

Propagation, impact and management of *Elymus repens* in continuous cereal cultivation

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Summary

The propagation of *Elymus repens* and the efficacy of different control measures were studied in a spring barley - spring wheat rotation. Both mechanical and chemical control were applied. The number of *E. repens* shoots increased 2.5-fold in untreated plots during the six-year trial period. The best control of *E. repens* was achieved with chemical or mechanical treatment in fallow and with pre-harvest application of glyphosate. Relatively constant and precise regression parameters were estimated for a non-linear model describing the yield response as a function biomass of *E. repens*. The threshold infestation for *E. repens* adjusted to the cost/benefit situation in Finland was about 40 g dry matter m⁻², and the shoot density producing this amount varied between 40 and 160 m⁻², depending on moisture conditions in summer.

Introduction

Couch grass, *Elymus repens* (L.) Gould is the most frequent and troublesome perennial grass weed in the Nordic countries (Denmark, Finland, Norway, Sweden). Despite continuous mechanical and chemical control measures, *E. repens* causes significant yield losses every year in cereal-dominated crop rotations.

The objectives of this study were to follow the propagation of *E. repens* in continuous rotation of spring cereals and to compare the efficacy of different control measures and economic returns.

Materials and methods

A long-term field trial was started in the autumn 1985 on a heavily infested barley field (> 100 *E. repens* shoots m⁻²). The crop rotation on clay soil included spring barley (*Hordeum vulgare* L.) and spring wheat (*Triticum aestivum* L.) in alternate years. The management regimes against *E. repens* were as follows: stubble harrowing once every year, mechanical fallow in 1986, glyphosate-treated fallow in 1986, pre-harvest glyphosate in 1985, glyphosate in stubble every second year, every fourth year or when considered necessary. Glyphosate rate was 1.44 kg a.i. ha⁻¹ (Roundup® 4.0 l).

The cultivation of crops followed the conventional agronomic practices in Finland; the seed rate for barley was 500 viable kernels m^{-2} , and 600 kernels for wheat. The crop was sown with a combined fertilizing and sowing machine which placed the NPK fertilizer (90 kg N ha^{-1}) between the crop rows which were 12.5 cm apart. The plots were ploughed to the depth of 20-25 cm every autumn. The infestation of *E. repens* was assessed just before harvest. Grain yield was obtained from plots of 23 m^2 .

The relationship between crop yield (Y) and *E. repens* infestation (E) was described with the model (2)

$$Y = Y_{wf} \{1 - IE / [100(1 + (I/A)E)]\}$$

where Y_{wf} is a theoretical yield in the absence of *E. repens*, I is the percentage yield loss when infestation approaches zero, and A is the maximum percentage yield loss at infinite densities. The economic control thresholds for *E. repens* were calculated with a computer programme (5).

Results and Discussion

In untreated plots, the number of *E. repens* shoots was 170 m^2 in 1986, and it increased to 400 m^2 after six years. The annual biomass production of *E. repens* was 110-240 g dry matter m^2 , and it was correlated well with the amount of precipitation in early summer. The average biomass per single *E. repens* shoot varied from 0.25 g in dry years to 0.92 g in rainy growing seasons.

As the range of *E. repens* infestation was limited, it resulted in rather low and inconstant estimates (22-94%) for parameter A in the separate trials. Consequently, in the final model the parameter A was constrained to be 100%; then the estimates for the parameter I in the biomass model were rather stable, 0.34-0.39, within a yield range of Y_{wf} 2.5-4.0 t ha^{-1} except in 1990 (0.17) which was a dry summer. In the density model, the estimates for I varied between 0.05 and 0.34.

The most effective (>95 %) and long-lasting control was achieved with the pre-harvest application of glyphosate in 1985 and with chemical or mechanical fallow in 1986. At present, pre-harvest treatment with glyphosate is not allowed in Finland. In fallows, chemical treatment is recommended instead of mechanical harrowing to avoid leaching of nutrients during the growing season and to maintain the soil structure.

Glyphosate in stubble provided only a moderate control during the first years (1985-1987) due to the poor weather conditions in delayed applications in the end of September. On the other hand, the stubble treatments with glyphosate were efficient under favourable conditions in 1989 and 1990.

No stubble harrowing could be performed in 1986 and 1987 due to the wet conditions, but when harrowed in dry conditions in 1989 and 1990 the subsequent control rate in 1991 was 80%. In Sweden, where the method is more wide-spread, it is usually possible to harrow stubbles twice before ploughing in autumn (3).

The best economic result was achieved with a single pre-harvest application of glyphosate in stubble in 1985, which provided a 1.4 times higher net return than the untreated regime during the six-year trial period. Both in the chemical and mechanical fallow, the excellent control of *E. repens* compensated the loss of one year's yield (1986), and the economic result was equal to the chemical stubble treatments.

The economic threshold for stubble treatment with glyphosate was calculated assuming a yield level of 3 tons ha⁻¹, weed kill of 85%, a grain price of FIM 2000 per ton and control costs of FIM 600. The threshold biomass was estimated to be 40 g dry matter m⁻², and the shoot number of *E. repens* needed to produce this biomass ranged 40-160 m⁻² according to the amount of precipitation during the summer.

For the practical adjustment of thresholds the infestation should be expressed in terms of relative leaf cover and e.g. apply the calculation method of Kropff and Spitters (4). The possible overestimation of yield loss with our threshold value due to the aggregated occurrence of *E. repens* (1) is "corrected" by assuming that we already try to avoid the yield loss of the next crop.

References

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