DIVIDED HARVESTING METHOD. THE IMPACT OF AGRICULTURAL TECHNOLOGY ON THE YIELD OF ENERGY HAY

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Abstract
In Estonia, the most promising perennial grass used as raw material for production of heat energy is reed canarygrass (*Phalaris arundinacea* L.). Nordic countries (Finland, Sweden) implement a technology including single harvest of the above-ground biomass from frozen soil early in spring. This technology cannot be used in Estonia as the ground does not freeze to the extent of bearing harvesting machines every year. Harvesting in spring is virtually impossible as herbage lodges excessively under the snow weight. A divided harvesting method of reed canarygrass was tested in field trials in 2010–2013 at the Estonian Crop Research Institute. Herbages were cut in July at the height of 60–65 cm, mass was dried as hay, stubble hay was left to grow and was harvested next spring before the growth started but soil had become dry. The effect of seeding rate, row spacing and nitrogen fertilizer on the dry matter yield of reed canarygrass was investigated. The amount of produced heat by trial variants was calculated. The variant with narrow spacing (15 cm), seeding rate of 8 kg ha^{-1} and usage of fertilizer N70 in the beginning of growth and N70 kg ha^{-1} after the first cut was giving the best results. Two cuts of this variant yielded on average 8.12 t ha^{-1} per year, of which the stubble hay, harvested in spring and with better combustion properties, made 64%. Energetic value of the yield was 138 GJ ha^{-1} per year.
Key words: divided harvesting method of reed canarygrass, dry matter yield, quality of yield, energetic value.

Introduction

According to the energy sustainability index of the World Energy Council (WEC), Estonia was ranked 68th among 129 member states in 2013 (World Energy Council, 2013). To direct the future of the energy industry, the Government of Estonia has initiated the drafting of the National Development Plan of the Energy Sector until 2030 (https://valitsus.ee/sites/default/files/content-editors/arengukavad/enmak_koostamise_ettepanek.pdf). The planned solutions must consider obligations resulting from the EU policy framework. The aim of the EU is to increase the percentage of renewable energy to at least 20% of total consumption by 2020 and to 27% by 2030. The increase in the share of renewable energy is necessary due to the decreased supply of fossil fuels, but also in order to enhance energy security and reduce the environmental impact of the energy industry.

There are regions in Europe that have set an objective to be entirely free of fossil fuels. This movement is most advanced in Germany, where by 2014 there were 6 regions completely independent from fossil fuels and 3 regions quite close to this level. Altogether 146 regions have set the same target in the long run, which makes more than one third of Germany's territory and includes 25 million inhabitants. Sweden and Austria have also started with the development of regions free from fossil fuels (http://www.100-ee.de). Estonia too has good preconditions for such a development, considering the availability of renewable energy resources like forests, wind and sun. Moreover, there are currently 283,000 ha, i.e. 25%, of arable land out of use in Estonia. This land could be used for energy crop production. Setting such a target has several benefits for Estonia.

1. With decreasing EU aid, maintenance cutting of arable land out of agricultural production will cease. The production of plant-based biofuel would help to prevent the fields from turning into brush and preserve them for the production of other cops in the future, when there will probably be an increased solvent demand for plant products due to the growth of world population.
2. The expansion of plant-based biofuel production will create new jobs in the countryside and reduce the migration of labour force to other countries, which has been the most topical problem in Estonia for the past decades.

In Estonia and other Baltic countries, trials have been conducted with energy field crops like tall fescue (*Festuca arundinacea* Schreb.), smooth bromegrass (*Bromus inermis* Leyss.), cock's-foot (*Dactylis glomerata* L.), reed canarygrass (*Phalaris arundinacea* L.), festulolium (×*Festulolium* Asch. et Graebn.), fodder galega (*Galega orientalis* Lam.), large-leaved lupine (*Lupinus polyphyllus* Lind.) and hemp (*Cannabis sativa* L.) (Kryževiciene, 2006, Lillak et al., 2007; Kryževiciene et al., 2008; Lauk et al., 2009; Raave et al., 2009; Rancane et al., 2014). Reed canarygrass has been most promising of these grasses in this region as well as in Finland and Sweden; this is mostly due to its high and stable dry matter yield over the years (Larsson et al., 2006; Pahkala, 2007). In Finland, large-scale growing of reed canarygrass for heat production was started in 1990 (Pahkala et al., 2008). In Estonia, this species has thus far been investigated from the point of view of fodder production. In trials carried out on peat and alluvial soil, reed canarygrass has yielded 8–12 t of dry matter per ha in a three-cut regime (Annuk, 1992**)**.

Growing of reed canarygrass for energy production has not been studied much in Estonia. Preliminary attempts to use the technology implemented in Finland (one-cut harvest from soil frost in early spring) have essentially failed. This is due to the following reasons: 1) in Estonia, the ground does not freeze to the extent to bear harvesting machines every year; 2) during winter the plants with a height of 1.5–2.0 m lodge so much that harvesting them has been impossible (Raave et al., 2009). Similar results have been obtained in the USA (Tahir et al., 2011). Reed canarygrass is used in Estonia for heating currently only to a small extent. The implemented technology involves making one cut in July, drying the mass in the field to make hay and using it later for heating. This method has several shortcomings:

1) The combustion properties of reed canarygrass harvested in summer are not very good.
2) A lot of plant nutrients (in particular K) are removed from the field with the yield, which must be compensated with fertilization.
3) Reed canarygrass does not tolerate low cutting during the vegetation period. Reserve nutrients in the lower parts of the straw are of vital importance for its further growth, as it has only a few lower leaves near roots. Thus, a considerable part of the above-ground biomass (high stubble) remains unused as yield.
4) In the second half of summer, reed canarygrass grows an aftermath, which cannot be harvested for fuel; in autumn the humidity content of biomass is too high, in spring the aftermath is so lodged that harvesting becomes virtually impossible.

The research that was carried out at the Estonian Crop Research Institute in 2008–2013 aimed at developing a method that would allow diminishing or removing the above shortcomings from the production of reed canarygrass for fuel. This can be achieved by using a divided (in two parts) harvesting method. In the second half of July, when there are most favourable weather conditions in Estonia for hay drying, reed canarygrass is cut at the height of 60–65 cm, stubble hay is left to grow until the beginning of the next year's vegetation period and is harvested from the soil frost, or if there is no frost, later after soils have dried enough to bear machinery. The advantages of this method are:

1) The above-ground biomass of reed canarygrass from the whole vegetation period can be used for fuel. In early spring, cutting can be made as low as the harvester and the surface flatness allow. Together with stubble hay, the aftermath from the second half of summer is also harvested and can be used.
2) Stubble hay lodges less (or does not lodge at all). The upright plants dry and the soil also dries faster, which enables to start the spring harvest earlier and have a prolonged harvest period.
3) The amounts of plant nutrients removed from the field with the yield decrease.
4) Two thirds of the harvested yield has better combustion properties, because its potassium and chlorine contents decrease considerably due to translocation of mineral substances during overwintering (Samson and Mehdi, 1998). While burning reed canarygrass that has stood in the field over winter and was harvested in spring, the melting temperature of ash is higher than in case of reed canarygrass harvested in summer or autumn (Burvall, 1997).

The experiments conducted in Jõgeva investigated the effect of seeding rate, row spacing and nitrogen fertilizer on the dry matter yield of reed canarygrass and on the quality of yield while using the divided harvesting method. The amount of energy produced with the yield of trial variants was calculated.

Materials and Methods

Field trials were established in May 2008 in a field that had been bare fallow in the previous year. The trials were situated on leached soil (K_o) the agrochemical parameters of which at the time of trial establishment were as follows: pH KCL 5.8, P 27, K 67, Ca 2150, Mg 159 mg kg^{-1} and C_{org} 24 g kg^{-1}. Prior to the establishment, mineral fertilizers at the rate of P 19, K 67 kg ha^{-1} were applied to the trial plot; the complex fertilizer Scalsa (micronutrient-enriched) was used. Phosphorus-potassium fertilizers later were not applied. Altogether three trials were established.

1. In the row spacing trial, the variants were 15, 30, 45 and 60 cm, the seeding rates respectively 8, 6, 5 and 4 kg ha^{-1}. The first variant was sown with seed drill Hege 80, the rest of the variants with seed drill Hege 90-1. The fertilizer rate was N 140 kg ha^{-1} both in the year of seeding and the following year, and it was applied in two equal doses.
2. In the seeding rate trial, the variants were 4, 6, 8 and 10 kg of 100% pure live seeds (PLS) per ha, narrow spacing (15 cm) was used for sowing with seed drill Hege 80. The fertilizer rate was N 140 kg ha^{-1} both in the year of seeding and the following year, and it was applied in two equal doses.
3. The nitrogen fertilizer trial was established with the seeding rate of 8 kg ha^{-1}, sown with narrow spacing with seed drill Hege 80. The variants of fertilizer rates were both in the year of establishment and the following year as follows: N 35 + N 35; N 35 + N 35 +N 35; N 70 + N 35 and N 70 + N 70 kg ha^{-1}.

In the trials, ammonium salpeter was used as nitrogen fertilizer. In the years of maintenance, stands were fertilized twice: the first time one week after the beginning of growth and the second time after the harvest of first growth (end of July). In a treatment with split nitrogen application in spring, the second top-dressing was scheduled to the onset of plants' culm elongation. Fertilizers were given with fertilizer spreader Hege 33. All trials were established and conducted in four replications in a randomised block design. In the year of seeding, the trial area was sprayed with the herbicide MCPA 750 for the control of broadleaf weeds, the application rate being 1.0 l ha^{-1}. At the time of spraying, the plants of reed canarygrass had 2–4 leaves. To debilitate the survived weeds, the trial area was cut once with the MF 70 motorobot at the height of 15 cm. In the variants sown with wide spacing, weeds were additionally controlled mechanically. The stand established in the year of seeding was cut and the mass was harvested at the end of the vegetation period at the height of 10 cm. In the first year of maintenance (2009), the seed yield was harvested from the trial plots, stubble hay was cut and harvested in the middle of October after the end of vegetation. The determination of biomass yields started in the third year. In the years 2010–2012 the first growth was cut in the second half of July at the stage of full maturity of seeds at the height of 60–65 cm, the mass was dried, gathered and weighed. Stubble hay was left to grow in the field and was harvested the following spring (2011–2013, respectively) before the start of the vegetation period. The yield was determined with Hege 212 harvester. Samples for the determination of moisture content and for laboratory analyses were taken both from the yield that had been dried in the field and from the one harvested in spring. The analyses of soil and plant material were performed in the accredited laboratory of the Estonian Agricultural Research Centre. The following analysis methods were used: for the determination of moisture content in biomass EVS_EN 14774-3:2009; for the determination of crude protein (CP) content according to Kjeldahl method procedure EÜ 152/2009 IIIC; for the determination of acid detergent fibre (ADF) ASN 3429; for the determination of neutral fibre ASN 3431; for the determination of ash content EVS-EN 14775:2010 and for the determination of potassium PMK-JJ-4c (ISP-OES). The analyses of stems and leaves were performed in the laboratory of the Estonian Crop Research Institute. The trials were carried out with the variety 'Pedja'. The energetic value of the biomass of reed canarygrass was calculated on the basis of data by Strasil et al., 2005.

The vegetation period of the seeding year (2008) was rather chilly and rich in precipitation (in June 157%, in August 219% of the long term average), i.e. very favourable for the germination and development of canarygrass. The temperatures and amount of precipitation of the following year were close to the long term average. The vegetation periods of 2010 and 2011 had higher temperatures than the long term average and were arid, 2012 was close to the average as to the temperature, but more rainy in June (162%) and August (146%). The winters during the period of experiments were rich in snow in Jõgeva. The measured snow depth was more than 30 cm, in the winter of 2010/2011 even exceeding 50 cm.

For statistical analysis of the trial results, the software AGROBASE 20™ was used. To determine the significance of differences between variants, LSD test was used.

Results and Discussion

Based on the trial results of three harvest years, it can be said that the row spacing affected the yields of both straw and stubble hay (Table 1). The variant with narrow spacing yielded significantly more stubble hay in three years than the variant seeded with 60 cm row space. The difference was major in the first two years of comparison, in the third year it became minor. By that time the space between rows had become almost overgrown. The yield of straw had bigger variations over the years than that of stubble hay. This is due to the fact that reed canarygrass develops a different number of generative shoots in different years. Due to the same reason, seed yield of this species also varies a lot. In our trial, straw yield was significantly higher in the variant that had been seeded with 30 cm row spacing. In total of three years, the lowest dry matter yield of 17.5 t ha^{-1}, was obtained in the variant that had been seeded with 60 cm row space; the highest dry matter yield of 20.99 t ha^{-1} was obtained in the variant seeded with 15 cm spacing. Considering the least significant difference, the differences in dry matter yields of three years of variants 15, 30 and 45 cm were not significant.

The tested seeding rates of 4, 6 and 8 kg ha^{-1} did not have a significant effect on dry matter yield harvested during three years (Table 1). In comparison with the variant with the seeding rate of 4 kg ha^{-1}, a significantly higher dry matter yield was obtained only with the variant that was seeded with 10 kg ha^{-1}. The effect of seeding rate in the trial results of dry matter yield was more evident in the first yield determinations, later the plant cover became evenly dense as a result of shooting and yield differences were not statistically significant.

According to literature, while establishing reed canarygrass fields for energy production, it is recommended to use a seeding rate of 11–16 kg ha^{-1} with the germination rate of 90% in Finland (Pahkala et al., 2005). Seed fields of reed canarygrass can be established with a reduced seeding rate (Bender et al., 2011). In our trials, which aimed at the growing of biomass for energy production, the advantage of the recommended seeding rate of 10 kg was evident,

Table 1

Yields of straw and delayed harvested stubble hay of reed canarygrass, DM t ha^{-1}

Variant	Straw	Stubble hay	Straw	Stubble hay	Straw	Stubble hay	Straw	Stubble hay	Stubble hay	DM**
	22.07.10	27.04.11	14.07.11	12.04.12	26.07.12	02.05.13	total	total	%	total
Row spacing										
15 cm	3.38	4.93	2.10	4.30	2.39	3.89	7.87	13.12	62.5	20.99
30 cm	3.86	3.76	1.94	3.13	2.83	3.82	8.63	10.70	55.4	19.33
45 cm	3.20	3.58	2.55	3.42	2.39	4.56	8.13	11.55	58.7	19.69
60 cm	3.07	3.20	2.23	3.17	2.05	3.78	7.35	10.15	58.0	17.50
$LSD_{0.05}$	0.32	0.44	0.55	0.71	0.28	0.3	0.49	0.93	0.7	2.73
Seeding rate										
4 kg ha^{-1}	3.46	5.02	2.66	4.48	2.21	3.46	8.33	12.96	60.9	21.29
6 kg ha^{-1}	3.88	4.79	2.42	3.95	2.79	3.85	9.10	12.59	58.1	21.69
8 kg ha^{-1}	3.46	5.33	2.68	4.38	2.45	3.89	8.60	13.60	61.3	22.20
10 kg ha^{-1}	3.58	6.01	2.85	4.51	2.35	3.78	8.79	14.30	61.9	23.09
$LSD_{0.05}$	0.49	0.35	0.82	0.57	0.78	0.45	0.38	0.93	1.1	1.69
Nitrogen fertilizer										
N35+N35	2.51	5.49	2.30	4.10	2.05	2.83	6.85	12.42	64.4	19.27
2×N35+N35*	3.11	5.55	2.54	3.74	2.35	2.97	7.99	12.26	6.05	20.25
N70 + N35	3.17	5.54	2.76	4.04	2.21	3.25	8.15	12.83	61.2	20.98
N70+ N70	3.58	7.81	2.96	4.16	2.28	3.57	8.82	15.54	63.8	24.36
$LSD_{0.05}$	0.34	0.79	1.36	0.49	0.27	0.33	0.41	1.18	1.06	1.19

* interval in spring 3 weeks ** dry matter

but the differences in yields caused by the reduced seeding rates were not large. When the soil is free from perennial weeds and seeding is not late, the field can be established also with 4–6 kg per hectare. In favourable moisture conditions the species has a good shooting ability, which ensures the required further densification of the stand. The use of a reduced seeding rate is justified in the case when in the year after establishment, reed canarygrass is harvested for seed, straw is dried for energy hay and stubble hay is left in the field until the following spring (Bender, 2014). The stand that has been seeded with a lower seeding rate forms more generative shoots, which is a prerequisite for high seed yield.

As expected, the rate of the nitrogen fertilizer had the greatest effect on dry matter yield. By applying nitrogen during the vegetation period in two equal doses with the total rate of N 70 kg ha^{-1}, the total dry matter yield of straw and stubble hay of reed canarygrass over the three-year period was 19.27 t ha^{-1}. With the double application rate of nitrogen (2 × 70 kg ha^{-1}), the dry matter yield of straw and stubble hay was 5.09 t ha^{-1} higher. The difference of the above variant was greatest in the first year of comparison, in the following two years the extra yield was less prominent. The divided application of nitrogen in spring (N 35 + N 35) in comparison with a single dose (N 70) did not give a significant extra yield; on the contrary, the yields remained even lower.

In Finland, where they have long-term experience with energy hay production, nitrogen is applied in the year of establishment with the rate of N 40–60 kg ha^{-1} before reed canarygrass is seeded and in the following years with the rate of N 60–90 kg ha^{-1}. Harvest for energy hay starts in the third year (just like in our trials), and the stand is utilized there for 10 years. In Finland, the average dry matter yield of energy hay that is harvested in spring is considered to be 3–8 t ha^{-1} per year (Pahkala, 2007). With the implementation of a two-cut harvest system, we have achieved the same yield level – 5.8–8.1 t of dry matter per hectare per year. In Finland these results have been obtained in production conditions; the harvest losses are considered to be 20–50% from the above-ground biomass. Our results were obtained in trial conditions in which the harvest losses were kept as low as possible. Based on our earlier trials, in Estonia it is not expedient to fertilize reed canarygrass in spring with more nitrogen than 70 kg ha^{-1}. In years rich in precipitation, the stand may lodge, resulting in great losses in dry matter yield and the divided harvesting method loses its advantage.

Different data can be found in literature regarding the energetic value of reed canarygrass's biomass used for heating fuel. The variations may be due to the time of harvesting and the fact that often it is not the energetic value of dry matter but rather that of biomass with different moisture content that is presented (Alakangas, 2012; Platace and Adamovics, 2014). In

Table 2

Energetic value of dry matter of reed canarygrass straw and stubble hay over a three-year period

Variant	Straw t ha^{-1}	Stubble hay t ha^{-1}	DM* total t ha^{-1}	Energetic value of straw, GJ ha^{-1}	Energetic value of stubble hay, GJ ha^{-1}	Total GJ ha^{-1}
Row spacing						
15 cm	7.87	13.12	20.99	133.1	225.5	358.6
30 cm	8.63	10.70	19.33	145.9	183.9	329.9
45 cm	8.13	11.55	19.69	137.5	198.5	336.0
60 cm	7.35	10.15	17.50	124.3	174.5	298.8
Seeding rate						
4 kg ha^{-1}	8.33	12.96	21.29	140.9	222.8	363.6
6 kg ha^{-1}	9.10	12.59	21.69	153.9	216.4	370.3
8 kg ha^{-1}	8.60	13.60	22.20	145.4	233.8	379.2
10 kg ha^{-1}	8.79	14.30	23.09	148.6	245.8	394.5
Nitrogen fertilizer						
N 35 +N 35	6.85	12.42	19.27	115.8	213.5	329.3
2× N 35+ N 35**	7.99	12.26	20.25	135.1	210.7	345.9
N 70 + N 35	8.15	12.83	20.98	137.8	220.5	358.4
N 70+ N 70	8.82	15.54	24.36	149.1	267.1	416.3

* dry matter ** interval in spring 3 weeks

the Czech Republic, the energetic value of dry matter of reed canarygrass harvested in early spring has been determined to be 17.80 MJ per 1 kg dry matter. But when the same fuel contains 20% moisture, the energetic value is only 14.59 MJ (Strašil, 2012). The energetic value of biomass is in positive correlation with the content of lignin, therefore grasses should be harvested at the latest possible developmental stage (Raclavska et al., 2011). As far as known, the soil properties of the growing place also affect the energetic value of reed canarygrass (Burvall, 1997) as well as the harvest time. In the Czech Republic, the energetic value of dry matter of reed canarygrass harvested in different times has been studied and it became evident that the energetic value of biomass harvested in July was 16.91 and that of biomass harvested in early spring (March) was 17.19 MJ per kg of dry matter (Stašil et al., 2005). These two figures serve as basis for the calculations of energetic value of dry matter yields harvested from our trials (Table 2).

The biggest amount of energy was produced in the variant that was seeded with narrow spacing (15 cm) with the seeding rate of 8 kg ha^{-1} and fertilized with N 70 at the beginning of growth and second time with N 70 kg ha^{-1} after the first cut. In the total of three years, the energetic value of dry matter of this variant was 416 GJ per hectare. A yearly production of energy from straw and stubble hay harvested in spring could have been in this variant on average 138 GJ ha^{-1}. In our trials, least energy was produced in the variant seeded at 60 cm row space – 299 GJ ha^{-1} in total of three years, i.e. about 100 GJ ha^{-1} per year.

In addition, the quality of dry matter of reed canarygrass and its change dynamics were investigated in the trials (Table 3). Quality indices were chosen considering both the requirements of forage production (CP, ADF, NDF) and energy production (proportion of leaves and stems, K and crude ash contents). Based on the contents of crude protein, acid detergent fibre and neutral detergent fibre, the stand cut in the autumn of seeding year can be used as fodder. There is no sense of leaving it in the field over winter, since the stand will lodge and cannot be harvested in the following spring.

The dry matter of reed canarygrass harvested in July at the stage of full seed maturity and dried in the field is not valuable as fodder – it has low crude protein content and high acid detergent and neutral detergent fibre contents. Straw can be used for energy, but requires specific measures due to relatively high potassium and crude ash contents (15.20 g kg^{-1} and 54.6 g kg^{-1} respectively). The yield of reed canarygrass harvested in spring has the best properties for energy production. During winter the contents of potassium (1.81 g kg^{-1}) and crude ash (48.7 g kg^{-1}) in the above-ground biomass decrease considerably. A significant change occurs also in the proportion of leaves and stems in favour of the latter. As stems contain less mineral substances (including potassium) than leaves (Pahkala and Pihala, 2000), the loss of leaves in winter improves the combustion properties of the biomass harvested in spring.

The moisture content of straw of reed canarygrass that was cut in July and dried in the field was 14.5% in 2010, 20.3% in 2011 and 14.4% in 2012. The moisture content of stubble hay harvested in spring was 14.3% in 2011, 14.4% in 2012 and 15.2% in 2013. In 2013 the snow cover persisted at the trial site until 11 April, which was quite unusual compared with the long term average. The surface became dry only at the beginning

Table 3

Quality indices of reed canarygrass

Harvest time	Leaves,%	Stems,%	Weeds,%	CP g kg^{-1}*	ADF g kg^{-1}**	NDF g kg^{-1}***	K g kg^{-1}	Ash g kg^{-1}
Green mass (2008) autumn	58.7	36.8	4.5	98.3	291.0	480.8	14.30	106.2
Straw 14.07.11	54.4	38.8	6.9	91.8	348.6	617.4	15.20	54.6
Stubble hay 18.07.11	30.0	62.0	8.0	58.5	414.3	641.8	9.48	51.4
Stubble hay 10.10.11	41.9	54.4	3.8	77.2	438.2	652.8	7.66	63.6
Stubble hay 12.04.12	16.9	83.1	×	×	×	×	1.81	48.7

* crude protein. Conversion factor for the calculation from N-content 6,25; ** acid detergent fiber;
*** neutral detergent fiber

of May. Cutting of stubble hay took place on 2 May, not in April as in the two previous years. By that time vegetation had already started and a small amount of leaves from young shoots got into the cut stubble hay. The maximum permitted moisture content of reed canarygrass for energy production is 20%. The material harvested in our trials met this requirement at all harvest times. This kind of biomass does not require additional drying. It can be stored without risk of self-heating. In Finland, the moisture content of reed canarygrass that has been kept in the field over winter and harvested in spring has been 10–20% (Lindh et al., 2005). In Finland a higher price is paid for energy hay with the moisture content below 14% (Kontturi and Pahkala, 2007). In our trials we did not achieve this level at any of the harvest times.

Conclusions

Based on the results of experiments conducted at the Estonian Crop Research Institute in 2008–2013 it can be said that it is possible to grow reed canarygrass for energy production in Estonia provided that the divided harvesting method of biomass is used. In the case of the divided harvesting method, reed canarygrass yields 5–8 t of dry matter per hectare, 40% of which is gathered in July and 60% in the following spring before the start of vegetation. The total energetic value of biomass produced per hectare per year is 100–140 GJ. The advantages of the divided harvesting method are as follows:

1. The biomass of reed canarygrass formed during the whole vegetation period can be used for energy production.
2. Stubble hay does not ledge under snow cover, thus harvest losses are minimized.
3. Less nutrients are removed from the field with the yield, thus it is possible to save on fertilization costs.
4. Compared to cutting once during summer, the divided harvesting method ensures that 2/3 of the fuel has better combustion properties.

The production field should be established with narrow spacing (15 cm) and with a seeding rate of 8–10 kg ha^{-1}. Nitrogen fertilizer should be applied in two doses: in spring after the start of growth with the rate of N 70 kg ha^{-1} and in July after harvest with the rate of N 70 kg ha^{-1}. Since in July the harvest takes place in the late developmental stage of plants, it is possible to combine the divided harvesting with the seed production of reed canarygrass. In this case the first growth is cut with a combine harvester, seed is threshed and straw is harvested for energy hay.

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