

Project *brief*

Thünen Institute of Organic Farming

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Treated common vetch seeds as high-protein feed for chickens and pigs in organic agriculture

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- **Spring wheat and triticale are well suited for intercropping with common vetch as a grain crop**
- **With crude protein contents of 32-34 %, common vetch seeds are very rich in protein**
- **Differences between cultivars were found for the antinutritional factors convicin and total tannins, indicating a potential for future breeding activities**
- **Untreated common vetch seeds could be used at low dietary proportions of 4.6-8.0 % in diets for broilers, layers and pre-fattening pigs without negative effects**
- **All animals preferred the treated common vetch seeds, but intake remained moderate**

Background and aims

In organic agriculture, legumes are an integral part of crop rotations and contribute to meeting the protein requirements of monogastric livestock. In contrast to other grain legumes, common vetch (*Vicia sativa* L.) is characterized by low site requirements, grows in dry climates and on soils with low pH values. Primarily grown in intercrop mixtures as green manure, the protein-rich grains of common vetch are hardly used as feed for monogastric farm animals. The reason being the presence of antinutritional factors (ANF) in the seeds, which can have negative effects on animal performance and health. Therefore, we investigated treatment via germination or ensiling as a method to improve the feed value of common vetch seeds in this project. For this purpose, five vetch cultivars of different growth type were tested in mixed stands with cereals, their nutrients were analyzed, and feeding trials with broilers, laying hens and pre-fattening pigs were carried out.

Approach

In 2017-2019, a field experiment was conducted on intercropping of common vetch with spring cereals for grain use at a site with loamy sand. The year 2017 had very high precipitation, while 2018 was very dry and 2019 was slightly below the long-term average of 698 mm. The common vetch cultivars Berninova (Saatzucht Dr. Hege GbR), Ina and Jaga (Danko Hodowla Roslin), Slovena and Toplesa (Saatbau Linz) were grown in pure stands (120 germinable seeds (kfk) m⁻²) as well as in mixtures. The mixtures with spring wheat (2017-2019), spring rye (2017), and spring triticale (2018, 2019) were tested in common vetch:cereal-ratios of 25:75, 50:50, and 75:25, based on the respective sole crop seed density. Samples from the harvest of 2018 and 2019 were either germinated for four days (Keimrad[®] from Söllradl) or ensiled as model silages and stored for seven weeks to assess the effect of the

treatment. Subsequent analysis included both nutrients (crude nutrients, amino acids) and the ANF vicin and convicin, total tannins, and β -cyanoalanine and γ -glutamyl- β -cyanoalanine. Analysis of the cyanoalanine toxins was established as part of the project in Trenthorst. Feeding trials with broilers (Isa Hubbard JA 757, age 5-10 weeks), laying hens (LB+, age 22-36 weeks) and pre-fattening pigs ((DL x DE) x Pi, live weight 28-50 kg) were conducted with the cultivar Slovena, because it had shown stable yields in a previous project. In all trials, untreated, germinated or ensiled common vetch seeds were offered separately and compared with a vetch-free control. The diet formulation was based on 15 % vetch in the diet. In a second feeding trial with broilers, untreated common vetch seeds were mixed into the pelleted feed in proportions of 7.5, 10.0 and 12.5 %

Results

Field experiment: The grain and crude protein yields (Table 1) were strongly influenced by the weather conditions during the vegetation period and were largely determined by the proportion of vetch in the mixture. In the years with higher precipitation, the long-growing vetch cultivar Slovena achieved the highest grain yields with 30-35 % vetch and 65-70 % wheat in the seed mixture. The highest total crude protein yields were also obtained with the combination of Slovena and spring wheat at a vetch percentage of 40 % in the seed mixture, with the exception of the dry year 2018. Weed biomass increased with increasing vetch or decreasing cereal percentage in the seed mixture. Simultaneously, weeds removed significantly more nitrogen. Mixtures with long-growing vetch cultivars suppressed weeds more efficiently than short-growing ones. With higher vetch percentages in the seed mixture, crop stand height was lower, which can make it more difficult to harvest. Long-growing vetch cultivars pushed down the crop stand more

than low-growing ones due to their leaf mass. Spring wheat and triticale showed a similarly good performance, while spring rye did not prove successful due to a lower lodging resistance and too early maturity.

Table 1. Total crude protein yields 2017-2019, dt ha⁻¹

Vetch cultivar	Total crude protein yield, dt ha ⁻¹					
	2017		2018		2019	
	SW	SR	SW	ST	SW	ST
Berninova	5.9	4.6	8.4	8.3	7.6	7.2
Ina	10.2	7.5	7.0	7.1	8.2	8.8
Jaga	8.4	6.9	8.4	8.0	9.5	8.0
Slovena	10.7	8.2	8.6	8.4	10.7	11.5
Toplesa	7.9	5.8	8.7	8.6	9.7	10.2

SW=spring wheat, SR=spring rye, ST=spring triticale

Analysis of feed value: The common vetch seeds had a high crude protein content, which varied from 32 to 34 % depending on the cultivar. The starch contents were 47-49%. The sum of the first limiting amino acids for chicken, methionine and cysteine, varied from 5.2 (Slovena) to 5.8 g kg⁻¹ (Berninova). For vicin, only minor differences between cultivars were analyzed, with contents ranging from 6.7-8.2 g kg⁻¹. Convicin contents, on the other hand, depended on the cultivar, with 0.23-0.30 g kg⁻¹ in light-colored seeds and 1.1 g kg⁻¹ in dark-colored seeds such as Slovena. Cyanoalanine toxin contents were 9.6-12.9 g kg⁻¹ and showed no dependence on seed color. In contrast, tannin contents were significantly lower in light-colored common vetch seeds at 1 g kg⁻¹ than in dark-colored Slovena at 8.3 g kg⁻¹. Germination resulted in a slight increase in crude protein content and significant starch degradation, but no changes occurred during ensiling. Both treatments resulted in vicin degradation, but only ensiling reduced the levels of convicin and γ -glutamyl- β -cyanoalanine considerably.

Feeding trials: Broilers, laying hens, and pre-fattening pigs all showed a preference for treated common vetch seeds compared to untreated ones. Laying hens consumed the most germinated vetch seeds, and pre-fattening pigs consumed the most silage (Table 2). The highest voluntary intake of common vetch seeds was 13.2 % germinated seeds in broilers, while intake of untreated vetch remained low at 4.6-8.0 % across all trials. The only significant difference in animal performance was final live weight of broilers in trial 1, which was higher when vetches were fed than in the control. Feed conversion ratio was not affected by dietary treatment. In the second feeding trial with broilers, up to 12.5 % untreated common vetch seeds

could be included into the pelleted feed without negative effects.

Table 2. Voluntary intake of common vetch seeds, as % of daily feed consumption, and animal performance

Feeding trial	Animal performance			
	without vetches	with vetches		
		untreated	germinated	ensiled
Broiler 1				
% vetches in diet		5.7 ^a	13.2 ^c	7.7 ^c
Final live weight, kg	2.7 ^a	2.9 ^b	2.9 ^b	2.9 ^b
FCR*	2.4	2.6	2.7	2.7
Layers				
% vetches in diet		4.6 ^a	9.0 ^b	7.9 ^b
Laying percentage	87	88	89	86
FCR*	2.2	2.3	2.3	2.3
Pre-fattening pigs				
% vetches in diet		8.0 ^a	9.0 ^b	10.0 ^c
Daily weight gain, g	853	820	842	869
FCR*	2.2	2.4	2.4	2.1
Broiler 2				
		untreated		
% vetches in diet		7.5	10.0	12.5
Final live weight, kg	2.8	2.9	2.9	2.9
FCR*	2.3	2.2	2.3	2.1

*FCR=kg feed per kg weight gain and egg mass, respectively

Recommendations

Based on the field experiment, spring wheat and triticale can be recommended as intercropping partners for common vetch. With long-growing varieties such as Slovena, Toplesa and Jaga, sowing 40-60 kFk m⁻² vetches and 200-300 kFk m⁻² cereals achieved high total grain and crude protein yields. However, individual farm adjustment of seed ratios is recommended as yields are dependent on annual weather and site conditions. The analysis of feed value showed high crude protein contents for all tested cultivars. Differences between the cultivars with regard to some ANF, namely convicin and total tannins, indicate a potential for future breeding activities. Broilers, laying hens, and pre-fattening pigs all preferred the treated vetches in feeding trials with cultivar Slovena, but voluntary intake remained moderate. When included in pelleted broiler diets, untreated common vetch seeds could be used up to a dietary inclusion rate of 12.5 %. In conclusion, feeding of untreated common vetch seeds to monogastric farm animals can be recommended at low dietary proportions, and the effort of germination or ensiling does not seem to be justified.

Further Information

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Partners

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Publications

Kemper et al. 2020. Weed suppression and crop yield performance in sole and intercrops of common vetch and spring wheat depending on seed density ratio in organic farming. *J Kulturpflanzen* 72(1):12-24.

Höhne et al. 2022. Effect of common vetch (*Vicia sativa* L.) seeds in 100% organic diets for broiler chickens: acceptance and precaecal digestibility of crude protein and amino acids from raw, germinated and ensiled vetches. *Anim Feed Sci Technol* *submitted*

Support

