

The effectiveness of nitrogen rates on winter wheat and white clover bi-cropping grown for silage

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Introduction Whole-crop cereals harvested for silage cover c. 500,000 ha in Europe (Wilkins & Kirilov, 2003). Generally dry matter (DM) yield of small-grain cereals is lower than that of maize. In some investigations, DM yield (of high nutritional value) reached 15 t/ha (Balsdon *et al.* 1997; Clements *et al.* 1997). Whole-crop silage produced in a bi-cropping system offers more balanced forage compared to pure cereals and legumes. Nitrogen rates can be decreased with bi-cropping. The aim of this investigation was to compare nitrogen effectiveness using two methods of winter wheat cultivation: direct drilling into stubble and bi-cropping with white clover.

Methods In the years 1998-2001 field experiments, with four replicates were carried out in the south-west of Poland. Two sowing methods of winter wheat were compared: direct drilling into stubble and bi-cropping. In both systems five application rates of N fertiliser were applied. For comparison, the control field was not treated with nitrogen. The measurements included DM, crude protein (CP) and energy yields and the effectiveness of N use. The results were analysed statistically using STATISTICA software.

Results Nitrogen fertilisation in the system of direct sowing into stubble increased DM, CP and energy yields to a greater extent than in the bi-cropping system (Table 1). Winter wheat and white clover bi-cropping resulted in 26% higher DM, 95% higher CP and 25% higher energy yields compared with direct sowing into stubble. Increases occurred at all rates of N application.

Table 1 Dry matter, crude protein and energy yields and effectiveness of nitrogen use with the two systems

Sowing method	Nitrogen rates kg N/ha	Dry matter yield		Crude protein yield		Energy yield	
		t/ha	kg DM/kg N	kg/ha	kg CP/kg N	UFL	UFL/kg N
Bi-cropping	0	6.07	-	676	-	4286	-
	30	6.20	4.4	686	0.33	4418	4.4
	60	6.65	9.7	715	0.65	4697	6.9
	90	6.72	7.2	781	1.17	5153	9.6
	120	6.65	4.8	790	0.95	5631	11.2
Direct sowing	0	3.20	-	209	-	2636	-
	30	4.26	35.2	279	2.30	3262	20.9
	60	5.63	40.5	356	2.44	4155	25.3
	90	5.92	30.2	476	2.97	4411	19.7
	120	6.60	28.3	544	2.79	4859	18.5
Significance		n.s.	-	n.s.	-	n.s.	-
Bi-cropping		6.46	-	729	-	4837	-
Direct sowing		5.12	-	373	-	3865	-
Significance		***	-	***	-	***	-

Conclusions The impact of N rates on DM, CP and energy yields was lower in the bi-cropping system, because of N fixing capabilities of legumes. The highest effectiveness with direct sowing into stubble was observed with 30 and 60 kg N/ha. Nitrogen applied before ear emergence had less influence on DM and energy yield, but a bigger impact on CP yield. Winter wheat and white clover bi-cropping system can be recommended for ecological farming.

References

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