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YIELD PERFORMANCE AND LER OF SELECTED ORGANIC MIXTURES OF LUPINS WITH SPRING CEREALS

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Abstract: The aim of the research was to assess the productivity of various organic cereal-grain legumes mixtures and to indicate their most favorable variants. The trial has been located in the IUNG-PIB Experimental Station in Osiny (eastern Poland) on a loamy sand soil. The presented results included two years (2018-2019). The following crops and cultivars were taken into account in the trial design: yellow lupine (Perkoz - self-determinate cultivar and Baryt - traditional cultivar); narrowleaf lupine (Regent - self-determinate cultivar and Kurant - traditional cultivar); oat (Krezus cultivar) and spring triticale (Mazur cultivar). The land equivalency ratio (LER) was calculated on the basis of determined yields. It was done in order to assess the yield benefit in a mixture. High values of LER noted for mixtures of spring cereals with lupines demonstrated their good mixing ability. It was shown higher values of LER for mixtures with oat than with spring triticale independently on the species of lupine.

Introduction: Cultivation of mixtures of grain legumes with cereals can be treated as a promising alternative to monocrops in organic farming systems, especially in the context of their potential higher productivity, but also better weed suppression. The aim of the trial was to assess the productivity of various cereal-grain legumes mixtures and to indicate their most favorable variants in conditions of organic farming.

The assumed hypothesis was that mixtures of lupines with oat and spring triticale are better adapted to the cultivation in organic farming than the crops sown in pure stands.

Material and methods: The trial has been established in 2018 and located in the IUNG-PIB Experimental Station in Osiny (eastern Poland). The following crops and cultivars were taken into account in the trial design: yellow lupine (Perkoz - self-determinate cultivar (SDC) and Baryt - traditional cultivar (TC)); narrowleaf lupine (Regent - SDC and Kurant - TC); oat (Krezus cultivar) and spring triticale (Mazur cultivar). The treatments included 8 mixtures of crops and 6 treatments in a pure stand. In total there have been 56 plots (14 treatments x 4 repetitions) of 30 m² (3x10m) area each. The trial has been run as a factorial randomised block design. The crop species and the cultivars were selected based on their traits suitable to cultivation in a mixture and also based on their adaptation to sandy soils that dominate in organic farms in Poland.

The land equivalency ratio (LER) was calculated on the basis of determined yields. LER is defined as follows:

$$\text{LER} = Y1/M1 + Y2/M2$$

where $Y1$ and $Y2$ are the yields (per unit of total area of the intercrop) of species 1 and 2 in the mixture, and $M1$ and $M2$ are the yields of the species in sole crops (per unit area of the respective sole crop).

LER demonstrates how much of the land area is required for monoculture to produce the same yields as obtained by intercrop (Willey and Osiru, 1972).

Results: In both years high yields of mixtures of spring cereals with lupines were noted. Narrowleaf lupine in a pure stand gave twice higher yields than yellow lupine. There were almost the same yields of spring triticale and oat in a pure stand. No significant differences in the level of yielding of particular groups of mixtures were observed (tab. 1).

Tab. 1. Yields and Land Equivalent Ratio (LER) of different mixtures of spring cereals with lupines (2018-2019)

Crop or mixture of crops	Yield in t/ha*	Land Equivalent Ratio (LER)
Mixtures of oat with lupines		
Oat + Narrowleaf lupine (SDC)	5,58a	1,45
Oat + Yellow lupine (SDC)	5,28a	1,49
Oat + Narrowleaf lupine (TC)	5,58a	1,44
Oat + Yellow lupine (TC)	5,46a	1,46
Mixtures of spring triticale with lupines		
Spring triticale + Yellow lupine (SDC)	4,33a	1,37
Spring triticale + Yellow lupine (TC)	4,60a	1,32
Spring triticale + Narrowleaf lupine (TC)	4,34a	1,15
Spring triticale + Narrowleaf lupine (SDC)	4,35a	1,16
Crops in a pure stand		
Spring triticale	4,48a	
Oat	4,81a	
Yellow lupine (TC)	0,84b	
Yellow lupine (SDC)	0,87b	
Narrowleaf lupine (TC)	1,66b	
Narrowleaf lupine (SDC)	1,73b	

*a,b-values with different letters significantly differ at $p < 0.05$.

Discussion: High values of LER noted for mixtures of spring cereals with lupines demonstrated their good mixing ability. It was shown higher values of LER for mixtures with oat than with spring triticale independently on the species of lupine. However narrowleaf lupine in a mixture with spring triticale did worse than yellow lupine (tab.1).

Nelson et al. (2012) indicated that organic intercrops consisting of cereals and grain legumes had the ability to give higher yields and reached also high LER at the level of 1.64 compared with their component monocrops. Similarly Bulson et al. (1997) reported high LER value for wheat–field bean intercrop in the organic system.

The obtained results confirmed the assumed hypothesis that mixtures of lupines with oat and spring triticale are better adapted to the cultivation in organic farming than the crops sown in pure stands.

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