Pestic. Phytomed. (Belgrade), 27(3), 2012, 245–252
DOI: 10.2298/PIF1203245T

UDC: 632.951:632.937:582.998.2
Scientific paper

The Possibilities of Slovakian Pyrethrum Production

Štefan Tóth[1], Michal Stričík[2], Štefan Týr[3] and Tomáš Vereš[3]

[1]Centre of Crop Production Reseach Piešťany, Research Institute of Agroecology Michalovce, Špitálska 1273, 071 01 Michalovce, Slovak Republic (toth@minet.sk)
[2]The University of Economics in Bratislava, Faculty of Business Economics with seat in Košice, Tajovského 13, 041 30 Kosice 1, Slovak Republic (michal.stricik@euke.sk)
[3]Slovak University of Agriculture in Nitra, Faculty of Agrobiology and Food Resources, Department of Sustainable Agriculture and Herbology, Tr. A. Hlinku 2, 949 76 Nitra, Slovak Republic (Stefan.Tyr@uniag.sk; Tomas.Veres@uniag.sk)

Received: July 12, 2012
Accepted: September 4, 2012

SUMMARY

This paper discusses possibilities for pyrethrum *Chrysanthemum cinerariaefolium* (Trevir.) Vis. production in southern regions of Slovakia, with an emphasis on target marketing, management constraints and further research. Pyrethrum is not a traditional crop in Slovakia but prospects have opened up for its cultivation. The high yields and quality of some suitable pyrethrum ecotypes provide the grounds for effective field production under favorable conditions. Pyrethrum yielding 1.275 t of dried flowers per hectare and having at least 1.5% pyrethrum content can be a profitable and highly lucrative crop with an economic result ranging from 413 to 1071 € per ha. A SWOT analysis revealed that pyrethrum production in Slovakia could take a course of an offensive strategy. However, intensive production of this commodity needs further development. Prospects for this non-traditional crop in Slovakia are also promising in terms of development of farming systems in which plant protection products of botanical origin would be welcome. Improved processing and stabilization of extract would further increase the possibilities.

Keywords: Pyrethrum; Slovakia; Prospects

INTRODUCTION

Current situation (DIRECTIVE 2009/128/EC) and prospective insecticide uses raise a number of questions and offer many unconventional market alternatives. Production and subsequent uses of plant materials and their phytoproducts is one of possible alternatives in the Slovak Republic (Tóth, 2011). One of the historically oldest phytopesticides on the markets is pyrethrum (Copping, 1998).

Pyrethrum is an insecticide of plant origin in extract or drug form but pyrethrum could also be the source of extract or drug. The sources of pyrethrum are some plants of similar names, especially *Chrysanthemum cinerariaefolium*

(Trevir.) Vis. (syn. *Pyrethrum cin., Tanacetum cin.*), belonging to the large *Asteraceae* family (Copping, 1998; Tomlin 2003; Elroby and Aziz, 2011).

Current taxonomic classification has transferred this species from the *Chrysanthemum* genus to *Tanacetum*. The species is called pyrethrum in the Slovak botanical nomenclature (Červenka et al., 1986; Dostál, 1989). Pyrethrum in its refined form is a yellow, viscous substance with oily consistency and weak flower odor. It is a compound consisting of six knows esters commonly referred to as pyrethrums. Pyrethrum is highly effective against many species of insects but its toxicity to people and warm-blooded animals is low because of its fast biotransformation (Crombie, 1980; Gerberg, 1995; Tomlin, 2003; Duchon et al., 2009; Srivasteva et al., 2011). It could be used by municipal utilities, or in organic, integrated or conventional crop cultivation because of its natural origin and high biocide effect. Pyrethrum has been used mainly for protection of cereal products, vegetables and animals. It could also be used to protect human habitats and animals against insects. There are two possible uses: the first is spraying the fine dry pulp of flowers and the other spraying their extract. A third form is incense sticks to protect against mosquitoes causing malaria. There are some extracts of pyrethrum used in sprays in many homes (MacDonald, 1995; Silcox and Roth, 1995; Nazari and Kambrabani, 2008).

The aim of this paper is to show the prospects for marketing pyrethrum produced away from its area of origin. We show retrospective participation of different countries and their world market shares, including pyrethrum products and some other production data.

MATERIAL AND METHODS

We used COMTRADE and FAOSTAT statistics for identifying the commodity and analyzing its historical development and status of world production, both imports and exports. We used COMTRADE data for commodity 130214 – Pyrethrum. These data show the financial value of pyrethrum's world imports and exports including products in USD and identify major importers and exporters. Statistical data from FAOSTAT were used to show the world scope of harvest areas, yields and production of pyrethrum in the period 1961-2010 (status 2012).

For a financial assessment of prospects for Slovak production of pyrethrum we used selected yield data (Tóth, 2011) and we adapted the calculation formula of RIAFE (Kubánková and Burianová, 2009). An earlier study by Tóth (Tóth, 2011) indicated possibilities for pyrethrum production in the Eastern Slovak Lowland, and reported detailed data about pyrethrum yields and growing conditions. The adapted calculation formula of RIAFE is suitable for a comprehensive financial statement of cost analysis for the growing process of reintroduced or newly introduced crops (Porvaz et al., 2011).

In the submitted work we also presented a SWOT analysis of prospects for pyrethrum production in Central European conditions with special regard to Slovak specificities. The SWOT analysis was used to describe the position of Slovak pyrethrum production internally and externally, which can identify a recommended future strategy based on product analysis and matching of strengths and weaknesses of the production on the one side, and production opportunities and threats on the other. This analysis assigns a weight to each criterion, percentages from 0 to 100, and strengths from 1 to 10. The higher the rating is, the higher the force. The resulting value is the product of weight and strength of a criterion. The recommended future strategies are established by matching the figures for each criterion, and quantifying the difference between the strengths and weaknesses, and opportunities and threats. The results of determination of our position in the coordinate system show a resulting product strategy. For the SWOT analysis, we adapted the approaches of Global Development Solutions (2011), the critical success factors in product development (Cooper and Kleinschmidt, 2007) and the strategy model valuation (Slávik, 1997; Zoborský et al., 2003).

RESULTS AND DISCUSION

The world scope of harvest areas, yields and weight production of pyrethrum in the period 1961-2010 is presented in Table 1. The trade value of pyrethrum world imports in USD and net weights in kg are presented in Table 2. According to this data, the world's most important pyrethrum producing country is Kenya. The world production reached 21,000 tons in 1972, with Kenya accounting for 14,400 t, Tanzania for 4,300 t, Rwanda for 1,000 t, Ecuador for 1,000 t and Japan for 380 t. In the 1980s, the world production of pyrethrum decreased with an expansion of synthetic pyrethroids. Currently, the world's pyrethrum stocks reach nearly 5,000 tons. The pyrethrum world import trade value is nearly 70 million USD and its net weight is nearly one thousand tons.

Table 1. Global scope of harvest areas, yields and weight production of pyrethrum in the periods 1961-2004 and 2005-2010, annually

Time period /Country	1961-2004			2005	2006	2007	2008	2009	2010
Index	**Minimum**	**Maximum**	**Average**						
Harvested area (ha)									
Japan	0	2.000	431.8	0	0	0	0	0	0
Papua New Guinea	150	1.700	918.6	1.800	1.800	1.800	1.800	1800	1.800
Rwanda	840	3.850	2.043.0	2.200	2.200	2.200	2.200	2.200	2.200
Ecuador	5	8.963	1.437.8	210	210	210	210	210	210
Tanzania	7.500	79.481	20.793.5	6.000	15.000	12.000	13.000	9.000	9.000
Kenya	7.633	37.000	18.486.9	9.000	9.000	9.000	1.000	500	500
WORLD TOGETHER	18.137	111.529	44.111.6	19.210	28.210	25.210	18.210	13.710	13.710
Yield (kg/ha)									
Tanzania	43.4	350.0	159.9	166.7	186.7	175.0	176.9	177.8	144.4
Papua New Guinea	333.3	588.2	465.9	611.1	611.1	611.1	611.1	611.1	611.1
Rwanda	251.0	561.0	427.2	454.5	454.5	454.5	454.5	454.5	454.5
Ecuador	177.1	789.5	438.2	500.0	500.0	500.0	500.0	500.0	500.0
Kenya	296.9	1.579.0	691.3	888.9	888.9	888.9	854.5	988.6	781.8
Japan	0.0	1.000.0	511.3	0.0	0.0	0.0	0.0	0.0	0.0
WORLD TOGETHER	161.0	1.092.1	459.6	619.7	485.8	515.9	332.8	364.6	339.6
Weight (t)									
Bolivia	0	40	3.1	0	0	0	0	0	0
Brazil	0	200	72.7	0	0	0	0	0	0
Tunisia	0	200	88.6	0	0	0	0	0	0
Italy	0	300	134.1	0	0	0	0	0	0
Morocco	150	300	177.3	0	0	0	0	0	0
Japan	0	2.000	413.6	0	0	0	0	0	0
Papua New Guinea	50	1.000	446.9	1.100	1.100	1.100	1.100	1.100	1.100
Ecuador	3	3.974	553.7	105	105	105	105	105	105
Rwanda	337	1.753	867.9	1.000	1.000	1.000	1.000	1.000	1.000
Tanzania	1.132	6.015	2.484.5	1.000	2.801	2.100	2.300	1.600	1.300
Kenya	5.269	28.643	11.150.5	8.000	8.000	8.000	855	494	391
WORLD TOGETHER	9.046	32.546	16.392.9	11.904	13.704	13.006	6.060	4.999	4.656

Abbreviation (1 t = 1000 kg)
Source: by FAOSTAT

Table 2. Pyrethrum world imports and the most important European importers, 2006

Country	Trade value (USD)	Net weight (kg)
USA	44.040.372	619.822
Canada	1.224.704	11.042
Italy	3.971.226	31.858
Spain	2.159.726	16.555
France	2.006.366	44.802
Netherlands	1.977.414	18.042
Germany	1.118.000	11.609
Switzerland	657.022	5.284
Sweden	185.314	1.290
UK	140.910	2.398
Belgium	105.203	2.498
Other.countries	11.365.587	154.727
WORLD TOGETHER	68.951.844	919.927

Source: by COMTRADE

The world's most important producer is still Kenya (Table1). FAOSTAT and COMTRADE data (Table 1 and 2) also identify other important pyrethrum producers, such as Papua New Guinea, etc., as well as leading importers (USA, Italy, Canada, etc.). Other countries where *Chrysanthemum cinerariaefolium* (Trevir.) Vis. is grown for insecticide use includes Australia, Brazil, Bulgaria, California, France, Russia, Spain, and Switzerland. Today we see a great effort of many research institutes and commercial companies to revitalize for many reasons the cultivation and processing of pyrethrum in agrarian systems in Croatia (Crmanić and Lelaska, 2003; Oplanić et al., 2005; Grdiša et al., 2009). It is similar in many European and overseas countries (Bhat and Menary, 1984; Zito, 1994; Singh and Singh, 1996; Otterbach, 2000; Salardini, 2001; Nazari and Kambrabani, 2008; Duchon et al., 2009).

The species *Chrysanthemum cinerariaefolium* (Trevir.) originating in Dalmatia has been described and accredited since 1840. According to various data, this European variant of Persian chamomile had been introduced to the favourable climatic and geographic conditions of the Adriatic coast. The species' area of distribution expanded to all inhabited continents and substituted another conventional source of pyrethrum owing to its economic aspect. Its cultivation has expanded in African countries, mainly in Kenya (1930), Tanzania and Rwanda, and in Ecuador, Papua New Guinea (1950) and Australia (1980). The countries involved in cultivation of pyrethrums and their imports and exports include France, German, Italy, Japan, the Netherlands, Brazil, Russia, Switzerland, Spain, Canada, Bulgaria, Serbia, Slovenia, etc. The idea of revitalization of its production and processing originates in Croatia, the ex-leader of world production (Bhat and Menary, 1984; Červenka et al., 1986; Dostál, 1989; Copping, 1998; Tomlin, 2003; Oplanić et al., 2005).

Pyrethrum as an agent with insecticidal effects was officially accepted for expoitation in the Adriatic region in 1860. It was the Dalmatian *Chrysanthemum cinerariaefolium (*Trevir.) Vis. that was planted on 2000 ha and its average yield reached 1000 t of dry drug in 1909. Croatia became the leader in world production of pyrethrum in 1914 (Ožanić, 1955 cit. in Oplanić et al., 2005). This crop production was leading on the world market because of the highly valued qualitative and quantitative characteristics of plant material grown in the Dalmatian region and in other parts of the former Yugoslavia (Montenegro, Herzegovina, Dubrovnik, Krk and Hvar islands), considering its quality and pyrethrins contents.

Pyrethrum production stopped in the Adrian area after the outbreak of First World War in 1914. Japan then emerged as a leader on the world market. It all changed again in the year 1918, when Dalmatia renewed its production. Pyrethrum production reached 1,000 t in 1919. It was discovered the same year that kerosene extracts of pyrethrum, obtained from dried slacks, had insecticidal effect. There was a gradual decrease in the production of pyrethrum powder on the market. The powder form of pyrethrum was replaced by liquid products about nine years later (Copping, 1998; Tomlin, 2003; Oplanić et al., 2005).

The results of a research by Staudinger and Ruzicka (1924) about structure identification of the active compound in pyrethrum extract were published in 1924. Based on these facts it was possible to initiate chemical synthesis of synthetic analogs. This led to a decline in the share of natural pyrethrins on the world market (Crombie, 1980). Cultivation of pyrethrum was abandoned despite the high quality of its genetic material in later years. The world's production center moved to areas of East Africa, mainly Kenya (1930), and Rwanda (1950), and to Ecuador. Kenya was the world's main producer of pyrethrum in 1945 and it still is. For the purpose of selecting new clones, seed was introduced to Kenya from Dalmatia between 1995 and 1997.

Wild growing *Chrysanthemum cinerariaefolium* (Trevir.) Vis. was considered hypothetically extinct in some areas of the former Czechoslovakia. Today there are not any current botanical records of this naturally occurring species in Slovakia or its extinct forms. There was some verification of possibly efficient pyrethrum production based on different ecotypes of this plant species and some efforts in Slovakia to design a production

technology with regard to optimum drug yield. Five ecotypes of *Chrysanthemum cinerariaefolium* (Trevir.) Vis. and one ecotype of *Chrysanthemum parthenium* (L.) Smith (syn. *Pyrethrum part., Tanacetum parth.*) were tested in different size plots, 0.5-0.4-0.3 m x 0.3 m, on an alluvial soil in the climatic conditions of Eastern Slovakian Lowland in 2005. The average yield of the most productive ecotype of *Chrysanthemum cinerariaefolium* (Trevir.) Vis. was 1056.3 kg.ha^{-1} of dry floral anthodium (drug) and 870.1 – 1023.9 – 1275.0 kg.ha^{-1} considering crop density. According to crop density, other productive ecotypes had the average drug yields of 860.5 kg.ha^{-1} and 695.4 – 851.9 – 1034.3 kg.ha^{-1}. Both of the best productive ecotypes of *Chrysanthemum cinerariaefolium* (Trevir.) exceed with their production the world's average best vintage (Tóth, 2011).

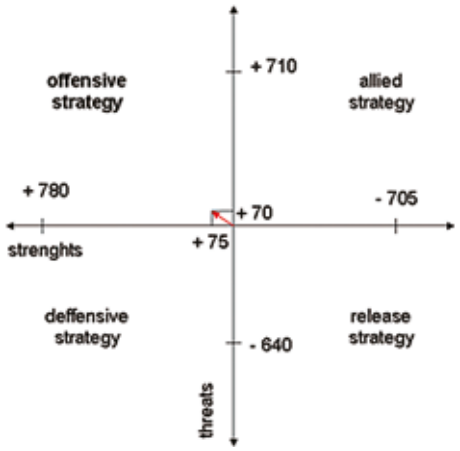

Figure 1. The offensive strategy as a result of SWOT prospects for Slovak pyrethrum production

Table 3. Structure of own production costs for pyrethrum *Chrysanthemum cinerariaefolium* (€) under RIAFE calculation formula (by seed availability and exercise price of $ 4 per kg dry drugs and rate of $ 1.4389 per € 1)

Index	**Second most productive ecotype**			**Most productive ecotype**		
Crop organization |m x m|	0.5 x 0.3	0.4 x 0.3	0.3 x 0.3	0.5 x 0.3	0.4 x 0.3	0.3 x 0.3
Seeds purchased	90	113	150	90	113	150
Seeds produced	0	0	0	0	0	0
Fertilizers purchased	50	50	50	50	50	50
Fertilizers made	0	0	0	0	0	0
Chemical protective equipment	25	25	25	25	25	25
Other direct material	5	5	5	5	5	5
Salaries	793	972	1.180	993	1.168	1.455
Social costs	278	340	413	347	409	509
Repairs and maintenance	0	0	0	0	0	0
Depreciation of tangible fixed assets	0	0	0	0	0	0
Agrochemical services	12	12	12	12	12	12
Other direct costs and service	15	15	15	15	15	15
Costs of ancillary activities	142	142	142	142	142	142
Reducing costs of settlement proceeds	0	0	0	0	0	0
Direct costs together	1.410	1.674	1.992	1.679	1.939	2.363
Production director	70	70	70	70	70	70
Administrative director	40	40	40	40	40	40
Total production costs per ha	1.520	1.784	2.102	1.789	2.049	2.473
Yield kg/ha	695.4	8.51.9	1.034.3	870.1	1.023.9	1.275.0
Production costs for main product ha	1.520	1.784	2.102	1.789	2.049	2.473
Production costs per ton	2.186	2.094	2.033	2.056	2.001	1.940
Revenue per ha	413	584	773	629	797	1.071
Revenue per ha	1.933	2.368	2.875	2.419	2.846	3.544
Subsidy per ha	0	0	0	0	0	0
Profit or loss per ha	413	584	773	629	797	1.071
Economic result per t	594	685	747	723	779	840

Source: own calculation

Table 4. SWOT analysis of prospects for Slovak production of pyrethrum

strenghts	W/V	F	weaknesses	W/V	F
– economic attractiveness, potential high return possibility of implementing marketing drugs (dried flowers) as well as final product (stabilized extract)	25/10	250	– lack of tradition in production and marketing and in commodity utilization	25/7	175
– existing international market demand and developed pyrethrum market (pharmacological industry and production of pesticides)	20/8	160	– relatively unfavourable availability and financial cost ratio for genetic material	35/6	210
– suitable soil and climatic conditions for pyrethrum production in southern Slovakia	20/6	120	– intensity of manual work		
– utilization of existing technical resources in the production process	10/4	40		40/8	320
– alternative to extensive production	5/2	10			
total	100	+ 780	**total**	100	– 705
opportunities	**W/V**	**F**	**threats**	**W/V**	**F**
– diversification of plant production structure	20/7	140	– undercapitalization of innovative research and development	70/7	490
– possibility to compensate for crops losses in marketing	15/8	120			
– development of domestic processing and finalization	30/8				
– applicability as phytoproduct in the municipal sector and plant protection systems in all land management and animal welfare	35/6	240	– undercapitalization of registration process for the final product	30/5	150
		210			
total	100	+ 710	**total**	100	– 640

W – weight, V – value, F – force

These ecotypes have a potential to be highly lucrative crops with economic results in the range of 413-1071 € (Table 3) because this annual crop could achieve 1.5 % content of pyrethrum in dry drug and a reasonable price of 4 $.kg^{-1}$ of dry drug. Labor cost is the principal item in our own costs calculation. This item consists of harvesting by hand with its efficiency calculated for the dry drug in the range of 1.4 to 2.1 kg per hour. Intensive growth of productive ecotypes needs further research and progress focused on innovative solutions for agricultural engineering elements, including the harvesting, as well as for food crops in relation to pyrethrum content in the drug and also for breeding. The yields of the less productive ecotypes of *Chrysanthemum cinerariaefolium* (Trevir.) Vis. were 355.8 $kg.ha^{-1}$ and 114.7 $kg.ha^{-1}$. These ecotypes are inappropriate for intensive growing in agro-environmental conditions in Slovakia but they may be appropriate for extensive production excepting the ecotype production of 2.5 $kg.ha^{-1}$ dry drug.

The average yield of the tested ecotype of *Chrysanthemum parthenium* (L.) was 253.1 $kg.ha^{-1}$ dry floral anthodium and 231.9 – 245.5 – 281.9 kg/h according to crop density. This ecotype is appropriate for extensive production in Slovak agro-climatic conditions and it has some specificity compared with *Chrysanthemum cinerariaefolium* (Trevir.) Vis. The positive aspect is its easily accessible and less costly genetic material. The negative aspects are higher demands, required labor for harvesting two to four times smaller flowers, lower pyrethrum contents in the appropriate drug, and reduced marketing feasibility.

Table 3 shows an analysis of prospects for a domestic production of pyrethrum. According to SWOT analysis (Table 4, Figure 1) it could take a course towards an offensive strategy for Slovakian pyrethrum production. The offensive strategy is the most attractive option. It is suitable for conditions in which strengths prevail over weaknesses and opportunities over threats. To utilize the strengths and opportunities offered by the sector a long-term strategic decision is required based on tactical and operational measures with medium- to short-term time frame.

REFERENCES

Bhat, B.K. and Menary, R.C.: Pyrethrum production in Australia: Its past and present potential. Journal of the Australian Institute of Agricultural Science, 50(3): 189-192, 1984.

COMTRADE DATA: http://www.comtrade.com [cit.20.02.2012].

Cooper, R.G. and Kleinschmidt, E.J.: Winning businesses in product development: the critical success factors. Research Technology Management, 50(3): 52-66, 2007.

Copping, L.G.: The BioPesticide Manual. 1st edition, BCPC, Hampshire, UK, 1998, pp. 1-333. ISBN 1 901396266

Crmarić, O. and Lelaska, S.: Micro-spreading of pyretrum (*Chrysanthemum cinerariaefolium* Vis.). Book of Abstracts of the 2nd Symposium of Croatian Society of Plant Physiology, Brijuni, Croatia, 2003, pp. 177-178.

Crombie, L.: Chemistry and biosynthesis of natural pyrethrins. Pesticidal Science, 11: 102-118, 1980.

Červenka, M. et al.: Slovenské botanické názvoslovie. Bratislava : Príroda, 1986, pp. 381-382.

Dostál, J.: Nová květena ČSSR. 2. Academia, Praha, 1989. pp. 1030-1032. ISBN 80-200-0095-X

Duchon, S., Bonnet, J., Marcombe, S., Zaim, M. and Corbel, V.: Pyrethrum: A mixture of natural pyrethrins has potential for malaria vector control. Journal of Medical Entomology, 46(3): 516-522, 2009.

Elroby, S.A.K. and Aziz, S.G.: Understanding the decomposition reaction mechanism of chrysanthemic acid: A computational study. Chemistry Central Journal, 5(1): article number 66, 2011. ISSN: 1752153X

EP: DIRECTIVE 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides. http://eur-lex.europa.eu

FAOSTAT DATA: http://faostat.fao.org [cit.17.02.2012].

Gerberg, E.J.: Pyrethrum for control of pests of medical and veterinary importance. In: Pyrethrum Flowers: Production, Chemistry, Toxicology, and Uses (Casida J.B., Quistad G.B., eds.), Oxford University Press, New York, 1995, pp. 302-310.

GLOBAL DEVELOPMENT SOLUTIONS: Value Chain Analysis of Selected Strategic Sectors in Kenya, 2011. http://www.matching-grant.or.ke/deloitte/Documents/pyrethrum_value_chain_analysis.pdf

Kubánková, M. and Burianová, V.: Náklady a výnosy poľnohospodárskych výrobkov v SR za rok 2008. VÚEPP, Bratislava, 2009, pp. 1-66. ISBN 9788080585259

MacDonald, W.L.: Pyrethrum flowers-production in Australia. In: Pyrethrum Flowers: Production, Chemistry, Toxicology, and Uses (Casida J.B., Quistad G.B., eds.), Oxford University Press, New York, 1995, pp. 55-66.

Nazari, F. and Kambrabani, M.: Extraction and determination of pyrethrins from pyrethrum cultivated in Iran. Journal of Medicinal Plants, 7(25): 79-84+119, 2008.

Otterbach, A.: Chromatographische Untersuchungen und Extraktion von Pyrethrinen und Pyrethroiden. Dissertation, Universität-Gesamthochschule-Siegen, Siegen, 2000, pp. 1-155.

Oplanić, M., Ban, D., Žnidarčič, D. and Trdan, S.: Economic profitability of Dalmatian pyrethrum (Chrysanthemum cinerariifolium Trevir. Vis.) production and processing. Lecture and Papers 7th Slovenian Conference on Plant Protection, Maribor, Slovenia, 2005, pp. 540-544.

Porvaz, P., Tóth, Š. and Stričík, M.: Význam a pestovanie konopy siatej Cannabis sativa L. pre energetické účely na Slovensku. CVRV - VUA, Michalovce, 2011, pp. 1-34. ISBN 9788089417360

Salardini, A.A.: The effect of hybrids, soil types and applied phosphorus on the growth and tissue composition of pyrethrum (*Tanacetum cinerariifolium* L.). Proceedings of the 10th Australian Agronomy Conference, Hobart, Tasmania, 2001. http://www.regional.org.au/au/asa/2001/2/c/salardini.htm

Silcox, C.A. and Roth, E.S.: Pyrethrum for control of pests of agricultural and stored products. In: Pyrethrum Flowers. Production, Chemistry, Toxicology, and Uses (Casida J.E., Quistad G.B. (eds.), Oxford University Press, New York, USA, 1995, pp. 287-301.

Singh, S.P. and Singh, A.K.: Criteria for economic attributes in pyrethrum to facilitate early clonal selection. Journal of Medicinal and Aromatic Plant Sciences, 18: 295-296, 1996.

Slávik, Š.: Strategický manažment. Ekonóm, Bratislava, 1997. ISBN 80-225- 0816-0.

Staudinger, H. and Ruzicka, L.: Insekten totende stoffe. Helvetica Chimica Acta, 7: 1924, pp. 177-259, 1924.

Srivastava, H.C., Chandrashekar, P., Kurien, G., Sreehari, U. and Yadav, R.S.: Malaria in seasonal migrant population in Southern Gujarat, India. Tropical Biomedicine, 28(3): 638-645, 2011.

Tomlin, C.D.S.: The Pesticide Manual. 13th edition. BCPC, Hampshire, UK, 2003, pp. 1-1344. ISBN 1 901396134

Tóth, Š.: The testing of the pyrethum *Chrysanthemum cinarariaefolium* (Trevir.) Vis. and *Chrysanthemum parthenium* (L.) Smith production possibility in Slovakia. Acta horticulturae et regiotecturae, 2/2011: 32-36, 2011.

Zito, S.W.: *Chrysanthemum cinerariaefolium* (Pyrethrum): *In vitro* culture and the production of pyrethrins and other secondary metabolites. In: Biotechnology in Agriculture and Forestry (Bajaj Y.P.S. (ed.), 26, Springer-Verlag, Berlin-Heidelberg, 1994, pp. 56-68.

Zoborský, I.M., Laclavík, J. and Stričík, M.: Agrárne služby. Slovenská poľnohospodárska univerzita v Nitre, Nitra, 2003, pp. 1-170. ISBN 80-8069-134-7

Mogućnosti proizvodnje buhača u Slovačkoj

REZIME

U radu se razmatraju mogućnosti proizvodnje buhača *Chrysanthemum cinerariaefolium* (Trevir.) Vis. u južnim regionima Slovačke, sa akcentom na ciljni marketing, ograničenja i dalja istraživanja. Buhač nije tradicionalni usev u Slovačkoj, ali su stvoreni uslovi za njegovo gajenja. Visok prinos i kvalitet nekih pogodnih ekotipova buhača daju osnov za efektivnu proizvodnju u povoljnim uslovima. Proizvodnja buhača sa prinosom od 1.275 tona sušenog cveća po hektaru i sadržajem piretruma od 1,5% učinili bi ovaj usev ekonomski isplativim, sa profitom 413-1071 € po hektaru. SWOT analiza je pokazala da proizvodnja buhača u Slovačkoj može imati karakteristike ofanzivne strategije. Intenzivna proizvodnja ovog useva ipak zahteva dalji razvoj. Perspektive ovog netradicionalnog useva u Slovačkoj takođe su u okviru razvoja poljoprivrednih sistema otvorenih za korišćenje sredstava za zaštitu bilja botaničkog porekla. Unapređenje obrade biološkog materijala i stabilizacija ekstrakta bi dalje povećali mogućnosti proizvodnje buhača.

Ključne reči: Piretrum; Slovačka, perspektive