STUDY ON THE ECONOMIC EFFECT OF PRODUCTION FREE FROM CHEMICAL USE[1]

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CONCLUSIONS

The assumption, that in case of production different from the conventional one, operational and production risk are increasing in farms, is supported by the calculations. Input/output relations undergo a change in each sector and this may have serious financial outcomes, which would importantly determine profit yielding capacity and efficiency of farming. The statement of Offermann and Nieberg is true of the cost structure, according to which essential cost difference between the two technologies can not be measured. By the aid of the calculation, it was successfully verified – in compliance with the opinion of Wookey – that organic production can be as profitable, as the conventional production or even more so. In contradiction to Bmvel's data, it can be demonstrated, that even a revenues, surpassing the result of conventional production may be realized in organic farms. On the whole, the results obtained strengthen the standing-point of Szente, according to which the profit, originating from organic production may be higher, than that from conventional production, although it fails already to reach the saliently high values, which were characteristic of the earlier years. In production technology, upon the effect of the change in operational elements and elimination of chemical use, increased yield risk is to be taken into account, although at the same time, the possibility of a more successful operation will increase through the market premium price. Subsidy of each technology is different, which means, that allowances associated with the expectable future much better environment-saving technologies will further increase profitability. Also market changes may promote this process, since consumers and institutions become increasingly disposed to take a turn to goods, produced free from chemicals. It is indicated also by statistical data, that more and more producers are dealing with organic production and also the size of areas turned on organic farming is continuously increasing. The rhythm of the development of organic markets is still lagging behind this, but the possibility is open to the agricultural sector being in process of transition. Conventional agriculture is yet unable to produce commodities, suitable for satisfaction of all demands of consumers in every respect, and also efficiency and profitability of production are very low, several sectors can be operated with loss only.

ABSTRACT

During the decades past, conditions of agricultural production and also customers' habits have changed. In contradiction to quantity production, production of high-quality foods became the general requirement. The role of production on industrial scale is decreasing and chemical-free farming is increasingly

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coming to the front. Parallel with reduction of chemical use, also the elements of production technology are changing: in nutrient economy fertilizers are replaced by organic- or green manure, as well as by other methods of weed- and pest control – physical, mechanical, biological, agro-technical, must be used. This may result in increased number of operations, influencing the cost structure. Also the return side – quality, quantity and sales price – will change and in consequence of their common effect, the income too. On the basis of the examination, it has been stated, that there does not exist significant difference between conventional and organic production in the order of magnitude of costs, yields are lower with chemical-free production, which, however, is compensated by higher sales price of the organic product and by the higher amount of subsidy, associated with the production. On the whole, profitability of organic production may approach to and even may surpass that of the conventional production, although the risk of income realization will increase, expectable values will scatter within a broad band.

INTRODUCTION

American examinations, carried out between 1974-1975 stated, that the average yield of maize, soybean, wheat and oat were by 3-7, 6, 23 and 1%, respectively, higher in the conventional farms as compared to the organic ones. (*Lokeretz et al., 1981*) According to the statements of another study, the yield of maize, wheat, oat, barley and soybean lagged scarcely behind the values, obtained in the conventional farm. Between 1971-1974, according to the examinations, performed in German biodynamical farms, average yield of winter barley was hardly lower than in the conventional farm, while the yield of winter wheat amounted to 4.54 t/he in the organic farm and to 4.09 t/he in the conventional farm. Also the average yield of oat was higher in the organic farm (3.9 t/he) as compared to that in the conventional farm (3.66 t/he). (*Melu, 1977*) Similar examinations were carried out in Germany, Netherlands, Great-Britain and the USA. Taking into account all of the examinations, production was by 10-30% lower in case of organic production. (*Vine – Bateman, 1981; Stanhill, 1990*). According to the studies of Steinmann, performed in Swiss farms, average yield of wheat amounted to 3.9 t/ha in organic farms, while conventional agricultural plants harvested during the period under examination 4.5 t/he of wheat (*Steinmann, 1983*). Examinations of *Stöppler et al. (1988)* is instructive, who compared the yield of 23 winter wheat varieties obtained in ecological production with the results gained in industry-like production. Up to a yield level of 4.5 t/he yields are nearly equal, but with the increase in yield level, the difference between the average yields received by means of the two methods of production increased too. Thus, in opposition to the yield of 8 t/he in conventional production, the yield in organic production amounted to only 6 t/he, which corresponds to a reduction of 25%. On the basis of examination of Schönberg, made at Kishantos, it can be stated, that average yields in organic fields were by 1.4 (winter wheat) and 12.0 (sunflower) lower than in the industry-like production (*Schönberg, 1996*). According to Szente's examinations, yield results of grain crops and apple amounted to 70-80% of those, obtained in conventional production (*Szente, 2005*). As *Offermann and Nieberg* stated, yields are generally lower in organic production but great differences may be experienced accord-

ing to cultures. As the examinations stated, only 60-70% of the conventional average was reached in the grain sector (*Offermann – Nieberg, 2000*). Another examination revealed, that the yield of the wheat is by 40% lower in the organic farms (*Bmvel, 2002*).

For investigation of the production value, however, examination of the scale of returns only is insufficient; also sales prices must be analyzed. According to the report of the *Central Statistical Office* (KSH) average sales price of ecologically produced wheat was 45 HUF/kg, while conventionally produced wheat has changed hands at 23.1 HUF/kg price on the average (*KSH, 2004*). The price of chemical-free yield amounted to 194.3% of the price of conventional product in the year under examination. Highest price was reached by vegetables and cereals; this may eventually be even by 150% higher. In England, the price difference between conventionally and ecologically produced vegetables was 0-150% on the average, while 35-100% for cereals (*Radics, 2002*). According to Vogtman's survey made in 1992 in Germany, the price of organic wheat was 193% of that of conventional wheat. Organic products may be sold at higher sales prices, e.g. according to an examination, extending over the EU-15 countries, Switzerland and Norway, a premium price even of 50-200% may be obtained (*Offermann – Nieberg, 2000*). The surveys, carried out in Hungary between 2002-2003 showed that the majority of the farmers may get even the double of the price of conventional products by means of ecological qualifications. By the present time, however, farmers receive only by 10-20% higher price for their organic products (*Szente, 2005*). There are significant differences between the two production technologies in the cost structure too. One of the fundamental differences between organic- and conventional farms consists of the levels of input costs. Dispersion cost of organic manure, the cost of manual weed control or scorching of weeds may be set against the cost of fertilizers and plant protecting chemicals (*Lampkin, 1990*). In relation to organic farming, German and Swiss studies report by 20% more live labour requirement as compared to conventional farming, while in Danish farms twice as much labour appears. As to the development of costs in association with ecological production, according to the general practical experiences two contrasting tendencies may be observed. While some type of costs (purchased materials) are decreasing, others (e.g. machine work, wage and its common charges) are significantly increasing. In organic production, the increase in demand on manpower is general, and it may be very variable according to cultures. Thus, e.g. in the production of organic winter wheat and organic winter barley demand on supplementary labour power disappear but for weed control in ecological sunflower culture advantage had to be taken sometimes of manual labour. Cost structures show similar picture in case of winter wheat and winter barley, the tendencies are nearly the same (*Radics, 2002*). Production costs of sustainable (e.g. organic) farming, in consequence of observation of the adequate ethical bases, are higher, than the costs of conventional agricultural production (*Bálint, 2000*). According to the examination of *Offermann and Nieberg (2002)* variable costs of the organic farms are generally lower, amounting to 60-70% of the variable costs of conventional farms. It has been stated, that fixed costs are by about 45% higher in organic farming. On the whole, the rate of costs in organic production amounts to 80-100% as com-

pared to conventional farming (*Offermann – Nieber, 2000*). In totality, as it was stated by Szente, cost level of organic production has increased during the recent two years, but those, who will chose the transition, must not take a more significant investment into account as compared with conventional production (*Szente, 2005*). As to the efficiency of farming, however, Vereijken stated, that in ecological farming average yields are lagging far behind those of industry – like farming, although higher sales prices and lower cost level altogether result in a significantly higher attainable gross margin, than the industry-like farming (*Vereijken, 1986*). A calculative example about the wheat production in great-Britain, presented by *Wookey (1987)* showed that gross margin for organic production amounts to 123% of the conventional results. *Steinmann (1987)* found in Swiss farms, that in case of ecological production, the income of farms was slightly superior, than that of the conventional farms. In Germany, a comprehensive comparison between farms (*Bmelf, 1989*) showed by about 12% higher family income in ecologically producing farms. Similar results were obtained also by *Schlütter (1986)* in his studies on biodynamical farms in Baden-Würtenberg. Offermann and Nieberg, as the final result of their studies, determined attainable profit at a rate of ±20% as compared to the result of conventional production (*Offermann – Nieberg, 2000*). On the basis of the data, reported by Bmvel, the profit of organic farms is by 30% lower, than that of the conventional farms, the cause of which may be sought after in lower yields and relatively high (according to their survey of 30%) wages cost (*Bmvel, 2002*). As the result of a Hungarian survey made in 2004, it has been stated, that the profit of organic production already did not reach even 20% of that of conventional production (*Szente, 2005*).

MATERIAL AND METHODS

The aim of the study presented herewith was to reveal the factors, causes resulting in differences in profitability between organic farming and conventional production. A comparison was made between the two production technologies as regards profitability. Profitability was defined as the difference between the production value (sales revenue) and production cost. Sales revenue is the function of sales volume and sales price. On the other side of production values, also subsidies, values of internal use and changes in inventory must be taken into account. For this purpose a model, elaborated earlier was applied (*Takácsné – Kis, 2004; Kis, 2005; Kis, 2006; Takácsné, 2006*). In order to verify the above facts, a comparative analysis was carried out, where two supposed farms with two sectors namely winter wheat and corn maize were investigated. One of them is keeping on with conventional production, while the other with organic production. In order to simplify the analysis, it was assumed, that both companies are farming on 100 he (50-50 he pro sector) and the same machines are at the disposal of each production technology. Expectable yield resulting from conventional production was equalized with the average yield values calculated by the Central Statistical Office in 2005, i.e. average yield of 4.49 t/he for winter wheat and 7.54 t/he for corn maize was taken into account. In case of organic farm, yield data were determined as 60-100% of the conventional average. Also sales prices were taken the data basis of the Central Statistical Office in relation to agricultural production. In 2005, average sales prices of maize and wheat were

in compliance with each other; both amounted to 21,000 HUF/t. In sales of organic yield, calculation was made by means of a premium price of 0-35%. Also labour costs were calculated on the basis of the data of Central Statistical Office. In 2005, a monthly gross average earnings of physical workers was 86,000 HUF. In calculating labour cost, this was taken for basis and was increased (by wage and its common charges) up to 118,000 HUF/capita/ month (*KSH, 2006*). In the technological plan, machine costs of operations were calculated on the basis of the data on the year of 2005 (*Gockler, 2006*). In case of operation costs, it was set out from overall costs of one-hour's operation, and this was reduced by the value of per hour depreciation, and by the value of wage and common public charges. Prices of materials used for production purposes (sowing seed, fertilizers, plant protecting chemicals) were stated on the basis of price lists obtained from merchants.

RESULTS AND DISCUSSION

Significant difference between the two methods of production is contained in numbers and types of operational elements. Plant protecting and nutriment supplying sets of instruments used in conventional production essentially differ from those applied in organic production. Care of plants means in organic production rather an increased number of mechanical operations (inter-row cultivation, application of weed-comb, manual labour force). Demands on nutritive materials in the two sectors are contained in Table 1.

Table 1

Demand on nutritive materials in the sectors under study

(active ingredient, kg/10 t)

	Winter wheat	Corn maize
N	32	32
P	26	23
K	24	30

Source: Antal, 1987

Nutriment supply in conventional production is accomplished exclusively by means of fertilizers, taking into account the yield level. Whole dosage of phosphorus and potassium and two-third of nitrogen (active ingredients) are dispersed in autumn, while the remainder of the nitrogen in the spring. In organic production, in order to re-establish the producing power of the soil, organic manuring is taken into consideration, adapted to the requirement of the given plant. NPK content of organic manuring and its persistence can be taken into account for two years, according to Table 2 (*Antal, 1987*). Upon the effect of organic manuring, the cost of nutriment supply in the following year will be lower; therefore material cost of organic manuring in the first year was decreased by 40% in the study.

Among the costs, in case of organic production, also the cost of attestation must be taken into consideration, which means 1% of the turnover+15% VAT (*Biokontroll, 2004*). Subsidy, examined as a factor influencing the side of production value was taken into account in case of conventional production at a rate of 18,904 HUF/he of EU-subsidy, and 19,124 HUF/he of national subsidy. For the transition to organic farming – ac-

cording to an order of the Ministry of Agriculture and Rural Development – for these sectors a support of 176.47 EUR/he may be requested which equals to about 45,882 HUF/he. In preparing the technological plan for both sectors according to farming types, it can be stated, that great and significant difference between the technologies on the cost side can not be demonstrated (Table 3). Cost of fertilizers and plant protecting chemicals applied in conventional production may be set against the material cost and dispersion cost of organic manuring in ecological production, and in case of maize against the inter-row cultivation, to be carried out on several occasions.

Table 2

Nutritive material furnishing by livestock manure and the persistence of nutriments

(kg/10t)

Year	N	P	K
1	18	20	40
2	12	15	20

Source: Antal, 1987

Table 3

Production costs according to sectors taken as a function of the technologies under study

(HUF)

	Winter wheat Conventional	Maize conventional	Organic wheat		Organic maize	
Total cost/50 he	7,549,357	9,156,513	7,576,615	7,632,305	10,045,279	10,125,585
Total cost/he	150,987	183,130	151,532	152,646	200,906	202,512
Total cost/t	33,627	24,288	56,248	33,997	44,409	26,858

Source: own calculation

When supply with nutritive materials was planned in case of organic farming, active ingredient values calculated for conventional production were taken into account and the quantity of organic manure to be dispersed was determined on the vases of the lowest nutritive ingredient. Due to this calculation process, the resulting quantity of organic manure for winter wheat was 80 t/he and for corn maize 130 t/he, taking into consideration the effect of organic manure persisting for several years and the desired rate of active ingredient. It should be noted, hat nitrogen was the limiting factor in both cases, thus of the two other nutritive elements (P and K) significantly higher amounts were dispersed (from P by 30-50% higher, from K the treble of the prescribed quantity). According to the above calculation, the cost of conventional production is lower, than that of the agricultural firm switching over to organic farming, although it may be observed in practice that owing to other beneficial effects of organic manuring, costs of organic production will presumably be lower in a well established ecological farm. In examining the possible sales revenue, it can be stated, that by means of organic production a higher sales revenue can be realized through the market premium price (Table 4). It is true still nowadays, that a high-quality organic product, possessing a certificate, may be sold at premium price, saturation of the market did not yet ensue,

indeed, even on the domestic market, increase in demand on certain products may be observed (*Takács – Takács-György – Járási, 2003*).

Examining efficiency, it can be seen, that efficiency values of ecological farming are scattering within a wide band, but under favourable ecological, climatic and economic conditions, organic production may be suitable for the production of significantly higher profit, than the industry-like plant production with chemical use. Profitability of the conventional production fluctuates around the zero value, nevertheless, organic production, in spite of the inherent risk, assures a good chance to reach better results.

Table 4

Expectable sales revenue per sector as a function of the technologies studied

	Winter wheat Conventional	Maize conventional	Organic wheat	Organic maize
Sales revenue/50 he	4,714,500	7,917,000	2,828,700 – 6,364,575	4,750,200 – 10,687,950
Sales revenues/he	94,290	158,340	56,574 – 127,291	95,004 -213,759
Sales revenue/t	21,000	21,000	21,000 – 28,350	21,000 – 28,350

Source: own calculation

Table 5

Expectable result per sector as a function of the technologies studied (inclusive of subsidy)

(HUF)

	Winter wheat Conventional	Maize conventional	Organic wheat	Organic maize
Sectoral result/50 he	-933,457	661,887	552,405 – (+) 2,927,780	-1,099,569 – (+) 4,757,875
Sectoral result/he	-18,669	13,238	-11,048 – (+) 58,556	-21,991 – (+) 95,157
Sectoral result/t	-4,158	1,756	-4,101 – (+) 13,041	-4,861 – (+) 12,620

Source: Own calculation

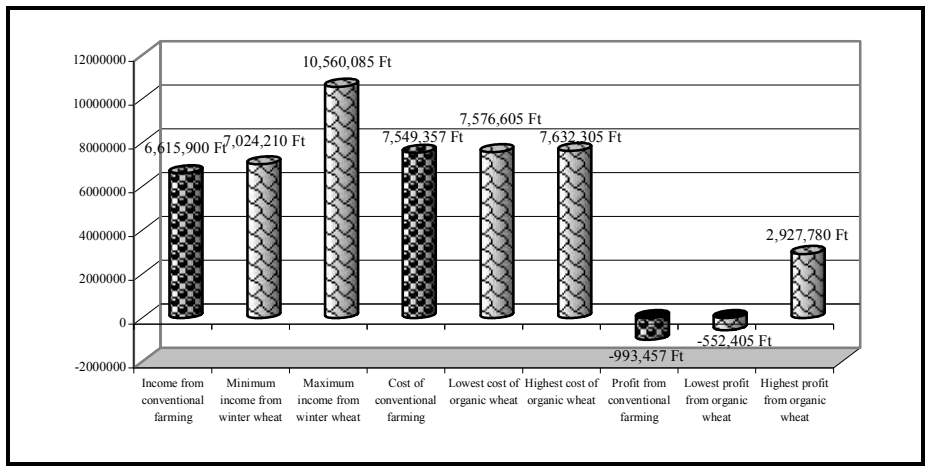
Production of winter wheat is unable to produce income under conventional technological conditions; a loss of about 930,000 HUF comes into being in the sowing area. In organic farming the simulated values are fluctuating within a band extending from – 550,000 HUF to about 2.9 million HUF (Figure 1).

Examining the maize sector, it can be seen, that conventional technology resulted in a profit amounting to 600,000 HUF (taking into account subsidizations, too), while in case of organic farming, the revenue range is situated between a loss of 1million HUF and a gain of 4.7 million HUF, fluctuating within a wide band (Figure 2).

When the theoretical farm, possessing a production area of 100 he, is examined, it can be stated, that on farm level the result of conventional production together with the subsidies is superior to a loss of 270,000 HUF, while in contrast to this, the result of organic production may fluctuate between a loss of 1.6 million HUF and a gain of 7.68 million HUF. These results correspond to the results obtained from our earlier researches, where similar differences were detected in the course of modeling of other sectors (*Takácsné, 2006*).

Figure 1

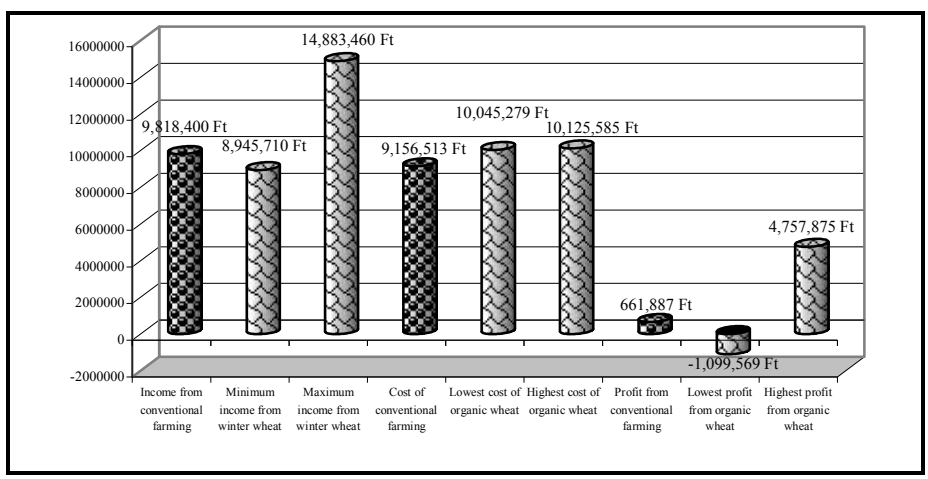
Comparison of the profitability in the wheat sector (inclusive of subsidy)



Source: own calculation

Figure 2

Comparison of the profitability in the maize sector (inclusive of subsidy)



Source: own calculation

REFERENCES

(1) Antal József. 1987. Növénytermesztők zsebkönyve. Mezőgazdasági kiadó, Budapest. P.508. – (2) Bálint András 2000. Ökopolitika. Édenkert Magazin. – (3) BMELF – Bundesministerium für Ernährung, Landwirtschaft und Forsten (1991): Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten, 1991. Landwirtschaftsverlag GmbH, Münster-Hiltrup. – (4) BMVEL. 2002. Ernährungs- und agrarpolitischer bericht der Bundesregierung. Bonn. P. 40-41 – (5) Gockler Lajos. 2006. A mezőgaz-

dasági gépek beszerzési ára és üzemeltetési költsége 2005-ben. FVMMI, Gödöllő. – (6) Kis Sándor (2005) A csökkentett növényvédő szer felhasználás versenyképessége a konvencionális termeléssel szemben Debreceni Egyetem, AVK, 2005. Agrárgazdaság, vidékfejlesztés, agrárinformatika" nemzetközi konferencia CD kiadvány CD\presentations \vallalatgazdasagtan_2\2.pdf P.12 – (7) Kis Sándor (2006) Kemikália használat változása a növénytermelésben, eltérő gazdálkodási alternatívák. Károly Róbert Főiskola, Gyöngyös 2006. Konferencia Kiadvány CD:\Természeti erőforrások és környezetgazdálkodás\krf12.doc ISBN 963 229 623 0 p. 8. – (8) Lampkin, N. 1990. Organic Farming. Farming Press Books, Ipswich, UK. – (9) Lockeretz, W., Shearer, G. and Kohl, D. 1981. Science 211, 540-547. – (10) MELU. 1977. Auswertung drei-jähringer Erhebungen in neun biologisch-dynamisch bewirtschafteten Betrieben. Baden Würtemberg. Ministrum für Ernährung, Landwirtschaft und Umwelt, Stuttgart. – (11) Mezőgazdasági termelés 2005. KSH. Bp. 2006. P.47 – (12) Offermann F – Nieberg H. 2000. Economic performance of Organic Farms in Europe. Organic farming in Europe: Economics and Policy. 5. – (13)Offermann F – Nieberg H. 2001. Wirtschaftliche Situation ökologischer Betriebe in ausgewählten Ländern Europas: Stand, Entwicklung und wichtige Einflussfaktoren. Agrarwirtschaft 50. 7. 421-427 p. – (14) Radics László (szerk) 2002. Ökológiai gazdálkodás II. Szaktudás Kiadó Ház, Budapest – (15) Schlüter, C. 1986. Arbeits- und betriebwirtschaflice Verhältnisse in Betrieben des alternativen Landbaues. Agrar- und Umweltforschunkgin Baden-Wüttemberg, 10. ulmer Verlag, Stuttgart – (16) Stanhill, G. (1990). The comparative productivity of organic agriculture. Agriculture, Ecosystems and Environment, 30, 1-26. – (17) Stöppler, H. 1988. Zur Eignung von Winterweizensorten hinsichtlich des Anbaues und der Qualität der Produkte in einem System mit geringer Betriebsmittelzufuhr von aussen. PhD Thesis, University of Kassel, West Germany (cited in Lampkin, 1990) – (18) Szektorális környezeti indikátorok. 2004. KSH. P.17-18 – (19) Szente Viktória. 2005. Az ökoélelmiszerek termelésének, kereskedelmének gazdasági és piaci összefüggései. PhD értekezés. Kaposvári Egyetem, 2005. P.151. – (20) Tájékoztató az ellenőrzés és tanusítás rendjéről. Biokontroll Hungária Kht. 2004. – (21) Takácsné György Katalin - Kis Sándor (2004) Növényvédelemmel kapcsolatos gazdasági döntések üzemi szintű hatásának vizsgálata XLVI. Georgikon Napok, Keszthely, „Új kihívások, új lehetőségek a mezőgazdaságban" Konferencia kiadvány CD. CD:\o_Taka_K.htm Veszprémi Egyetem Georgikon Mezőgazdaságtudományi Kar, Keszthely, 2004. ISBN 963 9096 2 – (22) I. Takács – K. Takács-györgy – E. Járási: Alternatives of Organic Farming in Hungary According to Farm Structure and Profitability of Production. International Conference on Quality in Chains. Editors: L. M. M. Tijksen – H. M. Vollebregt. Acta Holticulturae 604. July 2003. Wageningen. Vol. 2. 481-486 pp. – (23) Takácsné György K. 2006. Eltérő növényvédő szer használatra alapozott technológiák ökonómiai hatása a gazdálkodásra X. Nemzetközi Agrárökonómiai Tudományos Napok konferencia. Gyöngyös. CD\Agrárközgazdaság és ágazati ökonómia\krf276.doc. 8 p. – (24) Vereijken P.: From conventional to integrated agriculture, Neth. Journ. Of. Agric. Sci.,Amsterdam, 1986. p.186-195 – (25) Vine, A., and D. Bateman. 1981. The practice of organic farming. p. 17-53. In Organic Farming Systems in England and Wales: practice, performance, and implications. Dep. Agric. Econ., Univ. College of Wales, Aberystwyth. – (26) Wookey, B. 1987. „Rushall: The Story of an Organic Farm." Basil Blackwell, Oxford.