COMPARATIVE ECONOMIC STUDIES IN THE FLAX PRODUCTION TECHNOLOGY

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Abstract. Products from flax have the highest hygroscopic and other characteristics affecting the health of the people. Increased demand for flax products was also promoted by the development of new technologies of industrial processing (for example, cottonisation of the short flax fibres), discovery of new healing properties of flax seeds, etc. More than 90 % of the Latvian products from flax are exported to the countries of Western Europe and America. At the present time for an overwhelming majority of agricultural farms of Latvia more economical is the combine harvesting technology of flax. However, when the yields of the flax are higher than 4.6-5.0 t/ha and the output of one set of self-propelled machines exceeds 120 ha, the efficiency of the combine and the swath harvesting method is practically the same. Due to the increase in the prices of fuel and electric energy, the borderline between the equal economical efficiency will shift towards lower yields.

Key word: flax production, harvesting methods, economical efficiency.

Introduction

Intense search is going on in Latvian agriculture at present for the products (including non-foods) which could be in demand in the European market. The demand for flax products in the world during the recent years, although exposed to certain fluctuations, has, on the whole, a clear tendency to growth. This is explained by a sufficient level of supply of the population in the developed countries and striving to use clothes and household articles which are most benevolent for the people’s health. Products from flax have the highest hygroscopic and other characteristics affecting the health of the people. Increased demand for flax products was also promoted by the development of new technologies of industrial processing (for example, cottonisation of the short flax fibres), discovery of new healing properties of flax seeds, etc. More than 90 % of the Latvian products from flax are exported to the countries of Western Europe and America. In spite of the fact that increase in the areas under flax proceeds rather slowly after the heavy crisis of 1992-1993 in flax production, there are also essential achievements. The degree of the flax fibre yields has grown twice in Latvia during the last decade. However, an urgent task in the field of flax growing remains the solution of the problems of raising the quality of the flax fibre, lowering the prime cost and energy consumption for its production.

Methods

The tasks of the research were an economical and agrotechnical estimation of several variants and methods of a mechanised technology for harvesting and processing flax products, as well as the improvement of machines for harvesting flax. The object of research was the application of technological methods of harvesting flax (flax-pulling, combing or threshing of the seedy part of flax, and spreading in swaths) presently used in Latvia and some West European countries – the combine harvesting and swath harvesting.

In the calculations of combine harvesting with tractor MTZ-82A a combine harvester LK-4A, a tractor trailer, a general-purpose conveyer dryer and a grain combine harvester adapted for threshing the flax fibre were used. For the research of swath harvesting a self-propelled flax puller and a flax comber produced by the Dehond firm, as well as a tractor trailer, a general-purpose conveyer dryer and a grain combine harvester adapted for threshing the flax fibre were used. In economical estimation algorithms for the calculation of technological charts were used on the basis of the computer programme Excel. The agrotechnical estimation was carried out using a standard methodology.

Results

Harvesting is the most labour-consuming stage in the technology of flax production (about 70 % of all the labour inputs), in many respects, determines the prime cost and quality of the end product, as well as overall energy consumption. During the recent 30 years combine harvesting of flax is mainly applied in Latvia. This method is comparatively less sensitive to increased moisture during the harvesting period.

The main shortcomings of this method are the huge energy consumption for the subsequent drying of the seedy part of the yield and a significant loss of the seed germinating ability. The optimum factor in combine harvesting is flax gathering at the stage of early yellow ripeness – when 25 % of the seed pods have yellow colour and 75 % – a yellowish-green shade. In contrast to the stage of full seed ripeness, harvesting within these terms ensures increased output of the long fibre by 18…22 %. However, the seeds and the obtained mass of flax generally have increased moisture in this period, and, respectively, huge energy consumption is needed for their drying. Drying and threshing the mass of flax requires the greatest consumption of fuel – 100…130 kg/ha, flax-pulling and combing – 10…15 kg/ha, processing of the flax swaths, baling and transportation – 22-30 kg/ha.

In the West European countries flax is generally harvested according to the so-called two-stage swath harvesting technology. In this variant flax is first pulled and spread in swaths together with the seed pods to allow the seeds to pre-dry and pre-ripen under natural conditions. The second stage of harvesting takes place 6-10 days after pulling, and its essence is raising and threshing (or combing) of the seed pods with subsequent spreading of the stalks. This method is assumed to enable a reduction of fuel and electric energy consumption about 2.6 times for pre-drying the seedy part of the yield, as well as a comparatively lesser specific consumption of fuel in flax pulling, combing, etc. (self-propelled machines of required efficiency are used in order to implement the particular technological process). The basic circumstance restricting the introduction of this technology in Latvia is the fact that its implementation requires significantly more expensive machines. On the whole, the capital investments in purchasing machines for the two-stage swath harvesting technology are approximately 10 times higher than for the combine harvesting technology using trailed combines of the LK-4 type. Another drawback of the swath harvesting technology is increased risk that the seeds may be damaged in rainy weather.

Fig. 1 shows the prime costs of processing the rotted straw of flax by the combine and the swath harvesting technologies against different backgrounds of yields. The difference in the prime cost of processing the rotted straw by the combine and the swath harvesting technologies decreases with the increase in its yields. Thus, when the yield of the rotted straw is 1.8 t/ha, this difference constitutes 43 Euro/ha, but when the yield is 5.4 t/ha – only 3-4 Euro/ha. More rapid output is achieved by the more expensive machines for swath harvesting which ensure higher yields of a quality seed material on seed-growing farms. Estimations that were carried out considering higher quality of the produced flax seeds show that the introduction of self-propelled machines for the swath harvesting technology of flax may be justified, for the time being, only when the yields exceed 46-50 centners of the rotted straw per hectare and the annual output of one machine is more than 120 ha. According to prognoses for a ten-year perspective, both flax harvesting methods discussed will be applied in approximately equal proportions.

In order to prevent damage of the fibres and ensure uniform processes in all the layers of the flax spread out during the period of flax aging in the field (usually in September), it is necessary to perform certain operations on the swaths of flax – turning and fluffing. The type and periodicality of these operations determine the quality of the rotted straw produced and the maintenance costs affecting the prime cost of flax production.

During the fluffing (turning) of the swaths of flax short-time separation of the layer from the ground or the grass and insignificant mixture of the layers take place. By their design, the machines for fluffing are simple and cheap, they ensure high efficiency. In our experiments, when the yields of flax were 2.8 t/ha and the aging time was 19 days, application of single fluffing raised the sort number at least by 12 % in comparison with the previously widespread flax aging without special treatment. In practice fluffing is also obligatory before removing the flax straw from the field (this ensures its sufficient drying for pressing into bales).

However, when the yields of the flax stalks are higher than 4.2 t/ha, even double fluffing with a 10-day interval cannot ensure uniform aging (particularly, in the lower layer), and, in order to complete the biological process in all layers, it is necessary to continue aging 5-8 days more. This is bad not only because the harvesting terms are extended but also the potential quality of the rotted straw may become lower. Rising of the sort number was observed during the tests not only by 7.6 %, but also in comparison with the flax aging without special treatment.

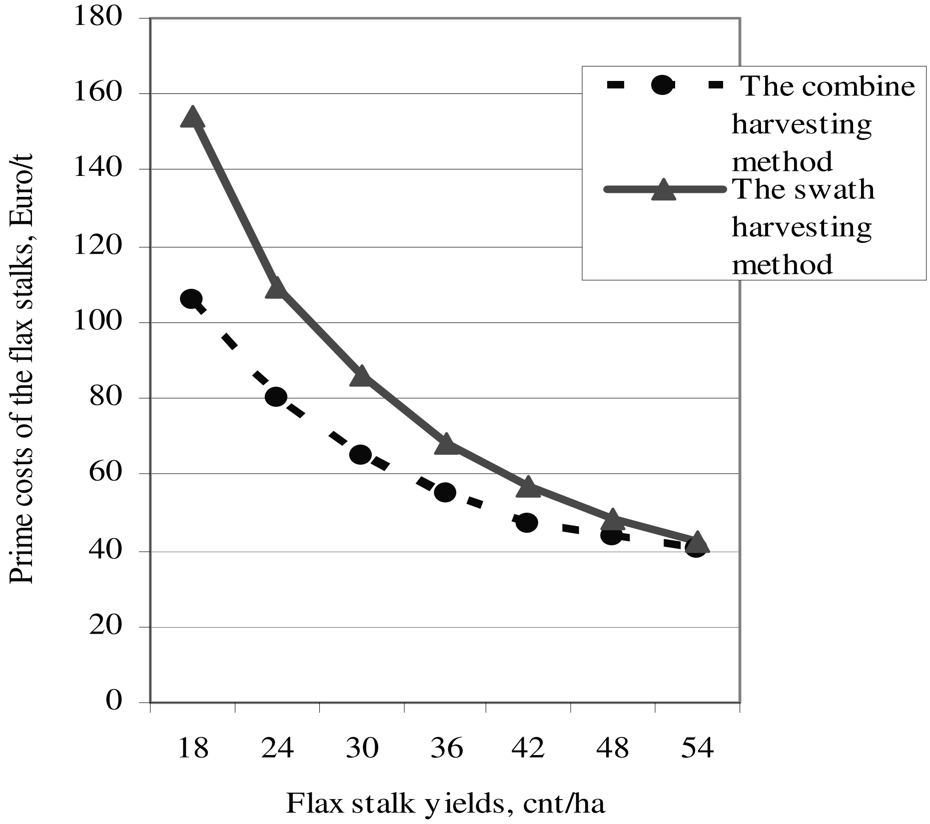

Fig. 1. **The prime cost of the rotted straw according to the combine and the swath harvesting methods of flax**

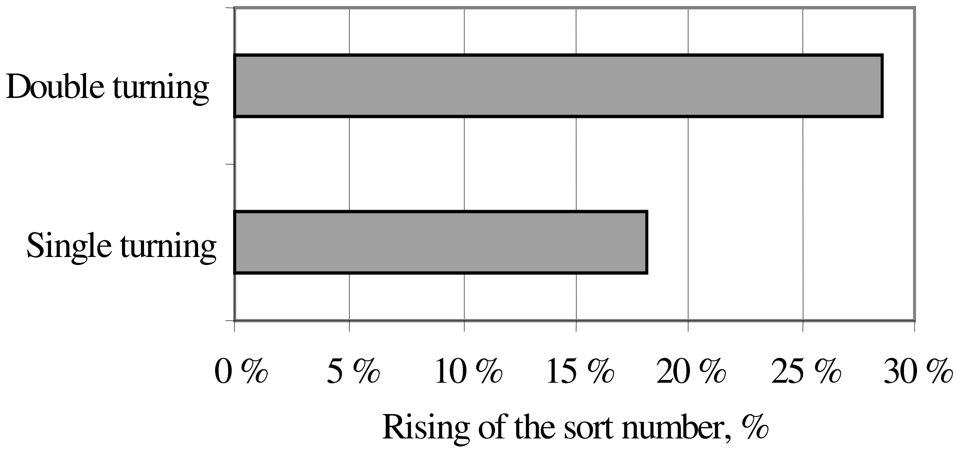

Fig. 2. **Efficiency of turning at the yield of the rotted straw 4.2 t/ha**

Separation of the flax layer takes place during its turning by 180º with subsequent spreading over the surface of the field. In experiments against the background of yields 4.2 and 6.0 t/ha application of double turning with a 90-day interval ensured increase in the sort number, respectively, by 18.1 and 28.5 % in contrast to aging without special treatment (Fig. 2). The third turning affects the result very little since, in spite of a slight improvement of the aging conditions, lower output of the long fibres takes place due to the tangling of the stalks in the layer. The design of the machines for the turning process are much more complicated and less efficient than the fluffers, which hampers their overall introduction in flax growing in Latvia. By the criterion of minimum specific production costs, the most efficient machines for areas less than 50 ha in Latvia are trailed turners. For the time being, the self-propelled machines (for instance, those produced by the DEHOND firm) are used on a very small scale because of their high price (approximately 5-10 times more expensive than the trailed ones).

Before the beginning of the 1990-ties about 70 % of the rotted straw was processed at the flax scutching mills of Latvia by the method of hot-water retting. This technology required great consumption of energy to heat the retting liquid and drying the rotted straw before the fibre is separated. As a result of accelerated decomposition of pectin substances in the flax stalks, the produced fibre was courser and had a yellowish-green shade. At the present price of energy carriers and from the considerations of energy saving the processing of rotted flax straw is not practiced at the flax scutching mills of Latvia.

Conclusions

At the present time for an overwhelming majority of agricultural farms of Latvia more economical is the combine harvesting technology of flax. However, when the yields of the flax are higher than 4.6-5.0 t/ha and the output of one set of self-propelled machines exceeds 120 ha, the efficiency of the combine and the swath harvesting method is practically the same. Due to the increase in the prices of fuel and electric energy, the borderline between the equal economical efficiency will shift towards lower yields. In order to raise the quality of the rotted straw when the yields are over 3.0-3.5 t/ha double turning of the flax layers is obligatory.

References

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