The dynamics of *Elytrigia repens* in different field crops in Lithuania

Die Wachstumsdynamik von *Elytrigia repens* in verschiedenen Fruchttarten in Litauen

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Summary

Growth dynamics of *Elytrigia repens* was studied during the period 2002-2004 at the Voke Branch of the Lithuanian Institute of Agriculture on a haplic luvisol sandy loam soil. The objective of the study was to determine the growth dynamics and development regularities of *Elytrigia repens* in different agrophytocenoses, such as winter rye, potato, spring barley, undersown spring barley, perennial grasses, bare fallow and untilled soil.

The highest increase in *Elytrigia repens* was identified in untilled soil and in the first-year perennial grasses. Disappearance of *Elytrigia repens* was most noticeable in bare fallow. In untilled soil the amount of *Elytrigia repens* by autumn increased by 6.4–7.2 times, the rhizome length per hectare reached 377 km and the air-dry weight amounted to 747 kg. In the first-year perennial grasses the amount of *Elytrigia repens* rhizomes in the course of the growing season increased by 2–3 times. In autumn, rhizome weight per hectare was as high as 650 kg. Conditions for *Elytrigia repens* stem growth in perennial grasses were worse.

Key words: *Elytrigia repens*, field crops, growth dynamics, rhizomes, weeds

Zusammenfassung


Der höchste Zuwachs der *Elytrigia repens* wurde in perennierenden Gräsern festgestellt, und die stärkste Veränderung der *Elytrigia repens* in der Schwarzerde. In der Schwarzerde war in der Herbst die Länge der Rhizome 47-fach und das Gewicht sogar 53-fach im Vergleich mit der Kontrolle geringer.


Stichwörter: *Elytrigia repens*, Ackerbau, Rhizom, Unkraut, Wachstumsdynamik
with perennial grasses, and perennial grasses of the first year of use.

## 2 Materials and methods

Research into growth dynamics of *Elytrigia repens* was done during the period 2002-2004 at Lithuania Institute of Agriculture’s Voke Branch in five six-course crop rotation fields: in winter rye (*Secale cereale* L.), potatoes (*Solanum tuberosum* L.), spring barley (*Hordeum vulgare* L.), spring barley undersown with red clover (*Trifolium pratense* L.) and timothy (*Phleum pratense* L.), and in perennial grasses of the first year of use.

The experiments were done on a sandy loam lying on gravel luvisol (IDp). The agrochemical characteristics of the ploughlayer were as follows: pH 5.6-6.2, humus 1.37-2.5 %, available P$_2$O$_5$ and K$_2$O 130-250 mg kg$^{-1}$ and 146-254 mg kg$^{-1}$, respectively.

The weather conditions during the experimental years were diverse (Table 1). In 2002 the spring was changeable, the temperatures of the three summer months were by 1-2°C higher than long-term average, there was no shortage of moisture, and the autumn was warm. In 2003 the spring was early and warm, the summer was rainy, and the weather conditions in the autumn were close to long-term average. The year 2004 was distinguished by cool and dry spring, very hot and droughty summer, and warm and dry autumn.

Next to each of the five six-course crop rotation field, there were measured plots of 75 m$^2$ (15 x 5) and replicated 4 times. Conventional soil and crop management practices were employed; no herbicides were used in all crop stands. Ploughing to a depth of 18 – 20 cm was performed regularly.

In the crop rotation field winter rye ‘Duoniai’ variety was grown. Seed rate was 200 kg ha$^{-1}$, 60 kg ha$^{-1}$ phosphorus and 60 kg ha$^{-1}$ potassium were applied after second cultivation in the early spring. The potato variety ‘VB Goda’ was grown after winter rye. Tuber rate was 3 t ha$^{-1}$, 90 kg ha$^{-1}$ of nitrogen, 60 kg ha$^{-1}$ of phosphorus and 120 kg ha$^{-1}$ of potassium was applied. The barley variety ‘Aukšniai 3’ was sown after potatoes with a seed rate of 190 kg ha$^{-1}$, 60 kg ha$^{-1}$ of phosphorus and 120 kg ha$^{-1}$ of potassium was applied. The barley variety ‘Auksiniai 3’ was sown in the beginning of the growing season.

*Elytrigia repens* stems (tillers) were counted in each plot’s 1 m$^2$ (4 sites 0.25 m$^2$ each) every month from April to various agricultural crops’ harvesting. The length and air-dried mass of *Elytrigia repens* rhizomes were measured three times per growing season: i) in spring before soil tillage or in May, ii) in summer, in July, iii) in September, and in all cereals in August. *Elytrigia repens* plants were dug out from 0.25 m$^2$ plots from 20 cm depth. Species composition and air-dried mass of all weeds were determined only before cereal and potato harvesting.

Experimental data were processed by ANOVA method. Prior to the analysis the data of *Elytrigia repens* stem number, rhizome length and mass were transformed using the formula $\sqrt{x+1}$.

## 3 Results and Discussion

In winter rye *Elytrigia repens* was the most abundant species of all the weeds in the crop. Quackgrass accounted for 49.3 %, annual dicotyledonous for 44.7 %, perennial dicotyledonous for 4.9 %, annual monocotyledonous for 1.1 % (Table 2). The most prevalent weed species were short-growing, annual dicotyledonous – *Arenaria serpyllifolia* L. (31.2 % of all dicot weeds), *Polygonum aviculare* L. (22.6 %), *Veronica arvensis* L. (12.3 %), and of perennial dicotyledonous the most prevalent was *Cerastium arvense* L. (3.4 %). Due to the suppressive power of winter rye, the air-dried mass of the aboveground part of all weeds was only half of that in potato and barley crops. At low to medium infestation levels, the yields of some crops are less affected by quackgrass than others. This is the case with winter grains (winter wheat and especially winter rye, but not spelt wheat), buckwheat and potatoes (*Kashaubinita* and *Palikute* 2004).

The conditions for *Elytrigia repens* propagation were not favorable in winter rye. In spring, in the first half of the growing season, winter rye suppressed *Elytrigia repens* and slightly inhibited its growth. In June the number of this grass stems was by 17.3 % lower in May, however until cereal harvesting it had reached the same level again (Figure 1, a). Because winter crops develop in cool temperatures in the fall and early spring, as does quackgrass, the two compete directly with one another (*Riesenberg* et al. 2000).

The main indicator of *Elytrigia repens* growth intensity is the changes in rhizomes during the growing season. In the first half of the growing season the nutrients accumulated in rhizomes were used for the formation of this grass tillers and generative organs. As a result, the number of rhizomes declined. In July the length of rhizomes was 13.9 m m$^{-2}$, and mass 9.0 g m$^{-2}$, or by 64 % and 43 % lower than in May. The quackgrass tillers that grew later started to grow new rhizomes and to accumulate nutrients in them. Regardless of these changes during the growing season, at winter rye harvesting a more marked reduction (54 %) was observed only in the length of this grass rhizomes and their mass again nearly reached the level which was in spring.

If there is a high infestation of quackgrass, the soil can dry out. Moreover its subterranean tillers can destroy all soft obstacles like potato tubers or similar components of plants. On the other hand it can be used as cattle feed (*Gin-
In potatoes (Figure 1, b) *Elytrigia repens* accounted for 55.8 % of all weeds (81.5 weeds m$^{-2}$), annual dicotyledonous for 31.4 %, perennial dicotyledonous for 7.9 %, and annual monotoxiclated for 4.9 %. The prevalent weed species were *Chenopodium album* L. (7.2 %), *Viola arvensis* Murr. (4.9 %), *Tripleurospermum perforatum* (Merat) M. Lainz (3.4 %), *Poa annua* L. (2.7 %), *Sonchus arvensis* L. (1.5 %) (Table 2). In potatoes weeds were much larger than in winter rye, their aboveground mass before harvesting amounted to 140.8 g m$^{-2}$.

In potatoes, due to the spring soil tillage and crop management, the number of quackgrass at the beginning of summer was twice as low as in May. However, later when no potato earthing up was done and when potatoes competed weakly with weeds the number of this grass gradually increased and in the autumn it started propagating very rapidly. Compared with the number of this grass before soil tillage (82.4 plants m$^{-2}$), the number of *Elytrigia repens* stems at the end of June was by 51.3 %, in July by 33.6 % lower, in August it almost leveled, and in September it was by 82.3 % higher. The changes in quackgrass rhizome length and mass during potato growing season were very similar to those of the aboveground part. In July the length and mass of rhizomes compared with those in spring declined by 34.7 % and 51 %, respectively, and in September at potato harvesting the length of rhizomes was only inappreciably higher and mass increased by as much as 78.3 %. The length of rhizomes per hectare amounted to 160 km, and their mass to 280 kg. Potato growers require effective control of quackgrass (*Elytrigia repens*) so as to obtain maximum yield (DAWENT et al. 1996).

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Fig. 1: Growth dynamics of *Elytrigia repens* in various agrophytocenoses: (a) winter rye, (b) potatoes, (c) spring barley, (d) undersown spring barley, (e) first year perennial grasses and (f) untilled soil. T.Voke, 2002-2004 average data ( - number of stems m$^{-2}$, - length of rhizomes m m$^{-2}$ and - weight of rhizomes g m$^{-2}$).

In spring barley (Figure 1, c) experiments were done in a field with a weed count of 179.1 m\(^{-2}\), of which annual dicotyledons accounted for 48.8 %, perennial dicotyledons for 11.9 %, annual monocotyledons for 4.2 %, and perennial monocotyledons for 35.1 % (Table 2). Of other weed groups the most prevalent were Chenopodium album L. (18.7 %), Viola arvensis Murr. (7.6 %), Stachys palustris L. (7.5 %), Tripleurospermum perforatum (Merat) M. Lainz (6.0 %), Sonchus arvensis L. (3.3 %) and Capsella bursa-pastoris (L.) Medik. (4.1 %).

The number of Elytrigia repens stems during the barley growing season practically did not change, in the first half of the growing season it slightly declined, while in the second half it slightly increased. At harvesting the number of this grass was by 1.2 times higher than in spring. More marked changes occurred in the development intensity of quackgrass underground organs. In July the length of rhizomes was by 81 %, their mass by 84.6 % lower than in spring, before soil tillage. The differences were significant. However, in the second part of the growing season Elytrigia repens produced new rhizomes and intensively accumulated storage nutrients in them. At barley harvesting the length of rhizomes was by 2.4, mass by 3.5 times higher than in July, but almost by half lower than in spring. Significant differences were not determined. The length of rhizomes at cereal harvesting per hectare amounted to 107 km and mass to 212 kg.

The weed incidence in spring barley (Table 2) undersown with red clover and timothy differed in significantly higher number of Chenopodium album (46.6 %). The number of
Elytrigia repens stems was almost the same, but quackgrass accounted for 26.8 % of all weeds. The growth dynamics of this grass in spring barley under sown with perennial grasses was very similar to that in barley. During the growing season there were fewer Elytrigia repens stems in May by 27.7 %, in June by 19.5 %, in July by 23.7 %, compared with the number in spring before soil tillage (in April). The number of this grass increased by harvesting, but there were no significant differences (Figure 1, d).

The variation of Elytrigia repens rhizomes was similar to that in barley but weaker. The length of rhizomes in July declined by 68.3 % and mass by 66.3 % compared with those in spring. The differences were significant. Until harvesting the number of quackgrass rhizomes increased, their length per hectare reached 131 km and mass 230 kg, and this was by 1.7 times higher than in July but by 1.9 and 1.6 times lower than in May. Significant differences were not determined.

In perennial grasses of the first year (Figure 1, e), until the first cut the number of Elytrigia repens stems was by 14.6-18.0 % lower than in April. Later, when after harvesting the suppressive power of perennial grasses declined, in the second half of the growing season the amount of this grass aboveground part started to increase. At the end of September, compared with the number of stems in April, it was by 36.2 % higher. However there were no significant differences between the changes in the aboveground part of quackgrass.

Unlike in the crops of other agricultural plants (Figure 1, f), in perennial grasses of the first year the number of Elytrigia repens rhizomes consistently increased during the whole growing season. In July rhizomes were by 1.5, in September by 2.4 times longer than in spring, their mass was by accordingly 1.6 and 2.9 times higher. The differences were significant. The length of rhizomes per hectare increased from 117 km in spring to 286 km in September, their mass increased from 225 kg to 650 kg, respectively.

When Elytrigia repens is growing in a competing crop, the development of its rhizomes slows down. Different species of agricultural plants show different shading abilities. There are opinions, that the biggest shading ability has winter rye (PERMIN 1982). Spring barley is the best competitor of weeds. Potatoes are weak competitors. It was found that quackgrass spreads mostly in small crops. There are particularly favorable conditions for the development of this grass rhizome in a sparse spring barley.

According to the data of investigations, the number of quackgrass shoots in various agricultural crops decreased only after soil tillage in the middle of vegetation period. If soil tillage was applied later the density of quackgrass reached and even exceeded the initial amount in early spring. In uncultivated soil the increasing of this grass stems was observed during all periods of vegetation and its amount increased on average even 6.6 times as compared to the initial amount in early spring.

**Literature**


