Analysis of economic risks of hop growing

Analýza ekonomických rizik při pěstování chmele

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Abstract: The hitherto development of agricultural production shows that one of the characteristic attributes of the present period is great economic instability. Monitoring of the development of prices of inputs and outputs as well as climatic conditions reveals that similar problems are not limited to the Central European countries. Prosperity and competitiveness of the production is a function of mutual relations of costs, prices and yields. For the sound managerial decision-making, it is necessary to continually analyse and evaluate the rate of risk – soundness of the planned results (Rataj, Kavka 1999; Rataj 2001). For that reason, this contribution concerns the analysis of economic risks of the hop growing that takes into account statistical data in the time horizon of the last 15 years for the "Žatec poloranný červeňák" of traditional planting (further only ŽPČT) and 7 years for ŽPČ virus free (farther only ŽPČV) and the hybrid sorts (farther only HYBR).

Key words: hop, risk, costs, gross profit, gross margin

Abstrakt: Z dosavadního vývoje zemědělské výroby je zřejmé, že se současné období vyznačuje kromě jiného velkou ekonomickou nestabilitou. Ze sledování vývoje cen vstupů a výstupů, jakož i povětrnostních podmínek vyplývá, že podobné problémy mají ne jen země střední Evropy. Od vzájemného vztahu nákladů, cen a výnosů v tržním prostředí se odvíjí prosperita a konkurenceschopnost výroby. Pro manažerské rozhodování je proto nevyhnutné dostupné informace neustále analyzovat a hodnotit míru rizik – reálnost plánovaných výsledků (Rataj, Kavka 1999; Rataj 2001). Proto je v příspěvku zpracována analýza ekonomických rizik pěstování chmele, vycházející ze statistických údajů v časovém horizontu posledních 15 let u Žateckého poloraného červeňáku tradiční výsadby (dále jen ŽPČT) a 7 let u ŽPČ viruprostého (dále jen ŽPČM) a u hybridních odrůd (dále jen HYBR).

Klíčová slova: chmel, riziko, náklady, hrubý zisk, příspěvek na úhradu

The hitherto development of agricultural production shows that the contemporary period is marked, among other, by great economic volatility. Monitoring of the price evolution of inputs and outputs as well as weather conditions shows that similar problems are not limited to the Central European countries.

The prices of inputs are reflected in the production costs of both the items that cannot be influenced by the farmer (purchasing prices, taxes, rent, fees and charges) and the items that farmer can influence (number of operations, doses etc). The second group of the cost items is interconnected with technological processes used, and is often expressed through unit costs of production (Nozdrovický, Rataj 2001).

The prices of outputs and yields form market production. Both components of market production are under the influence of the market environment on the one hand and weather conditions and the level of technological discipline of the enterprise on the other hand.

The prosperity and competitiveness of production are based on the mutual relations of costs, prices and yields in the market environment. For the sake of managerial decision making, it is therefore inevitable to analyse continually the available information and to evaluate the rate of risks – soundness of the planned results (Rataj, Kavka 1999; Rataj 2001). For these reasons, this contribution deals with the analysis of

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economic risks of hop growing. It is based on statistical data from the last 15 years for the Žatec "poloranný červeňák" of traditional planting (farther only ŽPČT), 7 years for the ŽPČ virus free (farther only ŽPČV), and for hybrid varieties (farther only HYBR).

METHODOLOGY

The algorithm of random numbers generation based on beforehand-established conditions and statistical distribution was used for the modelling.

As the comparison parameter, we chose the value of Gross Profit (farther only GP) and the Gross Margin (farther only GM) for one ha of the land.

Value of Gross Profit (GP) is established as

$$GP = MP - Tc$$

where
MP = market production (CZK/ha)
Tc = total costs (CZK/ha)

Value of Gross Margin (GM) is established this way

$$GP = MP - Vc$$

where
MP = market production (CZK/ha)
Vc = variable costs (CZK/ha)

Market Production (MP) is established as

$$MP = Y \times P$$

where
Y = yield (t/ha)
P = farm price (CZK/t)

Total Costs (Tc) are established as

$$Tc = Vc + Fc$$

where
Vc = variable costs (CZK/ha)
Fc = fixed costs (CZK/ha)

For the modelling, we chose the parameters that can be expected to change. On the side of market production, the variables are yields of hop and farm prices. On the cost side, based on the technology, these are either variable costs (costs of labour, material, and repairs and maintenance of machines) or total costs (variable costs + fixed costs – business expenditures, depreciation and fixed annual charges for 1 ha of hop).

The modelling is based on the principle of generating random values in the range of marginal conditions according to statistical distribution analysed in advance. The input parameters are always **optimistic and pessimistic** estimates of the parameter and its **most frequent** incidence = ***peak* of the distribution**.

The values of yields are modelled according to input analysis in the Figure 1 and marginal conditions in Table 1, based on normal distribution.

The values of prices are generated according to input analysis in the Figure 2 of marginal conditions in Table 2, based on triangle distribution with peaks of most frequent incidence of farm price.

The values of total and variable costs are generated according to marginal conditions in the Table 3, based on triangle distribution with the peaks of the most frequent occurrence of costs.

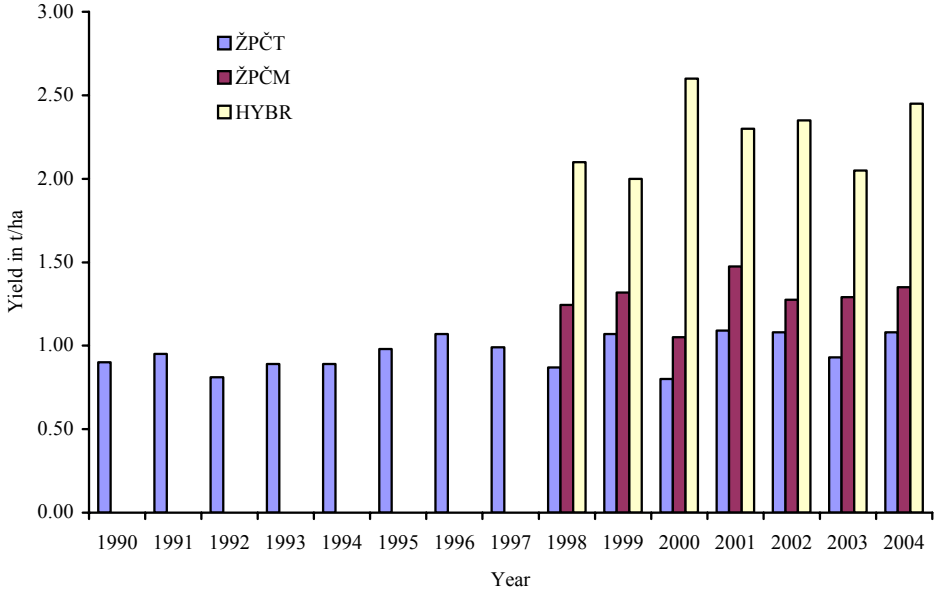

Figure 1. Progress of hop yields according to the Hop Institute Ltd. in Žatec

ANYLYSIS OF THE PARAMETERS FOR COMPUTATION

Yield

According to results of the monitoring of the Hop Institute Ltd. in Žatec, the average yield of hop was in the followed period 0.95 t/ha for ŽPČT, 1.28 for ŽPČV, and 2.23 for HYBR. The value in individual years is indicated in the Figure 1. The yield is relatively even and corresponds with normal distribution.

Farm price

Farm price of hop depends directly on the individual year and also on the exchange rate between CZK and USD or EURO. For the sake of analysis, we used average prices tracked by the Hop Institute Ltd. in Žatec. The analysis of this data yielded triangular statistical distribution (Figure 2). The average value of price in the period in question is 138 430 CZK/t for ŽPČT, 131 500 for ŽPČV, and 79 000 for HYBR.

Costs

The value of costs is analysed both on the basis of expert estimate and by evaluation of the computation of the consultation system AgroConsult for the growing technologies of ŽPČT, ŽPČV, and HYBR. The value of the costs I is an expert estimate, which approximates the current reality in the Czech hop-growing enterprises. The costs are by about CZK 25 thousand lower than value of costs II, which normatively reflects the costs of full renovation of hop plantations, grows and machinery. It reveals that the current farm prices make impossible for the enterprises to fully recover the costs of hop growing.

With regard to the fact that the data for more years were not available and that the cited values are rather expert estimate based on practical experience and computation by the expert system AgroConsult, we chose the triangular distribution, which better suits to such type of data source.

Table 1. Marginal conditions for modelling of yield in t/ha

Variety	Estimate		
	pessimistic	peak of distribution	optimistic
ŽPČT	0.80	1.15	1.35
ŽPČV	1.00	1.30	1.50
HYBR	1.60	2.25	2.70

Table 2. Marginal conditions for modelling of farm price in CZK/ha

Variety	Estimate		
	pessimistic	peak of distribution	optimistic
ŽPČT	107 000	135 000	160 000
ŽPČM	112 000	133 000	160 000
HYBR	70 000	80 000	100 000

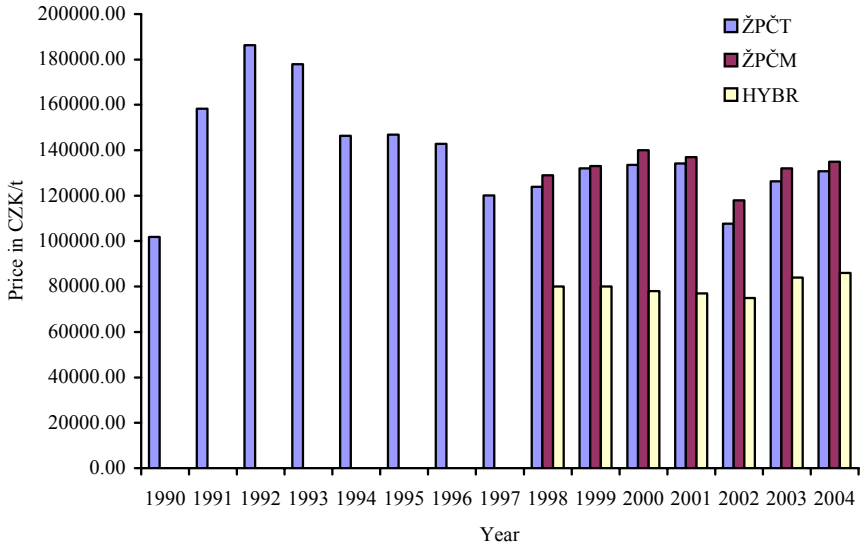

Figure 2. Progress of hop farm prices

Table 3. The marginal conditions for modelling of costs in CZK/ha

Type of costs	Variety	Estimate		
		pessimistic	apex of distribution	optimistic
Total costs I (Tc)	ŽPČT	160 000	147 000	135 000
	ŽPČV	175 000	162 000	150 000
	HYBR	190 000	178 000	160 000
Total costs II (Tc)	*ŽPČT*	*185 000*	*172 000*	*160 000*
	ŽPČV	*200 000*	*187 000*	*175 000*
	HYBR	*217 000*	*205 000*	*187 000*
Variable costs (Vc)	ŽPČT	135 000	120 000	114 000
	ŽPČV	146 000	136 000	130 000
	HYBR	160 000	148 000	135 000

Qualified estimate of the Market Production (MP), Gross Profit (GP), and Gross Margin (GM) – statistical computation from the values of most frequent incidence i.e. peak of distribution

The estimate of GP I, GP II, and GM (Table 4) must be considered as static, where stability of individual input parameters is assumed. But since the situation is constantly changing, it is obviously necessary to dynamise the parameters in order to get a better view. The question we asked the model was as follows: **What is the risk that in the case of change of parameters we will get GP on the level of qualified estimate?** ***When interpreting risk in the area of plant production, is it possible to use a classification where the risk up to 20% is low, 21 to 40% is acceptable, 41 to 60% high, and above 60% very high (unacceptable)?***

Table 4. Estimates of MP, GP and GM in CZK/ha

Type of costs	Estimate		
	ŽPČT	ŽPČV	HYBR
Market production (MP)	155 250	172 900	180 000
Gross profit I (GP I)	8 250	10 900	2 000
Gross profit II (GP II)*	–16 750	–14 100	–25 000
Gross Margin (GM)	35 250	36 900	32 000

*GP II is negative. For this reason, we analyse both this negative value and threshold of profit i.e. reaching zero GP II in our farther discussion.

Table 5. Characteristics of statistical indicators GP I, GP II and GM – ŽPČT variety (CZK/ha):

Indicator	GP I	GP II	GM
Mean value	–601.00	–25 656.86	23 820.35
Standard deviation	20 237.89	20 155.92	19 763.64
Minimal value	–58 258.55	–85 031.30	–35 058.55
Maximal value	83 956.39	41 428.53	83 956.39

RESULTS

Results for variety ŽPČT

By entering input parameters into the model, the following results were obtained for the ŽPČT variety:

a. Characteristics of statistical indicators GP I, GP II and GM (Table 5)

b. Common evaluation of GP I, GP II a GM in graphic rendering (Figure 3):

c. Interpretation of the question of risk analysis

Interpretation is established by statistical evaluation of the computed values.

Reaching GP I that was established by the qualified estimate (8 250 CZK/ha) can be expected with the risk of 65.8%. There is 34.2% probability of exceeding this value.

Reaching GP II – according to the qualified estimate, there is a loss in this case (–16 750 CZK/ha) that will occur with probability of 65.8%. Reaching zero profit can be expected with the risk of 88.9%. There is 11.1% probability of exceeding this value.

Reaching GM in value established by the qualified estimate (35 250 CZK/ha) can be expected with the

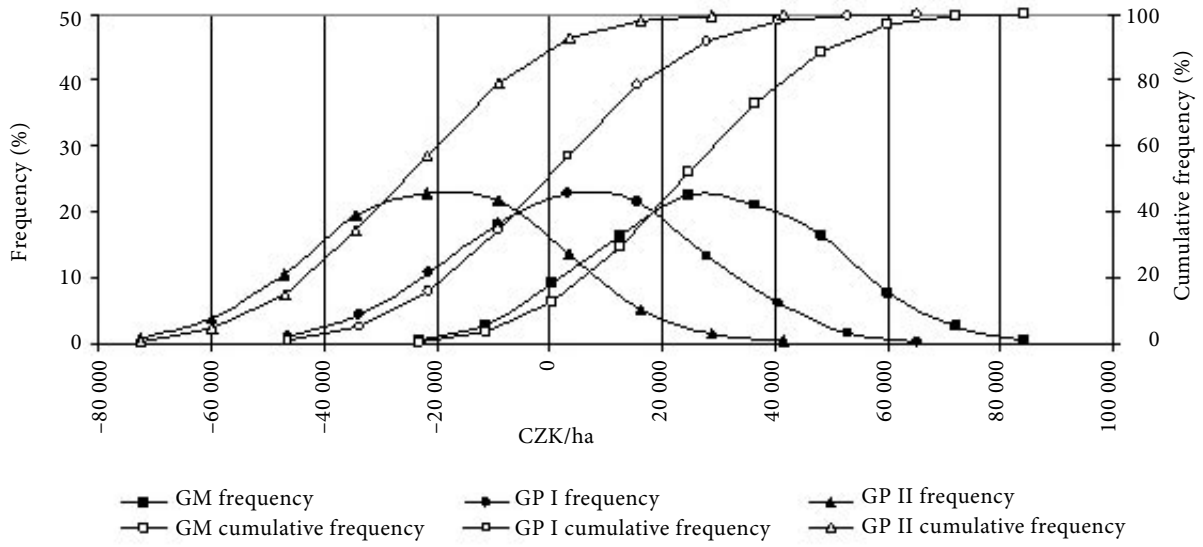

Figure 3. Common evaluation of GP I, GP II a GM in graphic rendering (ŽPČT variety)

risk of 70.6%. There is a 29.4% probability of exceeding this value.

Risk values for farther estimates of GP and GM are given in Table 6.

Results for ŽPČV variety

By entering input parameters into the model, we obtained the following results for variant ŽPČV:

a. Characteristics of statistical indicators of GP I, GP II and GM (Table 7)

Table 6. Overview of the risk values for the planned GP and GM – ŽPČT variety)

Gross profit (GP)			Gross margin (GM)	
planned CZK/ha	risk I %	risk II %	planned CZK/ha	risk %
10 000	68.8	95.4	50 000	90.1
8 500	66.2	94.8	40 000	77.6
6 000	61.9	93.7	30 000	61.4
5 000	60.1	93.3	25 000	52.6
4 000	58.4	92.9	20 000	43.2

Table 7. Characteristics of statistical indicators of GP I, GP II and GM – ŽPČV variety (CZK/ha)

Indicator	GP I	GP II	GM
Medium value	8 503.11	–16 170.85	33 499.57
Standard deviation	19 164.02	19 192.14	18 718.76
Minimal value	–46 346.77	–69 057.73	–17 432.87
Maximal value	73 443.54	44 790.69	90 785.54

b. Common evaluation of GP I, GP II and GM in graphic rendering (Figure 4)

c. Interpretation of the question of risk analysis

Interpretation is established by statistical evaluation of the computed values.

Reaching GP I that was established by the qualified estimate (10 900 CZK/ha) can be expected with the risk of 55.5%. There is 44.4% probability of exceeding this value.

Reaching GP II –according to the qualified estimate there is a loss in this case (–14 150 CZK/ha), that will occur with probability of 55.6%. Reaching zero profit can be expected with the risk of 79.6%. There is 20.4% probability of exceeding this value. *Reaching PU in value established by qualified estimate (36 900 CZK/ha) can be expected with the risk of 58.2%. There is a 41.2% probability of exceeding this value.*

Values of risk for further estimates of GP and GM are given in Table 8.

Table 8.Overview of risk values for the planned GP and GM – ŽPČV variety

Gross profit (GP)			Gross margin GM)	
planned CZK/ha	risk I %	risk II %	planned CZK/ha	risk %
20 000	71.5	96.2	50 000	79.8
10 000	53.8	60.4	40 000	63.6
8 000	49.8	88.3	30 000	43.9
6 000	45.8	86.1	25 000	33.9
5 000	43.7	85.0	20 000	25.2

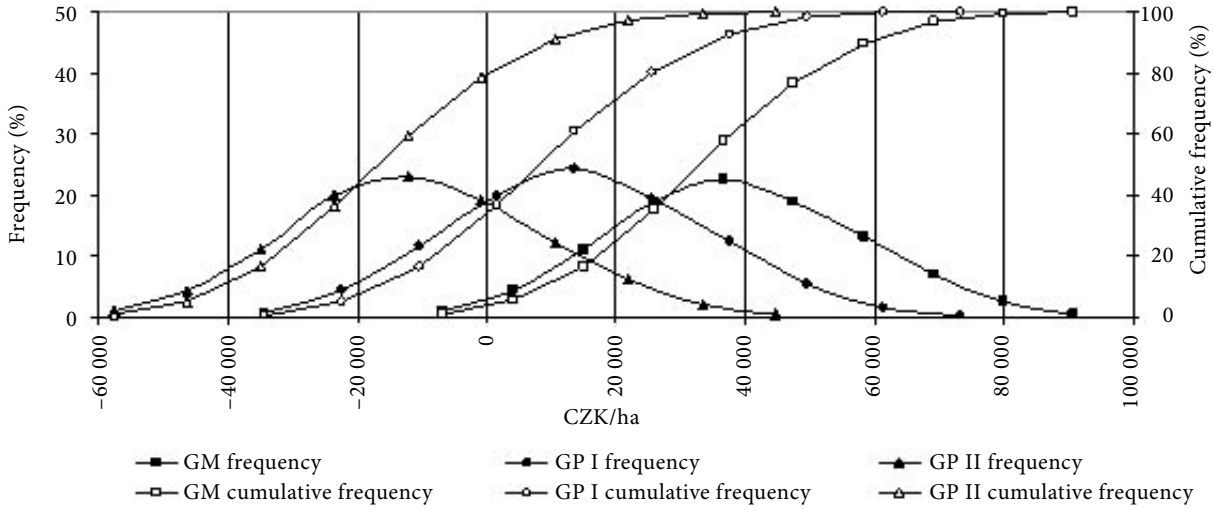

Figure 4. Common evaluation of GP I, GP II and GM in graphic rendering (ŽPČV variety)

Results for variety HYBR

By entering input parameters into the model, we obtained the following results for variant HYBR:

a. Characteristics of statistical indicators of GP I, GP II and GM (Table 9)

b. Common evaluation of GP I, GP II and GM rendered graphically (Figure 5)

c. Interpretation of the question of risk analysis

Interpretation is established by statistical evaluation of the computed values.

Reaching GP I that was established by the qualified estimate (2 000 CZK/ha) can be expected with the risk of 43.4%. There is 56.6% probability of exceeding this value.

Reaching GP II – in this case according to the qualified estimate there is a loss (–25 000 CZK/ha), that will occur with probability of 43.7%. *Reaching zero profit can be expected with the risk of 79.7 %. There is 20.3% probability of exceeding this value.*

Reaching GM in value established by the qualified estimate (32 000 CZK/ha) can be expected with the risk of 45.9%. There is a 54.1% probability of exceeding this value.

Values of risk for further estimates of GP and GM are given in Table 10.

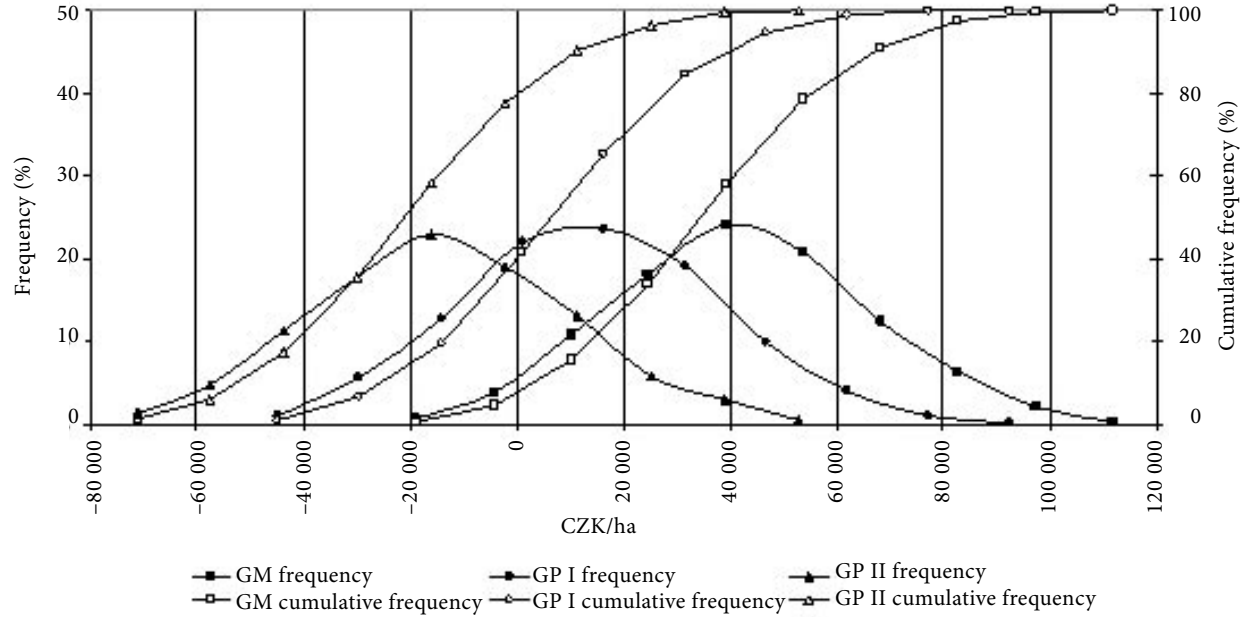

Figure 5. Common evaluation of GP I, GP II and GM rendered graphically (HYBR variety)

Table 9. Characteristics of statistical indicators of GP I, GP II and GM – HYBR variety (CZK/ha)

Indicator	GP I	GP II	GM
Mean	6 565.04	–20 687.70	34 971.09
Standard deviation	24 103.63	24 030.42	23 783.73
Minimal value	–59 949.34	–85 023.82	–33 377.81
Maximal value	92 211.51	52 719.05	111 817.51

Table 10. Overview of risk values for the planned GP and GM – HYBR variety

Gross profit			Gross margin	
planned CZK/ha	risk I %	risk II %	planned CZK/ha	risk %
5 000	48.0	84.5	50 000	73.3
4 000	46.5	83.5	40 000	59.0
3 000	44.9	82.4	30 000	42.5
2 500	44.2	82.1	25 000	34.2
2 000	43.4	81.6	20 000	27.8

CONCLUSIONS

We can draw the following results and recommendations from the analysis of the economic risks of the growing of hop:

1. When planning gross profit from growing of market crops, we must take into account the risk of not obtaining the planned results. Generally, the higher is the planned partial gross profit, the higher is the risk of not fulfilling the target. When interpreting the risk in plant production, it is possible to use the classification where risk to 20% is low, 21 to 40% acceptable, 41 to 60% high and above 60% very high (unacceptable).
2. It was proven that regarding hop growing, there is a very high risk of obtaining gross profit and higher gross margin for any variant. The riskiest variant is ŽPČT – traditional planting.
3. From the computations, it follows that there are not enough resources for full recovery of fixed costs especially for renovation of hop plantations and machinery. This long-term disproportion should be resolved by contributions for hop growing. The problems of the connected processing and sell chains should be also resolved.
4. The presented method of modelling economic risks of hop growing can be applied to other crops, too. The accuracy of the results of modelling positively correlates with the proximity of the growing region to the input parameters (production technologies, machines, and used material) or, even better, to the particular agricultural enterprise.

List of used symbols

GM – gross margin of hop growing (CZK/ha)
GP – gross profit of hop growing (market production – total costs (CZK/ha)
HYBR – hybrid varieties of hop
MP – market production from the hop growing (CZK/ha)
Tc – total costs of hop growing (CZK/ha)
Vc - variable costs of hop growing (CZK/ha)
ŽPČT – hop "Žatecký poloraný červeňák" – traditional planting
ŽPČV – hop "Žatecký poloraný červeňák" – virus free planting (meristémy)

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