PRODUCTION AND QUALITY OF MILK THISTLE (*SILYBUM MARIANUM* /L./ P. GAERTN.) CULTIVATED IN CULTURAL CONDITIONS OF WARM AGRI-CLIMATIC MACROREGION

ÚRODA A KVALITA PESTRECA MARIÁNSKEHO (*SILYBUM MARIANUM* /L./ P. GAERTN.) PESTOVANÉHO V KULTÚRNYCH PODMIENKACH TEPLÉHO AGRO-KLIMATICKÉHO MAKROREGIÓNU

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Abstract: *Polyfactorial field experiment was established and investigated during the vegetation periods of 2004, 2005 and 2006 at the Dolna Malanta locality (Nitra district, Slovak Republic). This locality is geomorphologically situated in western part of Zitava upland as an independent part of river Danube lowland. From the agriclimatic conditions point of view, this locality belongs to the warm agriclimatic region, dry agriclimatic microregion, and mostly mild winter zone. In the year 2004 yields of milk thistle (Silybum marianum /L./ P. Gaertn.) achenes, e.g. fruits, ranged from 232.9 kg.ha^{-1} (RMF variant: – incorporated crop residues with intercrop and artificial fertilizers) to 794.5 kg.ha^{-1} (KBF variant: – without crop residues and intercrop, artificial fertilizers have been used) at the standard humidity (14%). In the year 2005 the yields varied from 554.0 kg.ha^{-1} (RMO variant: – incorporated crop residues with intercrop, no artificial fertilizers) to 1 480.0 kg.ha^{-1} (RBO variant – incorporated crop residues without intercrop and artificial fertilizers). In the year 2006 the yields varied from 1 425.6 kg.ha^{-1} (RBO variant: – incorporated crop residues without intercrop, no artificial fertilizers) to 1 832.0 kg.ha^{-1} (KBF variant – without crop residues, without intercrop and with application of artificial fertilizers).*

Abstrakt: *Poľný polyfaktorový pokus bol založený a hodnotený počas vegetačného obdobia rokov 2004, 2005 a 2006 na lokalite Dolná Malanta (okres Nitra, Slovenská republika). Územie, kde je situovaná pokusná plocha, sa geomorfologicky nachádza v západnej časti Žitavskej pahorkatiny, t.j. samostatnej jednotky Podunajskej nížiny. V rámci územného agroklimatického členenia patrí lokalita do agroklimatickej oblasti teplej, agroklimatickej podoblasti suchej a agroklimatického okrsku prevažne miernej zimy. Priemerné úrody nažiek pestreca mariánskeho (Silybum marianum /L./ P. Gaertn.) v roku 2004 prepočítané na štandardnú sušinu (14%) sa pohybovali v intervale od 232,9 kg.ha^{-1} (variant RMF – zapracované pozberové zvyšky, s medziplodinou a s hnojením priemyselnými hnojivami) do 794,5 kg.ha^{-1} (variant KBF – bez pozberových zvyškov, bez medziplodiny a s aplikáciou priemyselných hnojív). V roku 2005 boli dosiahnuté úrody od 554,0 kg.ha^{-1} (variant RMO – zapracované pozberové zvyšky, s medziplodinou a bez hnojenia priemyselnými hnojivami) do 1 480,0 kg.ha^{-1} (variant RBO – zapracované pozberové zvyšky, bez medziplodiny a bez hnojenia priemyselnými hnojivami). V roku 2006 boli dosiahnuté úrody od 1 425,6 kg.ha^{-1} (variant RBO – zapracované pozberové zvyšky, bez medziplodiny a bez hnojenia priemyselnými hnojivami) do 1 832,0 kg.ha^{-1} (variant KBF – bez zapracovania pozberových zvyškov, bez medziplodiny a s aplikáciou priemyselných hnojív).*

Key words: *quantitative-qualitative parameters, milk thistle, Silybum marianum /L./ P. Gaertn, yield*
Kľúčové slová: *kvantitatívno-kvalitatívne parametre, pestrec mariánsky, Silybum marianum /L./ P. Gaertn, úroda*

INTRODUCTION

Milk thistle (*Silybum marianum* /L./ P. Gaertn.) is a medicinal plant cultivated in

agriculture. The achenes, e.g. fruits of the plant are commonly used as a medicinal drug, which are the raw material for isolation of different substances with liver-protection activity. Production of high quality milk thistle achenes depends on conditions of cultivation that directly influence the quality of final product. According to Spitzová – Starý (1985) the raised demand for the drug – *Silybi mariani semen* – caused needs of their cultivation in cultural conditions as well as shows more issues and questions from the point of view agronomic and physiology character. The obtained yield depends mainly on the managing of mechanization harvest (Gromová et al., 1988; Schuenke, 1992), because of non-uniform ripening time of the milk thistle fruits. Milk thistle belongs to the medicinal plants, which introduction to the cultural growing condition of Slovakia was successful (Gromová et al., 1993; Šalamon, 2000). Recovery of milk thistle cultivation in the conditions of Slovakia nowadays is a result of long-term research of Gromová (1997) and introduction of food adjunct (*Anthemis – food adjunct for the liver*) to the production in 2005. The food adjunct contains dry extract from milk thistle achenes in combination with the extract from Dyer's Chamomile (*Cota tinctoria* /L./ J. Gay).

MATERIAL AND METHODS

The medicinal plant milk thistle (*Silybum marianum* /L./ P. Gaertn.) belongs to the *Asteraceae* family. Different genera of *Silybum* sp. are widely cultivated in the agri-ecological conditions of Slovakia. Cultivar ´Silyb´ originated from Czech Republic is the most cultivated one as well as the most used for the pharmaceutical processing. It provides the achenes production with appropriate quality. This cultivar was used for direct sawing on the plots of Experimental Base in this experimental work. Experimental Base of Faculty of Agrobiology and Food Resources, Slovak University of Agriculture in Nitra is situated in cadastre of Dolna Malanta village near Nitra, Slovak Republic (18°07` E, 48°19` N). Geographically this locality is situated in the western part of river Zitava upland. Experimental locality has flat character with little declination to south. The altitude is 177-180 m above sea level (Hanes et al., 1993). The experiment was realized in the framework of agri-climatic areas in the territory with the following features: *Macro area:* warm with sum of temperature during days when t > 10°C in a range of 3,100 – 2,400°C; *Area:* predominantly warm with temperature t > 15°C in a range of 3,000 – 2,800°C; *Sub area:* very dry with climatic humidity factor for the months June – August $K_{VI - VIII}$ = 150 mm; *ward:* predominantly mild winter with an average of absolute temperature minimum T_{min} = from -18 to -21°C. The average long-term (1961 – 1990) annual precipitation is 532.5 mm, for the vegetation period it is 309.4 mm (Table 1). The average long-term (1961 – 1990) annual temperature is 9.8°C and for the vegetation period it is 16.4°C (Špánik et al., 1996). Type of the soil is brown soil. Selected soil properties: proportional soil weight: 2.60 – 2.63 $t.m^{-3}$; content of humus in arable soil / topsoil is 1.95 – 2.28 %; soil reaction: 5.03 – 5.69 (acidic, almost mild acidic). The experimental soil was created at the proluvial sediments. The soil profile of brown soil contains three genetic horizons (Ap, Bt, C), and their stratography is following: Humus horizon (Ap) with depth 0.00-0.32 m; underneath, which is the main diagnostic luvisolic Horizon (Bt) and this one was created as a result of alluvial accumulation of translocated colloids. Its depth is from 0.33 to 0.65 m. Then there is a transitional horizon (Bt/C) with a depth from 0.66 to 0.85 m and follows continually into the soil forming substrate up to the depth of 1.5 m. The studied brown soil is clayey in its sub layer and in its topsoil is mildly firm. Humus is of a humo-phulvate type (Hanes et al., 1993). Polyfactorial field experiment was established and experimentally controlled during the vegetation period of the years 2004 – 2006. The experiment was arranged in one independent block. Plant material was harvested in the ontogenetic stage the achenes ripening. Harvesting was done with adapted combine harvester. The yield data of milk thistle achenes was taken

from randomly selected areas (3 x 1 m^2, e.g. three replications in each variant) and calculated to the yield in $kg.ha^{-1}$. Milk thistle is an annual crop, therefore it was fully integrated to four-cycle *crop rotation* with following order of crops: 1. Common pea; 2. Winter wheat; 3. Milk thistle; 4. Maize cultivated for grains (Kováč et al., 2005; Macák et al., 2006). Description of variants: (1) *Crop residues* of cultivated pre-crop: first year maize, than according to the crop rotation winter wheat (no crop residues - K, with crop residues - R); (2) Cultivation of white mustard (*Sinapis alba* L.) as a freezing-out *intercrop* (no intercrop - B, with intercrop - M); (3) *Fertilization* using artificial fertilizers (no fertilization - O, with fertilization - F). There were used doses of nutrients in the fertilized variant calculated according to Kubínek (1987): 20.0 $kg.ha^{-1}$ N, 20.0 $kg.ha^{-1}$ P and 80.0 $kg.ha^{-1}$ K.

Table 1

Average air temperatures (T) and sums of precipitation (P) of the experimental locality in month intervals during the long-term period 1961-1990 (Špánik et al., 1996)

Month	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	Year	IV. –IX.
T (°C)	-1.7	0.6	5.0	10.4	15.1	18.0	19.8	19.3	15.6	10.3	4.5	0.2	9.8	16.4
P (mm)	31.2	31.8	29.6	38.5	57.7	64.0	51.4	57.7	40.1	35.8	54.8	39.9	532.5	309.4

RESULTS AND DISCUSSION

The yields of milk thistle (*Silybum marianum* /L./ P. Gaertn.) achenes were recorded on the investigated variants in 2004 as follows: variant without crop residues from 588.6 $kg.ha^{-1}$ (KMO – with intercrop, no fertilizers) to 794.5 $kg.ha^{-1}$ (KBF – no intercrop, with fertilization) as it is shown in Table 2. At the variants with crop residues, there were found obtained yields from 232.9 $kg.ha^{-1}$ (RMF – with intercrop and fertilization) to 580.3 $kg.ha^{-1}$ (RBO – without intercrop and no fertilization). In the second experimental year (2005), yields were found in the variants without crop residues from 1,005.0 $kg.ha^{-1}$ (KBO – no intercrop, no fertilization) to 1,314.0 $kg.ha^{-1}$ (KBF – without intercrop, with fertilization). In the variants, which the crop residues were ploughed under, the yields were measured from 554.0 $kg.ha^{-1}$ (RMO – with intercrop, no fertilization) to 1,480.0 $kg.ha^{-1}$ (RBO – without intercrop, no fertilizers). In the third year of experiment (2006) the yields varied from 1 425.6 $kg.ha^{-1}$ (RBO variant: – incorporated crop residues without intercrop, no artificial fertilizers) to 1 832.0 $kg.ha^{-1}$ (KBF variant – without crop residues, without intercrop and with application of artificial fertilizers). Danim – Yom-Tov (1990) described the accumulation of yield potential of above ground biomass and yields of achenes within milk thistle as a medicinal plant. These authors characterized the yields of milk thistle achenes as depended mostly on applied artificial fertilizers. It is possible to consider as an average obtained yield of milk thistle about 0.75 $t.ha^{-1}$, in optimal growing conditions it can be even more than 1.5 $t.ha^{-1}$ (Kubínek, 1987). The milk thistle yields in the agri-ecological conditions of south Slovakia were recorded from 0.5 to 1.7 $t.ha^{-1}$ (Gromová et al., 1993; Habán, 1996, 2004). Obtained yields of this medicinal plant in the experiment within evaluation of influence of crop residues, intercrop, and fertilization correspond to the results of these authors.

CONCLUSIONS

Selected quantitative parameters of milk thistle (*Silybum marianum* /L./ P. Gaertn.) yields were analyzed during 2004 – 2006 growing seasons. According to three years results it is recommended to continue the research of the production parameters of milk thistle yields in following growing seasons. There will be a qualitative parameters of milk thistle yield (content of active ingredients in the drug sylimarine: silychristin, silydianin, silybin and isosilybin –

determined according to adapted method of Quaglia et al., 1999 using HPLC analytic system) added in the next stage of the research.

Table 2

Average yields (kg.ha^{-1}) of milk thistle (*Silybum marianum* /L./ P. Gaertn.) at the standard humidity level (14%) in 2004 – 2006

Variants			Yield / Years		
Crop residues	Intercrop	Fertilization	2004	2005	2006
No crop residues (K)	No intercrop (B)	No fertilization (O)	644.8	1.005.0	1.699.0
		With fertilization (F)	794.5	1.314.0	1.832.0
	With intercrop (M)	No fertilization (O)	588.6	1.063.0	1.763.5
		With fertilization (F)	689.7	1.294.0	1.790.5
With crop residues (R)	No intercrop (B)	No fertilization (O)	580.3	1.480.0	1.426.5
		With fertilization (F)	328.6	1.317.0	1.697.0
	With intercrop (M)	No fertilization (O)	295.3	554.0	1.572.0
		With fertilization (F)	232.9	1.071.0	1.660.0

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