

Undersown tall fescue as a cover crop after forage maize in 2014

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Abstract

Grass cover crops installed following the harvest of forage maize often develop poorly due to the late sowing date. Undersowing of grasses is an alternative, provided the undersown grass does not compete too much with the maize crop. This trial evaluated the competition of undersown tall fescue (*Festuca arundinacea* Schreb.) in forage maize. Differences in competition were obtained by using 6 contrasting herbicide treatments that affected tall fescue differently. The yield of forage maize without undersown grass (control: 21,688 kg DM ha⁻¹) was significantly higher compared to maize with undersown grass that was not inhibited by herbicides (17,887 kg DM ha⁻¹). A significant negative relationship was found between the maize yield and the grass biomass after maize harvest. At the beginning of the winter, the biomass of Italian ryegrass sown immediately after the maize harvest was at the same level of the undersown tall fescue. Our results indicate the necessity using the right herbicide treatment to combine good maize yields with the benefits of the undersown grass.

Keywords: *Festuca arundinacea*, *Zea mays*, herbicides

Introduction

Grass cover crops installed following the harvest of forage maize often develop poorly due to the late sowing date, resulting in a low nitrate-uptake potential. Dam (2006) found that under Dutch weather conditions, the simulated capacity of a catch crop to take up N is over 200 kg N ha⁻¹ if it is sown in the first half of August. For winter rye, it decreases on average by 3.3 kg N ha⁻¹ per day of postponement of sowing. Hence, cover crops sown after forage maize, harvested from mid-September till the end of October, have a low potential to take up nitrate. In addition, it is often not possible to sow a cover crop in wet autumn due to soil structural damage. Undersowing may resolve these problems provided the undersown grass does not compete too much with the maize crop. Liedgens *et al.* (2004) found that the yield of maize sown in a living mulch of Italian ryegrass was reduced to one-quarter of the normal yield. Therefore, the grass understorey is preferentially sown when the maize has reached the 3-4 leaf stage. Undersowing the grass when the maize has already emerged is not convenient for farmers. Late sowing jeopardizes the early grass growth due to an increased incidence of drought periods. The ideotype of a grass species for undersowing in forage maize on one that has low early vigour but good autumn growth. Such a grass can be sown at the same time as the maize without competing for water and nutrients while also having a good potential to take up N in the autumn. Tall fescue has the right ideotype (Cougnon, 2014). We evaluated the use of a commercial tall fescue seed mixture (Proterra maize, Barenbrug, the Netherlands) for undersowing in forage maize. Our research questions were:

1. How much is the maize yield affected by the undersown grass?
2. How large is the yield advantage of an undersown sward of tall fescue compared to a newly installed sward of Italian ryegrass immediately after the maize harvest?

Materials and methods

A field trial was established on a sandy loam soil in Melle in a randomized complete block design with three replicates. Each block consisted of a strip of 70 m long and 6 m wide (8 rows of 0.75 m). Each block was divided in seven plots of 10×8 m. On 28 April 2014, forage maize was sown at a density of 114,000 seeds ha⁻¹ and six of the seven plots in each block were oversown on the same day with tall fescue (20 kg ha⁻¹) using a 2.5 m wide conventional seed drill.

Prior to the establishment of the trial, the land had been fertilized with 170 kg N ha⁻¹, 28 kg P ha⁻¹ and 123 kg K ha⁻¹ from cattle slurry and with 100 kg N ha⁻¹ from mineral fertilizer. When the maize had reached the 3-4 leaf stage, 6 different herbicide treatments were applied on the plots, resulting in seven treatments (T1-T7) (Table 1). The applied herbicide treatments were either recommended in the technical sheet of 'proterra maize' (T1, T2) or recommended by agronomic advisers (T3, T4, T6 and T7). T5, a treatment affecting only dicot weeds, was included to see the effect of unsuppressed grass growth on the maize yield. Harvesting took place on 23 September with a field harvester. DM yield of forage maize was determined based on 8 m² per plot, a subsample of 10 plants was chopped and dried for 16 h at 75 °C. On the T1 plots (no undersown grass), a seed bed was prepared on 26 September to sow Italian ryegrass (*Lolium multiflorum* cv. 'Melquattro') at a density of 40 kg ha⁻¹ on 29 September. On 28 October, 25 November (2014) and 6 January (2015), the aboveground biomass of the cover crops in all plots was determined. On each plot, 1.8 m² grass was harvested by cutting the seedlings above the soil surface. The harvested biomass was washed with water to remove soil and dried for 16 h on 75 °C. ANOVA, multiple comparison of means and regression was performed in R using the *aov()*, *TukeyHSD()* and *lm()* functions respectively.

Results and discussion

The average maize yield was 20,559 kg DM ha⁻¹. The highest yields were found on the control treatment T1 (21,688 kg DM ha⁻¹) and on the treatment T7 (21,275 kg DM ha⁻¹). The maize yield on T5 (17,887 kg DM ha⁻¹) was significantly lower than the yield on the other treatments except T3 (19,933 kg DM ha⁻¹) ($P < 0.001$). Although maize yields in the other herbicide treatments were not significantly different from the control (T1), a negative relationship was found between the maize yield and the grass biomass harvested on 28 October ($y = 21,326 - 2.1x$; $R^2 = 0.62$; Figure 1a). The yield of the Italian ryegrass sown after the maize harvest increased faster compared to the undersown tall fescue (T1, Figure 1b). At the end of October (28-10-2014), the yield of the Italian ryegrass was 167 kg DM ha⁻¹; at the beginning of the winter (6-1-2015), it was 1,131 kg DM ha⁻¹ and at the same level of the yield of T3 (907 kg DM ha⁻¹) and T4 (698 kg DM ha⁻¹). Only the tall fescue on T5 had a higher grass yield (2,035 kg DM ha⁻¹) than the Italian ryegrass (T1) ($P < 0.01$) at that moment.

This quick development of Italian ryegrass was related to a high plant density and a dense ground cover, whereas herbicide treatments, competition of the maize and damage of the forage harvester resulted in heterogeneous swards of the undersown tall fescue. Also, the autumn of 2014 offered marvellous conditions for the development of Italian ryegrass. First, maize harvest was rather early due to the good summer. Second, soil conditions were good at harvesting, allowing the sowing of Italian ryegrass immediately after the maize harvest. Third, the autumn was very mild: the average temperature for the months September till November was 13.0 °C compared to 10.9 °C normally.

Table 1 Treatments in trial.

Treatment	Grass undersowing	Herbicide treatment
1	0 kg ha ⁻¹	88 g ha ⁻¹ tembotrion + 625 g ha ⁻¹ 5-metolachloor + 375 g ha ⁻¹ terbuthylazin
2	20 kg ha ⁻¹	88 g ha ⁻¹ tembotrion + 625 g ha ⁻¹ 5-metolachloor + 375 g ha ⁻¹ terbuthylazin
3	20 kg ha ⁻¹	44 g ha ⁻¹ tembotrion + 280 g ha ⁻¹ dimethamide-P 250 g ha ⁻¹ terbuthylazin + 33.6 g ha ⁻¹ topamezon
4	20 kg ha ⁻¹	66 g ha ⁻¹ tembotrion + 420 g ha ⁻¹ dimethamide-P + 375 g ha ⁻¹ terbuthylazin + 50.4 g ha ⁻¹ topamezon
5	20 kg ha ⁻¹	900 g pyridate
6	20 kg ha ⁻¹	720 g ha ⁻¹ dimethamide-P + 300 g ha ⁻¹ sulcotrion + 21 g ha ⁻¹ nicosulfuron
7	20 kg ha ⁻¹	560 g dimethamide-P + 500 g ha ⁻¹ terbuthylazin + 100 g ha ⁻¹ mesotrion + 21 g ha ⁻¹ nicosulfuron

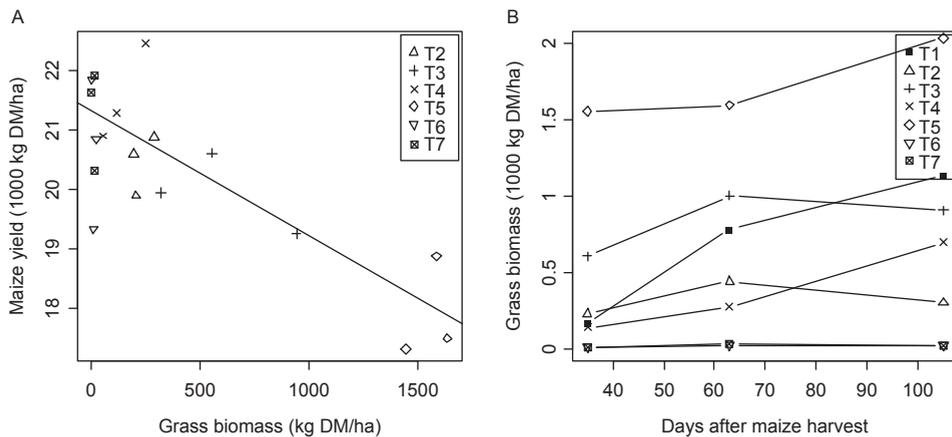


Figure 1 (a). Regression of maize yield on yield of undersown tall fescue on 28 October treated with different herbicide mixtures (T2 – T7; see Table 1) ($y = 21,326 - 2.1x$). (b) Evolution of the dry matter yield of Italian ryegrass sown after maize harvest (T1) and undersown tall fescue treated with different herbicide mixtures (T2 – T7).

Conclusions

Regarding our research questions, we conclude that:

1. Forage maize lost $2.1 \text{ kg DM ha}^{-1}$ per kg DM undersown tall fescue (harvested one month after the maize harvest).
2. Sowing Italian ryegrass after the maize harvest was the better option in the exceptional mild autumn of 2014.

References

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