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■ FERTILIZATION EFFECT ON WEED FLORA ■ MINIMAL SOIL DISTURBANCE-SOIL STRUCTURE

■ WALNUT LEAF COMPOST ■ ORGANIC FARMING EDUCATION



1st January 2014 – 31th December 2017
23/02/2015

„THE COMPLEX BREAK POINTS IN THE DEVELOPMENT OF COMPETITIVENESS OF THE AQUACULTURE SECTOR „ – NEW POSSIBILITIES FOR AQUACULTURE SECTOR

The project „Complex break points in the development of competitiveness of the aquaculture sector” (project number: VKSZ_12-1-2013-0078) is implemented in the frame of Program for R&D Excellence and Competitiveness Treaties within a consortium. 1,235 billion HUF is ensured from National Research, Development and Innovation Fund for project accomplishment. The research and development results of the project provide an opportunity for international market entry and penetration of the sector.



AquaFuture, a large-scale research and development project with dominant players of aquaculture sector, successfully completed first work phase of the project. The consortium members have started their research activities and the development of nutrition technology, both in production and fish processing, and research tasks set off against a variety of pathogens.

Main tasks of the project were generated by demands of entrepreneurs, of which competitiveness are set back by national aquaculture technologies and production, furthermore solution of these problems would step forward a serious market progress for the industry as a whole. The consortium has identified the elements which provide the opportunity to improve and develop breakthrough for the industry. The aquaculture field is needed to fully develop from basis of production to processed products so an impact will be achieved, which generates already a measurable result on our country and the EU at sector level.

Project contains From Farm to Table elements of conception and it concentrates on a total production process and it ensures availability of quality and well-controlled products for consumers. The development will be implemented in many parts of the country, through cooperation within project partners covering all areas of the sector. The project strengthens position of participants in the market to diversify their activities through the development of the supply and range of services.

Project partners:

ÖKO 2000 Ltd. (project coordinator)
Bocskai Halászati Ltd.
Czikkhalas Halastavai Ltd.
Hoitsy és Rieger Ltd.
Szabolcsi Halászati Ltd.
PLP Seafood Ltd.
Szent István University
Hungarian Academy of Sciences, Centre for Agricultural Research



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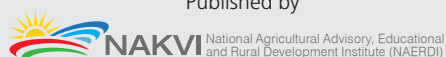
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Cover photo: Planting old treasures at Lokod in
Transylvania (Dominik Samol)

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PROFESSOR PÁL TOMCSÁNYI- THE MULTIDISCIPLINARY SCIENTIST

In 2014 the Hungarian scientific community celebrated the 90th birthday of professor Dr. Pál Tomcsányi, member of the Hungarian Academy of Sciences. He was donated by the "Cross of the Hungarian Order Merit with Star" last year. From among several greetings we present the greeting addresses of prof. dr. Magdolna Tóth (Corvinus University of Budapest) and prof. dr. Gedeon Totth (Budapest Business School), who gave a short review of prof. Tomcsányi's scientific activities and achievements.

HIGHLIGHTS FROM POMOLOGY WORKS OF PROFESSOR PÁL TOMCSÁNYI

MAGDOLNA TÓTH

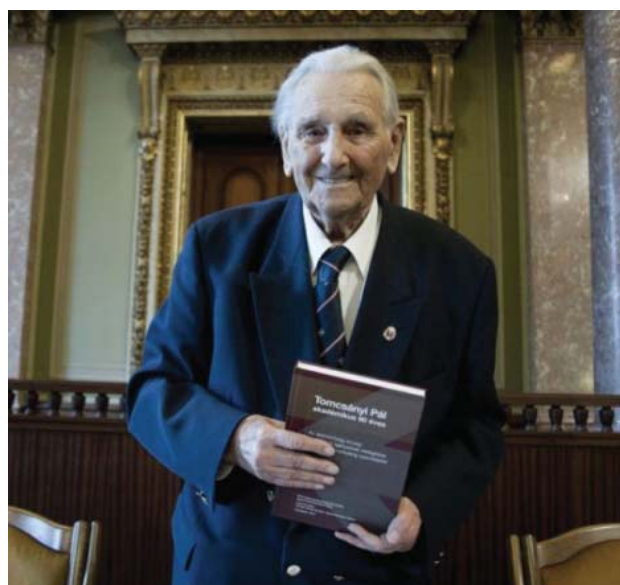
Corvinus University of Budapest, Department of Pomology, 1118 Budapest, Hungary

Pál Tomcsányi is a scientist who has practiced in several disciplines, so we can highly respect his manifold activity in the field of pomology. He dealt with the questions of science theory and profession history, he served the fruit cultivar evaluation and registration system in Hungary like a pioneer, enriched the literature of pomology with novel approaches and directly helped the practice of fruit production as well.

During his work of profession history in 1969, as one of the authors of the book titled „*Magyar Növénynevelés*” (*Hungarian Plant Breeding*), he reviewed the history of Hungarian fruit breeding and distinguished four eras: i) chance breeding till the beginning of the 20th century; ii) professional, from the beginning, till the middle of the 20th century; iii) investigatory, between 1950 and 1965; iv) investigatory and targeted breeding: from 1965.

Following his theory we can accept that the science of pomology can be divided into four fundamental fields, primarily based on the purpose that defines the action:

- **descriptive pomology**: verbal characterization of qualitative properties, recognition and differentiation of cultivars;
- **evaluative pomology**: experimental measurement and threshold comparison of quantitative properties and performances;
- **practical (economical) pomology**: definition of the complex production value of cultivars;
- **users pomology**: conducting experiments on cultivars



to meet the user needs and development of strategies related to the influence of needs.

In 1974, he described the definition of cultivar, assortment of cultivars and „cultivar policies” for the practical use of cultivars. Looking at the sources of this he distinguished the biological and economic life cycle of cultivars, also made a difference concerning to the changes in usage of cultivars. According to his interpretation the *biological change of cultivars* occurs by using healthier and more powerful plant material up to improvements in quality, although the type of the product shows no changes. When a cultivar is no longer suitable for the expectations of the market and needs to be replaced by a new suitable type, means the *economical change of cultivars usage*.

The evaluation of the cultivars was coordinated by the former institute of National Food Chain Safety Office under his professional management. He already created an advanced found for the investigation system of the value of cultivars in the 60's and renewed the planning of evaluation in the 70's with the help of his co-workers. After designing the first model for the economical evaluation of cultivars he developed a methodology and a synthetic economical value for these assessments.

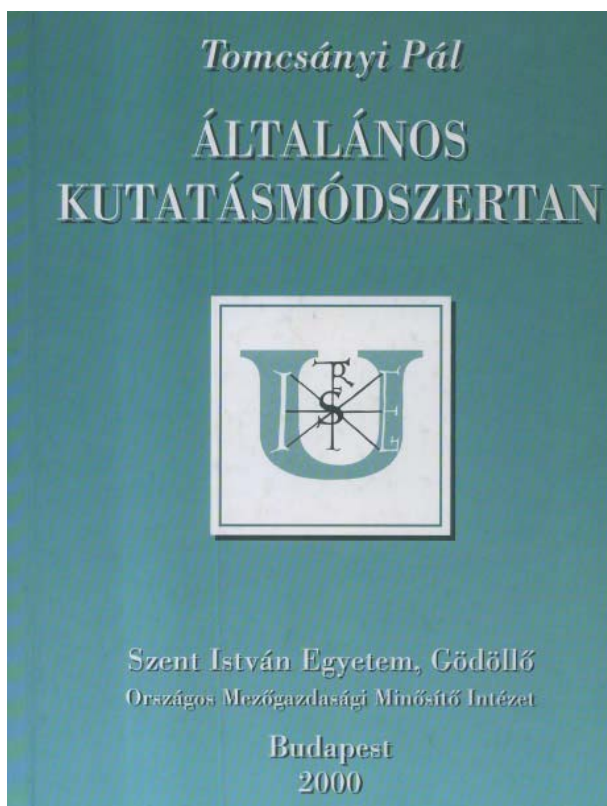


He played major role in the development and the introduction of cultivar classification in horticulture and forestry, and participated in the process of evaluation, description of new original cultivars. He enriched the system of cultivar evaluation with the method of organoleptic judgements.

He became known in Hungary and also in foreign countries by his outstanding professional writing activity. His scientific papers and studies published in German, English and French journals were considered as rarity in their time. He published six books of fruit cultivar literacy independently and with co-authors. The „Gyümölcsfajtáink” (*Our fruit cultivars*) titled pomology, written under his management and with his participation, is the most thorough and outstanding pomology work of his in the 80's. In addition to his scientific works he considered the connection with the practice to be relevant all along.

Academician Tomcsányi served the horticulture not just as a scientist only, but as a professor, in education too. He was inaugurated to be an honorary professor of the University of Horticulture and Food Industry in 1977. He was teaching horticultural marketing, knowledge of products and cultivars, and research-methodology both in graduate and PhD levels.

Those who are following his work in pomology, are grateful for the outstanding life achievement of this 90 years old academician. On behalf of the community of fruit scientists, congratulations for the valuable award he donated to him in 2014.



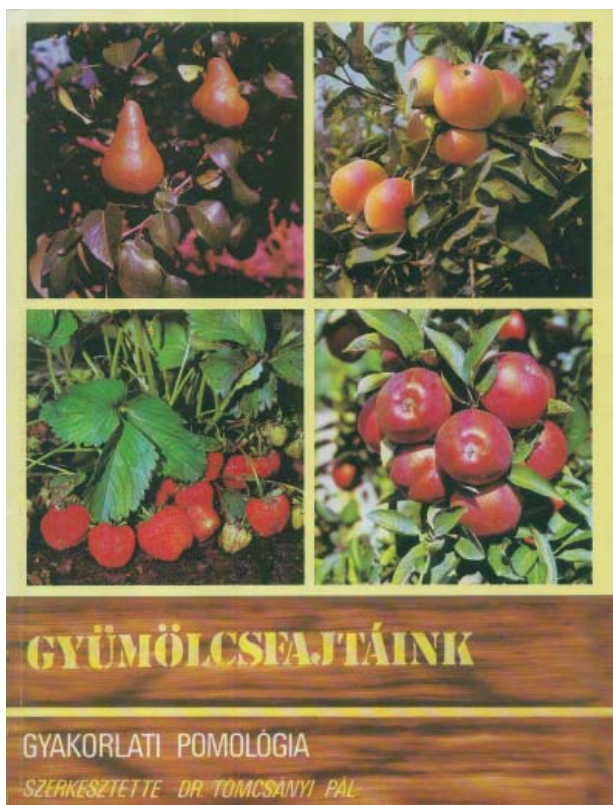
ESTABLISHMENT OF MARKETING AS SCIENCE IN HUNGARY

GEDEON TOTTH

Budapest Business School, College of International Management and Business, Department of Marketing, 1149 Budapest, Hungary

Hungarian marketing has iconic personalities who deserve respect by virtue of their recognition, the achievements of their academic careers, by their professional and personal qualities. Unfortunately, these days, true respect based on character and achievement is increasingly adrift. This makes us feel the more honored to have been granted this opportunity to greet you at the Hungarian Academy of Sciences on the occasion of your 90th birthday.

In a tribute to Pál Tomcsányi's achievement more than one of his statuses deserve mentioning; the scientist, the professor and the relentless pioneer fighting for the marketing to be recognized as a science in Hungary. And last but not least we are celebrating the person, „Uncle Pali”, whom love and respect of many and more have been earned by his generous guidance and faith-giving optimism. Now, I would like to talk about two of the above briefly; about



the spiritual father of Hungarian collective agricultural marketing and the professor infecting successive generations with curiosity towards marketing.

Community marketing, i.e. mezzo-marketing was born at the beginning of the 20th century. The Hungarian scenario, the era of economic scarcity, the preoccupation with the production of volumes did, for a long period, not require special attention to be paid to the consumer or to the satisfaction of consumer demand when designing production and supply. Already, when the magic word was slowly spreading in Hungary, understandably, the promotion of the concept first started in rather general terms, highlighting its more generalizable aspects such as market research and advertising, mainly as seen by economics. Today we celebrate the person who earned unparalleled reputation for developing sector marketing. In doing so, he was assisted by his immense knowledge of the sector. The excellence and relevance of the first marketing reference book of the industry, "*Piacos kertészet*" (*Marketing in Horticulture*) endures due to the author's exceptional understanding of the sector. While gathering my thoughts I realized that if the passages on marketing were deleted from *Marketing in Horticulture* we would be left with an excellent horticultural reference book. Already this book contains much on collective marketing, especially on practices in Germany and France. His deep insight into the sector and into marketing paved the way for the necessity of setting up a collective marketing organization, to which

he had become a most ardent contributor and advocate. He was fighting for the good cause, often pushing to limits, with the help of his colleagues, particularly Pál Sass. The establishment of AMC (Agriculture Marketing Centre), celebrating its 18th anniversary, was of primary importance in enhancing the competitiveness of Hungarian agriculture and the food industry. Hopefully, with coming of age AMC's activities and opportunities will also mature. Funding for collective marketing in the past 18 years has accounted for more than 30bn Forints, which, albeit not sufficient, clearly indicates the importance of agricultural marketing. In assisting numerous Hungarian producers enter global markets and thereby enhance the image of Hungarian products, in helping raise the recognition and reputation of popular Hungarian products and in promoting a widespread appreciation of traditional, often artisan products the designer and mentor of AMC has had a momentous role. As his young assistant I was honored to spend 14 years by Professor Tomcsányi's side. He was teaching much through his personality. He was one of the most popular professors at the university, referred to as a real gentleman by his students. Everything, even the toughest issues can be addressed in a witty, helpful and intriguing way: this was the lesson we, the younger ones, learned from him. That his approach to marketing should be definitive even today is a belief I share with many of my colleagues and try to pass on to my students; to be really successful at marketing a good marketer has to have a deep insight into his field.

Greeting Professor Tomcsányi on the occasion of his 80th birthday at the Academy his old-time friend and schoolmate, László Csel tei said, "Among other things at least four personal attributes are needed for creation and academic achievement: capacity, persistence, knowledge and will." And something else, which we could call humaneness. That while professional jealousy, intrigues and the absence of support is, alright, used to be there in this trade too, 'Uncle Pali' was always driven by the desire to help, by the generosity and wish to resolve conflict and reconcile rivals. How many of us in my generation have sighed with relief when seeing his name delegated by the grim Committee of Scientific Qualifications or its successor as chair at their PhD defenses. Fears of being grilled by the Committee vanished and one could be sure that there was at least one person speaking with warm definiteness 'in defense' of the candidate.

As his student, as his assistant I was taught by Uncle Pali to conclude a lecture with something witty. I was searching my writings to find something fitting but finally I thought that speaking on behalf of a community I have to communicate a joint thought message. So:

May God keep you safe for many more years to come!

DETERMINING THE ENVIRONMENTAL ODOUR IMPACT OF AGRICULTURAL ESTABLISHMENTS

ANDRÁS BÉRES – NÓRA KOPLÁNYI – ORSOLYA JÓZSA – MIKLÓS GULYÁS – LÁSZLÓ ALEKSZA

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ABSTRACT

Among the effects of livestock establishments and more specifically, typically livestock farms – taking citizens' complaints into regard – their environmental odour is highly significant. The odour emission of livestock farms depend on the species and breed of the animals, the method of keeping them, the technology of feeding and mucking out, the contents of the fodder, the ventilation method, the cleanliness of the stalls, the location and method of manure storage. Determining and evaluating the odour impact caused by the establishment can be done based on the results of odour measurements at the sources of odour emission (stalls, surface sources, e.g. yards, pens, open-air manure storages) and atmospheric dispersion modelings based on them, but the environmental odour impact caused can be evaluated even based on field odour measurements, detections in the vicinity of the establishment. In our paper we want to provide a comprehensive picture of the options for determining the caused environmental odour impact.

keywords: odour impacts of animal husbandry, odour measurement, field odour measurement

INTRODUCTION

The odour impact of animal husbandry, livestock farms have raised more and more problems in the last decades because of the changing settlement structure at some places and the increased environmental sensitivity of the public (JRC 2013). The problem is only exacerbated by that in some regions of the country, traditionally agricultural areas were built in, residential buildings have been more closely erected to livestock farms (Béres et al. 2014). In the last decades, regulation related to disturbing environmental

odour impact have become significantly more strict, too, and now avoiding the creation of disturbing odour impact, determining and evaluating the expected environmental odour impact is a significant perspective during the environmental authorisation of new establishments or the expansion of existing ones (314/2005 Govt. decree). Occasionally, there is a need to determine the odour impact even by already operating livestock farms to examine the basis of emerging public complaints. Determining and evaluating the odour impact caused by the establishment can be done based on the results of odour measurements at the sources of odour emission (stalls, surface sources e.g. yards, hurdles, open-air manure containers) and atmospheric dispersion modelings based on them, but the environmental odour impact caused can be evaluated even based on the results of field odour measurements, odour detections in the vicinity of the establishment (IPPC 2002).

THE ODOUR IMPACT OF ANIMAL HUSBANDRY ESTABLISHMENTS

The odour emitted from the livestock farms can originate on one hand from building sources, from buildings where animals are kept, and on the other hand, surface sources that can be found at the establishment and in its vicinity (e.g. yards, hurdles, open-air manure containers, etc.). The odour emission of the livestock farms basically depend on the species and breed of the animals, the method of keeping them, the technology of feeding and mucking out, the contents of the fodder, the ventilation method, the cleanliness of the stalls, the size of surface odour sources and their emission intensity (Béres 1997; Béres et al. 2014). On picture 1, we show the size of specific odour emission¹ in the case of keeping swines which often induces public complaint (Büchele és

¹ Specific odour emission can be determined based on the odour concentration, volume stream of odour-polluted air leaving the stall, taking the total body mass of specimens kept in the stall into regard (one livestock unit (LU) equals 500 kg of live body mass).

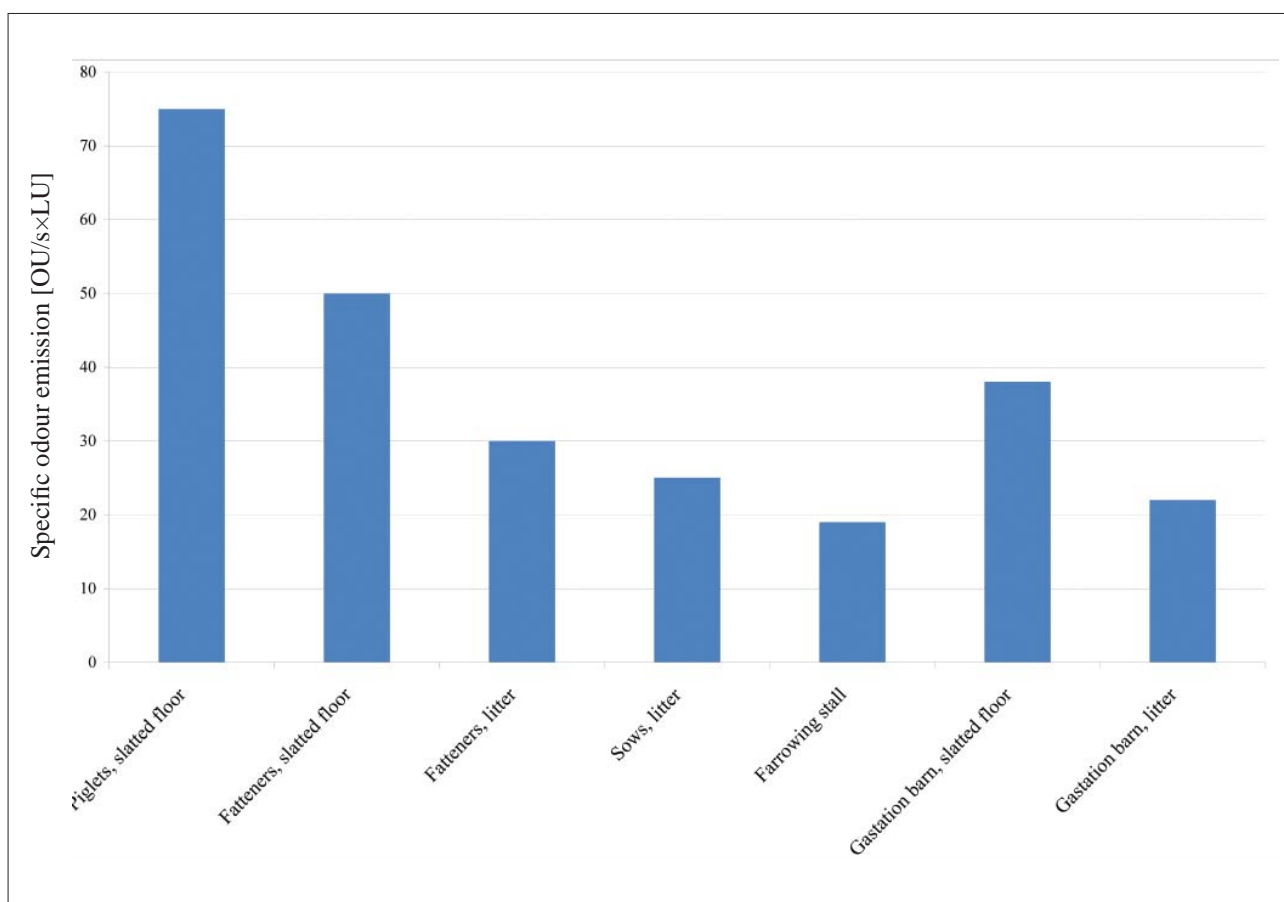


Figure 1: The specific odour emission of certain swine farms (OU – odour unit)

Eberhartinger-Tafill 2011; Bayerisches Staatsministerium für Landwirtschaft und Forsten 2003; Sächsisches Staatsministerium für Umwelt und Landwirtschaft 2008; Hartung 1995).

Based on the results of examinations, observations related to disturbing environmental odour impacts, odour material originating from different odour sources (e.g. livestock), the effects and induced reactions on residents living in the vicinity of the source were written down. The most prevalent of these are the following: change of respiratory rate, shortness of breath, feeling unwell, sickness, nausea, vomiting, headache, restlessness, sleeping disorders, allergic reactions, conflict with the owner, manager of the odour source (Béres 1997). These developing reactions – similarly to the sense of smell itself – significantly depend on the age, sex, health condition, sensitivity, current mental state, psychological condition of the subject of the effect. In general, it can be said in summary of the presented effects and reactions that the materials with odour impacts generally do not cause direct illness or health deterioration but they affect the well-being of someone by the induced reactions (Matzke 1986).

DETERMINING THE ODOUR IMPACT WITH ODOUR MEASUREMENT AND DISPERSION MODELINGS

Determining and evaluating the odour impact caused by the establishment can be done based on the results of odour measurements at the sources of odour emission (stalls, surface sources, e.g. yards, pens, open-air manure storages, etc.) and atmospheric dispersion modelings based on them, but the environmental odour impact caused can be evaluated even based on field odour measurements, detections in the vicinity of the establishment. The samples are taken at the odour sources at the farm when the odour emission of each source is determined (IPPC 2002). The samples used for odour measurement are collected in special bags, the material of which ensures that the contents of the sample remain unchanged for 24 at least hours. The way of transporting, containing the samples is also strictly regulated. When the odour samples are taken, sampling tools must be used depending on the type of the sampled emitting source: in the case of sampling spot or building sources, a so-called lung principle based sample-taking instrument, in the case of surface sources, a sample-taking bell or a ventilated sample-taking bell

(e.g. in the case of open-air manure containers) is used (MSZ EN 13725:2003).

Determining the odour concentration of odour samples is done by an olfactometer in a laboratory environment (with an odour-measuring instrument, picture 2), the sensor of which is the human nose. People participating in odour measurement have to pass a selection procedure prior to the measurement described in a standard concerned with odour measurement. There are many other expectations for those who are measuring set by the concerning standard (they have a certain age, have legal capacity, do not have flu-type illness, do not use cosmetics on the day of the measurement, cannot consume very spicy food, etc.). The measurement is led by an experienced measurement leader who is responsible for handling the samples, directing the activity of people taking part in the measurement, the whole measurement process. Apart from the instruments used during the measurement, the concerning standard contains regulation related to the room where the measurement is done, too (e.g. temperature, humidity, lighting, noise pollution) (MSZ EN 13725:2003).

Knowing the odour concentration determined at each emission source and the volume of outgoing odour-polluted air, the rate of odour impact created in the vicinity of the examined sources can be determined by using a mathematical model describing the atmospheric dispersion of air-polluting material, taking factors influencing the dispersion into regard (e.g. the geometric features of the emitting sources, wind conditions, topographic features, roughness of surface – foliage, building density, radiance conditions, etc.) (Géczi and Béres 2011). The calculated modeling result – depending on the type of the model used – shows for example the value of odour concentration in the vicinity of the sources depending on the distance

from the sources (the result can be represented on a map, too). In this case, the so-called odour protection effect area of the sources can be determined taking the odour emission threshold limits dependent on the type of the odour (very disturbing odours: e.g. animal fodder production, less disturbing odours: e.g. baking activity, coffee roasting) into regard (IPPC 2002). If the odour protection effect area determined based on the thresholds and represented on a map affects objects that need to be protected (e.g. residential buildings), then the odour impact of the examined emission sources (e.g. livestock farm) is deemed to be disturbing (306/2010).

The result of the modeling – in the case of another dispersion model used – can show the value of odour frequency depending on the distance from the sources (this result can also be represented on a map). Based on the examinations, odour frequency measured in odour hours is compared to the threshold value dependent on the type of use in the examined environment (for example in Germany, this value is 10% in the case of residential areas). If the measured odour frequency is bigger in the area that needs to be protected (e.g. residential area) than the frequency threshold value, the environmental odour impact caused by the examined source is deemed to be disturbing (Feststellung und Beurteilung von Geruchsimmissionen 2009).

DETERMINING THE ODOUR IMPACT WITH FIELD ODOUR DETECTIONS

According to what is described above, the environmental odour impact caused by the odour emission of the examined livestock farm can be evaluated based on the results of field odour detections done in the vicinity of the establishment, too. In this case, the value of odour impact can be measured by determining how high odour frequency is. When this method is used, the detection spots are designated by applying a network of squares with equal sides (raster) on a map in the environment of the odour source examined. Odour detections are done at the pre-designated detection spots with specified operational and meteorological circumstances by people with a tested smelling ability; odour frequency is measured in odour hours several times per spot. At the nodes, only the perceptibility of the odour is examined (yes/no answer). A detection lasts for 10 minutes per occasion, and during this, 6 detections have to be registered per minute (a total of 60 detections). An odour



Picture 2: The olfactometer used during odour measurement and people participating in the measurement (photo: Miklós Gulyás)



Picture 3: The use of Nasal Ranger field olfactometer for odour measurement (photo: Kálmán Samu-Nagy, Nóra Koplányi)

hour is realized if at least 10% of the duration of the measurement (6 times per 10 minutes in the case of sensing by organ) is deemed to be “smelly”. The index number of odour frequency is the rate of odour hours described by the method mentioned above compared to the total number of hours per year (VDI 2006). According to what is described above, if odour frequency is higher in the area to be protected (e.g. residential area) than the threshold limit, the odour impact caused by the examined source is deemed to be disturbing (Feststellung und Beurteilung von Geruchsmissionen 2009).

DETERMINING ENVIRONMENTAL ODOUR IMPACT WITH FIELD ODOUR MEASUREMENT

In the United States, research was started at the end of the 1950s financed by the U.S. Public Health Service to develop the method of field odour measurement and an instrument suitable for it (Huey et al. 1960; St. Croix Sensory, Inc. 2005a). According to the results of the developments, the first field odour measuring instrument (field olfactometer), the so-called scentometer was manufactured by the Barnebey-Cheney Company and after that, the Barnebey Sutcliffe Corporation. Thanks to the field olfactometer, a dilution series can be created directly at the site of the measurement by mixing the examined odorous environmental air with odourless air (de-odourised environmental air). Each dilution level of the dilution series is evaluated by the measuring person, setting the so-called dilution-to-threshold. The set value characterizes the strength of the odour that can be sensed in the examined environmental air, the odour concentration by showing the rate of dilution where the odour of the odour-polluted air cannot be sensed. The field olfactometer manufactured by St. Croix Sensory, Inc. the a Nasal Ranger works according to the same principle

(St. Croix Sensory, Inc. 2005a). The use of the Nasal Ranger field olfactometer during odour measurement is shown in picture 3 (Koplányi 2014).

Of course, the examination of measuring people is necessary for the use of field olfactometer, too, which can be done following the method described above according to the MSZ EN 13725:2003 standard, but the odour sensitivity test kit developed to test the sense of smelling using so-called odour pens can also be applied well for this end (Józsa 2014; St. Croix Sensory, Inc. 2005b).

With the field olfactometer, the size of odour impact created in the vicinity of the examined odour source based on a pre-defined measurement plan (measurement spots, date and duration of measurement) and if there are many measurements, even the occurrence frequency of the disturbing odour impact. The field olfactometer can be used well for the operator of the odour source to make self-tests to prevent the creation of the odour impact in the environment of the odour source.

CONCLUSIONS

According to what we described above, there are several methods to set determine the odour impact of environmental odour sources, for example in the case of livestock farms: we can use odour measurements even directly at the odour-emitting source, we can apply odour detections or field odour measurements in the closer or wider environment of the odour source. Every method – taking the limits of each one into regard – can be used suitably to determine and evaluate the odour impact of the odour source. The method to be used must be chosen every time by knowing the characteristics of the odour emitting source and its environment, taking the available technological opportunities into regard, from the perspective of the odour feature (odour strength, odour frequency) to be determined and evaluated.

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“THE EARTHWORM IS THE BEST WORKMATE OF THE FARMER” –or the beneficial effects of minimal soil disturbance on soil structure

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ABSTRACT

In recent decades in Germany the soil structure has been greatly improved in a substantial part of the arable land. Soil erosion can be observed less commonly. Since the 1970's in Germany the intensity of soil disturbance has been significantly reduced. The less disturbed soil has more mechanical load, namely the stability of soil structure. The perforated structure with stable biopores ensures ecological functions, such as infiltration, aeration, root permeability, fertility. For this reason, soil compaction and soil erosion occur less frequently, they can be detected only in exceptional cases. But in Hungary the same cannot be stated, therefore it is desirable to explore the cause for differences. Usually the best soil structure can be found on arable lands where ploughing is not applied. In Germany there was an opportunity for us to study the condition of soils in farms which use no-till system. We have analyzed the effect of soil cultivation methods on soil structure.

keywords: soil structure, tillage methods, compaction, earthworm

INTRODUCTION

Since the 1970's in Germany – partly because of rational aims – the intensity of soil disturbance has been greatly reduced; even ploughing tends to be evaded.

Several forms of reduced/adaptive soil cultivation have become widespread, but basically mixed tillage systems dominate, since plant protection strategies to be developed for cultivated crops have a vast impact on tillage systems. Although the majority of farmers still use ploughs, they

do not employ them regularly, and they plough the soil less deeply than they used to. Farmers plough for plant protection purposes only – and only before certain crops – while before other plants in the crop rotation they use merely a heavy duty cultivator. An ever increasing number of farmers use cultivators for primary tillage, and do not use ploughs at all.

With the decrease of soil disturbance, the structure of soils significantly improves. Our experiences are promising, and the improvement of soil quality can be verified by field test methods as well. The improvement of soil structure can be linked to an increased biological activity of soils, as tillage without inverting provides favourable conditions for earthworms (*Lumbricus terrestris*). Earthworms get enough food on the surface in the form of organic residues (mulch), and as a result their activity improves the structure of the soil. In order to facilitate/establish sustainable soil use, it is absolutely necessary to study the link between German tillage methods and the quality of soils, as well as share gained experiences in order to contribute to the adaptation of optimised soil disturbance methods in Hungary. Nothing proves this idea better than the words of Heisenberg: “Science has two components: observing phenomena and sharing the results...” (Heisenberg 1978). This was our aim in planning a study tour to Germany.

SOIL COMPACTION: ITS FORMING AND DEFINITION

In accordance with Act CXXIX of 2007 about soil conservation, the sustainment of the yield potential of arable lands is our common task, therefore land users should prevent or terminate the compaction of soil in order to avoid excess water or inland inundation. Soil

is a conditionally renewable natural resource, as well as the basic production means of agriculture and forestry. Thus, soil protection primarily means quality protection: the protection and improvement of quality, but first and foremost the prevention of physical, chemical and biological deterioration.

The German Packungsdichte is a complex concept, but basically it means a simple field method that aims at the assessment of the condition of soil structure. This field method primarily examines the degree of density of the soil, which has a fundamental impact on the most important aspects of soil, such as porosity, water and air permeability, root penetrability and fertility (DIN 19682-10:2007).

Compaction basically reflects the adhesive and cohesive forces between soil particles, which are manifested in the soil's resistance to cultivation. Soil compaction depends on several factors: the morphological, physical and chemical properties of the soil, as well as the vegetation that covers the ground, the way the land is used, and also the method of tillage.

When determining compaction, the moisture content of the soil plays an important role.

Regarding soil compaction, the following categories can be established with field methods: friable soil, loose soil, slightly compacted soil, compacted soil, heavily compacted soil, very heavily compacted soil, and solid soil.

In trying to visually determine soil structure in the field, the simple and universally applicable "Spatendiagnose" ("spade test") method may help, but reliable and practically useful results are obtained through the joint analysis of regular soil sampling, plant studies and crop yield (Tebrügge and Eichhorn 1992). Soil tests carried out in the field are practically the intersections of theoretical research on soil science and soil tillage.

Spade tests actually mean the examination of the place where the plant is grown. During this process the structure and colour of the soil, root distribution, pores in the soil, as well as transition horizons were examined. The name and description of the method comes from Görbing (Görbing 1947). Spade tests can be used to examine the soil down to approximately 25-28 cm below surface, regarding its structure, water content, the location of the solid layer, the condition of the soil, and accordingly, the suitability for cultivation (Birkás 2007; Birkás 2011). In most cases earthworms and wormholes can be found within the depth of shovel blade. In critical situations it is worth digging two spits deep. The great advantage of the method is that it can be gained information about the condition of the soil right in the field. Since there are using a smaller soil profile, it can be excellently observed root distribution or the ratio of macropores. However, if the soil is too wet or too dry, it can be a problem. This is why sampling should take place in spring, when the saturation of the soil is optimal. Spade tests can also supplement the examination of soil compaction.

FIELD EXPERIENCES: A GERMAN STUDY TOUR

In connection with sustainable cultivation and the field study of soil structure, this summer we had the opportunity to visit Justus-Liebig University in Giessen, Germany, which is one of the most significant universities in the area of agriculture, soil studies and soil protection in Germany (Justus-Liebig-Universität, Institut für Bodenkunde und Bodenerhaltung). It is characterised by a high degree of interdisciplinarity. The study tour was made possible by the Campus Hungary Higher Education Staff Long Term Mobility B2/4H/12385. So there was an opportunity to observe and study the educational and research structure of Germany, a country with highly advanced economy. At the Justus-Liebig University, where some thematic research involving practical problem solving is also part of PhD studies, so it seemed like a good chance to learn about educational/research techniques that – due to the significant innovation – are more developed than what Hungarian infrastructural conditions allow. This research is aimed at solving actual problems, and the results are immediately utilized in the agricultural and environmental industries. Within each research unit of the university, PhD students and visiting professors of the same study field but coming from different countries work together, thus create an international scene where it is possible to share research, educational and professional experiences with one another. They carry out theoretical research primarily, relying on an advanced laboratory infrastructure

However, in order to emphasize and widely share the importance of practical knowledge, it was necessary to establish presentation and training centres on German universities and colleges. One perfect example of such a centre is the Hochschule Weihenstephan – University of Applied Sciences in Triesdorf. The significant results had been achieved in the area of agriculture that is highly adjusted to local conditions and circumstances. Furthermore the two institutions of higher education mentioned above have developed very strong bonds with farmers, in the area of applied research, experimental development and education.

They realized that the more complicated problems in the area of practical agricultural research should always be solved with the contribution of farmers, for it is in the intersection of discovery and applied research where the solution to the problems lies. This way the crossing points of education and research (theory and practice) will be highly satisfactory. Innovation and interdisciplinarity are also greatly propagated. The Hochschule in Triesdorf regularly offers agricultural MBA courses (in German), where practical farm activities are combined with the mastering of theoretical knowledge. Those who enrol in the courses will receive an internationally acknowledged degree and understanding, since this training is internationally

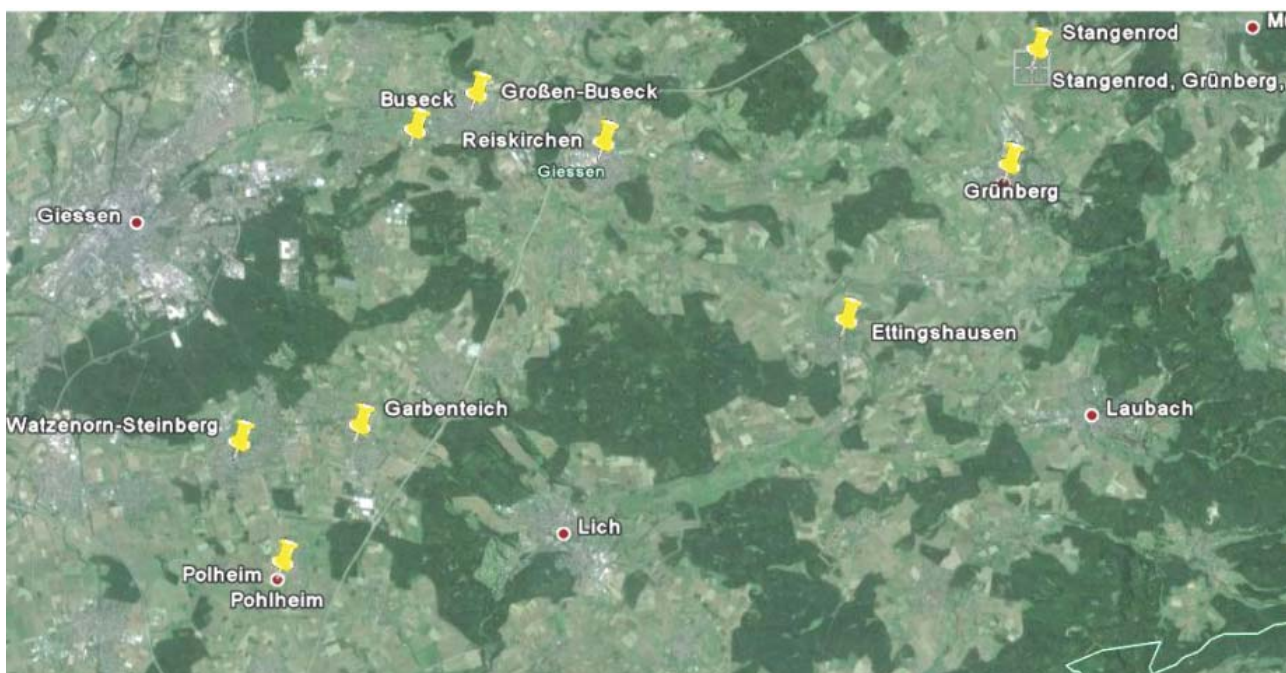


Figure 1: The Giessen basin, Grünberg and its surroundings, Vorderer Vogelsberg
 Source: Google Earth map

accredited. Such an educational, research and student base attracts a number of manufacturers and dealers, who provide practical training opportunities for high quality educational / research activities.

THE EFFECTS OF SOIL DISTURBANCE ON SOIL STRUCTURE – OUR EXPERIENCES IN GERMANY

The colleagues of the Institute of Soil Science and Soil Protection at Justus Liebig University feel responsible for the sustainable use of natural resources including soil, and they realised years or decades ago that this requires active cooperation with farmers.

There was a great opportunity to study the condition of German soils in order to explore the effects that tillage methods and tools have on the soil. This study was organised by the scientists of the institute, under the leadership of Professor Dr. Tamás Harrach. It is important that the signs of the interactive relationship between the soil and the tools used on it can and should best be studied in the field, taking into consideration the biological processes of the soil. Since, from the viewpoint of plant production, not only the nutrient content but also the structure of the soil can be a limiting factor (Tebrügge and Eichhorn 1992; Beste 2002).

The different levels of this method indicate how compacted or loose the soil is. This includes a number of very important aspects about the condition of the soil, such as total porosity, the ability of plants to grow roots, or the amount of water that the soil can contain, as well

as the soil's permeability. During our first study tour, we visited the German and Bavarian farms as indicated in Figure 1 (basically in the Giessen basin and in the Vorderer Vogelsberg subregion), where we learnt about the tillage methods used, as well as the condition of the soil of cultivated lands. This also provided the opportunity for researchers to share their experiences with local farmers.

With the active contribution of farmers, it could be observed how local farms or family farms work. With the German colleagues, we could also carry out soil field diagnostic tests on the areas belonging to the farms listed in Table 1.

When deciding which farms to visit during this study trip, primarily those farms were chosen which cultivate the soil without using ploughs. One of the reasons behind such tillage methods is that some of these lands have shallow topsoil, since they have been formed on the basalt of the mountain. Because of this these soils contain a large amount of hard basalt and rubble. However, both in the shallower, poorer basalt soils and in the more fertile loess soils, another aspect is considered: besides economy, farmers favour methods which rather increase the fertility of the soil than decrease it. Both reasons are a motivation and challenge for farmers.

Accordingly, tillage methods involving minimal soil disturbance are rather widespread in Germany. The quality of tillage methods are also valued by how much the biological processes in the soil are taken into consideration. The agricultural engineering industry in Germany, including market leading Horsch Company, recognized this, and, through its absolute partnership, has facilitated the

TABLE 1: Main information of farms				
farm/ farmer location	landscape, mean annual temperature/ average annual precipitation	area of cultivated land (crops)	main soil types (score on a 100 point scale)	cultivation method
Peter Fay Pohlheim, Watzenorn- Steinberg	Giessen basin 8.9 °C / 600 mm	120 ha (rapeseed, autumn wheat, rye, spring barley in crop rotation)	some shallow gravelly and clay topsoil from basalt (30-35), some excellent loess soils 70-84)	with cultivator for 10 years, no ploughing for 5 years
Agrarservice Bank GmbH Oliver Jung Reiskirchen, Ettingshausen	Vorderer, Vogelsberg 8.0 – 9.0 °C / 600 - 750 mm	700 ha (rapeseed, autumn wheat, spring barley, spring barley in crop rotation)	some shallow gravelly and clay topsoil from basalt (30-35), some leached loess soils (55-68), some excellent loess soils (68-74)	with cultivator—parts of the area has not been ploughed for 20 years
Dr. Dietmar Schmidt Buseck, Großen- Buseck	Giessen basin 8.8 °C / 600 - 650 mm	165 (rapeseed, autumn wheat, autumn or spring wheat, autumn barley in crop rotation)	some shallow gravelly and clay topsoil from basalt (45-65), mostly excellent loess soils (68-75)	with cultivator, no ploughing
Manfred Balsler Pohlheim, Garbenteich	Giessen basin 8.8 °C / 600 mm	70 ha (rapeseed, autumn wheat, rye, spring barley, autumn barley)	some shallow gravelly and clay topsoil from basalt (36-55), some Stagnosol loess soils (55-70)	with cultivator, sometimes shallowly with disc harrow – for 10 years partially, for 5 years totally without ploughing
Reinhard Keil Reiskirchen, Ettingshausen	Vorderer, Vogelsberg 8.5 °C / 600 - 650 mm	260 ha (rapeseed, autumn wheat, spring barley)	some shallow gravelly and clay topsoil from basalt (38-55), some leached loess soils (55-68)	traditional tillage with ploughing, but sometimes cultivator without ploughing
Henning Schäfer Grünberg, Stangenrod	Vorderer, Vogelsberg 8.1 °C / 750 mm	190 ha (rapeseed, autumn wheat, autumn barley, spring barley in crop rotation)	some shallow gravelly topsoil from basalt (38-55), some leached loess soils (55-74)	with cultivator—partially without ploughing for 12 years, mostly without ploughing for 4 years

spreading of tillage methods adapting to local needs and conditions (by the continuous development of related machinery). The farms cultivate their lands with joint acquisition and use of machinery, which is based on the ownership share of cultivated land areas.

Due to the minimal disturbance of soil, a large part of farmlands in Germany is in a very good condition, or at least significantly better than 30-40 years ago. The same is not true about Hungary, despite that fact that according to the Programme of National Cooperation published in 2010, soil protection is one of the main aims of the government: *“The aim is to create diverse agriculture, environmental and landscape management which produces valuable, healthy, and safe food in a way that taxes the environment and local energies and raw materials to the least possible extent while preserving our soil, water stock, wildlife, and natural values.”* (PNC 2010) Thus, it is desirable to explore the causes for these differences, since by adapting German good practice, soil structure in Hungary could also be improved (although some farms make soil conservation tillage for 32 years). The basic difference lies in the intensity of soil disturbance.

The less the soil is disturbed, the better its structure, since excessive tillage causes the disintegration of soil structure, while optimised disturbance facilitates biological processes in the soil, as well as the proliferation of earthworms, thus having a key role in the development of excellent, stable soil structure.

Optimised soil disturbance methods have provided us with good results, the achievements are well documented. The structure of the soil is especially good in areas where the land has not been ploughed for years or decades. The greatest disadvantage of ploughing – besides its being energy and time consuming – is that it inverts the soil too deep. This way organic remains get into the deeper parts of the soil (down to 20-40 cm), leaving no mulch on the surface, therefore earthworms (*Lumbricus terrestris*), which play a crucial role in improving the porosity and structure of the soil, will not have enough food that is rich in organic material. Without ploughing, however, mulch remains on the surface, which provides the necessary conditions for earthworms. (Note here that an even distribution of mulch does not require any extra effort, since this can be done at the same time as harvesting the



Figure 2: Structure of undisturbed soil



Figure 3: Biopores and roots permeating the pores in undisturbed soil

crops.) So, fewer disturbances and more mulch lead to more earthworms, the activity of which results in a better soil structure. Besides plant remains as food, the lime content of the soil is also important, therefore lime-free soils should regularly be supplemented with lime, or else biological processes will deteriorate, which has an adverse effect on the activity of earthworms.

Of course, the soil cultivation methods have other roles as well. Applying ploughs or deeper disc harrows have plant protection objectives, too. Consequently, those who apply minimal soil disturbance, use chemicals for weed control and plant protection. Therefore, when introducing adaptable cultivation systems, the greatest challenge is to develop an appropriate plant protection strategy. The use of chemicals is an obvious choice, but there are other solutions as well. This is proven by the increasing numbers of organic farms that change over to reduced/optimised tillage and minimal disturbance cultivation methods.

The spade test method was applied to examine soil structure in the field. Nowhere within the farmlands did we experience any "harmful compaction". The part of the once ploughed topsoil that has been tilled with a cultivator 18-25 cm deep was definitely loose and friable, which was not true about the layers beneath. Previously, the soil had been ploughed 32-35 cm deep. The topsoil that has not been disturbed for years is more difficult to dig 25-35 cm below the surface, and at first sight it seems compacted, but at closer inspection it is revealed that this relatively compacted layer also has a lot of biopores, especially former root spaces and wormholes.

Figure 2 illustrates the structure of such soil that has not been ploughed for years, where, close to the surface, the structure is loose and friable, and there is no harmful compaction in the deeper layers either. The large number

of vertical biopores ensures infiltration, ventilation and root growth (Figure 3). Thus, ecological functions of the soil are intact, so harmful compaction can be excluded. At the same time, the more compacted matrix has higher stability, and it prevents the subsoil from compaction caused by heavy tillage implements and traffic. So, in the soils, the subsoil below the once ploughed level shows no sign of compaction. Here an especially large number of biopores are visible to the naked eye (Figure 3). This layer should not be disturbed in such condition, because the current, moderate compaction ensures higher load capacity, while the loosening of the layer would annihilate the existing, definitely stable biopores.

With the simple spade test method described above, it can be seen in the whole section that the optimised amount of disturbance has a positive effect on the structure of the soil. As a result of leaving mulch on the surface, earthworms start

to flourish (Harrach 2011), they improve the structure of the soil and its porosity. With this kind of farming, soil compaction and water logging hardly ever occur, there will be no crust formation on the surface, and soil erosion rarely takes place, either. If plant protection strategies work as well, plants will grow successfully, and they will not show any signs of deficiency caused by inappropriate structure of the soil, even where the heaviest traffic occurs at the edge or in the cultivation rows of the plot.

Therefore, poor soil structure and harmful compaction can be identified by the presence of crust formation on the surface, water-logging, signs of soil erosion, and last but not least, the insufficient development of crops. These signs should particularly be monitored in case of extreme weather. With the spade test method, it can be easily identified which layer of the soil is affected by harmful compaction. It should be particularly careful where biopores (former root spaces, wormholes) are missing. Harmfully compacted layers should be loosened, because heavy compaction cannot be improved by biological processes only. Note here, though, that the stability of loosened soil is poor, and the risk of recompaction is high. Thus, intervention should take place only where appropriate, and even in such cases, the soil should not be disturbed any deeper than truly necessary. The soil should be loosened only when its water content is optimal for the operation.

It has been proven by a number of experiments and practical cases that direct sowing without soil disturbance can also give maximal yield, provided that the appropriate sowing strategy and plant protection technique are applied. The soil should be loosened only if its structure has been damaged.

In order to assess the condition of the soil, each year farmers perform 3 or 4 field tests, or have them performed

by professional soil experts, in line with due agricultural work.

To perform these tasks is their primary interest, since their "taxing" system is based on maintaining or improving the soil's condition, (there exists a so called 100 point soil classification system to help the assessment of the soil).

Through the examples of the farms we visited during this study tour in Germany, it became perfectly clear for us that the interdisciplinary nature of adaptive agriculture (involving agriculture, engineering and plant protection) is becoming more and more important. Moreover, in addition to basic research, practical experience is also indispensable, while spectacular results can be achieved through the cooperation of regional agricultural research institutions and farms.

CONCLUSIONS

We were pleased to discover that we share our views with German colleagues and local farmers concerning the potentials and challenges of sustainable and adaptive agriculture, consequently the aims of our research work are the same: to improve the condition of soils. This research, however, should never be an end to itself; it should always help to find answers to actual social challenges, according to the motto: "Science that looks far: responsible answers for the future."

However, we all agree that the natural environment contributes to human well being. The optimal depth of soil cultivation is a highly disputed question in Germany as well, since ploughing and the several operations associated with it, are, among other things, quite energy consuming. This is why there is a growing demand for economically more efficient solutions that require fewer operations. There is, however, no universal solution to the problem; the appropriate soil tillage strategy should always be developed according to local and specific conditions and experience, during which several factors should be taken into account, namely:

- In case of ploughless cultivation earthworms will proliferate and improve the structure of the soil

- Vertical wormholes reaching down to the soil, as well as those leading to the surface are of particular importance. The greater the number of such wormholes per square metre, the better the conditions for infiltration and thus the permeability of the soil.

- Disturbance of the subsoil is appropriate only when compaction of deeper layers need to be loosened.

- In order to achieve optimal soil structure, the straw is shredded at the time of harvest (ideally into pieces smaller than 4 cm), and that it is spread equally. Novel sowing

techniques enable leaving mulch on the ground, which is very valuable from the viewpoint of soil biology and soil protection.

- Plant protection strategies should apply a moderate amount of chemicals, and they should prefer the use of ecological methods.

The path to adapt optimal soil disturbance in Hungary and to assessing our potentials in the light of our abilities leads through an all-society awareness raising educational activity, as well as proper educational and research work. The feasibility of such a path has been fully confirmed by this study tour.

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NATIVE NUTS IN HUNGARY: WALNUT AND HAZEL

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THE TREE OF ZEUS...

Walnuts are native to Asia Minor and Central Asia. They are already included in the Song of Songs (6, 11), because such a tree blooms in the garden of Israel. It had already been grown in Galilee and the Lebanon Mountains foothills at the age of Jesus; in Greece, it only occurred in the wild in the mountains. *Theophrastus* writes that because of the abundant yield of olives, the Greeks did not even think about growing walnuts. The situation changed when new (noble) varieties landed in Greece from Persia named '*karyon basilikon*'. According to an ancient Greek custom, walnuts are thrown during a wedding, and this can be found among Hungarian wedding customs, too, probably as a residual impact of Eastern Christianity.

The walnuts are also known in ancient India where their Sanskrit name was '*akhota*'. However, they were only later introduced in China, only later, during the Han Dynasty (150-140 BC). Supposedly Chang-kien brought it from Tibet.

In Greece, Laconian princess Karya became the lover of Dionysus, but the girl died unexpectedly. It was Dionysus himself who brought the news of her death to Laconia, and its people built a temple of Artemis Karyatis. It was the first time when women-shaped columns were used that have become the symbols of the walnut nymphs and



Figure 1: Kyrgyzian walnut forest (1988)



Figure 2: Pistillate flowers of walnut species: *Juglans regia* (A) and *J. nigra* (B) (2000)



Figure 3: Walnut nymphs' temple (Erektheion) in Athene (1978)



Figure 4: After shell cracking (A) and fertile twig of black walnut (B) (2000)



Figure 5: Unknown local cultivars (A) (2003) and of blood-kernel walnut at village Fadd (B) (2003)

Karya. Artemis really liked the dance of the walnut nymphs, watching them gladly. The caryatids wore green cane wreaths on their heads during the ecstatic dance. Walnut – as a tree of life – was also a symbol of fertility, perhaps this is why it is also a female figure. Karya derives from the Phoenician mythology, and worshipping her took root with the spreading of noble walnut strains in Greece.

Strabo wrote that many mountain walnut trees (Greek walnut) are around Synope (3 XII. 12). Walnuts are light- and water-intensive species, they can be found in Rhodope Mountains below 1200 m. Today, the growth limit is around 63 degrees north latitude, hickory and pecan nuts – native to the New World – are more important to the Indian subcontinent, Africa and Australia, though *Juglans regia* is also prevalent.

It is the favorite tree of Jupiter and Zeus; **Ovid** wrote in *Metamorphoses* (Book I):

“and ripe blackberries clinging to the bush,
and corners and sweet acorns on the ground,
down fallen from the spreading tree of Jove.”
(translation of Brookes More)

The Romans also grew the walnuts, the relevant descriptions of **Cato** and **Varro** show a good knowledge of plants and experience in growing them. Among the foreign

varieties, Greek walnuts (which could be the almond) are mentioned, and Abella (Campania) and Praenaste (Latium) varieties were also valuable. Great care was taken by the Romans to store the walnuts. The harvest was put in sand or a bowl and dug underground. One of the most valuable pieces of data on walnut is from **Varro**: walnut trees make the edge of the estate infertile. It probably refers to the observation that walnut has a strong allelopathic effect on surrounding vegetation.

Germanic mythology also includes walnuts. The god Loki put Iðunn and the golden apple inside a walnut by magic and in pursuit, the Æsirs made the walnut to be thrown into woodchips. The woodchips were quickly ignited so the eagle was unable to chase Loki any longer because it fell into the fire choking. Only then was Loki able to obtain the golden apples. European folk tradition may lend walnut kernel magic power on this Germanic legend, saying that it is similar to the brain.

THE HUNGARIAN WALNUT IN NUTSHELL

The Hungarians may had the first chance to see walnuts first in the area between the Volga river and the Sea of Azov (maybe thanks to the Alans or Turks). The conquerors probably liked the fruit because it was highly esteemed



Figure 6: Hazelnut and filbert orchards in coast of Black Sea (original map)

indigenous in Transylvania, the Central Mountains and in certain parts of Transdanubia. Opinions are quite contrary to each other, but it sure that (at least) most of the country belongs to secondary gene center. Rapaics (1940) writes that people tried to replace local varieties in Transylvania probably with French walnuts, but the experiment failed: the Sebeshely local strains had much better yield even according to the comparison of cumulative harvests.

LINGUISTIC HISTORY – BRIEFLY

In our medieval forests, walnut trees occurred in many places mixed and later they cleared their closer environment, other trees around them were exterminated, therefore larger and smaller groves have been formed, especially in often inundated flood plains. Apart from the words 'dió' and 'dia', 'gia', 'gyofa' and 'gyabukar' also mean walnuts in old Hungarian. The word *gyos* can be read in the Latin text of the founding document of Pécsvárad (1015) or 'ad *gyofa arbor*' in the charter dated 1264. There is a lot of interesting data in the forestry history book of Csöre (1980).

The glossary of *Murmelius* (1553) quite accurately described the common walnut (*Juglans regia*), which is 'nux graeca' in Latin and this word form was transferred to various languages. The name of Egyptian nuts can be read in the *Calepinus* dictionary but it corresponds to pistachios. *Fabriczius Szikszai* included three types of walnuts: thin-skinned, tough and small-kerneled walnut.

In the middle Ages, it had remained an important fruit that was partly collected. Its tree was always highly valued, perhaps honouring the walnut tree and worshipping it as something ancient and mythical can also be traced back to this period. It is the symbol of immortality in archaic popular belief therefore it was also planted on graves. It was planted at the parcel boundaries of vineyards in The Great Hungarian Plains, next to the dug wells and at the end of vines rows. The grandfather always take ultimate care of them to bring plenty of grandsons and then to remind him of their adulthood...

There have been less and less pure walnut orchards, closed areas of it beside plantations since the 17th century

because they are planted as solitaires when possible. It was placed between vine rows in sandy areas because they probably did not factor in the yield decrease. Lippay (1667) shares his experiences of walnut: it is better to plant them alone not to inhibit the vegetables.

Today, the world's largest walnut growers are China (1.7 million tons), Iran (450.000 tons), the USA (430.000 tons), Turkey (195.000 tons), Mexico 111.000 tons) and Ukraine (97.000 tons); in exports, the European leader in France (FAO Database). The Hungarian walnut stock is quite significant: a smaller part of is in orchards and vineyards, but trees are mostly located scattered and in home gardens. Old methods of growing it are related to local strains (Milota, Fertőd and Alsószentivány). Modern plantations – for local reasons – are mostly in Szabolcs-Szatmár-Bereg and Somogy county. Vernacular walnut production is characterized by the continuous renewal of the 40-year-old tree stock.

AND HAZELS...

We wanted to indicate the unfortunate lack of this delicious nut and our disappointment with it because we can only see its bushes in some gardens, as forest communities or on the edges of forests; it is hardly grown in Hungary, although cultivated on a large scale worldwide.

The Greeks and Romans made a distinction between wild and precious hazels, even *Theophrastus* mentioned them already. *Cato* wrote that hazel bushes produce edible and tasty seeds and described is as 'avellana'. *Virgil* used the name *Corylus avellana*, according to him, avella is a reference to the name of the town Avella in Campania.

Pollen studies show that about 10.000 years ago, hazel had a very large population area in Europe, West Asia (and the Balkan); it is native to East Asia and North Africa (Terpó 1974). In particular, Turkish, Italian and Spanish cultivation is significant, but its production is also well-developed in Mediterranean countries. Since the early Middle Ages, Athens, Sicily and Byzantium were the center of hazel



Figure 7: Native hazel shrub in 'Nagyerdő' (Nagykörös) (2010)



Figure 8: Of blood leaf hazelnut (2010)

trade. A suburb of Constantinople (*Fündüklü*) is named hazel village. Mostly wild hazelnuts of Trapezunt (present-day Trabzon) were brought here. Hazel is one of those fruits that were and are both cultivated and collected – a similar phenomenon can be observed in the case of wild chestnuts.

THE DIVERSITY OF HAZELNUT

Hazelnut is grown in the Crimea and the Northern European states, especially in Germany. The results of the work of their breeders are shown by that many hazel strains are German. Hazelnut cultivation in the south of France and England should also be mentioned. *Corylus avellana* is significant in Hungary and the whole of Europe, but if we go East, we will see several other species grown, e.g. Trabzon hazelnuts (*C. pontica*), the filbert (*C. maxima*), Turkish hazel (*C. colurna*), and *C. americana* in America.

Our ancestors have long been aware of hazelnuts despite that there is no ancient Finno-Ugric word for it. Even data in documents do not say a lot of it than that its fruits were collected in the forests, but they do not mention its cultivation. Nut was only eaten by shepherds, loggers and rangers. In the 16th and 17th century, aristocratic needs had to be met by imports. It is strange that hazel is native in Hungary but it has not been produced even in a primitive manner.

The establishing charter of Tihany Abbey (1055) also mentions a hazel bush which was definitely an older bush because it serves as a border sign:

„...begins at the ‘munorau kerekű’ (hazel forest) beside ‘fizeg’ (Füzege) that leads to ‘uluues rnegaii’ (the mere of Ölyvös) to lead to füzeg azaa (Füzes valley) after monaraubukurea (hazel bush)...and it continues until the other road that leads back to monarau kerekv (hazel forest).” (translated to Hungarian by Surányi 1982).

Moniario tree can be read in the *Schlägli*-vocabulary, *monyero* tree in the *Beszterce* glossary, *Murmelius* mentions ‘*moniario*’, *Calepinus* writes ‘*mogyoró*’ and ‘*mogyoró*’ is in the *Szikszai Fabriczius* dictionary; ‘*Nux pontica*’ Praenestina means Trebzon hazels. Lippay (1667) also gave useful advice for hazel cultivation: bushes should be planted at a damp place which can be done from seed, etc. Its wood is valuable: it can be used for tire or added to gunpowder and it was also used as charcoal chalk. Some strains are cultivated in home gardens.

The countries producing the most hazel are Turkey (700.000 tons), Italy (90.000 tons), USA and Azerbaijan (30-30.000 tons), followed by Georgia and China (25.000 tons) (FAO Database).

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EFFECT OF FERTILIZATION ON WEED FLORA IN MAIZE

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ABSTRACT

Plant nutrition is one of the most important intensification factor of crop production. However the nutrients utilization may be modified by a number of productivity factors, including weed presence. Thus, the knowledge of occurring weed species, their abundance, nutrient and water uptake significantly important to establish an appropriate basis for the evaluation of their risk or negative effects on crops. That is why investigations were carried out in a long-term fertilization experiment on the influence of different nutrient supplies (Ø, PK, NK, NPK) on weed flora in maize field at Nagyhörcsök in Hungary.

The weed surveys recorded similar diversity on the experimental area: the species of *A. artemisiifolia*, *S. halepense* and *D. stramonium* were dominant, but *C. album* and *C. hybridum* were also common. These species and *H. annuus* were the most abundant weeds.

Based on the totalized and average data of all treatments, density followed the same tendency during the experimental years. It was the highest in the PK treated and untreated plots, and significantly exceeded the values of NK fertilized areas. Presumably the better N availability promoted the development of nitrophilic weeds, while the mortality of other small species increased.

Winter wheat and maize forecrops had no visible influence on the diversity and the intensity of weediness. On the contrary, there were consistent differences in the density of certain weed species in accordance to the applied nutrients. *A. artemisiifolia* was present in the largest number in the untreated control and PK fertilized plots. The density of *S. halepense* and *H. annuus* was also significantly higher in the control areas. The number of their individuals was smaller in those pilot sites where N containing fertilizers were used. Contrary to them, the density of *D. stramonium*, *C. album* and *C. hybridum* was the highest in the NPK treatments.

keywords: weed flora, diversity, density, fertilization, maize

INTRODUCTION

Plant nutrition is one of the most important intensification factor of crop production. The quantity of nutrients that could be taken up from the soil has a decisive effect on the development and the yield of crops. The water supply, which greatly influences nutrient availability, is the most important yield-limiting factor in the agriculture (Árendás et al. 2010).

The utilisation of nutrients may be modified by a number of productivity factors, including the ratio of crops and weeds (Lehoczky et al. 2007). The ability of dominant weeds to accumulate micronutrients varies and depends on the species and the sort of elements (Glowacka 2012). Hejzman et al. (2012) concluded that high N, P and K application rates changed the species composition in sown cut grasslands very quickly and definitely. For example, high N application rates could support the spread of weedy species.

According to Kalsoom et al. (2012) the combined use of NPK was more effective in promoting plant height, fresh and dry biomass and root weight than using them separately. Their findings revealed that macronutrient (fertilizer) application in maize not only favoured the crop growth, but also promoted the growth of perennial weeds. The knowledge of occurring weed species and their abundance, nutrient and water uptake is very important to set an appropriate basis for the evaluation their risk or negative effects on crops (Lehoczky et al. 2012, 2013, 2014).

Among the cultivated plant species, maize has a strategic importance in food supply and is grown on fairly great areas. Its cultivation with wide inter-row spacing and its relatively slow growth at the early stages, however, makes this crop quite sensitive to weed competition, especially during drought years (Glowacka 2012; Yang et al. 2013) and drying spells. Proving the effects of interspecific competitions, Ryan et al. (2010) illustrated that the poor efficacy of weed management in organic systems was the main reason why organic maize did not out-yield conventional ones

under standard management conditions. Moreover, they supposed the increased soil resource availability and the faster crop growth rate had probably contributed to the enhanced crop competitiveness and tolerance.

All in all, studies on weed flora and its correlation with nutrient supply are useful and contribute to the clarification of interactions and inter-specific competitions among weeds and cultivated plant species. That is why examinations were carried out in a long-term field experiment on the influence of different nutrient supplies under different weed flora in maize field.

MATERIAL AND METHODS

Present study based on a long-term fertilization field experiment (launched in 2003) with maize (*Zea mays* L. cv. PR4983) on a calcareous loamy chernozem soil (*Calcaric Phaeosem*, according to FAO) at Nagyhörscök (Fejér County, Hungary) experimental site of the Centre for Agricultural Research, Institute for Soil Science and Agricultural Chemistry for studying the influence of different nutrient supplies on weed flora in maize.

In order to estimate the soil nutrient status of the experimental area, samples were taken in August 2003. Soil analysis results were as follows: pH_{KCl} : 7.1; organic matter: 2.96%; total salt content: 0.02%; $CaCO_3$: 3.9%; y_1 : 0; $AL-P_2O_5$: 90 mg kg^{-1} ; $AL-K_2O$: 167 mg kg^{-1} ; KCl soluble Mg: 130 mg kg^{-1} ; KCl-Mo: 0.1 mg kg^{-1} ; EDTA soluble Fe: 22 mg kg^{-1} ; EDTA-Mn: 131 mg kg^{-1} ; EDTA-Cu: 2.2 mg kg^{-1} ; B: 0.2 mg kg^{-1} .

Fertilization was carried out as treatments [control (Ø), PK, NK, NP, NPK] with different active ingredients, the



Figure 1: The experimental area at Nagyhörscök in 2013

applied doses being: 150 kg N, 100 kg P_2O_5 and 100 kg K_2O per hectare. P and K fertilizers were spread before autumn ploughing, N was applied in spring, but there were no treatments on control areas (Figure 1).

Weed survey on the 4.9x15.00 m (73.5 m^2) size random block experimental plots was done in six replications. The forecrops were winter wheat in 2011 and maize in 2012. Weed samplings were conducted randomly on 19 June 2012 and on 20 June 2013 in the 8-10 leaf growth stage of maize, in its BBCH 18-19 stages. Based on the sampling, flora composition and the weed density were determined.

The dominance order of weeds was established with the Berger-Parker index (Magurran 1988). Experimental data were statistically analysed with analysis of variance (ANOVA) by MStat software.

TABLE 1: The average frequency and the order of dominance of weed species on the experimental plots in the first weed survey on 19 June 2012

No.	Weed species	Code	Life form	Photosynthesis type	Freq.	Berger-Parker index
1	<i>Ambrosia artemisiifolia</i> L.	AMBAR	T_4	C_3	12	0.360
2	<i>Sorghum halepense</i> (L.) Pers.	SORHA	G_1	C_4	11	0.250
3	<i>Datura stramonium</i> L.	DATST	T_4	C_3	12	0.130
4	<i>Helianthus annuus</i> L.	HELAN	T_4	C_3	12	0.060
5	<i>Solanum nigrum</i> L.	SOLNI	T_4	C_3	10	0.050
6	<i>Chenopodium album</i> L.	CHEAL	T_4	C_3	5	0.040
7	<i>Chenopodium hybridum</i> L.	CHEHY	T_4	C_3	7	0.030
8	<i>Echinochloa crus-galli</i> (L.) P.B.	ECHCG	T_4	C_4	8	0.020
9	<i>Amaranthus blitoides</i> S. Watson	AMABL	T_4	C_4	1	0.020
10	<i>Fallopia convolvulus</i> (L.) Á. Löve.	FALCO	T_4	C_3	9	0.010
11	<i>Stachys annua</i> L.	STAAN	T_4	C_3	9	0.010
12	<i>Hibiscus trionum</i> L.	HIBTR	T_4	C_3	4	0.010
13	<i>Heliotropium europaeum</i> L.	HELEU	T_4	C_3	5	0.010
14	<i>Sisymbrium sophia</i> L.	SISSO	T_{2-3}	C_3	2	0.000
15	<i>Portulaca oleracea</i> L.	POROL	T_4	C_3	1	0.000
16	<i>Xanthium strumarium</i> L.	XANST	T_4	C_3	1	0.000
17	<i>Ajuga chamaepitys</i> (L.) Schreb.	AJUCH	T_4	C_3	1	0.000

TABLE 2: Density of weeds (number of weeds per m²) in the experimental plots supplied with different nutrients in the first (19 June 2012) weed survey

Weed density (piece · m ²)				
∅	PK	NK	NPK	LSD _{5%}
131.3	122.0	97.7	81.7	14.0

RESULTS AND DISCUSSION

In the first weed survey carried out on 19 June 2012 altogether 17 species occurred on the herbicide-free sample areas of the experiment, out of which 53% were recorded in all treatment and three of the most frequent species (namely *Ambrosia artemisiifolia* L., *Datura stramonium* L. and *Helianthus annuus* L.) were present on all plots. The occurrence of *Sorghum halepense* (L.) Pers. and *Solanum nigrum* L. was common as well. Based on the totalized and averaged density, the order of dominance was as follows: *A. artemisiifolia* (36%), *S. halepense* (25%), *D. stramonium* (13%), *H. annuus* (6%), *S. nigrum* (5%), *Chenopodium album* L. (4%) and *Chenopodium hybridum* L. (3%). In addition to these, the further ten species recorded in the plots appeared only at a 0.1-2 % rate (Table 1).

Compering the different fertilization treatments with each other, in June 2012 the average weed density was the highest in the untreated areas, which significantly exceeded the values of NK and NPK treatments in the control and the PK treated plots (Table 2).

In the case of *H. annuus*, *Stachys annua* L. and *Hibiscus trionum* L., statistically justifiable deviations were established in weed density among the fertilization treatments. In addition to this, remarkable differences were observed in the number of individuals of *A. artemisiifolia*, *C. album*, *D. stramonium*, *S. nigrum* and *S. halepense*, depending on the sort of applied nutrients.

The average number of *H. annuus* was the largest in the control plots. As compared to the control and PK fertilized areas, it was present in a significantly smaller amount in the NK and NPK treated plots. The density of *S. annua* was also higher in the untreated control and PK treated areas. Similarly, *H. trionum* reached the largest number of individuals in the control, while it showed significant deviation by occurring in minimum amount in NPK treated plots. The density of *A. artemisiifolia* and *S. halepense* was the highest in the untreated plots, as well. In contradiction with this, *D. stramonium*, *C. album*, *C. hybridum* and *Amaranthus blitoides* were present with the highest number in the NPK treatments (Figure 2).

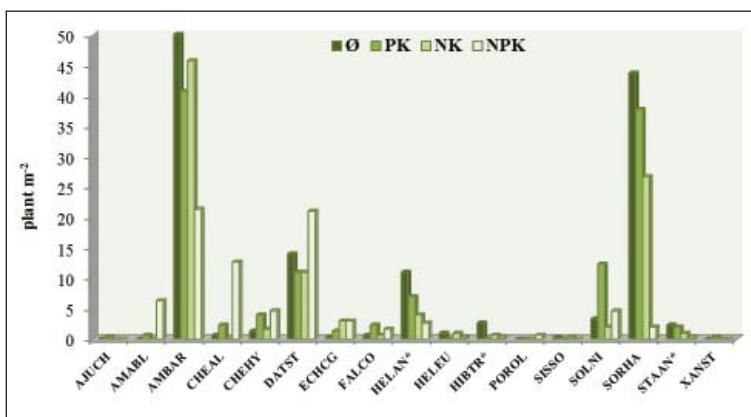


Figure 2: Density of weed species (number of weeds per m²) in the experimental plots supplied with different nutrient treatment (control, PK, NK, NPK) in the first weed survey on 19 June 2012

*Significant differences in weed density among the treatment: LSD_{5%} was 4.61 for HELAN, 2.93 for HIBTR and 1.69 for STAAN



Figure 3: Distribution of weed dominance at Nagyhörcsök on 19 June 2012

To evaluate the character of the weed flora, the number of the Raunkier's life forms and the C₃-C₄ species was determined in every treatment in 2012 and in 2013, too. The most dominant life form was T₄ but the G₁ and T₂₋₃ species are also occurred. The numbers of C₄ species were similar in all treatments however the C₃ species were the prevailing types (Figure 3).

Following year, on the 20 June, 2013 altogether 19 weed species were distinguished on the experimental area.

TABLE 3: Average frequency and the order of dominance of weed species on the experimental plots in the second weed survey carried out on 20 June 2013

No.	Weed species	Code	Life form	Photosynthesis type	Freq.	Berger-Parker index
1	<i>Ambrosia artemisiifolia</i> L.	AMBAR	T ₄	C ₃	23	0.565
2	<i>Sorghum halepense</i> (L.) Pers.	SORHA	G ₁	C ₄	23	0.144
3	<i>Chenopodium album</i> L.	CHEAL	T ₄	C ₃	17	0.133
4	<i>Datura stramonium</i> L.	DATST	T ₄	C ₃	24	0.087
5	<i>Chenopodium hybridum</i> L.	CHEHY	T ₄	C ₃	11	0.023
6	<i>Echinochloa crus-galli</i> (L.) P.B.	ECHCG	T ₄	C ₄	10	0.021
7	<i>Fallopia convolvulus</i> (L.) Á. Löve..	FALCO	T ₄	C ₃	16	0.014
8	<i>Solanum nigrum</i> L.	SOLNI	T ₄	C ₃	14	0.011
9	<i>Helianthus annuus</i> L.	HELAN	T ₄	C ₃	14	0.009
10	<i>Hibiscus trionum</i> L.	HIBTR	T ₄	C ₃	9	0.007
11	<i>Convolvulus arvensis</i> L.	CONAR	G ₃	C ₃	7	0.005
12	<i>Lepidium draba</i> L.	LEPDR	G ₃	C ₃	4	0.002
13	<i>Amaranthus blitoides</i> S. Watson	AMABL	T ₄	C ₄	4	0.002
14	<i>Anagallis arvensis</i> L.	ANAAR	T ₄	C ₃	1	0.002
15	<i>Heliotropium europaeum</i> L.	HELEU	T ₄	C ₃	4	0.001
16	<i>Stachys annua</i> L.	STAAN	T ₄	C ₃	4	0.001
17	<i>Sisymbrium sophia</i> L.	SISSO	T _{2,3}	C ₃	3	0.001
18	<i>Polygonum persicaria</i> L.	POLPE	T ₄	C ₃	1	0.000
19	<i>Ajuga chamaepitys</i> (L.) Schreb.	AJUCH	T ₄	C ₃	1	0.000

Table 4: Density of weeds (number of weeds per m²) in the experimental plots supplied with different nutrients in the second (20.06.2013.) weed survey

Weed density (piece · m ⁻²)				
∅	PK	NK	NPK	LSD _{5%}
142.2	156.7	93.7	129.5	44.6

Despite the fact that 39% of them were present in all treatments, *D. stramonium* was the only one that could be recorded on every plot of all replications. The specimens of *A. artemisiifolia*, *S. halepense*, *C. album* and *Fallopia convolvulus* (L.) Á. Löve were also common.

Compared to the total number of individuals, four species were dominant with the following order: *A. artemisiifolia* (54%), *C. album* (16%), *S. halepense* (10%) and *D. stramonium* (9%). In addition to these, the further 14 species recorded in the plots accounted for 11% of total density (Table 3).

Following the previous year's tendency, the highest density was observed in the PK treated and untreated plots, where the number of individuals significantly exceeded the values recorded for NK areas (Table 4).

Regarding density, *A. artemisiifolia* was the most abundant and common weed in the experiment. In 2013 it was still present in the largest number in the control and the PK fertilised plots. Compared to the PK supplied areas, its density was significantly lower in the NK and NPK

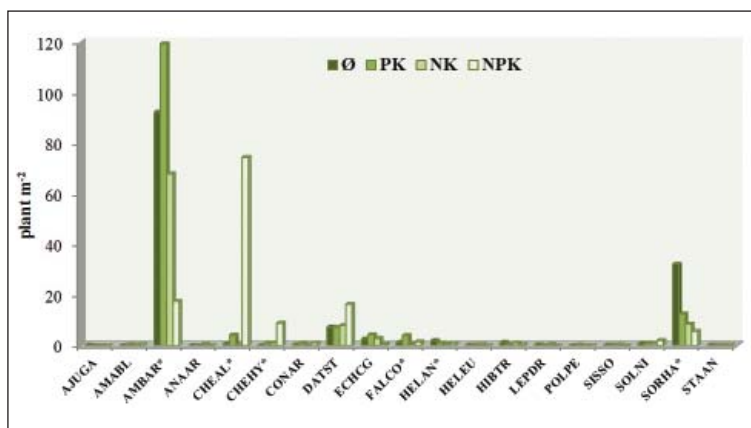


Figure 4: Density of weed species (number of weeds per m²) in the experimental plots supplied with different nutrients in the second weed survey on 20 June 2013

*Significant differences in weed density among the treatments: LSD_{5%} for AMBAR: 35.2, CHEAL: 37.3, CHEHY: 5.7, FALCO: 2.4, HELAN: 1.5, SORHA: 15.1

treatments, while in comparison to control areas it was significantly lower in the NPK treated plots (Figure 4).

Similarly to the previous year, the average number of *C. album* was remarkably larger in the NPK fertilised plots than in the controls and all of the other treatments. *C. hybridum*

also appeared with significantly higher density in the NPK treated plots. Likewise, the number of *D. stramonium* was the largest and significantly higher in the NPK treatments. Following the former records, *S. halepense* had significantly higher density in the control areas. The volunteer *H. annuus* occurred in a small number, out of which the highest density was found in the controls, with significant deviation from this only in the NK treatments. The occurrence of the low-density *F. convolvulus* was the highest in the PK fertilised plots, but it showed significant difference only from the NK supplied areas' data (Figure 2).

The dominant life form was T_4 similar to the first survey. G_1 , G_3 and T_{2-3} species also occurred, but less mass. The numbers of C_4 species were similar in all treatments, likewise one year before.

CONCLUSIONS

In present study the weed surveys were carried out in a long-term fertilization experiment under maize at Nagyhorcsök. Similar weed diversity was recorded in 2012 and 2013 where the *A. artemisiifolia*, *S. halepense* and *D. stramonium* were dominant, but *C. album* and *C. hybridum* were also common. These species and *H. annuus* were the most abundant weeds according to our surveys.

Based on the totalized and average data of all treatments, weed density followed the same tendency in the experimental years. The PK treated and the untreated (control) plots had the highest diversity, and significantly exceeded the values obtained for NK fertilized areas.

There were consistent differences in the density of certain weed species in accordance with the applied nutrients. *A. artemisiifolia* was present in the largest number in the control and the PK fertilized plots, while its density was significantly lower in the NPK treatments. *S. halepense* also occurred in significantly larger number in the control areas. The volunteer *H. annuus* had the highest density in the controls; the number of its individuals was the smallest in plots where N containing fertilizers were used. In contradiction with this, the density of *D. stramonium*, *C. album* and *C. hybridum* was the highest in the NPK treatments, which exceeded the values of the control and the other treated plots.

The most dominant life form was T_4 and the most occurred weed species was C_3 type during the experiment.

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EVALUATION OF WALNUT (*JUGLANS REGIA L.*) LEAF COMPOST AS GROWING MEDIA

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ABSTRACT

The use of compost derived from walnut (*Juglans regia* L.) leaves has been a theme of contention for a long time. Some people might avoid the use of walnut leaf compost, referring its inhibitory effects on germination and growth. Very often walnut leaves are burned, in this way the soil is deprived of organic matter. In our compost trials, we examined what are the effects of walnut leaf compost, composting circumstances, and the solution of compost on white mustard (*Sinapis alba*) as an organic assay plant. The experiments were carried under the control of Szent István University, Faculty of Agricultural and Environmental Sciences, Institute of Environmental and Landscape Management, Department of Ecological Agriculture on the site of the Experimental Organic Garden in Gödöllő, Babatvölgy, maintained by GAK Nonprofit Ltd. Over a three years experiment, we found that the fresh walnut leaves and the immature compost (younger than six months) has negative effects on the germination, the emergence and the growth of test plant. However, 9-10 months composting eliminated these negative effects. At the same time, the influence of nutrients from walnut leaf compost on the test plants was clearly visible, resulting 2-4 times higher green mass weight compare to the control. We recommend, that walnut leaves should not be burnt but be piled up (in November or December) in to a composter bin or simply in a compost heap, then 10 months later (the following autumn) we can use the matured compost. To get the best quality compost it is worth to turn it up once or twice.

keywords: walnut leaf compost, *Juglans regia*, *Sinapis alba*, composting time, germination inhibitor

INTRODUCTION

In organic farming, the reuse of organic by-products is essential, returning them into organic cycle of the farm helps to maintain soil fertility. In autumn, in gardens and orchards, the leaf litter (as walnut leaves) is very often burnt. Due to the high lignin content, decomposition of tree leaves, such as walnut, beech, oak and plane take an extended period of time to break down (Dömsödi 1989; Kocsis 2005). The utilisation of walnut (*Juglans regia* L.) leaf compost has been discussed for years and many people avoid the use of walnut leaf derived compost altogether, because of its perceived germination inhibitory effect. In the case of walnut leaves, growth inhibition is caused by the complex compounds, such as tannin and juglone in the leaves, but this unfavourable effect ceases after an adequate period of composting (Kovács 2000; Ruzskai 2011; Tirczka and Hayes 2012). Differences were found between the juglone content of different walnut cultivars, and decomposition of juglone over time was observed (Girzu et al. 1998). Beside juglone, 10 different other phenolic compounds were found in walnut cultivars and the antibacterial effect of these compounds was examined (Amaral et al. 2004; Pereira et al. 2007). Our purpose was to summarize 3 years of trials of walnut leaf composting and to place walnut leaf compost in its rightful and objectively justified place.

MATERIAL AND METHODS

The experiments were carried out under the control of Szent István University, Institute of Environmental and Landscape Management, on the site of the Experimental Organic Garden in Gödöllő, Babatvölgy, maintained by GAK Nonprofit Ltd.

In every November for three years, we collected walnut leaf litter from the same place, then placed the uncrushed



Figure1: Composting walnut leaves in wire net composter

walnut leaves in to wirenet composters, size of 1m³, for 9 months of composting (from December to the following August) (Figure 1). The composts were not covered or additionally wetted, and mixed only when samples were taken.

The samples were dried, ground and sifted (3mm), and we stored them in cool and dark conditions, until the germination experiment (September) period commenced. We examined the effects on germination for white mustard (*Sinapis alba* L.) as assay plants in pots, for the control we used quartz sand. The 270cm³ pots (each containing 50 seeds) were placed in an open field in four replicates and randomized block. Irrigation was maintained as needed. After 14 days of germination, we evaluated the emergence percentage and the weight of plants. The results were evaluated by ANOVA (Sváb 1981).

RESULTS

In the experiment of 2009/2010, we took samples from the composts three times (November, March, August). For germination, we mixed the compost with sand (ratio of compost: 10, 30, 50, 70, 90 % (V/V)). The emergence of mustard was 90% in control pots, and 83-92% was in the different compost mixtures (Figure 2).

In 2010/2011, samples were taken on seven occasions (in November, March, April, May, June, July and August) and for germination tests the compost was not mixed with sand.

The lowest emergence rate was found in samples of April (58%) and May (51%). From June, the emergence rate improved (86%), and from July the value of it (88%) was not significantly different from the control (96%) (Figure 3).

In the trials of 2011/2012, samples were taken four times (in November, June, July, August), and compost was used without addition of sand (Figure 3). We found the significantly lowest emergence percentage (74%) at the starting point of composting, (Nov. 2011) the other treatments showed similar values to the control (88-96%).

We deemed plants as having emerged, which had cotyledons or leaf or stem raised above the compost level. The similar emergence percentage rates of different treatments did not imply the same development stage of test plants, which is why we measured the fresh weight mass of plants too.

In 2009/2010, only in the samples of November 90% were the fresh weight masses significantly lower, compared

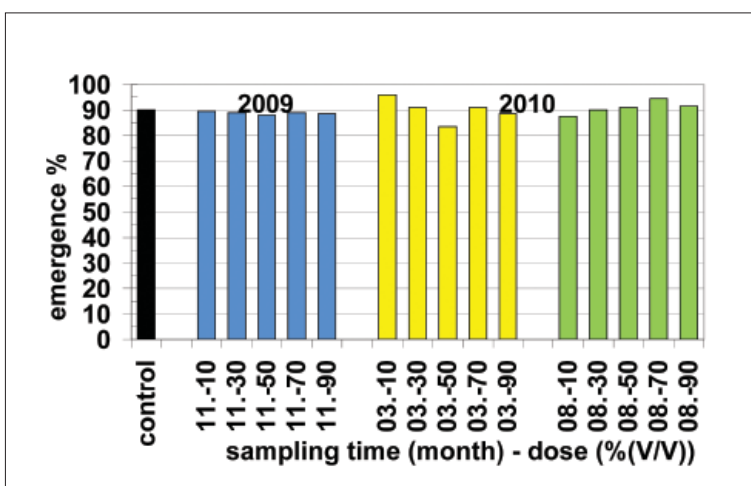


Figure 2: The emergence of mustard seedlings in media of different maturity stages and dosage of walnut leaf compost, 2009/2010

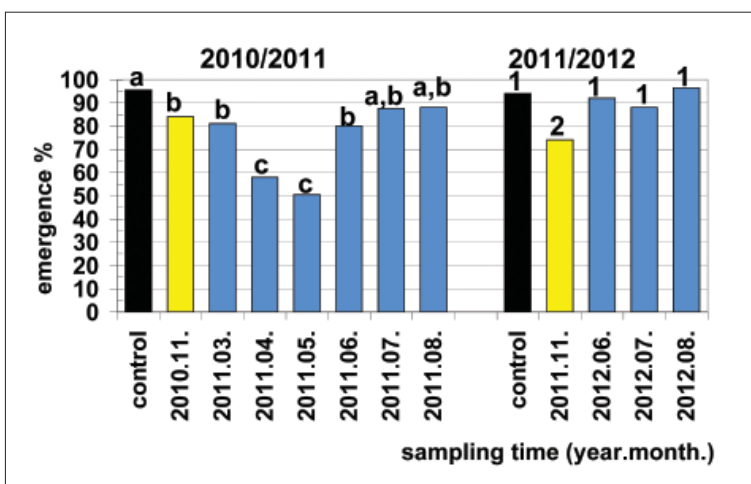


Figure 3: Emergence of mustard (*Sinapis alba*) seedlings in media of different maturity stages of walnut leaf compost, 2010/2011 & 2011/2012 (The treatments marked with same character are not significantly different)

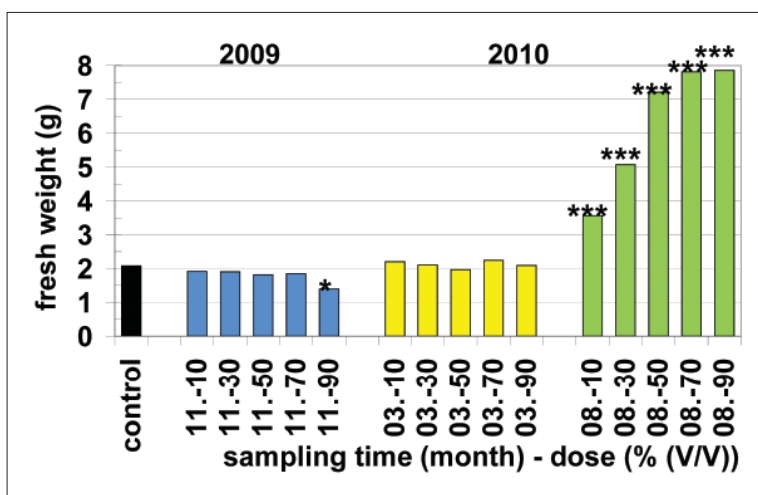


Figure 4: The fresh weight mass of mustard (*Sinapis alba*) plants in media of different maturity stages and dosage of walnut leaf compost. (2009/2010) (Significant difference to control: *P5%, SD5% 0,6293; ***P0,1%, SD0,1% 1,075)

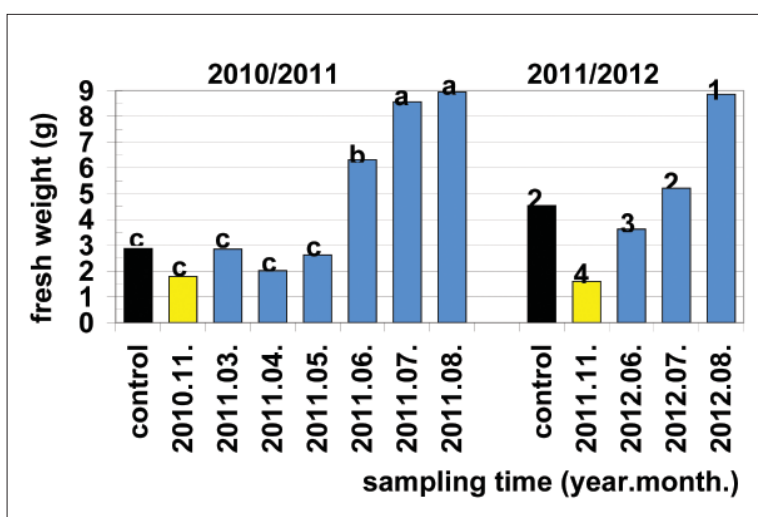


Figure 5: The fresh weight mass of mustard (*Sinapis alba*) plants in media of different maturity stages of walnut leaf compost, 2010/2011 & 2011/2012 (The treatments marked with same character are not significantly different)

to the control (Figure 4). In the samples of August, in every treatment the fresh weight mass was significantly higher compared to all the other samples. As dose of compost was increased up to 70% , the fresh weight mass was increased also, but between 70% and 90% compost content showed no difference. After nine month of composting, in the treatment of 10% compost: sand mixture the fresh weight mass was 1.6 times higher than in control, and in 90% compost medium this value was 3.8 times higher than for that of the control.

In 2010/2011, the fresh weight mass of mustard was lowest at the first sampling (start of composting, November) and at the spring samplings (1,8-2,6g), which results were not significantly different compared to the control. However, from the seventh month of composting (from June) the fresh weight mass increased significantly higher (Figure 5). In

August, the fresh weight mass of mustard was three times higher than that of control and five times higher than in the sample of November. The negative effects of undecomposed walnut leaves ceased by the ninth month of composting in case of mustard assay plant (Figure 6). These results were confirmed by the 2011-2012 experiment (Figure 5). The walnut leaf compost samples of November clearly blocked the growth of mustard fresh weight mass. As the decomposition of leaves improved over time, this inhibitory effect decreased and finally disappeared. The fresh weight mass of mustard grown in the nine month old compost was 5,5 times higher than of that grown in the November sample. Additionally, the compost's nutrient content showed its positive effect more definitely, resulting in a two times higher fresh weight mass than for the control.

In 2011/2012 we prepared water solutions of non-composted walnut leaves (Nov. 2011) and nine month old compost (Aug. 2012) (100 g of compost was soaked for 24 hours in 500cm³ water, then filtered). In four replications, filterpapers were wetted by the same amount of each solution, and a control using distilled water. We germinated mustard seeds for 9 days on these filter papers, and took sample at the 3rd day and at the 9th day. The solution of nine month old compost had no negative effect, and 96% of seeds were germinated by the third day. The germination rates were the same for the control. For the solutions of uncomposted walnut leaves, on the third day there was no germination, and on the ninth day only 15% germination (Figure 7).

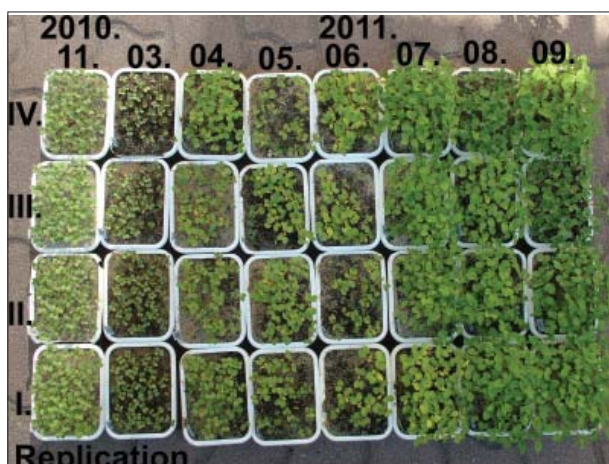


Figure 6: Growth of mustard seedlings in media of different maturity stages of walnut leaf composts (2010/2011)

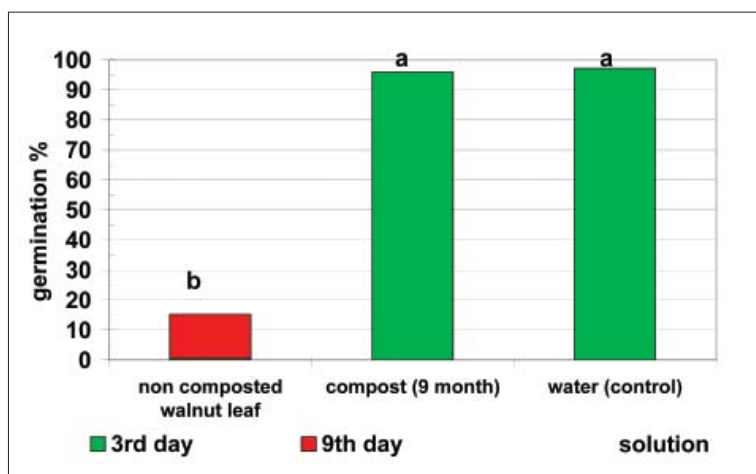


Figure 7: Effect of different compost solutions on germination of mustard

DISCUSSION

According to our results, we must agree with Dömsödi (1989) and Kocsis (2005) that composting of walnut leaves takes long time. We can affirm that the unfavourable effects of growth inhibitors (egs.: tannin and juglone) ceases after composting as Kovács (2000) and Ruzskai (2011) had found. We found the optimal decomposition time for walnut leaves is 9 months (Figure 3). In the experiment of 2009/2010 the results were not significantly different and maturity and dose of compost did not seem to influence the results (Figure 2). In 2010/2011, the intensity of walnut leaf decomposition was greater in spring. In the samples, taken at this time, percentage emergence rates for mustard were lower and lower (51-58%). This result clearly showed the germination inhibitory effect of decaying walnut leaves. In Figure 3, the inhibitory effect of walnut leaf visibly decreased by the composting time and finally the inhibitory effect ceased.

The similar emergence percentage rates of different treatments did not imply the same development stage of test plants (Figure 6.), that is why we measured the fresh weight mass of plants too. These results showed in both years, that in the first six month of composting the walnut leaf has an inhibitory effect not only on germination but on plant growth as well, but it ceased after 9 months composting (Figure 5).

The water solution experiment in 2011/2012 affirmed the results above (Figure 7).

CONCLUSIONS

The undecomposed walnut leaf and its compost in the first 6 month of the composting period have unfavourable effects on germination, emergence and the fresh weights of test plants. After 9 months composting time this negative effect disappeared. Although, the walnut leaf compost is not rich in nutrients, as a growing medium it

resulted in higher fresh weight masses for test plants than for the control quartz sand. Our recommendation is that walnut leaves should not be burnt at autumn but should be composted and mixed once or twice, then used in our gardens the following autumn, after sifting. However, further investigations would be interesting and affirmative, the influence of walnut leaf compost could be tested on different assay plants, and chemical analysis of compost is recommended.

ACKNOWLEDGEMENTS

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VOCATIONAL TRAININGS FOR IMPROVING ORGANIC FARMING EDUCATION

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ABSTRACT

The importance of the organic sector is recognized by the EU Action Plan on Organic Farming. In Hungary, the new national strategy for agriculture underlines the importance of sustainability, with the need to provide job opportunities and secure living in the countryside, and the need to promote local food and food sovereignty whilst protecting the environment. It is essential for this very practical sector that new organic growers are able to receive a practice-oriented vocational training. In the ECOVOC project we focused on the education of farmers, career changers, and secondary school leavers in the field of organic horticulture in order to enable them to initiate their own market gardens. Our aim was to synthesize a practice-oriented curriculum specially designed for Hungarian use which is based on the international project partners' most successful pedagogical methods. Pilot courses were organized in order to gain feedback related to the content and the knowledge transfer from potential future learners with the aim of incorporating them into the final curriculum. As the main outcome of the project, two curricula were fully elaborated. One is designed for organic vegetable growers whilst the other is for organic fruit growers. Both training curricula meet the requirement of adult education in their structure and content while applying best pedagogical methodologies and good practices. Another important outcome of the ECOVOC project is the establishment of further development of the topic, by exploring the need of different target groups related to vocational training in organic farming. The practical importance of this issue is also recognized at an international level as the continuation of the project, the development of practice-oriented trainers' training in ecological small scale production (ECO-Motive project), is supported by the European Union.

keywords: organic farming; vocational training; curriculum in vocational education; trainers' training; community employment programme, disadvantaged target group





INTRODUCTION

On the European level, vocational training is an important tool for social integration appearing emphatically in the implementation framework of the EU strategic goals as well as in the Education and Training 2020 priorities (EU 2020) (ET 2020). Vocational training is directly related to one of the EU 2020 goals, which aims at increasing the current employment rate from 69% to 75 % and lifting people out from entrenched poverty that concerns 20 million people. The third ET 2020 priority also emphasizes the importance of promoting equity, social cohesion and active citizenship that includes the development of inclusive vocational trainings. This is confirmed by the Bruges Communiqué on enhanced EU Cooperation in Vocational Education and Training (2011-2020) that sets a distinct priority for the creation of “inclusive training” and highlights the importance of the inclusion of disadvantaged groups in appropriate vocational education.

In Hungary, the differences of regions occurring in the economy and local infrastructure basically determine the living possibilities of rural populations and affect in the long run the income-earning opportunities of rural families, which has significant and perceptible impact not only on a regional, but also on a national level (rural qualified people are moving to cities, less childbearing desire but more social tension can be detected, etc.). As the Hungarian government recognized this problem, in accordance with EU strategy, a new public supported employment programme was elaborated and initiated in 2011 with the following aims: linking the work with practical training in order to overcome employment disadvantages; increasing the qualification level of job seekers with the development of their professional skills by providing possibilities for practical experiences. The long-term goal of the employment at regional and at community level is to expand the local work opportunities for rural population; to reduce social tension resulting from unemployment at the national level. For the individuals gaining full employment may enable

an opportunity to break out from entrenched poverty and disadvantage, providing a chance to supply himself/herself, and to begin to address issues of personal development and stability.

Beyond the general benefits of the vocational training detailed above, it has a special role in agriculture, including organic farming.

The importance of organic farming in agriculture is not disputed, neither on a national nor an international level. Beyond the relatively well-known approach according to which the chemical residue-free food produced with organic methods, both helping to protect the environment (biodiversity conservation, energy input reductions, emissions reduction) as well as contributing to the population’s healthier nutrition (higher mineral and vitamin content, more beneficial antioxidant level, etc.) and to a better-quality life for the long-term, numerous other advantages of this type of farming have to be taken into consideration that are also recognized by the Hungarian decision-makers. Therefore, increasing the area of organically farmed land is on the ‘primary target list’ of the National Rural Development Strategy (Aims 2: Diversified and Viable Agriculture), whilst the Hungarian National Action Plan for Organic Agriculture (2014-2020) also aims to increase the size of organically farmed land area to 350,000 hectares to 2020 compared to the present 131 000 hectares.

In order to reach this target certain conditions are already given, as Hungary has excellent production characteristics. However to become a successful organic farmer with a profitable business, professional knowledge and practical experience are essential, which can be reached by participating in suitable practical vocational trainings that place the method of knowledge transfer into the centre stage (National Rural Development Strategy, target 5: Reinforcing the rural communities, improving the quality of life for rural population). The possibility of vocational education also has to be made available to low-educated, disadvantaged people for which the community employment would provide a framework programme.

This is also confirmed by the modern andragogy, which says that adult education should be based on well-established practice, since teaching adults (without taking account the qualification) is very complex. Not only academic, but also competency-based knowledge is needed. In order to acquire this, methodological practices are essential (Bordás 2011). Teaching adults is a real 'challenge', as it can start, protect and strengthen the processes of personality development (Knowles 1984; Zinnecker 1993), while the result of learning for an adult is the knowledge based on experience gained during everyday activities (Molnár 2009). For practice-oriented organic farmer- and future trainers trainings, gaining experiences and taking over the experiences of an advanced farmer (which cannot be acquired from books) mean the practice that the learner can apply during his/her future activities. During the application of adult adapted teaching methodologies in case of farmer- and trainers training, it is important to note that the target audience consists of adults, who have already completed obligatory education and trainings, therefore they train themselves voluntarily and orientate according to their interests.

Taking into account the EU directives and the Hungarian conditions, the primary goal of the project ECOVOC (2011-2013) was to elaborate the curriculum for „Vocational Training in Organic Vegetable and Fruit Production” with professional and applied pedagogical methods for adult learners as primary end-user target group. We are aware of the fact that one single project cannot provide a complete reform on vocational education and training but can serve as a good starting point of the promotion of organic farming at a national level.

MATERIAL AND METHODS

The target audience of vocational trainings are adult learners, secondary school leavers and unemployed adults with bacalaureate. In order to gain the best result, during the implementation of the ECOVOC project, six institutions of five European countries (Hungary, United Kingdom, France, The Netherlands, Spain- Catalonia) cooperated during two years.



In the second year of the project ECOVOC we tested out how the almost fully elaborated organic vegetable and/or fruit producer trainings would operate. In order to gain feedback from learners, 4 distinct pilot courses were organized. These pilot courses were not designed for the comprehensive testing or trialing of the one-year vocational training program (aimed at adults with its pedagogy, and with its harmonized theory-practise ratio) but for the assessment of the real target group. The aim was to get acquainted with the people personally, who are interested in the topic, who wish to learn and who plan to launch their own market garden. The trial trainings were organized in March and April 2013. 47 people were selected for the pilot trainings out of 110 applicants. During the selection, the geographical location of the applicants was taken into consideration.

Four different training topics were selected in order to represent the planned modules of the vocational training curriculum. Accordingly, the following topics were discussed during the pilot trainings: pruning of fruit trees (15 participants); examination of the soil's organic material content (11 participants); composting techniques (11 participants); growing organic vegetable seedlings (10 participants). These practical knowledge trainings focused on basic knowledge transfer and specific questions related

to practice. The number of group participants was ideal for this.

Simple, comprehensive learning material was prepared for the participants in order to make the pilot course more efficient. Learning materials provided basic information related to the subject of the pilot course in order to better explain the topic.

The participants of the pilot courses filled out a questionnaire “supplemented” with oral discussions at the end of each pilot course. On a 5-point-rating-scale participants evaluated the content of the training and the method of the knowledge transfer, indicating the strength and weaknesses and also the improvable areas. These questionnaires prepared for each pilot training also included concrete questions that allowed participants to express their opinion and recommendations for future courses (schedule of training, topics included in the training, usefulness of the teaching material, method of the knowledge transfer, etc.). Furthermore, these questionnaires provided important information related to



the profile of the participants (gender, age, inhabitancy, qualification, professional experience, etc.).

RESULTS

The summary of the responses derived from the questionnaire helped to improve the quality of the vocational training curriculum which was one of the most important purposes of the pilot trainings. The results of the survey are the following:

38 % of the applicants were male and 62 % were female. This statistic does not correspond to the European trend concerning the participation in Vocational Education and Training (VET). According to the survey “Attitude towards to vocational education and training” (Special Eurobarometer 369 2011) realized in the EU 27, men are more likely than women to have taken VET in some time in their lives. This difference can be derived from the nature of the offered VET (organic farming) and the EU country variations on this point.

The answers of the questionnaire revealed that most of the participants do not have agricultural qualification (figure 1.) and more than half of the participants do not have growing experience (figure 2). Half of those who had agricultural experience engaged in conventional farming, and only half of them dealt with organic farming. The result of these surveys showed that the aim of the target audience of vocational training in organic farming was not only to obtain a certification but to voluntarily improve their skills and last but not least their personality correspond to their interests.

According to the summary of the questionnaires, 27 % of the participants were between the ages of 36 and 45, whilst the second largest age group was constituted by the participants aged 46 to 60, representing 23 %. The newly graduated young adults constituted the smallest group as only 6 % of the participants were 18-25 years old. These results correspond to the EU statistics, as people in the 25-39 and 40-54 age groups are more likely to have experienced vocational trainings.

The third ‘group’ of results comprises the opinion and the suggestion of the participants and the trainers of the pilot courses related to the content of the trainings and the methodology of knowledge transfer (e.g.: how the trainers could match theoretical knowledge with practice; how the trainers managed to clarify relations between observations and the farmer’s everyday practice.). The unanimous opinion of the participants suggests that vocational trainings, independently from the nature of their specific theme, have to be assigned to accurately identified target groups in order to gain the expected results; vocational trainings have to focus on practice-based teaching methods; learning by doing teaching method should be more often applied; practice should be supplemented with teaching material that supports learners to understand the basic context.



DISCUSSION

During the pilot courses organized in March and April 2013 within the framework of the project ECOVOC, we learned from the feed-back gained from participants that there is a strong demand for organic farming trainings for rural people. Accordingly, we developed a 380-hours organic vegetable grower curriculum and a 380-hours organic fruit grower curriculum designed for adults -as main outcomes of the 2 year duration project- that meet the expectations of the end-users and provide the most flexible and feasible educational form in the organic sector. These accredited adult vocational courses are successfully launched in 2013 and also in 2014 with 15 participants per course.

Another important information that we learnt in the course of the pilot trainings, that the trainings, in order to be the most effective, need to be addressed to specific target-groups.

Among the pilot course participants there were trainers from disadvantaged regions working with minority groups. They established and worked together in organic gardens with the purpose of providing jobs and sustainable livelihoods in the countryside and promoting self-support but even the trainers themselves were inexperienced (not only in the sense of technical knowledge of ecological

farming techniques but also as trainers, regarding their knowledge and experience with different pedagogical methods). Therefore the result of the pilot courses suggested that different target groups for further improvement of vocational trainings should be explored.

Accordingly, target group identification and vocational training customization are involved in the ECO-Motive (2014-2017) project concept. This new project is strongly built on the ECOVOC basic concept and carries forward its values. However, the result of the ECOVOC pilot courses confirmed the need for a different approach on how to reach the goals set up by the Hungarian Government concerning the support of organic farming in relation with employment programme. Therefore, ECO-Motive will offer target-group adapted vocational training programme for trainers in order to motivate and employ the primarily addressed disadvantaged, unemployed and low-skilled rural people.

Bearing in mind the different educational attainment and professional background of the vocational trainings' participants and contributors, the ECO-Motive project focuses on the identified different target groups while preparing curriculum for trainers and course materials for end-users.

In the light of the results of the ECOVOC pilot courses, 4 distinguished target groups are identified: future trainers,



end-users, teachers of trainers and decision-makers. These target groups are involved in the implementation of the ECO-Motive project and connected to the expected project outcomes according to the followings:

- **Future trainers** in organic farming: practitioners, unemployed adult with agricultural background and/or with working experiences in agriculture.

Rural municipalities that are engaged in agricultural activities and might have already been involved in community employment programmes or are employing unemployed local adults, in many cases are in direct contact with persons

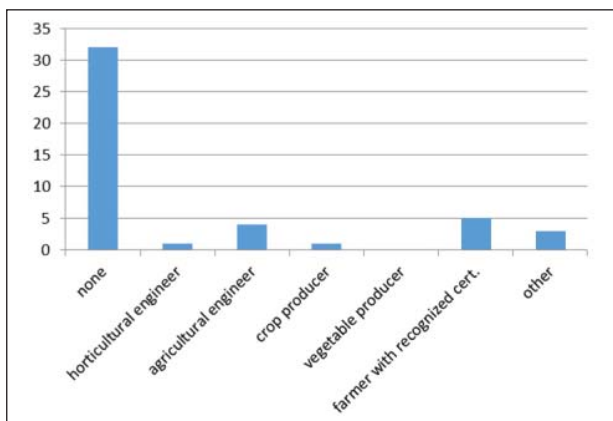


Figure 1: Qualification of participants on the test courses

who supervise and coordinate the professional agricultural works. These persons are often agricultural engineers (unemployed agricultural engineers/agriculturalists) or practising farmers with few teaching experiences that should be essential if the goal is to transfer their knowledge and skills to end-users. In Hungary, the number of those municipalities is limited where the community's agricultural activities are directed by a person who deals with organic farming himself/herself. Nevertheless dealing with organic farming is not a basic requirement to become an excellent trainer. A well-planned trainer-training should provide a professional module containing the basics of organic farming and its global view and approach. In addition to the professional modules designed for trainers- training, appropriate teaching methods and special sensitization module should be advisable also to include. These insights would prepare the trainers on which way they should transfer the knowledge to the often low-skilled end-users.

- **End-users:** disadvantaged young adults; rural unemployed adults; low-skilled adults (end-users of the training)

The end-users would become the real users of the trainers' training, in a form facilitated by the trainers (trainings organized for the end-users will be delivered by the already trained trainers).

- **Teachers** of future trainers as learners

Teachers of trainers would play a key role as the acquired pedagogical methods associated with professional knowledge must "flow through" them in order that they will be able to transfer their knowledge and skills to the trainers so that the trainers will be able to adequately transfer their own knowledge and skills to the end-users.

- **Decision makers:** rural local authorities; social civil societies

In order to reach the target set up in the National Rural Development Strategy and the Hungarian National Action Plan for Organic Agriculture, decision makers' thinking needs to be influenced. Presentation of organic model gardens would provide an excellent opportunity for the

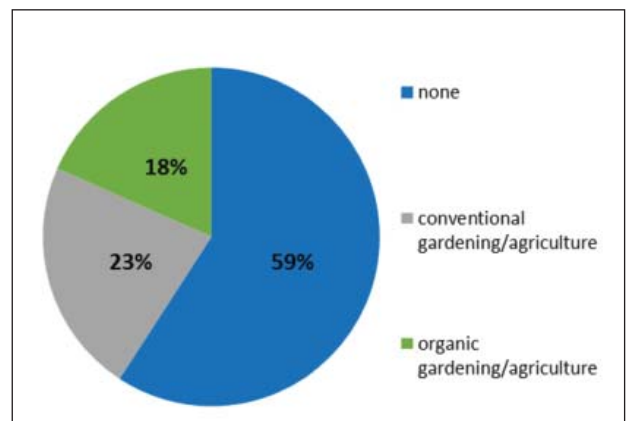


Figure 2: Professional experience of the participants

decision-makers (primarily mayors and local authority decision-making bodies) to see good examples. Another important opportunity for the 'decision-makers' thinking-forming process' would be the regularly organized consultations and forums. These meetings should include not only professional items but also social attunement that will contribute substantially to the global understanding of organic agriculture. The long-term effect of the inclusion of decision-makers in initiatives and projects (namely in the ECO-Motive) are measurable when issues related to organic global approach become the subject of positive evaluation also at higher decision-making levels (e.g. ecological farming and/or ecological small scale production become supported by the government in the community employment programmes).

All target groups are strongly interrelated with each other, and the persons placed in one of the above mentioned target group categories can play multiple functions (eg: A mayor with agricultural education, directs the agricultural activities of the community. He/she also needs to acquire not only the basic knowledge of organic farming but also an holistic approach. By the sensitization module his/her thinking will be influenced, and by the organic farming related pedagogical methods she/he will learn the appropriate method how to transfer his/her organic farming knowledge and practice experiences to the unemployed end-user). This example illustrates that all target groups should be considered as learners.

CONCLUSIONS

The objective of the ECOVOC project was to elaborate a practice-oriented training, in which the experience and pedagogical methods of our foreign partners were integrated and applied under Hungarian circumstances. In the second phase of the project vocational trainings were tested with the target audience and organizers had an opportunity to get acquainted with the future potential learners. Both the personal and the written feedback showed that it is highly appreciated when the priority of a training is the practice, however also provides practical knowledge in the theoretical part. Accordingly, two practice-oriented vocational training curricula in the field of organic farming were elaborated and successfully accredited and then launched in 2013 that meet the requirements of modern adult education in their structure while applying pedagogical best practices.

The other important conclusion of the ECOVOC pilot trainings was that further target groups should be involved to vocational trainings that requires target group identification and then target group adapted trainings, as in Hungary there are no fully elaborated courses in ecological farming designed specifically for disadvantaged and/or unemployed, low-skilled rural people.



Therefore as a further improvement of the ECOVOC project outcomes, a new project concept was borne out. The ECO-Motive project involves the basic values of ECOVOC with more focus on the development of vocational trainings that meet the needs of various target groups.

The idea behind the ECO-Motive project is based on the successful agricultural employment model-programs of the last three years in Hungary. It is testified that there is a need for guided employment programs. The disadvantaged micro-regions and communities can be assisted to "catch up" and successful cooperation with local minority governments can be realized if after the community employment fixed-term programme further job opportunities could follow on, and if the program (in more cases coordinated by local municipalities) could provide such an added value for the individual that may influence his/her approach to work. This added value can be found in the training-based coordinated work.

Unfortunately, the training areas related to agricultural model programs do not include ecological small-scale farming that would provide a fortunate coupling with progress towards a sustainable economy and society.

Labor-intensive, value creating ecological small-scale farming could be well-suited to community employment programmes with a condition of providing a special training

that influences the thinking of individuals. End-users need a special training so that they continue ecological small-scale production either in cooperation (communally) or as individuals after the community employment work programme. In order that the training becomes feasible, future trainers should be also trained. Trainers would be armed with professional knowledge and prepared for the most effective deliverance of their knowledge. Trainers would successfully manage ecological farming in community employment programmes and would help to establish self-supporting small-scale farms in rural areas. If vocational trainings focusing on organic small scale farming that are realized by the ECO-Motive project and supported by the decision makers then the following positive effect can be predicted for the future:

At the local level: New working opportunities can be created for local unemployed, low-skilled and disadvantaged adults by which their living conditions will be improved in the long run. New job opportunities can be created for local unemployed agricultural engineers/agriculturalists by the fulfilment of trainer's tasks (organization and coordination of organic production activities related to the local community combined with teaching). Provided tools elaborated during the ECO-Motive project can help the local authorities to initiate training in small scale organic farming practices which will lead longer-term solutions. Through providing human development opportunities, and not just utilising the manpower of unemployed and disadvantaged adults, more sustainable solutions can be achieved. During the course of the ECO-Motive project trained trainers will become acquainted with the global approach of organic farming (including its social dimension) that will also influence higher level decision-making.

At the regional level: Newly created work opportunities emerging from human capacity development (gained from the elaborated training courses) could keep the rural population in place and provide them continuous work. This can strengthen the labour-intensive organic sector within the quality-oriented farming sector and strengthen local food sovereignty.

At the national level: Through vocational trainings operated by local municipalities across Hungary, the knowledge and skill base in rural areas can improve, specifically in a sustainable direction. Local authorities which begin to implement community work programmes based on the development of human capacities, will begin to see the development of new, sustainable job opportunities. Rural communities become more self-sustaining, and more cohesive (resulting in less drift to urban areas). More resilient local communities are able to contribute more to the common wealth and are less dependent on short-term support. The introduction of new teaching methods in trainers' training with the inclusion of the social sensitization and motivation module, can affect

the whole of society, helping to increase understanding and tolerance within the population.

It can be concluded that the most important intended impact of the ECO-Motive project, as a continuation of the successful ECOVOC project is that organic farming becomes a supported activity by the government in the community employment programmes that would affect each identified target group related to organic small scale production.

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