



Defining optimum practices for Italian ryegrass seed production in Serbia

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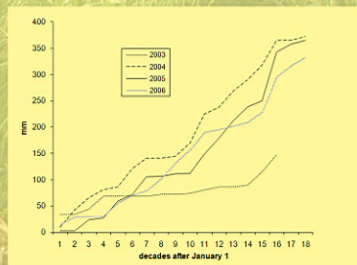
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Introduction

Italian ryegrass is one of the leading forage grasses in Serbia, producing high-quality forage from early spring to late summer. Excellent ryegrass seed yields were achieved in Serbia in the first year, but local seed production covers only 50% of total seed demand. Optimum stand density for maximum yield in Italian ryegrass has not been determined yet, and recommended SRs, IRSs and SNRs for Italian ryegrass varied considerably. At high seed and nitrogen rates, seedling competition for resources may actually reduce yields. Maximization of the first-year SY is much more important than the cumulative productivity over several consecutive crops due to disorganization of established spatial conditions and an inability to predict the next stand density. As the amount of seed shattered can easily be 10% of the harvested crop, it can develop into a very dense stand in the next season, thus increasing the SR more than 10-fold. This field study was conducted to determine the methods for managing the seed crop of Italian ryegrass in the first production year using different SRs, IRSs and SNRs.

Methods

The study was maintained for 4 consecutive years, between 2002 and 2006, near Šabac, Serbia (44°47' N, 19°35' E, 80 m asl.) which is located in a semi-humid region (with very variable years). Seed from the primary growth of tetraploid Italian ryegrass cv. Tetraforum was harvested in the first production year after the establishment. Italian ryegrass was planted each autumn prior to the preceding summer seed harvest. SR was equivalent to 5, 10, 15 and 20 kg ha⁻¹, providing 12 plant spatial treatments in combination with IRS, i.e. 20, 40 and 60 cm. The harvest plot was 10 m², and replicated four times in a randomized complete block design. NPK fertilizer 8-16-24 was applied in fall (250 kg ha⁻¹), with treatment application of N (0, 50, 100 and 150 kg ha⁻¹) in spring. After seed threshing, the straw was collected and weighed as SDM. This measurement was used for calculating harvest index, using the formula HI (%) = [SY / (SY + SDM)] * 100. Soil in the experimental area was humoflvisol (2.54% humus), with rinsed limestone; soil texture: clay loam; CaCO₃: 0.36%; pH in KCl: 5.25; K, O: 15 mg kg⁻¹ and P, O₂: 3 mg kg⁻¹. Monthly precipitation during the 4 years of the experiment was very contrasting.

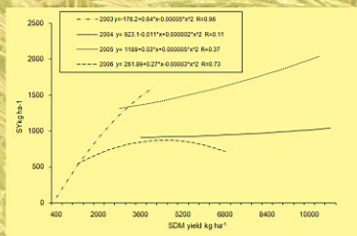


Results

Accumulated precipitation during the spring of 2003 was deficient, and the lowest average SY was observed in 2003 (785 kg ha⁻¹), while the highest was in 2005 (1559 kg ha⁻¹). Reduced SY and SDM in 2003, when compared to other years, were attributed to a spring rainfall shortage and a significant influence of the treatments. The SYs and SDM yields in 2003 were the highest with 20 cm IRS and the 20 kg ha⁻¹ SR, showing that SY can be managed by increasing stand density during drought stress conditions. The results indicate that there was no interaction effect between the applied factors, and that they influenced SY independently. Higher precipitation during the 2 consecutive years resulted in abundant SDM accumulation. In the spring of 2004 and 2005 lodging was extremely high and increased as crop density increased, especially when higher SNR were used. The SY differences in 2004 and 2005 were mainly due to a low accumulation of assimilates and early season lodging at the time of heading in 2004. Furthermore, the 2004 conditions favoured secondary tillering during seed filling; these vegetative tillers were competing for assimilates with seed sinks. There was also some crop lodging in 2006, but it occurred late in the seed-filling period. SY were affected by IRS all 4 years, but an opposite effect occurred in arid and humid weather conditions, respectively. Lodging tolerance appeared to be the highest at the 60 cm IRS, as compared with the other treatments. A favourable effect of increased SR and narrow IRS on SY was observed in 2003. SDM was strongly influenced by stand establishment throughout the experiment, and the biomass yield response to density was more consistent than that one of SY. The HY, as an indicator of seed production efficiency, was significantly influenced by the applied treatments. The highest HY was observed in 2003, which was due to the very low SDM obtained. Regarding low SY and reduced SDM production, the HI could not be considered an objective indicator in this production year. SY compared with SDM allowed comparison through regression equations, and presented correlation between straw and seed yield. The highest correlation was between seed and straw yield in arid year.

Conclusions

The results of the present study indicate that in order to maximize seed productivity in the first production year a high seeding rate is preferable (15-20 kg ha⁻¹), and that medium row spacing (40 cm) is the least uncertain. Also, the results support the use of a relatively low nitrogen rate for Italian ryegrass seed production in the first harvest year.



Main factors	2003			2004			2005			2006		
	SY	SDM	HI	SY	SM	HI	SY	SM	HI	SY	SM	HI
IRS A	**	**	**	**	*	**	**	**	**	**	**	**
SR B	**	**	**	NS	**	**	**	**	**	**	**	**
SNR C	NS	**	NS	*	NS	**	*	**	**	**	**	**
A X B	*	NS	NS	NS	NS	**	NS	NS	NS	NS	NS	NS
A X C	NS	NS	NS	NS	NS	**	NS	NS	NS	NS	NS	NS
B X C	**	**	NS	NS	NS	NS	NS	NS	*	**	**	**
A X B X C	NS	NS	NS	NS	*	NS	NS	NS	NS	**	NS	*
Average	785	1806	29.56	955	6746	12.62	1559	5941	21.13	839	3506	20.82
CV	34.7	30.4	11.4	22.7	18.0	25.4	22.5	23.3	19.3	21.6	26.6	25.4

Abbreviations:
 SR – seeding rate
 IRS – inter row spacing
 SNR – spring nitrogen rates
 SY – seed yield
 SDM – shoot dry mass
 HI – harvest index