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ZIEMAS RIPŠA (*Brassica rapa* L. *var oleifera subvar. Biennis*) PERSPEKTĪVAS BIODEGVIELAS RAŽOŠANAI IGAUNIJĀ

Narits L., Annamaa K.

Biodegvielu izmantošana ir iespējama alternatīva fosilajām šķidrajām degvielām. Eiropā biodīzeļa ražošanai visvairāk izmantotā izejviela ir rapšu eļļa. Igaunijas augšanas apstākļos šim mērķim vispiemērotākais ir ziemas ripsis (WTR). Tam ir labāka rezistence pret kaitēkļiem un augu slimībām nekā vasaras rapsim. Tādējādi, samazinātas pesticīdu un herbicīdu lietošanas rezultātā WTR kultivēšana ir lēta un videi draudzīga.
Biodīzeļa ražošanai visnozīmīgākais rādītājs ir WTR eļļas raža uz hektāru. Igaunijas zemnieki atzinuši WTR kā eļļas kultūru ar augstu ražu un ļoti labu kvalitāti.
Jēltauku saturs, sēklu raža un jēltauku raža divām pamatšķirnēm un septiņām perspektīvām šķirnēm tika novērtēta divu-gadu izmēģinājumā Jõgeva laukaugu selekcijas institūtā. Rezultātā, visdaudzsološākā šķirne biodīzeļa ražošanai bija JSv 01-13051: sēklu raža 2004. gadā – 3,179*** kg ha^{-1} un 2006. gadā – 3,756*** kg ha^{-1}; jēltauku saturs 2004. gadā – 449 g kg^{-1} un 2006. gadā – 446 g kg^{-1}; jēltauku raža 2004. gadā – 1,427*** kg ha^{-1} un 2006. gadā – 1,675*** kg ha^{-1}.

SIMPLIFICATION OF WINTER RYE (*SECALE CEREALE* L.) GROWING TECHNOLOGY

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Abstract
The paper presents the data on winter rye cultivation technology studies conducted during the period 1994-2006. The field trials carried out on a *Haplic Luvisol* were designed to estimate the effects of soil preparation, seed rate and nitrogen fertilization on winter rye grain yield and on the

number and weight of weeds. It was determined that the number and mass of weeds when winter rye was treated with a higher rate of nitrogen and reduced soil tillage system, which do not include ploughing.
With increasing the sowing rate of winter rye from 2.7 million seed ha^{-1} to 5.7 million seed ha^{-1} the weed dry mass decreased from 27.7 g m^{-2} to 19.8 g m^{-2} in the disk – cultivated ploughed soil and from 36.5 g m^{-2} to 23.6 g m^{-2} in the ploughed soil. Nitrogen fertilization had a greater effect on the yield than the seed rate. Having used nitrogen, winter rye yield was by 70.4% higher in the ploughed soil and by 66.6% higher in the disked soil compared with the yield of rye crops that unfertilised.

Key words: winter rye, soil cultivation, nitrogen fertilisation, seed quantity, yield

Introduction

Of all cereal species grown on light soils winter rye is the most important and most-widely grown crop. Its roots are capable of penetrating into deeper soil layers and can utilise nutrients more efficiently compared with other winter or spring cereals. Furthermore, winter rye is very good at utilising the moisture accumulated during winter, is less affected by drought and is tolerant of acid soils (Lazauskas, 1999). Of all cereal crops grown at the Lithuanian Institute of Agriculture's Vokė Branch during the 1997-2000 period winter rye was found to be best at suppressing weeds. The number of weeds in the winter rye crop was on average 87 per m^2 and the air-dry weight amounted to 19-24.2 g. Winter rye is currently grown and in the future will be grown mostly in Lithuania's south eastern subzone and Šilutė district, where the area sown with winter cereals accounts for about 45-50% of the total area under cereals (Nedzinskas, 2001).
With the current increase in the prices of fuel, lubricants, fertilisers and other agricultural inputs, simpler and cheaper soil tillage practices have become increasingly popular and attempts are being made to abandon the most difficult and costly technological process inversion of the whole ploughlayer. Conventional deep ploughing is being replaced by a shallower ploughing or loosening without inversion of the ploughlayer, and by sowing the seed into completely untilled or only in surface-loosened soil; however, in combination with better fertilisation these practices can result in a high yield (Budzynski *et al*., 2003). Other authors indicate that deeper ploughing forms a deeper ploughlayer, which secures a higher grain yield compared with shallow ploughing (Kouwenhoven *et al*., 2002; Chmielewski, Kohn, 2000; Kessavalou, Walters, 1999). It was found that in shallowly ploughed sandy loam soil cereal yield was by 10-13% lower and in the direct-drilled soil by as much as 16-17 % lower compared with that in conventionally deeply ploughed soil (Kadžienė et al., 2006). Research conducted in various countries confirm the fact that when there is no weed competition, reduced soil tillage does not decrease the yield of agricultural crops and makes the soil physical properties even more favourable for crops (Miedaner *et al*., 2003; Kahnt, 1995). Experimental evidence obtained at the Lithuanian University of Agriculture's Experimental Station on neutral reaction soil with a medium humus status suggests that with no inversion of the whole arable layer and with ploughing or loosening at the 12-14 cm depth, weed seeds tend to concentrate in the upper soil layer. In the second crop rotation small-seeded weed species became highly prevalent (Pranaitis, 2002). The best weed control on couch-grass infested sandy loam soil was achieved by stubble cultivation after pat harvesting and deep or moderately deep ploughing before sowing: there were 3-4 times fewer couch-grass stems in the rye crop compared with that in the soil without stubble cultivation but with only deep, moderately deep or shallow ploughing. In the soil with a low couch-grass incidence rye grain yield was very similar both in the treatments where the stubble was broken and the soil was deeply ploughed and in the treatments with stubble breaking but no ploughing and in the treatments with only shallow ploughing (Pranaitis, 2002).
The objective of the present study was to identify and compare the effects of conventional and reduced soil tillage on winter rye as affected by different seed rates, moderate (N_{45}) and increased (N_{90}) nitrogen fertiliser rates

Materials and Methods

The experiments were conducted at the Lithuanian Institute of Agriculture's Vokė Branch during the period 1994-2006. The soil where winter rye was grown is characterised as sandy loam haplic

luvisol (LVh) according to FAO classification, with a humus content of 1.85-2.06%, total nitrogen 0.127%, available phosphorus 177-193 mg kg^{-1} and potassium 198-230 mg kg^{-1} soil, and pH_{KCl} 5.7-5.9. Oats were a pre-crop to rye. After oat harvesting (on August 8-13) the soil for rye was deeply ploughed (at the 22-24 cm depth) or only disked at the 8-10 cm depth.

The experiments were done observing the following design:

(i) Soil tillage (A factor): 1) soil for rye was ploughed and 2) soil for rye was not ploughed but disked;

(ii) Nitrogen fertilisation (B factor): 1) no nitrogen fertilisation, 2) N_{45} fertilisation and 3) N_{90} fertilisation;

(iii) Winter rye seed rate (C factor): 1) 2.7 million viable seed (90 kg ha^{-1}), 2) 4.2 million viable seed (140kg ha^{-1}) and 3) 5.7 million viable seed (190 kg ha^{-1}).

Prior to rye sowing (on September 2-4) the whole experimental field was applied with phosphorus and potassium fertilisers $P_{60}K_{60}$ and was cultivated at a 5-7 cm depth. In the first ten-day period of September winter rye was sown by the seed drill 'Saxonia'. In spring, after resumption of rye vegetative growth the respective treatments were fertilised with nitrogen. The number of rye seedlings was determined upon the complete emergence and the number of plants was estimated upon resumption of vegetative growth after the winter. The number of weeds, their species composition and airdry mass were identified in the rye crop at the beginning of July. The above-mentioned parameters were estimated in each treatment by counting and/or taking samples from two 0.25 m^2 plots. Rye was harvested by a combine harvester 'Sampo'. While thrashing, 1 kg samples were taken for estimating grain moisture, purity and 1000 kernel weight. Rye grain data were adjusted to 15% moisture.

Initial plot area was 75 m^{-2}. The harvested plot area 47 m^{-2}. Experimental treatments were replicated 4 times.

Statistical data analysis

The results were analyzed statistically for the randomized split-plot design and the Tukey test was used to verify the significance of differences at $\alpha = 0.05$. All data were subjected to ANOVA.

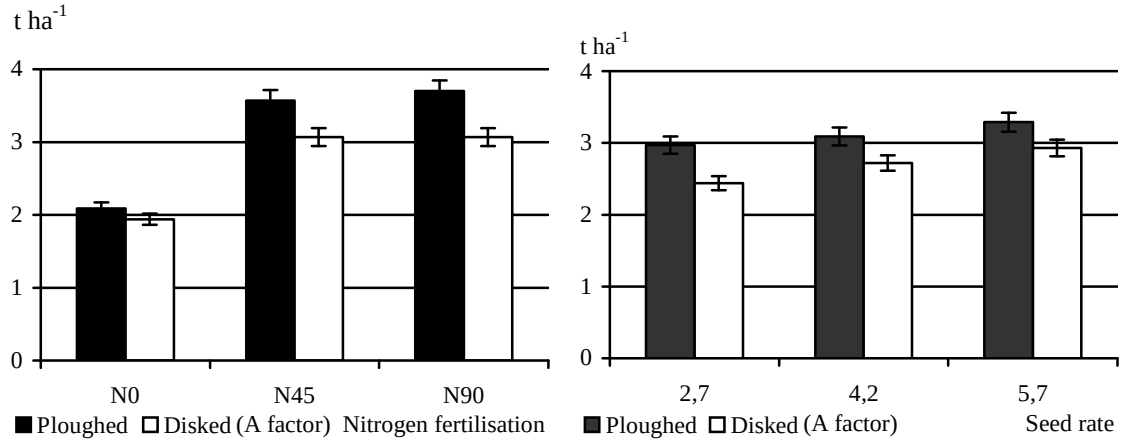
Results and Discussion

Autumn soil tillage practically had no effect on rye emergence, the number of plants increased in proportion to the seed rate sown both in the ploughed and disked treatments. Rye demonstrated the best winter survival when the soil had been ploughed and fertilised with phosphorus and potassium before sowing. The averaged data suggest that 80-83% of the autumn-emerged plants survived the winter. When the soil disked unploughed and unfertilised, the winter survival of rye plants was 6.0-7.5% lower.

Rye winter survival was also affected by the seed rate. The best winter survival (86-91%) was demonstrated by the rye that had been sown at the lowest sowing rate of 2.7 million seed ha^{-1}. Increasing the seed rate to 5.7 million ha^{-1} in ploughed and $P_{60}K_{60}$ –applied soil, 65-73% of autumn-emerged plants survived the winter, and disked unploughed and fertilised with potassium and phosphorus the plants that survived the winter amounted to 62-68%.

Rye grain yield

Agricultural practices such as soil tillage and nitrogen fertilisation as well as seed rate also had some effect on the rye grain yield. The averaged data indicated that the grain yield amounted to 3.11 t ha^{-1} in ploughed soil and was by 13.2% lower in unploughed but disked soil (Fig. 1).



LSD_{05}A – 0.19, LSD_{05}B – 0.14, LSD_{05}C – 0.07, LSD_{05} AB – 0.21, LSD_{05}AC – 0.16 and LSD_{05}ABC – 0.28)

Figure 1. The effect of nitrogen fertiliser (B factor) and seed rate (C factor) on winter rye yield (Traku Voke, averaged data from 1994-2006;

Nitrogen fertilisation had the greatest effect on winter rye grain yield. In the ploughed soil not applied with nitrogen the rye grain yield was low 2.09 t ha^{-1}, in the disked soil the grain yield amounted to 1.94 t ha^{-1}. Fertilisation of rye with N_{45} yield in ploughed soil was 70.4% higher and in the disked soil by 66.6% higher compared with the grain yield of rye that wasleft unfertilised. When fertilised with N_{90} rye was slightly lodged in separate years and the yield increased only inappreciably compared with that from the treatment fertilised with N_{45} rate.

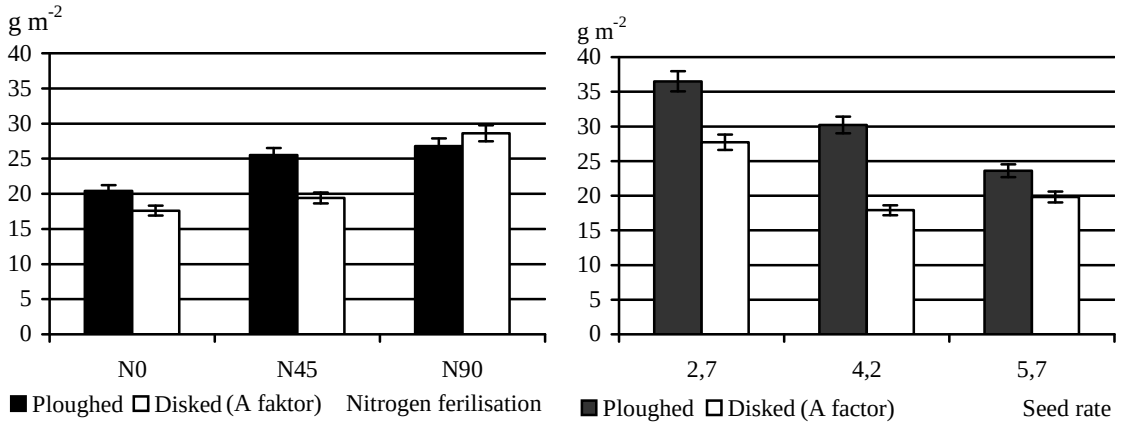
Our tests suggest that the optimal seed rate on sandy loam soil is 5.7 million viable seed ha^{-1} or 190 kg ha^{-1}. Averaged data from long-term trials show that sowing 2.7 million seeds ha^{-1} the grain yield of rye amounted to 2.70 t ha^{-1}, the seed rate of 4.2 million ha^{-1} generated a grain yield of 2.91 t ha^{-1}, and having increased the seed rate to 5.7 million ha^{-1}, the grain yield increased to 3.11 t ha^{-1}.

Weed incidence in the rye crop

Increasing the seed rate from 2.7 million viable seed ha^{-1} to 5.7 million ha^{-1} the number of weeds inappreciably declined, however, their air-dry weight consistently declined with an increase in seed rate (Fig. 2). Sowing 2.7 million seeds ha^{-1} in the ploughed soil the air-dry mass of weeds per 1 m^{-2} amounted to 36.5 g, and having sown 5.7 million seed ha^{-1} the air-dry mass of weeds declined to 23.6g and the weeds were small because of the dense rye crop which competed well with weeds.

When the soil for rye had not been ploughed but had been disked, the weed weight was markedly lower, but no consistent reduction with increasing seed rate was observed. As was mentioned, the weed incidence in the rye crop was very diverse, and especially in the unploughed soil, which determined their inconsistent reduction.

With nitrogen application to rye both in the ploughed and unploughed but disked soil weed mass consistently increased. When the soil for rye was ploughed and was not applied with nitrogen weed mass per 1 m^{-2} amounted to 20.4 g, with the application of N_{45} weed mass increased to 25.5 g m^{-2}, and with the increase of the nitrogen rate to N_{90}, weed mass increased to 26.8 g m^{-2}. A similar increase in the weed weight in the rye crop in relation to the nitrogen fertiliser rate occurred in the rye stand where the soil had not been ploughed but disked. In the plots where the soil had not been ploughed but had been disked and the rye had not been fertilised with nitrogen, weed mass was very low 17.6 g per 1 m^{-2}. Having applied N_{90} the weed mass increased to 28.6 g.



LSD_{05}A -1.66, LSD_{05}B – 2.04, LSD_{05}C – 2.28, LSD_{05} AB -3.01, LSD_{05}AC – 4.16 and LSD_{05}ABC – 4.65)

Figure 2. The effect of nitrogen fertilisation (B factor) and seed rate (C factor) on the number of weeds in winter rye and on weed mass (Traku Voke, averaged data from 1994-2006;

When increasing the seed rate of rye from 2.7 million ha^{-1} to 5.7 million viable seed ha^{-1} in the ploughed soil the number of annual and perennial weeds consistently declined. When the soil had not been ploughed but had been disked, the increasing of the rye seed rate practically did not have any effect on the incidence of perennial weeds, and there was a similar number of weeds was both of the treatments sown with the lowest and the highest seed rates.

Conclusions

When the soil for winter wheat after the oat pre-crop had been ploughed at the 22-24 cm depth or only had been disked at the 8-10 cm depth the same number of plants emerged, which increased in proportion to the seed rate sown. Rye exhibited the best winter survival (80-83% of autumn-emerged plants) when the soil had been ploughed and the lowest seed rate of 2.7 million ha^{-1} was sown.

In ploughed or disked soil the total number of weeds was similar, however in disked soil the number of perennial weeds was higher by 23.7%. By increasing the sowing rate of rye from 2.7 million seed ha^{-1} to 5.7 million seed ha^{-1} the weed mass consistently increased.

Rye yielded better in ploughed soil where the grain yield was by 13.2% higher than in the unploughed but disked soil. Nitrogen fertilisers had the greatest effect on rye grain yield. Having fertilised rye with N_{45} in the ploughed soil the grain yield was 70.4% higher and in the disked soil 66.6% higher compared with the grain yield from fields that were not fertilized. When increasing the sowing rate from 2.7 million seed ha^{-1} to 5.7 million seed ha^{-1} the rye grain yield increased on average by 15.5%.

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ZIEMAS RUDZU (*SECALE CEREALE* L.) AUDZĒŠANAS TEHNOLOĢIJAS VIENKĀRŠOŠANA

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Rakstā ietverti dati par ziemas rudzu audzēšanas tehnoloģijas pētījumiem, veiktiem laika periodā no 1994.-2006. gadam. Lauka izmēģinājumi veikti smilšmāla augsnē (*Haplic Luvisol*) ar mērķi novērtēt augsnes sagatavošanas, izsējas normas un slāpekļa mēslojuma ietekmes uz ziemas rudzu graudu ražu un uz nezāļu daudzumu un svaru. Tika konstatēts, ka ziemas rudzos lielāks nezāļu skaits un masa ir pie minimālās augsnes apstrādes (bez aršanas) un pie lielākas slāpekļa normas.
Palielinot ziemas rudzu izsējas normu no 2.7 miljoni sēklu ha^{-1} uz 5.7 miljoni sēklu ha^{-1}, nezāļu sausā masa samazinājās no 27.7 g m^{-2} līdz 19.8 g m^{-2} augsnē bez aršanas un no 36.5 g m^{-2} līdz 23.6 g m^{-2} uzartā augsnē. Slāpekļa mēslojumam bija lielāka ietekme uz ražu nekā izsējas normai. Lietojot slāpekli, ziemas rudzu raža bija par 70.4 % augstāka artajā augsnē un par 66.6 % augstāka diskotā augsnē (bez aršanas), salīdzinot ar nemēslotu rudzu graudu ražu.

RESULTS OF WEED MONITORING IN THE LONG-TERM EXPERIMENTAL FIELD IN PRIEKULI

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Abstract
The negative role of weeds in agriculture will be emphasized. They can considerably reduce an amount and the quality of the yield. To make out the influence of different agroecological factors on the weed infestation of arable land, a long-term field experiment was commenced in the Priekuli Plant Breeding Institute (57°19'N, 25°20'E). The investigation was established on a soddy podzolic light loam soil. Data on species and the amount of weeds was collected from the fields of five different fertilization systems. The aim of the research is to show the weed dynamic data, obtained from a 17-year period, in regards to the fertilization system and the management practice in the classical crop rotation: barley – clover/grass – rye – potato.
Results show that the least amounts of the weeds were in unfertilized fields. More weeds were in plots, where stable manure was used as fertilization.

Key words: weeds, long-term experiments, fertilization, crop rotation

Introduction
The negative role of weeds in agriculture is well known. Weeds compete with crops for nutrients. An increase in weed invasion, results in a more intensive consumption for soil nutrients by the agricultural community. Intensive nutrient consumption by weeds leads to an increasing drop in crop yield (Lauringson *et al*., 2000).
The main purpose of crop rotation is to maintain the fertility of the soil, to increase the amount and the quality of the yield. The crop is influenced by soil properties, weeds, the spread of diseases and pests. For this reasons it is not good to grow a crop that was harmed by the same diseases and pests