EVALUATION OF ECONOMIC RISKS IN PRODUCING WINTER OILSEED RAPE

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Abstract
This paper analyses two data series covering the period of 5 to 10 years regarding specific selected key parameters for companies using the counselling services of the Union of Oilseeds Growers and Processors in Prague (UOGP) and some other companies that make no use of these services (OTHERS). For the selected key parameters, the risk analysis of reaching the gross profit, the gross margin and the break-even point was conducted with the aid of the Monte Carlo stochastic simulation method. The results of the calculations show that the companies using UOGP consulting achieve on average, at the same level of risk, a gross profit higher by 53%; a gross margin higher by 30% and their break-even point is lower by 11%. Taking advantage of the knowledge and services provided by a consulting company has positive economic benefits, and it increases the competitiveness of companies.

Key words*: gross profit; gross margin; break-even point; Monte Carlo method.*

INTRODUCTION

Oilseed rape is one of the most important agricultural crops in the Czech Republic. Winter oilseed rape on arable land in the production year 2015/2016 amounted to 359,243 hectares, which meant on average 14.4% of the arable land, while the dispersion in individual farms amounted to a number between 0.19% up to 35%, or even more *(Volf and Zeman, 2016).*

The high amount of winter oilseed rape and its ongoing increase are mainly due to its market attractiveness. This, on the one hand, means a higher market production, mainly due to higher yields and farmer prices. Farmer prices (Tab. 2) and yields (Tab. 1) drive the market production. Both components of market production are under the influence of the market environment, the influence of weather and the level of compliance with the technological discipline in the respective company. Technological discipline means strict adherence to all operational processes and to their technological (cultivating) parameters. Strict adherence to technological discipline also has an impact on input prices and thus on costs *(Janotová, 2016;* also see Tab. 3), concerning items that the farmer generally cannot influence (such as purchase prices, taxes, rent, fees) as well as the items which depend on his decisions (such as number of operations, machine sets, dosages, etc.).

The monitoring of the development of input and output prices for winter oilseed rape production shows considerable price differences; the prices are also influenced by consulting (or in our specific case in the membership in UOGP). The prosperity and competitiveness of the production depends on the mutual relation between costs, prices and revenues in the market environment. For managerial decision-making, it is therefore essential to analyse constantly the available information and to evaluate the degree of feasibility of the managerial targets *(Wolke, 2008; Smejkal and Rais, 2009),* which includes evaluating risks.

Producing winter oilseed rape is influenced by a number of factors which are intertwined. Unfortunately, greater attention has not been given to the benefits of the expert experience from companies providing counselling on the economic results of winter oilseed rape yet. Against this background, this paper evaluates the economic risks of growing winter oilseed rape based on UOGP's statistical data recorded over the last 5 to 10 years in order to quantify these risks using simulation models. The results are divided into two groups: for members of the UOGP and for non-members of the UOGP (hereinafter referred to as "OTHERS").The reasons for such segmentation are the above-mentioned potential differences between the two groups. The aim of this study was to analyse the economic risks of oilseed rape cultivation based on statistical data obtained over the last 10 years with the support of the Monte Carlo stochastic simulation method.

MATERIALS AND METHODS

Modelling is based on the principle of generating random values *(Gleissner and Berge, 2004)* within boundary conditions for their triangular statistical distribution (Evans et al., 2000). The input parameters are always based on optimistic and pessimistic estimations of the parameter and its most frequent occurrence, which is a so-called distribution peak (Tab. 4).

The risk analysis was conducted with the aid of the stochastic Monte Carlo simulation method's algorithm; its principle was described by *Kroese et al. 2011*, concerning generating a pseudo-random variable for input parameters. The calculation principle is based on simulating a critical variable using 100 000 simulations (of risk situations) and constructing a two-sided frequency distribution interval at a materiality level of 0.05. The mathematical model created in Microsoft Excel using the Crystal Ball Add-In is utilised to determine the mean value of a magnitude that results from a random sample. Consequently, data obtained through simulations can be statistically evaluated.

Parameters which are likely to change were selected. With regard to market production, the parameters concern changes in the oilseed yield and farm prices related to one hectare of winter oilseed rape. On the cost side, they concern changes in variable costs (such as labour, materials, maintenance of machines) or in total costs (= variable costs increased by fixed costs, e.g. overhead costs, annual depreciation, insurance) related to one hectare of winter oilseed rape. As a reference parameter, the value of gross profit (GP – see relation 2) and contribution to the gross margin (GM – relation 3), which were reached per hectare, have been selected. In order to compare the results reached by the group of farmers who were members of the UOGP and a group of non-members, the parameter of an achieved break-even point (BEP – relation 4) was selected.

Yield values were generated based on the input analysis in Tab. 1 and on the boundary conditions in Tab. 4; values of the farm price, according to Tab. 2 and 4, and cost values, according to Tab. 3 and 4.

Market production (MP) is set as:

$$MP = Y.P \quad \text{(CZK/ha)} \tag{1}$$

Y – yield (t/ha)
P – price (CZK/t)

Gross profit (GP) is set as:

$$GP = MP - TC \quad \text{(CZK/ha)} \tag{2}$$

MP – market production (CZK/ha)
TC – total costs (CZK/ha)

Gross margin (GM) is set as:

$$GM = MP - VC \quad \text{(CZK/ha)} \tag{3}$$

VC – variable costs (CZK/ha)

Break-even point (BEP) is the variant of relation 2 when:

$$GP = 0 \tag{4}$$

Subsequently, this question was determined for the model: "Which risk can be expected when a certain value of gross profit or gross margin is reached by changing the parameters?" (Tab. 4). The variation of this question was assessing the risk of reaching a break-even point where the GP = 0, or at what farmer price of rape seed this beak-point is reached.

For the risk analysis, the gross profit (excluding overheads, taxes, etc.), gross margin and break-even point values were used; all of them are important indicators for managerial decision-making. Planting technologies are also affected by natural influences and market conditions which the agricultural company cannot control itself. Therefore, special attention should be paid to the point at which planting becomes profitable, as well as to the gross margin analysis.

RESULTS AND DISCUSSION

Analysis of the parameters for calculation

According to the results monitored by **UOGP** (=Union of Oilseeds Growers and Processors) in Prague, in the following four tables, input parameters are analysed in the time series of 10 years, i.e. yield, farm price, cost, market output, gross profit and contribution to reimbursement.

Tab. 1 Development of the average winter oilseed rape yields according to companies which are UOGP members or non-members (OTHERS) in t / ha

Year / Type of the company	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
UOGP	3.32	3.21	3.47	3.08	3.18	3.06	3.73	4.28	3.71	3.74
OTHERS	2.86	2.73	2.96	2.65	2.54	2.54	3.23	3.69	3.21	3.25

Source: UOGP Prague

Tab. 2 Development of farmer prices for winter oilseed rape according to companies which are UOGP members or non-members (OTHERS) in CZK / t

Year / Type of company	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
UOGP	7 407	9 542	6 582	7 772	10 911	11 906	10 389	9 433	9 979	9 878
OTHERS	7 207	9 342	6 382	7 572	10 711	11 706	10 189	9 233	9 779	9 678

Source: UOGP Prague

Tab. 3 Development of the average winter oilseed rape production costs according to companies which are UOGP members or non-members (OTHERS) in CZK / ha; (VC = variable costs; FS = fixed costs; TC = total costs)

Year / Type of company		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
UOGP	VC	15 678	17 761	19 403	16 669	19 004	21 467	22 784	23 478	24 867	25 776
	FC	4 500	5 000	5 000	5 000	5 000	5 500	6 000	6 000	6 000	6 000
	TC	20 178	22 761	24 403	21 669	24 004	26 967	28 784	29 478	30 867	31,776
OTHERS	VC	14 894	16 873	18 433	15 836	18 054	20 394	21 645	22 304	23 624	24 487
	FC	4 500	5 000	5 000	5 000	5 000	5 500	6 000	6 000	6 000	6 000
	TC	19 394	21 873	23 433	20 836	23 054	25 894	27 645	28 304	29 624	30 487

Source: UOGP Prague and www.agroconsult.cz;

Tab. 4 Marginal conditions used for modelling

Indicators	UOGP			OTHERS		
	P	ML	O	P	ML	O
Yield (t/ha)	3.5	3.7	3.9	3.0	3.2	3.4
Farmer price (CZK/ha)	9 760	10 000	10 750	9 560	9 880	10 750
Total costs (CZK/ha)	30 700	29 700	28 400	29 500	28 500	27 300
Variable costs (CZK/ha)	24 700	23 700	22 600	23 470	22 500	21 450

Legend: P – pessimistic estimate; ML – most likely estimate; O – optimistic estimate

1. Yield (Y): According to the results monitored by UOGP (=Union of Oilseeds Growers and Processors) in Prague, the average yield of winter oilseed rape for the last 10 years amounted to 3.48 t / ha for UOGP members and to 2.97 t / ha for non-UOGP members (hereinafter referred to as "OTHERS"). According to an analysis of the last 5 years, the average yield for UOGP members was 3.70 t / ha and for non-members 3.18 t / ha. Based on the comparison of the average yields over the last 10 and 5 years, an increasing tendency was noticeable.

2. Farmer price (P): The farmer price (which in this paper means their selling price) for winter oilseed rape is directly dependent on the growing year, on the EUR to CZK exchange rate, the situation on the commodity exchange MATIF and the initial sales strategy of each agricultural company. Under such market conditions, larger companies which are generally involved with the UOGP have a competitive advantage. For the analysis, the average prices tracked by UOGP were also taken into consideration.

3. Costs: The value of the costs was broken down into variable (VC), fixed (FC) and total costs (TC). It was first analysed on the basis of the data monitored by UOGP Prague and then on the basis of an expert calculation done by the AgroConsult advisory system. During the last 10 years, the average cost was 9 380 CZK / t for members of UOGP and 9 280 CZK / t for OTHERS. In view of the slightly rising trend, the marginal conditions (Tab. 2) were set based on the data from the last 5 years, where the average price for UOGP members was 10 317 CZK / t and for OTHERS 10 117 CZK / t.

Market production (MP), gross profit (GP) and gross margin (GM)

The results of calculations concerning market production, gross profit and gross margin for UOGP members and OTHERS are shown in Tab. 5. The resulting values were calculated by multiplying the relevant input parameters according to the relation 1 to 3. The SAPS subsidies were not included in calculating the market output; this fact is important for the subsequent assessment of the risk connected to producing given that the SAPS subsidies were gradually reduced by the EU. The tables depict a comprehensive view of the situation in the winter oilseed rape production economy.

Tab. 5 Average MP, GP, GM and BEP values

Indicators	UOGP	OTHERS
Market production (CZK/ha)	37 000	31 616
Gross profit (CZK/ha)	7 300	3 116
Gross margin (CZK/ha)	13 300	9 116
Break-even point (t/ha)	2.97	2.88

Discussion

Based on the modelling of the input parameters using the built-in model, the following results were obtained. The results of the risk analysis are shown using the probability distribution graphs of the gross profit, the gross margin and the break-even point. The results obtained from the risk situations were statistically evaluated using descriptive statistics. For interpretation of the simulation results, a frequency curve was used. The frequency curve displays the frequency of the occurrence of the generated values in the scope of the selected range (between the minimum and the maximum value). Based on this range, the variance distribution can be analysed. Each analysed value (parameter) represents the result of one possible situation. The form of the value distribution in the frequency curve indicates the nature of the risk of the analysed parameter. The smaller the height of the curve and the range of the minimum and maximum values, the smaller is also the probable risk connected to the parameter being analysed.

The distribution curve displays the cumulative frequency of occurrence of the analysed parameter. By means of the distribution curve, it is possible to determine the probability with which the occurrence of individual generated values can be expected. In this interval, therefore, the probability of occurrence of any (whichever) value of this parameter can be analysed. The inverted value of probability determines the risk that the values can exceed.

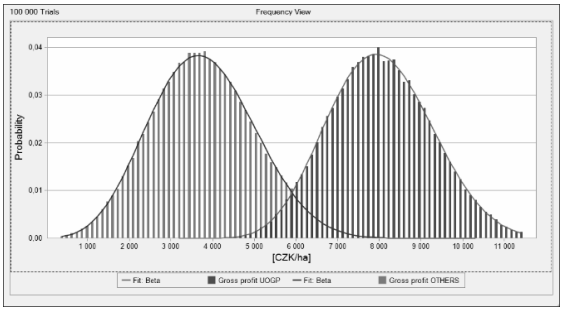

Fig. 1 Distribution curves and the probability of reaching gross profit

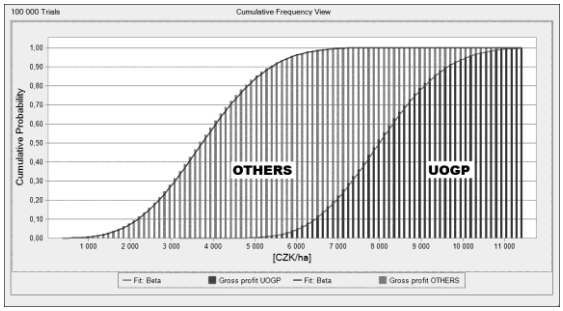

Fig. 2 Cumulative frequency graph of the probability of reaching gross profit

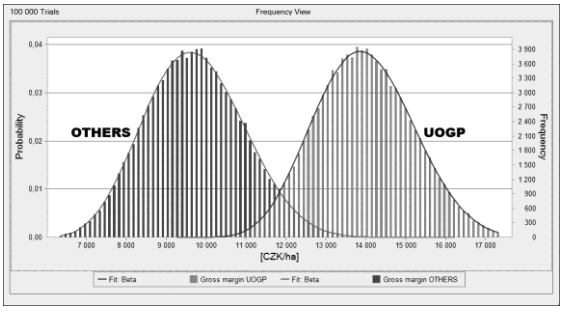

Fig. 3 Distribution curves and distribution of the probability of reaching a gross margin

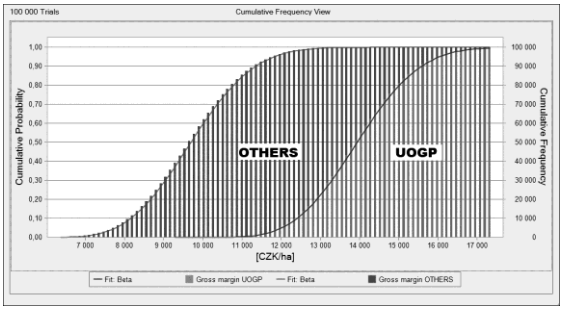

Fig. 4 Cumulative frequency graph of the probability of reaching gross margin

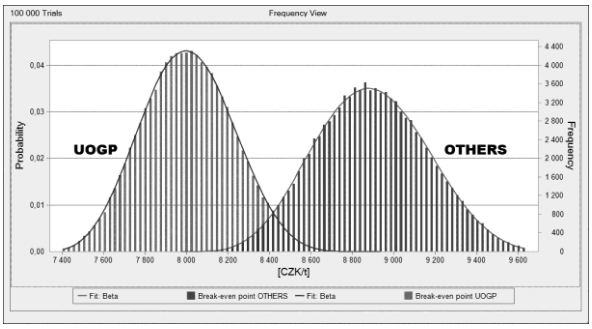

Fig. 5 Distribution curves and distribution of the probability of reaching a break-even point

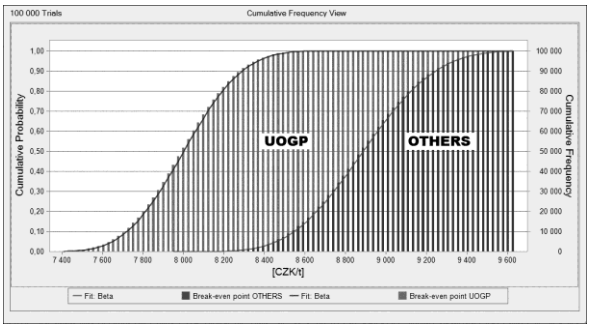

Fig. 6 Graph of the cumulative frequency of probability of reaching a break-even point

Tab. 7 Prediction of probability distribution of GP, GM and BEP

Indicators	Gross profit (GP) (CZK/ha)		Gross margin (GM) (CZK/ha)		Break-even point (BEP) (CZK/t)	
Percentile	UOGP	OTHERS	UOGP	OTHERS	UOGP	OTHERS
100%	4 025.14	-374.81	9 926.10	5 778.02	7 327.50	8 090.02
90%	6 453.48	2 184.25	12 402.29	8 172.03	7 721.63	8 545.18
80%	6 965.52	2 695.15	12 905.59	8 670.27	7 813.26	8 655.90
70%	7 347.80	3 080.04	13 286.12	9 045.66	7 883.00	8 740.39
60%	7 678.67	3 410.57	13 615.14	9 375.31	7 944.50	8 813.98
50%	7 994.35	3 724.95	13 933.97	9 689.86	8 002.62	8 884.52
40%	8 316.36	4 046.88	14 255.34	10 004.37	8 060.00	8 956.90
30%	8 663.32	4 397.94	14 598.93	10 352.95	8 122.83	9 033.50
20%	9 075.39	4 817.68	15 007.48	10 762.66	8 193.30	9 123.81
10%	9 639.40	5 396.98	15 577.92	11 342.61	8 291.26	9 245.64
0%	12 873.41	8 624.43	18 715.48	14 158.95	8 712.05	9 778.99

CONCLUSIONS

Companies which are taking advantage of the knowledge and services provided by a consultancy company and which comply with a good technological discipline achieve better economic results in winter oilseed rape production, despite the higher costs for the planting technologies. When planning the expected gross profit from the winter oilseed rape production, it is necessary to evaluate the feasibility of the managerial targets and to take into account the connected risks. Marin et al. (2017) applied the stochastic methods in order to model the crop yields. In general, it can be said that the higher the gross profit the company plans to achieve, the higher is the risk of reaching this target. Homolka and Mydlar (2011) found out in their research that profit is significantly influenced by the changes in the farmer prices of winter oilseed rape. When interpreting the issue of crop production risk, it is possible to use a classification where the risk up to 20% is rated as low, 21 to 40% as acceptable, and 41 to 60% as high and above 60% as very high (unacceptable).

Companies that are members of UOGP achieve the same likelihood of both higher gross profits (difference of average values is CZK 4 264 / ha) and gross margin (the average rank difference is 4 241 CZK / ha). An increasing range of winter oilseed rape production reduces unit fixed costs, and this results in growing profits. In addition, these companies achieve lower values of the break-even point (the average value difference is 886 CZK / t). This allows them at a lower purchase price of winter rape seed not to be in the red, in comparison with non-UOGP members.

For UOGP members, the gross profit of CZK 7 300 per hectare, based on the professional estimate, is reached with a probability of 71%. In comparison for UOGP non-members, the gross profit based on the professional estimate of CZK 3 116 / ha is reached with a probability of 69%. Thus, the level of risk is at an acceptable level.

The members of UOGP reach the value of the contribution to the fixed costs of CZK 13 300 per hectare with a probability of 69%, and the OTHERS reach a fixed cost allowance of CZK 9 116 / ha with a probability of 68%. The amount of the gross margin is sufficient to cover the fixed costs of both above-mentioned groups. Accordingly, it enables them to further develop their companies. According to Rayburn (2009), the possible benefits of using the stochastic methods are an improved performance and better economic results of the agricultural company.

The presented method of modelling the economic risks of growing winter oilseed rape can be applied to other crops as well. The accuracy of the modelling results depends on the accuracy of the input parameters of the assessed agricultural company and the growing region. In other words: In order to obtain the most accurate and appropriate results, it is highly recommended not to evaluate the average values collected within a large area (such as an entire EU-country), but rather to apply this method precisely to the input parameters specific for each agricultural company (considering its production technology, used material and machinery, selling price, costs, etc.) or to smaller regions with similar cultivation conditions.

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