

Influence of sowing date and rate on winter oilseed rape (*Brassica napus* ssp. *oleifera*) straw yield and seed/straw ratio

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Abstract

Winter oilseed rape growing mainly is practised for seed production and straw is chopped and incorporated into soil in farms of Latvia. Straw pellets for burning, biogas and ethanol could be produced from oilseed rape straw. Data of winter oilseed rape straw yield have not been well documented in Latvia. In order to investigate two agronomical factors (sowing date and sowing rate) influence on straw yield and seed/straw ratio of two type winter oilseed rape varieties field trials were carried out at Research and Study farm 'Vecauce' from year 2007/2008 to 2009/2010. Dry matter content in straw was within 88% to 91% on average in both years. Winter oilseed rape straw yield (g per m²) was within 1405 g to 350 g depending on year and sowing date. Sowing date significantly ($p < 0.05$) affected straw yield for 'Californium' in both years, but for 'Excalibur' in year 2008. Seed/straw ratio was similar in trial years 2008 and 2009 (0.45-0.69) for both used varieties.

Key words: winter oilseed rape, sowing date, sowing rate, seed yield, straw yield, seed/straw ratio.

Introduction

Bio energy production is still developing in the world and particularly in Latvia. Usage of raw materials such as straw (wheat, oat and/or oilseed rape straw) and other co-products for pellets are in developing process. Oilseed rape straw is lignocellulose containing agricultural residue that could be used for energy production. Thus oilseed rape seed yield is supplemented with raw materials which can be processed in energy – heat or bioethanol. Lignocellulose is the most abundant organic material on the earth and therefore is a promising raw material for bio energy production (Ofari and Becker, 2008). Both biogas and ethanol can be produced from the lignocelluloses' raw materials. We are in lack of data and deeper investigations on yield and usage of different origin straw, especially oilseed rape straw. Data about yield structure with accent on straw yield in Latvia are not found. Information of seed/straw ratio makes more easily to establish straw yield when seed is harvested. Values of winter oilseed rape yield structure elements (including straw yield) have not been well documented in Latvia before, some research was started in 2007 (Balodis and Gaile, 2007). The aim of our research described in current paper was to investigate influence of two agronomical factors (sowing date and sowing rate) on straw yield and seed/straw ratio of two type winter oilseed rape varieties.

Materials and methods

Two factor field trials using two type winter rape varieties were carried out at Research and Study farm 'Vecauce' (latitude: N 56° 28', longitude: E 22° 53') of Latvia University of Agriculture. Three years field trials were carried out starting with 2007/2008 up to 2009/2010.

Factor A -sowing date:

1st – called 1st August; 2nd – called 10th August; 3rd – called 20th August; 4th – called 1st September; 5th – called 10th September.

Factor B: sowing rate (120, 100, 80, 60 germinate able seeds per 1 m² for line variety 'Californium'; 80, 60, 40, 20 germinate able seeds per 1 m² for hybrid variety 'Excalibur'), in season 2009/2010 sowing rates were equated - 120, 100, 80, 60, 40, 20 germinate able seeds per 1 m² for both cultivars.

Soil at the trials' site was strongly altered by cultivation in 2007/2008 and soil-gleyic in 2008/2009 and 2009/2010 loam with pH KCl = 7.2 to 7.4; content of available for plants K was 169 to 194 mg kg⁻¹ and P - 100 to 115 mg kg⁻¹; humus content - 32 to 38 g kg⁻¹. Pre-crop was cereal mixture for silage in all years. Traditional soil tillage with mould-board ploughing and rototilling before sowing was used. The crop was fertilized with a complex mineral fertilizer at the rate of 12 to 28 kg N ha⁻¹, 18 to 30 kg P ha⁻¹, and 79 to 103 kg K ha⁻¹ before sowing depending on a year. To exclude possible impact of *Sclerotinia* stem rot (*Sclerotinia sclerotiorum*) incidence, fungicide Cantus d.g. (boscalid, 500 g kg⁻¹) 0.5 kg ha⁻¹ was used during full flowering (GS 65). Seed and straw yield was detected at GS 87 from sample sheets, and seed/straw ratio was calculated.

Data was analyzed using ANOVA; proportion of influence \square^{\square} (%) for mentioned factors was calculated.

Meteorological conditions were different according to year. Winters 2007/2008 and 2008/2009 was untypically mild, but winter 2009/2010 was hard for oilseed rape plant wintering because of thick and long lasting snow cover during winter, also air temperature was low. Winter 2009/2010 was crucial for plant surviving in late sown plots, but pools during snow melting killed even well matured plants.

Results

Results showed that winter oilseed rape straw yield (g per m²) was different depending on year (growing conditions, including meteorological conditions) and higher straw yield was observed for hybrid cultivar 'Excalibur' in all trial years. Average dry matter content in straw was within 88% in 2008 to 91% in 2010 what are standard for straw quality and agrees with Adapa et al, 2009. Data gained in year 2010 was not suitable for statistical analyses because of bad wintering (inappropriate plant densities) for many plots, only plots sown in 10th and 20th August for 'Excalibur' were appropriate for data analyses. Higher average straw yields were observed in year 2008 for both cultivars ('Californium' – 919.5 g per m² in 2008 and 652.0 g per m² in 2009; 'Excalibur' – 1098.0 g per m² in 2008 and 721.7 g per m² in 2009). Average straw yield was not significantly different in first three sowing dates in 2008. Different straw yields were noted for rape sown at different sowing dates in 2009 for cultivar 'Californium'; sowing time did not influence straw yield of cultivar 'Excalibur' (Table 1). Straw yield was significantly ($p < 0.05$) affected by sowing date (factor A) for 'Californium' in both years, but for 'Excalibur' – in 2008. Highest straw yield was obtained in second sowing date (10th of August) in year 2009, but in fourth sowing date (1st of September) in 2008 for both varieties. Straw yield was within 494 (10th August) to 523 g per m² (20th August) in year 2010 for 'Excalibur' and sowing date had no significant ($p > 0.05$) influence on result.

Table 1

Average straw yield (g per m²) depending on sowing date in year 2009 and 2010

Sowing date	Californium		Excalibur	
	2008	2009	2008	2009
1 st August	1223	568	1335	693
10 th August	1255	672	1405	752
20 th August	1154	622	1313	716
1 st September	616	809	763	779
10 th September	350	588	675	669
RS _{0.05}	136.1	87.5	150.8	122.1

Statistically significant influence of sowing date was higher in year 2008: $\square = 79\%$ for 'Californium' and $\square\square = 69\%$ for 'Excalibur', but lower in year 2009: $\square = 32\%$ for 'Californium'. Results

showed that mainly higher straw yields are possible to gain from oilseed rape sown up to 20th August which is recommend as last sowing date for high yields in Latvia's conditions.

Sowing rate (factor B) showed significant ($p=0.002$) impact on straw yield only in year 2009 for 'Excalibur'. It gives confidence that yield compensation mechanism works and also in lower plant densities (lower sowing rate) it is possible to obtain good straw yield.

Seed/straw ratio was within 0.54 – 0.69 for 'Californium', 0.45 – 0.66 for 'Excalibur' in year 2008 and 0.64 – 0.69 for 'Californium', 0.58 – 0.69 for 'Excalibur' in year 2009. Seed/straw ratio was lower in plots sown in 10th and 20th August for 'Excalibur' (0.42 and 0.49 respectively). Significant influence of sowing date on seed/straw ratio was not noted in year 2010 because of severe plant density changes during wintering. Values of seed/straw ratio were higher than data gained in other research about seed/straw ratio two decades ago (Seed/straw ratio within 0.30 to 0.52) in Germany (Huehn, 1993). It can be explained with absolutely different type of varieties which are used nowadays. Our results were significantly ($p<0.05$) affected by sowing date (factor A) for both varieties only in 2008 (Figure 1) and for 'Excalibur' – in 2009.

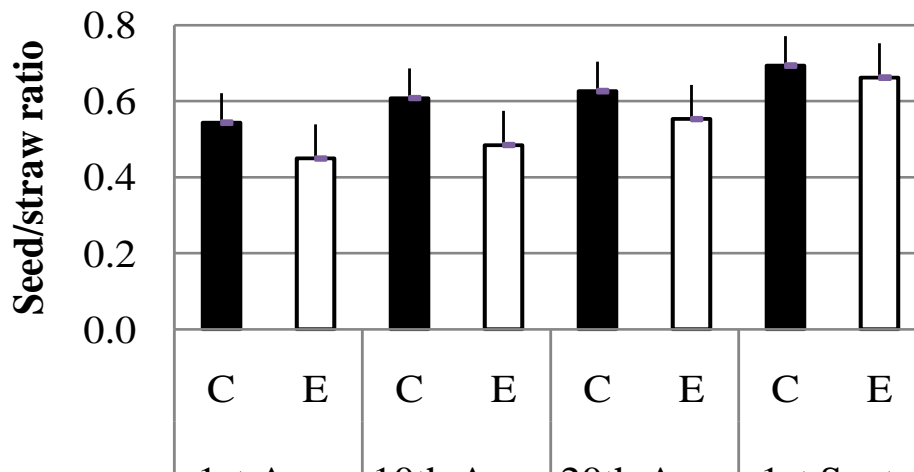


Figure 1. Sowing date influence on average seed/straw ratio of cultivars 'Californium' and 'Excalibur' year 2008 (■ - 'Californium' (C); □ - 'Excalibur'(E)).

Tendency was observed that a little higher seed/straw ratio was in later sowing dates in year 2008 (see Figure 1), but such tendency was not confirmed in 2009. On the one hand it is evident, that seed/straw ratio could be influenced by choosing sowing date but on the other hand – production of high seed yields are ruling for sowing date choice. Sowing rate did not affect significantly ($p>0.05$) seed/straw ratio in both years. More results are necessary to clarify of above-mentioned topic. Trial is continued in 2010/2011.

Conclusions

1. Winter oilseed rape straw yield was affected by growing conditions of a year as well as by used rape variety (919.5 g m^{-2} – 'Californium' (line) and 1098.0 g m^{-2} – 'Excalibur' F1 in 2008, and 652.0 – 'Californium' and 721.7 g m^{-2} – 'Excalibur' in 2009). Straw yield was also affected by sowing date, and decrease of it was observed in later sowing dates (1st and 10th September).
2. Seed/straw ratio data showed that straw yield is the greater component from the total winter rape biomass yield. Seed/straw ratio was similar in trial years 2008 and 2009 (0.45-0.69) for both used varieties; different was year 2010 when lower seed/straw ratio values were observed.
3. Further research is needed about different factors influencing straw yield and seed/straw ratio for better interpretation of research data in Latvian conditions.

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Acknowledgement

Research is founded by ESF project:

Contract No. 2009/0225/1DP/1.1.1.2.0/09/APIA/VIAA/129.