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The influence of winter wheat cover crop management on first-year *Poa pratensis* L. and *Festuca rubra* L. seed crops

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Abstract. From 1978 to 1984, field experiments were carried out to improve cover crop management of high-yielding winter wheat crops. Tillering of the grasses ceased if more than 85% of the solar radiation was intercepted by the cover crop. Therefore stimulation of undersown grasses has to be accomplished in the period before earing of the wheat. Suitable ways of doing this appeared to be: to select a late-closing wheat cultivar, to decrease the sowing rate and to postpone part of the earliest nitrogen dressing until later stages. Early autumn sowing appeared favourable for *P. pratensis*, but not for *F. rubra*.

Key words: grass seed, smooth stalked meadowgrass, Kentucky bluegrass, red fescue, *Poa pratensis*, *Festuca rubra*, cover crop management

Introduction. Tillers of *Poa pratensis* and *Festuca rubra* have to pass through a juvenile stage and then through a vernalization period, requiring together 10–15 weeks, before they can produce inflorescences. The ability of spring-produced tillers to flower is negligible: inflorescence production is dependent on vegetative growth before winter (Meijer, 1984). Sowing in June or July would produce the desired crop development, but then a harvest year would be missed. Undersowing in autumn together with (or shortly after) winter wheat has been found to give satisfactory results (Liefstingh & Vreeke, 1971). However, wheat growing has been intensified in recent years, resulting in denser crops and a later harvest. As a result, the conditions for undersowings have deteriorated. The objective of this research was to investigate how cover crop management could be adapted to combine high wheat yields with improved growth of undersown grasses.

Materials and methods. Field experiments were carried out during 1978-1984 in three locations in the Netherlands. Unless part of specific treatments, all wheat crops were sown in October at a sowing rate of 140 kg ha^{-1} and in rows 19–25 cm

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apart. The nitrogen fertilization was 200 kg ha^{-1} minus the mineral N in the soil (as measured in the 0–60 cm soil layer in February) and was split applied at Feekes stages 3 and 7. Unless otherwise specified, the grasses were sown on the same date as the cover crops, at a rate of 10 kg ha^{-1} and in rows 25 cm apart. After wheat harvest and straw removal, the grasses were fertilized with 60 kg N per ha. In February the spring nitrogen dressing was applied: 100 kg ha^{-1} to *P. pratensis* and 70 kg ha^{-1} to *F. rubra*.

In some of the trials, the percentage of full light under the cover crop at 5 cm above the ground was periodically determined by a line sensor (400–700 nm). Tillering was monitored by periodically counting the tillers in fixed squares of 0.125 m^2 per plot. Seed production data were obtained by harvesting 21 m^2 per plot.

The effect of sowing density of the cover crop was tested by varying the drill spacing (12.5–25–37.5–50 cm) or the sowing rate (110–160 kg ha^{-1}). In 5 experiments, grasses were sown on 4 dates. In the sowings until December the grasses were sown simultaneously with the wheat; in the two later sowings the grasses were sown in October-sown wheat. During 3 consecutive years, differences in light interception were determined between all wheat cultivars included in one of the trials of the Governmental Institute for Research on Varieties of Cultivated Plants. In two experiments, splitting of the nitrogen dressing was studied.

Results and discussion

Cover crop density and grass growth. At wider spacings the cover crop closed later and more light was transmitted to grass level. Except for the 50-cm spacings, at earing all crops attained about 95 % light interception (Fig. 1). An important observa-

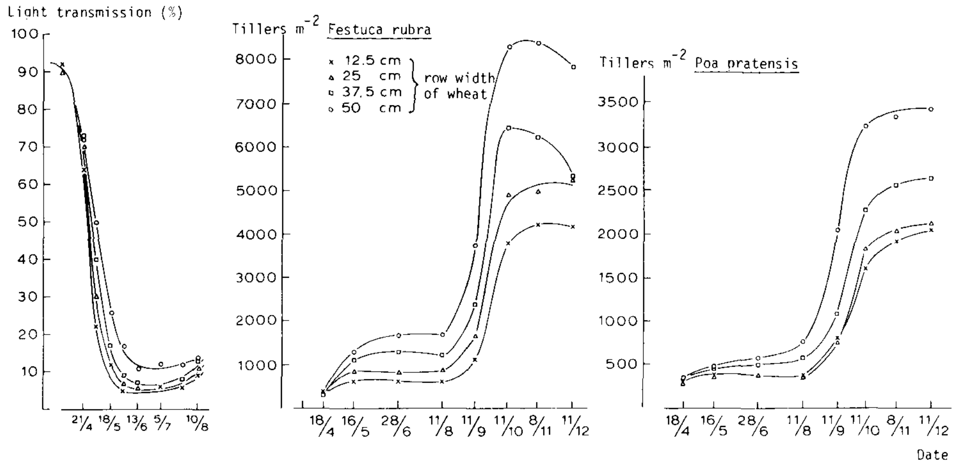

Fig. 1. The influence of row width of winter wheat on % light transmission (a) and tillering of undersown *Festuca rubra* (b) and *Poa pratensis* (c) seed crops during and after the cover crop period.

tion was that the grasses stopped tillering at the time the cover crop intercepted more than about 85 % of light. Tiller numbers remained almost stable from earing until harvest of the wheat. Death of tillers was only observed if the cover crop had lodged and locally less than 2 % of light was transmitted. So, improvement of grass growth can only be achieved up to first earing of the wheat. After more than 85 % of light is intercepted a decrease of cover crop density would have little effect on tillering, whereas wheat yield would be impeded (Gallagher & Biscoe, 1978). The widest drill spacings led to better tillering of the grasses (Fig. 1) and to higher grass seed yields. However, growers will not accept row spacings of 37.5 or 50 cm, because of decreased wheat yields. Drills 25 cm apart resulted in slightly but not significantly higher grass seed yields (Tukey 0.05) than those obtained from drills 12.5 cm apart. Reducing the sowing rate from 160 to 110 kg/ha also resulted in delayed closing of the wheat, improved grass growth and a tendency for higher grass seed yields. Norderstgaard (1984) found a positive effect on *P. pratensis* seed yields if wider drill spacing was combined with a reduced sowing rate. The best way of attaining a reduced cover crop density is probably a reduced sowing rate, because wheat yields are depressed less under favourable sowing conditions (Darwinkel, 1977).

Measuring light interception in wheat varietal trials showed that the closing behaviour of wheat cultivars differs considerably. The magnitude of the varietal effect on light transmission to, and tillering of, undersown grasses was comparable with the influence of the 12.5–37.5-cm row spacings in Fig. 1. In all years Arminda closed latest. Compared with Okapi, another wheat cultivar prevailing in the Netherlands, closing of Arminda on average lagged 10 days, or about 10 % of total radiation, behind. With decreasing light transmission from beginning of regrowth after winter until first earing, that difference is increasingly important and corresponds with about 20% more light attaining grass level over that period. Therefore, Arminda was estimated to be the most favourable cover crop for sowings of *P. pratensis* and *F. rubra*.

Sowing time. The highest production of *P. pratensis* was obtained with earliest sowings: seed yields declined progressively when sown after December. Late sowings hardly affected *F. rubra*: on the contrary, it was the September sowing that failed to yield high. Early sowing of this relatively fast-growing species gave rise to high numbers of leafy tillers. Obviously, the seed production of these crops was impeded by high crop density, as has been reported for early open-land sowings (Meijer, 1984).

Table 1. The influence of sowing time under autumn-sown wheat crops on seed yield of *Poa pratensis* and *Festuca rubra* (kg ha^{-1}). Means of 5 experiments (September 4 experiments).

	September	October-November	December-January	February-April
Poa pratensis	1340	1230	1140	800
Festuca rubra	1260	1420	1340	1360

Table 2. The effect of splitting the nitrogen dressing of the wheat crop on tillering of the grasses (3 weeks after wheat harvest) and on grass seed yield.

	Wheat dressing, kg N ha^{-1} F3 + F7 + F10	Grass crop, 20 September		Grass seed yield, kg ha^{-1}
		tillers m^{-2}	tiller weight, mg	
Poa pratensis	160	990	16.0	970
	100 + 60	1235	20.8	1110
	50 + 60 + 56	1435	21.8	1160
LSD 0.05		392	2.8	n.s.
Festuca rubra	160	1670	20.3	1100
	100 + 60	2250	22.5	1150
	50 + 60 + 50	2850	22.3	1200
LSD 0.05		521	n.s.	n.s.

Splitting the nitrogen fertilization. Data on percentage light transmission revealed that splitting of the nitrogen dressing often results in delayed closing of the wheat crop. Normally, a substantial part of the gift will be applied in early March at about Feekes stage 3. The longer part of the early dressing was delayed, the later the crop closure and the better the tillering of undersown grasses (Table 2).

Nordestgaard (1984) found no effect on grass seed yield of a 2–3-week delay of the total dressing. In our trials, the grasses possibly took advantage of late nitrogen dressing. As with the other adaptations of one single factor of wheat crop management, grass seed yields tended to be higher, although not significantly. A combination of some of these cover crop adaptations will probably produce a stable and reliable improvement of vegetative growth and seed yield of first-year grass crops.

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