Prospects for and developments in oilseed rape production in Lithuania

Stasys Bernotas, Irena Brazauskienė, Gvidas Šidlauskas
Lithuanian Institute of Agriculture

Abstract
This paper presents an analysis of oilseed rape cultivation possibilities and prospects for oilseed rape production in Lithuania. The analysis is based on the experimental evidence obtained from winter and spring oilseed rape trials conducted in central and western Lithuania over the period 1990-2003. Major technological parameters of winter and spring oilseed rape cultivation were identified. Lithuania's agriclimatic and soil conditions were found to be suitable for oilseed rape production. About 70% of the total oilseed rape cultivation area is situated in the central zone of Lithuania. It was estimated that Lithuania has a potential of increasing oilseed rape production area to 350-390 thousand hectares. Over the relatively short history of oilseed rape cultivation growers have gained adequate experience. Nevertheless, development of oilseed rape production in Lithuania faces a few constraints, firstly, unsettled credit conditions and state support system for rapeseed producers, secondly, irrational structure of oilseed rape producers (many small growers), thirdly, lack of advanced oilseed rape cultivation and management technologies and other minor hurdles.
The national scheme of oilseed rape production envisages that by the year 2010 the oilseed rape cultivation area will have been increased to 210 thousand hectares, and the seed yield to 2.6 t ha^{-1}.

Introduction

Oilseed rape is the main crop of moderate climate zones. The area sown with this crop is steadily increasing on a global scale. This is determined by the rapidly growing demand for vegetable oil for human consumption as well as for industrial needs. A positive, environment-wise approach encourages expansion of production and utilisation of ecologically clean biofuels and biolubricates whose manufacture is based on vegetable oil. Oilseed rape cake is a valuable protein-rich forage supplement, which helps balance livestock nutrition rations. Due to its phytosanitary properties and the capacity to suppress weeds, oilseed rape is valued as a perfect preceding crop capable of increasing crop rotation productivity [1,2,3,4].

Oilseed rape (*Brassica napus var.Oleifera DC*) is a relatively new crop, rapidly spreading on Lithuania's farms. The crop belongs to *Brassicaceae* family, it has winter (biennis) and spring (annua) forms, the seeds contain 40-50% of fat and 20-25% of protein. Oilseed rape is a long-day plant. The growing season of winter oilseed rape continues for 130-180 days (total growth period 270-320 days), and that of spring oilseed rape - 80-110 days. To mature the seed the crop needs 1700-2300^{o}C of effective accumulated temperatures. In Lithuania the growing season is sufficient for oilseed cultivation: from 169 days in the east to 202 days in the west of the country (April 15 – October 31). The effective accumulated temperatures of this period (> 5^{o}C) amount to 2200-2600^{o}C. To grow a stem and mature seeds oilseed rape utilises 1.5-2 times as much moisture compared with grasses. The annual demand for precipitation is 600-700 mm. The annual mean precipitation rate in Lithuania amounts to 640-650 mm, however, its distribution is uneven: the largest quantity of precipitation falls in the western part of the country (700-830 mm), while the smallest amount of precipitation falls in the central zone of the country (530 mm) [6,7,8,9].

Owing to the great abundance of cultivars and their ability to adjust to frequently extremely variable growing conditions, oilseed rape can be grown in a very wide range of agriclimatic conditions. A heavy and high quality oilseed rape yield can only be achieved provided the conditions for growing, development, wintering, nutrition, formation of yield structural components which vary subject to natural-climatic factors, soil peculiarities, crop and soil management practices and cultivation technologies, are brought maximally close to optimal [3,4,5,].

The objectives of this paper are to define the factors and constraints limiting oilseed rape production in Lithuania and to predict developments in rapeseed cultivation for the period of 2004-2010. The predictions and the analysis were based on the experimental evidence as well as on the assessment of the current situation on the domestic and foreign markets.

Experimental methods

Evaluation of the national oilseed rape production was based on SWOT analysis, experimental findings obtained through field and laboratory tests at the Lithuanian Institute of Agriculture over the period 1990-2003 and statistical data on rapeseed cultivation issues.

Sowing timing and seed rates of the double low winter rape cv. 'Valesca' were tested during the period 1996-2000 in the western and central parts of Lithuania on a dystric albeluvisol (sod podzolic gleyic light loam) with a pH value of 4.4-5.5, humus content 1.98-2.42 %, mobile phosphorus 115-149, mobile potassium 204-247 mg kg^{-1} soil (west Lithuania) and on a endocalcari – epihypogleyic cambisols with a pH of 7.1-7.6, humus 1.15-1.27 %, P_2O_5 112-157, and K_2O 106-146 mg kg^{-1} soil (central Lithuania). The sowing was started on July 31 and was continued every 5 days. The last sowing date was August 25. The following seed rates were sown on each sowing date 2, 3, 4, 5, 6 kg ha^{-1} viable seed. The crop was sown at narrow 12.5cm row spacings. Crop management was performed in compliance with the recommendations and technologies approved in Lithuania.

Other specific experimental details will be explained while discussing experimental results.

Results

Possibilities of oilseed rape cultivation. In west Lithuania winter oilseed rape sown before August 15 produced a seed yield by 0.8-1.13 t ha^{-1} higher than the crops sown at later dates (August 20 and August 25). This resulted from the fact that earlier-sown crops had developed better in the autumn and demonstrated a better overwinter survival. The best yielding (2.37 – 2.52 t ha^{-1}) was found to be oilseed rape sown on August 10 at a rate of 4-6 kg ha^{-1} seed as well as the crop sown on August 15 at a seed rate of 6 kg ha^{-1}. Increasing of seed rate from 2 to 4 kg ha^{-1} and sowing dates not later than August 15 resulted in a significant yield increase amounting to 0.28-0.42 t ha^{-1}. Oilseed rape crops sown on August 20 gave a significantly lower seed yield relative to the seeding rate compared with the earlier-sown crops because of the poorer overwinter survival and the markedly lower stand density. At this sowing date, increasing of seed rate from 2 to 6 kg ha^{-1} tended to enhance the seed yield from 1.29 to 1.72 t ha^{-1}, however, it did not compensate for the yield reduction resulting from sowing date delaying. Oilseed rape sown on August 25 had poorly developed in autumn and exhibited a bad overwinter survival. The stand density in spring amounted to 5-10 plants per square meter. All these factors resulted in a yield as low as 0.65-0.85 t ha^{-1}. Seed rates in this particular case did not have any significant effect.

Research on oilseed rape sowing timing and seed rates conducted in the central part of Lithuania during the period 1996-1999 have also shown that increasing of seed rate does not compensate for the seed yield of crops sown at an earlier date and seed rate. The highest seed yield 3.07-3.09 t ha^{-1} was recorded in the winter oilseed crops sown within the first ten-day period of August (05.08) at a seed rate of 4-6 kg ha^{-1}. In this treatment the oilseed rape plants had on average 8-10 leaves in the autumn with an assimilating surface of over 40 thousand m^2 ha^{-1}, a 10-16 mm thick root neck and formed a stand with an optimum density (30-40 plants m^{-2}) in spring. When a higher seed rate (8 kg ha^{-1}) was sown on the same date, this caused a yield reduction. When the sowing date was delayed until August 15, only a small (0.06 t ha^{-1}) but statistically significant yield reduction occurred. A still greater yield reduction (about 1 t ha^{-1}) occurred when the crop was sown at the end of August. Oilseed rape crops sown at late dates were not able to properly develop in autumn and consequently prepare for wintering which determined a much poorer development in spring. [5,10,11].

Many researchers have reported that the greatest possible concentration of oilseed rape in a crop rotation is about 30 %. In Sweden a crop rotation where oilseed rape accounts for not less than 10 % and not more than 30 % of the total crop rotation area is considered cost-effective. In Germany a practice when oilseed rape area is increased to 50 % for several years in the crop structure is employed. The French experience suggests that increased oilseed rape area in the crop rotation to 50 % resulted in a 10 % seed yield reduction as well as a decline in fat, oleic acid contents and an increase in nitrogen and linoleic acid contents in rapeseed. Having reduced oilseed rape concentration in the crop rotation from 33 % to 17 % the disease occurrence declined from 2 to 10 times [12,13,14,15].

Two four-course crop rotation experiments with winter and spring oilseed rape accounting for 25%, 50% and 75% of the crop rotation area were set up. The obtained results enable to estimate oilseed rape productivity, weed infestation, changes in soil agrochemical properties, especially those occurring in humus quality. It should be explained that no herbicides were used in this experiment, since one of the many purposes of the experiment was to identify the weed suppressive capacity of oilseed rape. The seed yield of winter oilseed rape was by 7-8 % higher in the crop rotation where it accounted for 25% (2.06 t ha^{-1}) than 50% . In Lithuania 60-70% of soils are suitable for oilseed rape cultivation, and this crop could account for 20-25% of the total crop structure, which would amount to 350 -390 thousand hectares [16].

As a result, Lithuanian agrimeteorological and soil conditions and observance of proper oilseed rape cultivation technology based on research evidence can secure a rapeseed yield of 3-4t ha^{-1}, especially of winter rape. Such yield level can stimulate an increase in oilseed rape cultivation area and can meet the demands of oil and biofuel production industries with a local raw material and develop exports.

The experience of the recent years shows that about 70% of the total oilseed rape production area is situated in the central zone of Lithuania (in 1998 – 27.2, 1999 – 59.8, 2000 – 41.1 thousand hectares). As was already mentioned, soil properties in this part of the country are the best for oilseed rape cultivation, therefore it is most likely that central Lithuania will continue to be the chief producer of rapeseed [16,17].

External and internal environment for oilseed rape cultivation. The current situation on the international rapeseed market is favourable for the development of oilseed rape production. This resulted from the increased demand for rapeseed oil and rapeseed cake. New application areas of rapeseed oil are emerging. One of these areas is biofuel production for vehicles and other industrial needs. (The total rapeseed oil production in Germany amounts to about 1 million tonnes, of which 70% is used for food, and the remaining 30% is processed into engine fuels). Due to the new applications of rapeseed oil, the Lithuanian oilseed rape production has good chances to firmly establish itself on the international market, especially on the common EU market, because according to the OECD forecasts, production of oil seeds in the EU will only partly (about 50%) meet the demand of the EU market [16,18].

Reformation of the national economy and restoration of market relations, changes in ownership forms, emergence of new economic entities (farmers' farms, agricultural partnerships etc.) and other factors resulted in significant changes in oilseed rape production. The period 1991-2000 was marked by the formation of growers' structure and variations in oilseed rape cultivation area and productivity.

- In 1991 oilseed rape was grown only in agricultural partnerships, while in the year 2000 about 90% of oilseed rape was produced by individual farmers and only about 10% by agricultural partnerships. Spring oilseed rape accounted for 90% of the total rape cultivation area. Spring rape productivity is lower (in 1999-2000 by 15-25%) compared with winter crops, but spring crops are not exposed to wintering risks. Oilseed rape is grown in almost all districts of Lithuania.
- Grouping of all categories of oilseed rape growers according to farm size (the data of oilseed rape crops declaration for 2000) suggests that:

a) on the farms of all categories more than 70% of growers cultivate oilseed rape on relatively small, up to 30 ha plots (Figure 1). In this group average oilseed rape cultivation area is 13.6 ha.

b) the dominating oilseed rape cultivation area on farms is 5.1-10.0 ha (Figure 1) and about 25% of farms grow this – sized area. The oilseed rape area cultivated by this group of growers accounts for 8% of the total oilseed rape production area. The average oilseed rape cultivation area on the farms falling within this group is 8.8 ha.

c) large farms whose oilseed rape cultivation area makes up from 30.1 to over 100 hectares in the crop structure account for 24%. This group of growers account for 60% of the total oilseed cultivation area. In this group the average oilseed rape cultivation area is about 70 ha.

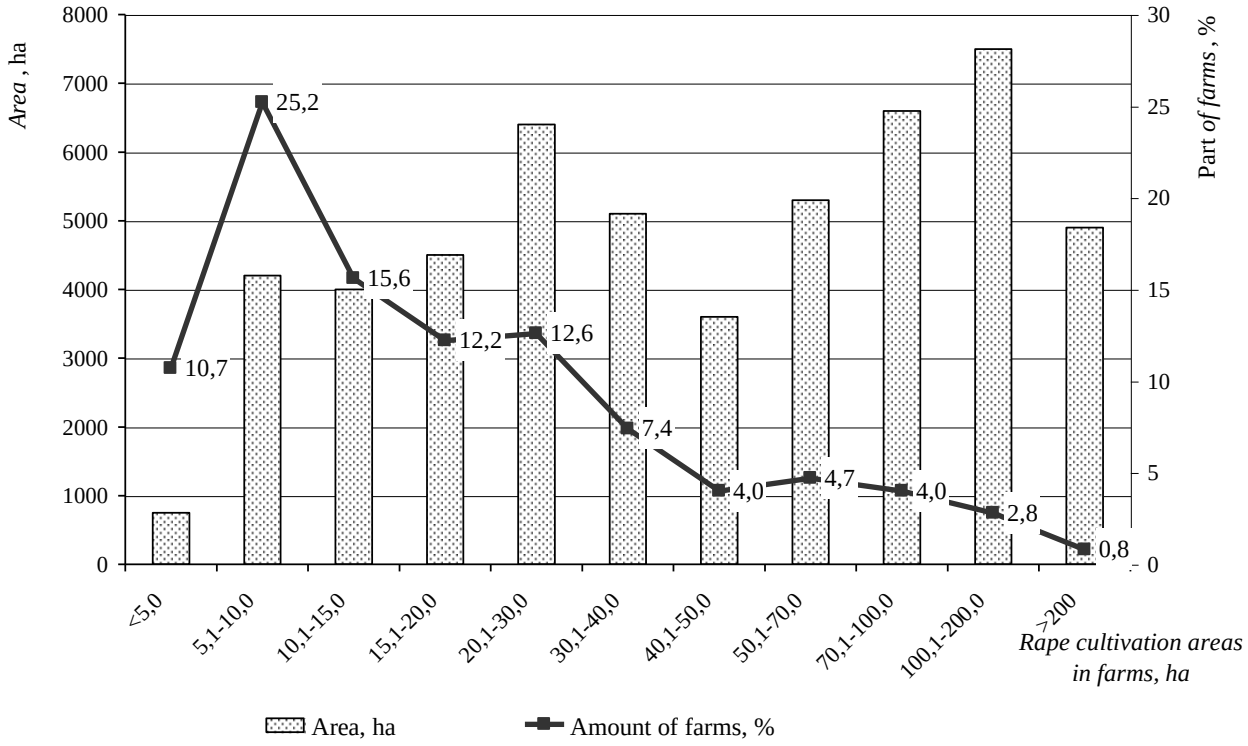

Figure 1. The composition of oilseed rape production farms according to cultivation area, 2000

- Increasing of rapeseed yield - in our country this positive trend was observed during the periods 1996-1998 and 2001-2003. During the aforementioned period rapeseed productivity on the farms of all categories increased to 1.68-1.92 t ha^{-1}, i.e. more than 30 %, compared with the period 1991-1995, when the seed yield amounted to 1.1-1.5 t ha^{-1}. On larger, specialised farms with a more intensive production the rapeseed yield totals 2.5-3.0 t ha^{-1} and more. Regardless of the positive developments, the national rapeseed yield level is relatively low. The average rapeseed yield was 1.7 t ha^{-1} for the period 1996-2002. It is markedly lower than in the EU countries involved in intensive oilseed rape production (in Germany 3.4 t ha^{-1}, France 2.9 t ha^{-1}). Dynamics of oilseed rape production area and productivity on Lithuanian farms for the period 1991-2003 is presented in Figure 2.

Rapseed production costs depend on crop and soil cultivation and management practices, growing technologies, natural conditions, costs of agricultural inputs, such as fertilisers, pesticides, fuel, machinery and other factors. It was estimated that at a rapeseed yield level of around 2.0 t ha^{-1} and taking into account average agriclimatic conditions of Lithuania, size of fields, soil peculiarities,

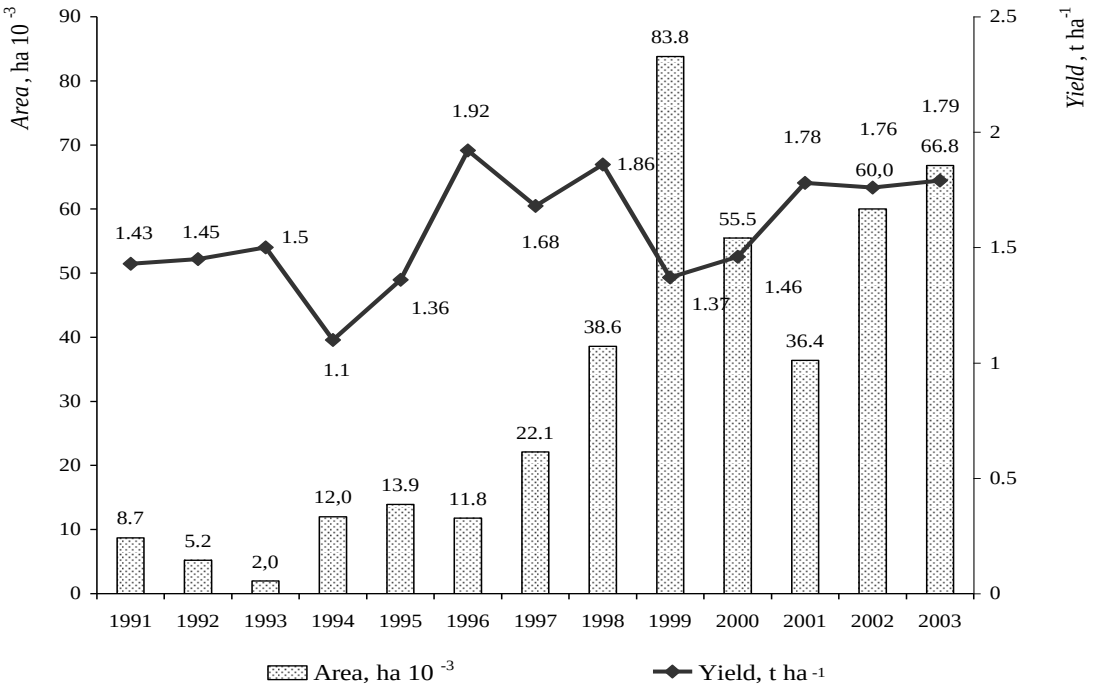

Fig. 2. Oilseed rape cultivation areas and productivity during the period 1991-2003

machinery output, labour costs, fuel price and farmers' income for rapseed sales on the domestic and international markets for 1999-2002, growers can only expect to cover rapeseed production costs (Table 1) [19,20, 21].

Table 1. Oilseed rape cultivation costs in Lithuania in 2003

Costs for:	Costs*, EUR ha^{-1}
Ploughing	23
Cultivation (2 times)	23
Application of complex fertilisers	7
Application of nitrogen fertilisers (2 times)	14
Sowing	14
Spray applications	
Herbicides (1 time)	7
Insecticides (2 times)	14
Combine harvesting	58
Rapeseed transportation	7
Rapeseed cleaning, drying, storage	9
Total	**176**
Complex fertilisers 0.4 t ha^{-1}	75
Nitrogen fertilisers N150	52
Seed	14
Herbicides	70
Insecticides	9
Total variable costs	**220**
Total production costs	**396**

* Productivity – 2.0 t ha^{-1}

Forecasts for oilseed rape production development. Forecasts of oilseed rape cultivation and oil production volumes were made taking into account the chief changes in the market demands for oil crops. These changes are resulting from the following factors:

a) structural changes in nutrition – consumption of plant origin fats is increasing compared with that of animal origin fats;

b) solution to the problem of protein shortage reduction in animal production;

c) production of bioefuel and other non-traditional produce from vegetable oil.

In order to become self-sufficient in rapeseed vegetable oil produced from the local raw material (i.e. to produce 31.0 thousand tons) for the year 2006, the cultivation area should be 50 thousand hectares, and the average rapeseed yield should be 2.3 t ha^{-1}. By the year 2010 it is expected to expand the oilseed rape cultivation area in Lithuania to 210 thousand hectares and to increase the average seed productivity to 2.6 t ha^{-1}. Spring rape should account for 55 – 65% of the total rapeseed cultivation area, while winter rape should account for the remaining 35 – 45 %. The area of oilseed rape crops grown for vegetable oil production for human consumption should be increased to 60 thousand hectares. Optimistic and pessimistic versions of the forecasts for oilseed rape production area and productivity dynamics for the period 2004-2010 are presented below.

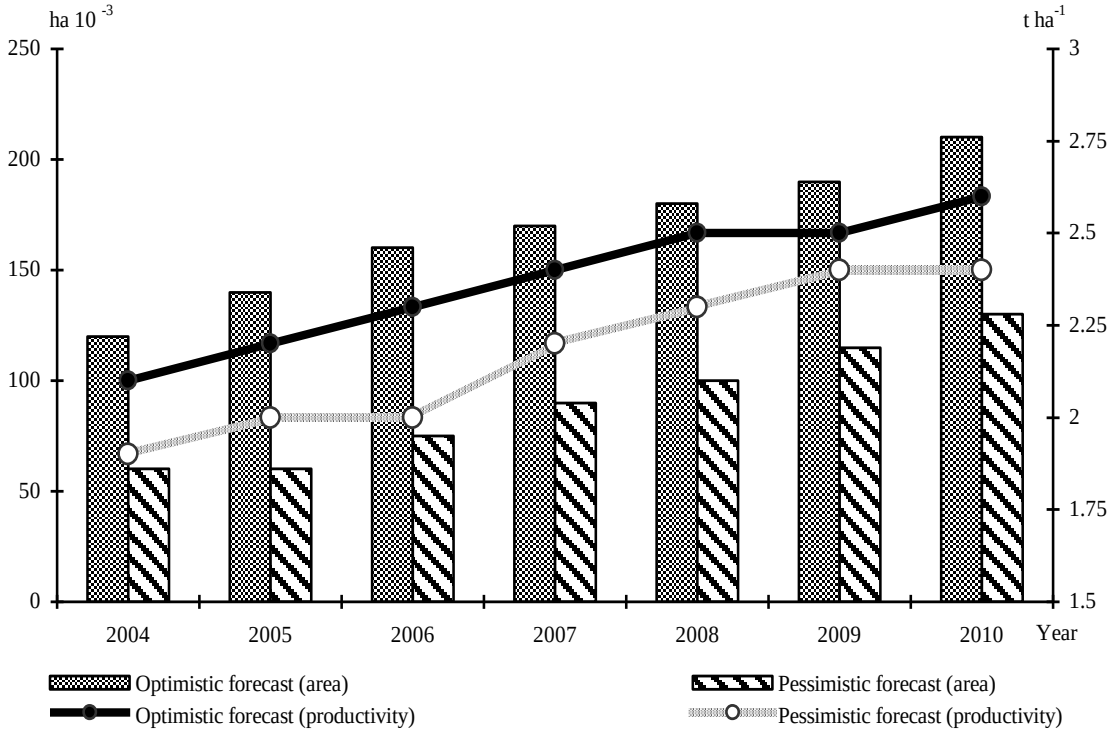

Figure 3. Prediction of oilseed rape cultivation area and productivity in Lithuania for the period 2004 – 2010

The national oilseed rape cultivation scheme was developed on the basis of the analysis and other factors discussed in this paper.

It was concluded, that:

- Lithuania's agriclimatic conditions are suitable for oilseed rape cultivation, there is a potential capacity to increase oilseed rape production area to 350-390 thousand hectares. Oilseed rape growers have gained a sufficient experience, seed production system has been partly developed. There is demand for rapeseed on the domestic and foreign markets. Scientific potential and regularly operating training and advisory network have been developed.

- The limiting factors and constraints for the development of oilseed rape production in Lithuania are absence of favourable credit and state support systems; irrational structure of oilseed rape growers, a lot of small growers lacking advanced production technologies, insufficient co-operation among oilseed rape producers and integration between growers and seed purchasing-processing enterprises, inadequate investment in research, farmers' training and promotion of the product.

The national oilseed rape cultivation scheme for the period until 2010 envisages that oilseed rape cultivation area in Lithuania will be increased to 210 thousand hectares and the average rapeseed productivity will reach 2.6 t ha^{-1}.

References

1. Ackman R.G. Chemical composition of rapeseed oil // High and low Erucic Acid Rapeseed Oil. Ed. J.K.G. Kramer, F.D. Sauer, W.J. Pigden. – Toronto, Canada: Academic Press, 1983, p.85-129
2. Anonymous. Oil Crops Yearbook // Economic Research Service, USDA. - Washington, DC, 1997
3. Bernotas S., Kalvaitienė S. Agrotechninių priemonių įtaka žieminių rapsų sėklų derliui Vakarų Lietuvoje // Žemdirbystė: mokslo darbai / LŽI. - Akademija, 1995, t.48, p.93-115
4. Velička R. Augalų derlius ir pasėlių piktžolėtumas sėjomainose su didėjančiu vasarinių rapsų plotu // Žemės ūkio mokslai.–2000, Nr.1, p. 9-14.
5. Velička R. Sėkloms auginamų rapsų agrotechnikos moksliniai pagrindai // Žemės ūkio mokslai. – 2002. – Nr.1, p. 27-40.
6. Botanikos vardų žodynas.-Vilnius, 1998.- 523 p.
7. Lietuvos TSR flora. T3. – Vilnius, 1961. - 662 p.
8. Montvilas R. Žieminių rapsų veislių vystymosi ir produktyvumo ypatumai // Žemdirbystė: mokslo darbai /LŽI.-T.73(2001), p.185-193.
9. Šidlauskas G. Vasarinių rapsų sėklų derliaus bei baltymų ir riebalų išeigos priklausomumas nuo azoto, fosforo ir kalio kiekio augaluose skirtingais vystymosi tarpsniais // Žemdirbystė: mokslo darbai / LŽI.- T.72 (2000), p.118-135.
10. Velička R. Rapsų technologiniai parametrai // Šiuolaikinės augalininkystės technologijos: moksl.str.rinkinys / LŽŪU.–Kaunas, 2001, p.3-17.
11. Montvilas R., Mittas V. Sėjos laiko ir sėklos normos įtaka žieminių rapsų sėklų derliui lengvuose priemoliuose // Žemdirbystė: mokslo darbai / LŽI.- T.72(2000), p. 103-117.
12. Spielhaus G. Raps möbelt einseitige Fruchtfolgen auf // DLG – Mitteilungen. – 1980, Jg.95, N12, S. 674-675.
13. Cramer N. Raps: Anbau und Verwertung. – Stuttgart: Ulmer, 1990,- 148 S.
14. Pouzet A. Agronomy // Brassica Oilseeds: Production and Utilization / ed. D.S.Kimber, D.J.McGregor, CAB International. -1995, p.33-110.
15. Kostrewska Marta K. Konkurencyjnosc chwastow w lanie rzepaku ozimego uprawianego w plodozmianie I monokulturze // Acta Acad.agr.ac techn. Olsten. Agr.-1998, N66, S.181-187.
16. Velička R. Rapsai // Monografija. – Kaunas, 2002.- 320 p.
17. Lietuvos statistikos metraštis 2000 // Statistikos departamentas prie Lietuvos Respublikos Vyriausybės.- Vilnius, 2000.- 612 p.
18. FAO Quarterly Bulletin of Statistics FAO // Roma, 1999,- vol.12, no1-2. - 235 p.
19. Rinkotyra Nr. 4 // Lietuvos agrarinės ekonomikos institutas. Vilnius, 1999.
20. Rinkotyra Nr.1 // Lietuvos agrarinės ekonomikos institutas. Vilnius, 2001.
21. Stanikūnas D. ir. kt. Žemės ūkio ir kaimo plėtros strategijos įgyvendinimo programos // LAEI - Vilnius, 2000.,- 700 p.