 and 60% share of peas respectively by 75 and 27%. On average, for all mixtures, the cost of seed was 393 zl·ha^{-1}, constituting an average of 60% in the direct cost structure (Table 1). The direct cost of production on average for the tested mixtures amounted to 205 zl·t^{-1}, while the highest level of unit production costs was recorded for the mixture with 80% share of peas (252 zl·t^{-1}).

The direct balancing cost calculated on the basis of direct costs to the price obtained from the sale of the mixture showed that to cover direct costs incurred for growing the mixture with 80% share of leguminous crop, the largest yield (1.07 t) should be allocated.

The highest level of gross margin, defining the level of coverage of direct costs with the value of production (without subsidies) was ensured by growing the mixture with the lowest share of peas (1745 zl·ha^{-1}) (Table 2). The higher level of financial result from the cultivation of this mixture resulted from the lower level of incurred direct costs. This ratio was higher than the surplus obtained from growing the mixture with 40 and 60% pea share by respectively: 7 and 30%. Together with increasing the percentage of legumes in the matter of sown seeds of the mixture, the level of direct surplus decreased. This is confirmed by the results of studies by Bojarszczuk and Księżak [3], who showed that the level of this indicator for growing the mixture with a 40% share of legume was about 10 times higher than for 80% .

Taking into account direct payments, the level of direct surplus from cultivating 1 ha of the mixture was on average 2455 zl·ha^{-1} and 2633, 2507 and 2226 zl·ha^{-1}, respectively for 40, 60 and 80 pea percentage. The starting of area payments or subsidies for production thus has a significant influence on agricultural income and strongly affects the reduction of the level of income risk of agricultural plants. This opinion was also confirmed by the research of other authors [14]. Own research showed that the share of subsidies in direct surplus was on average for the tested cereal-legumes mixtures of 19%. However, the largest share in the surplus surcharge was noted for blends with 80% share of leguminous crop in the mass of sown seeds of the mixture. In the studies by Bojarszczuk and Podleśny [5], the share of subsidies in direct surplus from lupine cultivation ranged from 27% in 2014 to 42% in 2012. In the case of cereal-legume mixtures, respectively, from 26 to 38%. However, according to studies by Czerwińska-Kayzer and Florek [7], the subsidies for yellow lupine production in 2011 constituted about 49% of total income. In studies by Bojarszczuk and Księżak [6], the share of subsidies in the final income in the case of cereal-legume crops was on average 90 to 98%, and the yellow lupine in pure sowing exceeded 100%.

4. Conclusions

1. The highest production value was obtained from the cultivation of a mixture of triticale with a 40% share of legume crop (2282 zl·ha^{-1}), which was the result of a higher yield level of this mixture. The lowest production value was obtained from growing the mixture with the highest (80%) share of pea (2091 zl·ha^{-1}).
2. The highest level of direct costs was generated by the mixture of triticale with the highest percentage of pea.
3. The highest level of direct surplus was ensured by the mixture with the lowest share of pea. This ratio was higher than the surplus obtained from cultivation of the mixture with 40 and 60% share of legumes by respectively: 7 and 30%.

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