Defining optimum practices for Italian ryegrass seed production in Serbia

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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, seeding competition for resources may actually reduce yields. Maximization of the first-year SRS 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 scattered can easily be 10% of the harvested crop, it can develop into a very dense stand in the next season, thus increasing the SRS 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 SRSs, IRSs and SNRs.

Methods

The study was maintained for 4 consecutive years, between 2002 and 2006, near Sabac, Serbia (44°47'N, 19°33'E, 80 m asl), which is located in a semi-humid region (with very variable years). Seed from the primary generation of tetraploid Italian ryegrass cv. Tetrafo- num was harvested in the first production year after establishment. Italian ryegrass was planted each autumn prior to the preceding summer seed harvest. SRS was equivalent to 5, 10, 15 and 20 kg ha⁻¹, providing 12 plant spatial treatments in combination with IRS, i.e., 30, 40 and 60 cm. The harvest plot was 16 m², and replicated four times in a randomized complete block design. NPK fertilizer 0-10-24 was applied in full (230 kg ha⁻¹), with treatment application of N (6, 30, 100 and 300 kg ha⁻¹) in spring. After seed threshing, the straw was collected and weighed as SDM. This measurement was done for calculating harvest index, using the formula $H/F = (S/G) 	imes (S/SDM) 	imes (SDM/SDM)$. Soil in the experimental area was humicluvisol (22.0% humus), with mixed loam to sandy loam texture; clay loam; CaCO₃: 0.34%; pH in KCI: 5.25; Al: 30.15 mg kg⁻¹ and P₂O₅: 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 SRS was observed in 2003 (743 kg ha⁻¹), while the highest was in 2003 (1139 kg ha⁻¹). Reduced SRS and SDM in 2003, when compared to other years, were attributed to a spring rainfall shortage and a significant influence of the treatments. The SRS and SDM yields in 2003 were the highest with 20 cm IRS and the 20 kg ha⁻¹ SRS, showing that SRS 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 SRS 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 SNRs were used. The SRS differences in 2004 and 2005 were mainly due to a fine accumulation of assimilates and earliness of lodging at the time of heading in 2004. Furthermore, the 2004 conditions favoured secondary thickening during seed filling, while vegetative tillers were competing for assimilates with seed links. There was also some crop lodging in the 2005 harvest year, but an opposite effect occurred in arid and humid weather conditions, respectively. Lodging tolerance appeared to be the highest at the highest IRS, as compared with the other treatments. A favourable effect of increased SRS and narrow IRS on SRS was observed in 2005. SDM was strongly influenced by stand establishment throughout the experiment, and the biomass yield response to density was more consistent than that seen of SRS. The P₂O₅ as an indicator of seed production efficiency, was significantly influenced by the applied treatments. The highest $H/F$ was observed in 2005, which was due to the very low SDM obtained. Regardless low SRS and reduced SDM production, the P₂O₅ could not be considered an objective indicator in this production year. SRS 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 airdry.

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.

Abbreviations:
- SRS – seeding rate
- IRS – inter row spacing
- SNR – stand density
- SDM – shoot dry mass
- H/F – harvest index