THE SEED QUALITY AND YIELD OF SOYBEAN VARIETIES IN DEPENDENCE ON GROWING CONDITIONS

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Abstract: *Field experiment was established to evaluate the influence of different fertilization treatments on yield and relationship between quality parameters (proteins, oil, fibre, ash matters) of three soybean varieties Korada, Supra and OAC Vision at experimental farm Oponice (south-western Slovakia) in 2005-2007. The experimental site belongs to warm and moderate arid climatic region. Soybean was growing after sugar beat forecrop each year. The conventional tillage practices were used. Fertilization treatments were as follows: I. Non-fertilized control, II. LAV 27 % (40 kg.ha^{-1} N) in growing stage of first pair of true leaves (BBCH 101), III. Humix komplet (rate 8 L ha^{-1}) applied in growing stage of first pair of true leaves (4 L ha^{-1}) and before flowering (4 L ha^{-1}), IV. DAM 390 (20 kg ha^{-1} of N) applied in growing stage before flowering (BBCH 501). Seeds were inoculated by HiStick preparation. The significantly highest yield of soybean seeds was achieved in year 2005 (4.15 t ha^{-1}). The most productive variety was Korada (3.89 t ha^{-1}). Fertilizer DAM 390 highly significant influenced yield of soybean seeds (4.09 t ha^{-1}). Application of all forms of nitrogen increased yield of soybean seed expressed by relative response to control from 25.8% by application of LAV; 34.5% by application of Humix komplet; up to 38.6% in DAM 390. Experimental factors (year, variety, fertilization) significantly correlated with substance content in soybean seed. There was found out very high direct correlation dependency between fibre content and oil content. For agro climatic condition of south-west of Slovakia variety Korada and Supra are recommended.*

Key words**:** *soybean, variety, fertilization, yield, quality*

INTRODUCTION

Soybeans [(*Glycine max* (L.) Merr.] are becoming an important economic crop in many growing area as a major source of protein, energy, polyunsaturated fat, fibers, vitamins, minerals, both for humans and livestock. Soybean seeds contain an average of 36-38% protein and 19% oil, on dry weight basis, but both genetic and environmental factors can strongly affect the seed composition (KRISHNAN, 2000). In Slovakia acreage of growing area of soybean decrease to 5.5 thousand hectares with average yield 1.41 - 2.1 t ha^{-1} during 2006-2008. For increasing and the stabilization of growing area we need new commercially growing varieties suitable for Slovak conditions. As a result of breeding initiatives, several cultivars with improved yields, seed quality, protein content and quality, and disease resistance, are now being widely grown worldwide.

MATERIAL AND METHODS

Field experiment was established to evaluate the influence of different fertilization treatments on yield and yield components of three soybean varieties at experimental farm Oponice (West Slovakia, 48° 28´N, 18° 9´E)) in 2005-2007. The experimental site belongs to warm and moderate arid climatic region. The average rainfall is 607 mm. The average temperature is 9.5 °C, for the growing season 16.1°C. The main soil type is loamy Haplic Luvisols on loess. Forecrop was sugar beet each year. The conventional tillage practices were

used. Mouldboard ploughing in autumn and harrowing in the spring were used. During seedbed preparation pre-emergent herbicides were applied. The sowing/harvest data of growing soybean are as follows: 2005 3 May/10 October; 2006 27 April/20 October; 2007 24 April/1 October. The sowing pattern was 0.6 million of fertile seeds per hectare into the depth 0.05m, row space was 0.125m. The agrochemical soil characteristics before sowing are in table 1.

Table 1

The agrochemical soil characteristics (0.3m soil layer) before sowing in 2005-2007

Year	Content of available nutrients in soil (mg kg^{-1})							Humus %	pH
	N_{an}	N- NH_4^+	N- NO_3^-	P	K	Mg	Ca		
2005	37,71	11,37	26,34	82,0	323,0	200,0	5 220	2,68	7,19
2006	25,94	10,70	15,24	92,0	323,0	430,0	6 440	3,20	7,13
2007	27,00	14,82	12,18	60,0	232,0	260,0	2 310	2,42	7,48

Seeds were inoculated by HiStick preparation. The fertilization treatments were as follows: (I) unfertilized treatment; (II) application of nitrogen fertilizers LAV 27 % (40 kg ha^{-1} nitrogen) in the growth stage of first pair of true leaves unfolded – BBCH 101; (III) Humix komplet in split application of total dose 4+4 L ha^{-1} applied in growth stage of first pair of true leaves unfolded – BBCH 101 and in growth stage of first flower buds visible – BBCH 501, (IV) DAM 390 - 20 $kg.ha^{-1}$ N – BBCH 501. Growth stage of soybean was described according (Munger et al., 1997). Humix complet contain bioactive ingredient and nutrients for plant nutrition with 2.5% of humic acids, 4.0% total N, 0.5 P_2O_5, 3% K_2O, and micronutrients: Fe, Cu, B, Co, Zn, Mn, Mo and pH of 11-13. Grain yield and yield of aboveground biomass and harvest index were determined. The Canadian variety Korada, Supra and OAC Vision were tested. The aims of the present study were to evaluate the influence of different fertilization treatments on yield and relation between selected quality parameters (proteins, oil, fibre, ash matters) of three soybean varieties Korada, Supra and OAC Vision. Statgraphic plus for ANOVA analysis and correlation was used. Relative response was calculated according formula: [treated-control)/control x 100].

RESULTS AND DISCUSSIONS

Precipitation distribution influences the growing and development of soybean plants. Year 2005 and 2006 were characterised as normal in temperature with deficit precipitation rate during spring month. Sufficient amount of precipitation during July – September was noted in 2005. In 2006, only August has normal saturation of precipitation doses with dry July and September. The driest spring period (April-May) was noted in 2007. Yield of soybean seeds of three Canadian varieties response their capability to adaptation on Slovak growing conditions. The yield of seed in fertilization treatments of Korada, Supra and OAC Vision is documented in figure 1. The yield of soybean seed was influence by growing conditions, varieties and fertilization. According previous studies, the good growing conditions during formation of generative organs of soybean plants are precondition for the high yield of seeds (ŠINSKÝ et al., 1990; CANDRÁKOVÁ et al. 2008). The significantly highest yield, in average of years and fertilization treatments (excluding unfertilized control treatment) reached variety Korada (4.15 t ha^{-1}). Yield was 14-20% higher than yielded varieties Supra and OAC Vision. Application of fertilization significantly increases the yield of seeds.

Application of all forms of nitrogen increased yield of soybean seed expressed by relative response from 25.8% by application of LAV (40 kg N) growth stage of first pair of true leaves unfolded (BBCH 101), 34.5% by application of Humix komplet in both application data, up to 38.64% in DAM 390 apply before flowering (BBCH 501).

The better growing conditions were noted during 2005. Varieties Korada and Supra have significantly greater yield with comparison to OAC Vision (tab. 2). For evaluating causal effects we simply correlate the yield, year conditions, and supplement doses of nitrogen and different germplasm of commercial varieties in table 3.

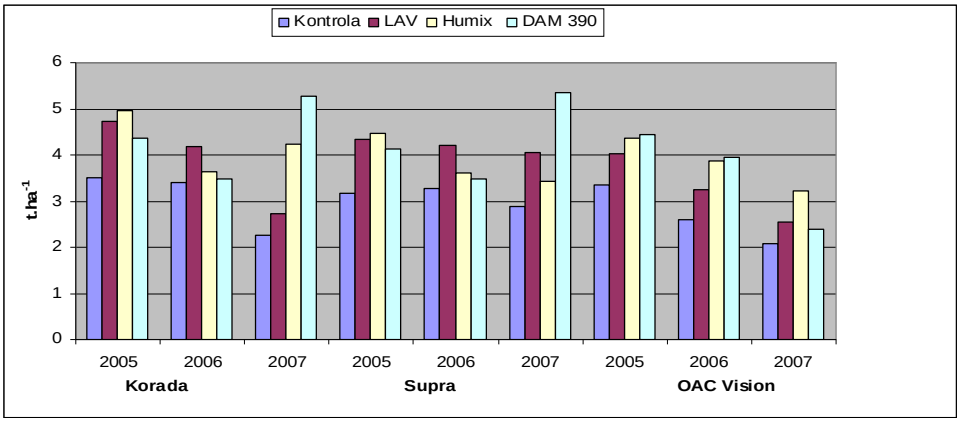

Figure 1: Yield of soybean varieties in different nitrogen fertilization treatments in t ha^{-1} during 2005-2007

Table 2

ANOVA analysis of significance of yield of soybean seeds 2005-2007. The means between years, varieties and fertilization followed by the same letter are not significant at P<0.05 probability level

Factor		Yield of seeds (t ha^{-1})
Year	2005	4.15b
	2006	3.57a
	2007	3.34a
Variety	Korada	3.89b
	Supra	3.86b
	OAC Vision	3.34a
Fertilization	Control	2.95a
	LAV	3.71b
	Humic komplet	3.97b
	DAM	4.09b

Table 3

Correlation coefficient of evaluated yield and quality parameters

Factor	Protein	Oil	Fibre	Ash
Yield	$-0,2837^{++}$	$-0,2343^{+}$	$-0,2361^{+}$	-0,0748
Year	$0,7230^{++}$	-0,0227	-0,0196	-0,0007
Variety	0,1655	$0,5070^{++}$	$0,5075^{++}$	$0,5219^{++}$
Fertilization	-0,0009	0,1700	0,1695	0,1132
Proteins	-	-0,0908	-0,0839	$-0,2423^{+}$
Oil	-	-	$0,9902^{++}$	$0,4536^{++}$
Fibre	-	-	-	$0,4487^{++}$

With concordance to IRIM (2008), year condition as integrated factors of temperature and precipitation has positive relationship with protein content. The content of oil, fibre and

ash reflects the response of genetic background of evaluated varieties to stress factors during seed formation. The stronger correlation relationship was between oil content and fibre.

CONCLUSIONS

The evaluated parameters were affected by variety, year conditions and by fertilization. For agro climatic condition of south-west of Slovakia variety Korada and Supra are recommended. There was found out very high direct correlation dependency between fibre content and oil content. Providing supplemental nitrogen increased yield of soybean seed expressed by relative response from 25.8% by application of LAV (40 kg N) growth stage of first pair of true leaves unfolded (BBCH 101) to 38.64% in DAM 390 apply before flowering (BBCH 501). Significantly higher yield of seeds was reached by variety Korada (3.89 t ha^{-1}) and Supra (3.86 t ha^{-1}) by comparison to OAC Vision (3.33 t ha^{-1}). The evaluated varieties Korada and Supra have high yield potential expressed in agro climatic condition of south-western Slovakia.

Acknowledgements: This paper was supported by VEGA project 1/0466/10 "Adaptation of sustainable agriculture and mitigation of impact of climate change.

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