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Principles of Common Buckwheat Production

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ABSTRACT

Common buckwheat (*Fagopyrum esculentum* Moench.) is a fast growing plant with a variety of utilizations. Buckwheat grain is used primarily for human consumption but also for livestock feed. Its usages as a green fodder, green manure and bee pasture are also worth mentioning. Because of its rapid growth buckwheat can be grown as a second crop as well. It is a low input plant, it does not often require direct fertilization or plant protection measures therefore it is appropriate for growing organically. These parameters can make buckwheat more attractive for not only Hungarian, but also for other European farmers. In this paper the history and state of buckwheat production are reviewed and the production practices are detailed.

Keywords: alternative crop, low input plant, utilization, organic farming, buckwheat

CONTENTS

INTRODUCTION

In parallel with the expansion of low-input agricultural systems and the growth of the organically cultivated areas there is an increasing demand for crops those have promising potentials to be grown successfully in these systems. Among crops that are sown on smaller areas such as buckwheat, may be found species suitable for low-input agricultural systems. Besides the agronomic features, the utilization potentials of a crop are also crucial aspects of the successful production. Common buckwheat (*Fagopyrum esculentum* Moench.) is among the minor crops in Europe (Michalova 2001). The wild ancestor of common buckwheat most closely related to cultivated populations was found in the Sanjiang area of Yunnan province of Southwestern China (Konishi *et al.* 2005). The beginning of buckwheat cultivation goes back to ancient times; it was cultivated and eaten in the 2nd-1st century B. C. according to archaeological evidences found in China (Li and Yang 1992). It became popular in Europe in the Middle Ages (Ohnishi 1993). Buckwheat is utilized in many ways, primarily in human consumption (Campbell 1997). It can be used as functional food because buckwheat grain is gluten-free (Alvarez-Jubete *et al*. 2009) and has antioxidant activity (Holasova *et al*. 2002). It is an undemanding crop, therefore it can be grown under extensive production systems (Antal 2005). It can be grown on a wide range of soil types (Láng 1965), and requires high amount of precipita-

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tion especially at emergence (Varga 1966). It is susceptible to frost (Láng 1965) therefore it is sown from the end of April as a main crop. As a second crop, it may be sown until as late as the end of July. Maintenance works are rarely necessary because of its rapid growth (Varga 1966) and weed suppression ability (Gocs 2004). The date of harvest should be well-chosen otherwise seeds may be lost due to shattering (Varga 1966). It can be either direct combined or harvested in two stages (Józsa 1985).

ORIGIN OF BUCKWHEAT

The origin of common buckwheat (*Fagopyrum esculentum* Moench.) was first considered to be located in Siberia or in the area of the Amur River (De Candolle 1883). According to Vavilov buckwheat is originated in the Chinese centre (Vavilov 1926). The ancestor of common buckwheat (*F. esculentum* ssp. *ancestrale*) was discovered by Ohnishi at the Wulang River valley of Yongsheng district in Yunnan province of southern China. The observation of the richest distribution of wild *Fagopyrum* species in Southern China seemed to confirm the theory of being Southern China the original birthplace of common buckwheat (Ohnishi 1991). However, further researches conducted by Ohnishi led to different conclusions. Natural populations of the ancestor were also found in other places in Yunnan and Sichuan provinces (Ohnishi 1998) and in eastern Tibet (Ohnishi and Konishi 2001). AFLP analyses revealed that the natural populations of the wild ancestor which are most closely related to cultivated populations are those from the Sanjiang area of Yunnan province (Konishi *et al.* 2005).

HISTORY OF CULTIVATION

China was the place where the cultivation of buckwheat commenced. Archaeological findings such as buckwheat unearthed from the grave of western Han Dynasty (206 B. C. – 8 A. D.) proved that buckwheat was cultivated and eaten in the 2nd-1st century B. C. in China (Li and Yang 1992). The routes of diffusion of buckwheat were surveyed through RAPD analyses by Ohnishi. These analyses concluded in the following findings. Buckwheat diffused to the Himalayan regions and Tibet from southern China. Buckwheat probably diffused to Japan through northern China and the Korean peninsula. As for the European emergence of buckwheat, it diffused first to northern China than it reached Europe and Pakistan via the Silk Road (Murai and Ohnishi 1996). Although buckwheat became popular in Europe in the Middle Ages, it may already had been introduced into Europe in very ancient times (first or second century or earlier) on the basis of archaeological evidences (Ohnishi 1993).

The date of introduction into Hungary is not exactly known. At the end of the 15th century 'pohánka' and 'hajdina', the Hungarian words for buckwheat appeared in some charters. Buckwheat was mainly cultivated in the Upper-Tisza Region in Eastern Hungary and in Szeklerland, South from the former and also in the Lower Alps in Western Hungary. Buckwheat was first produced in Western Hungary in the Őrség region (Kárpáti and Bányai 1980).

BUCKWHEAT PRODUCTION IN THE WORLD AND IN HUNGARY

According to FAO statistics the harvested area of buckwheat in the world approached 5 million ha in 1992 and decreased significantly until the end of the 1990's to approximately 2.7 million ha. Although some increase can be noticed in the subsequent year, the average production area in the following years was much smaller than it was before 2000 (**Fig. 1**). The cultivated area of buckwheat in the world was 2 721 725 ha in 2007 (**Table 1**). According to FAO statistics buckwheat was grown on the biggest areas in 2007 in the Russian Federation, China, Ukraine, Kazakhstan, Poland, the United States of America, Brazil, Japan, France and Lithuania.

Table 1 Buckwheat production and cultivated area in the world in 2007. (FAOSTAT 2009)

Country	Area harvested (ha)		Production (tonnes)	
Russian Federation	1193200		1004850	
China	750000	F	300000	F
Ukraine	310100		217400	
Kazakhstan	138100		81400	
Poland	72680		84236	
United States of America	68000	F	68000	F
Brazil	48000	F	52000	F
Japan	46100		26300	
France	32945		117148	
Lithuania	21700		20900	
Belarus	11452		12997	
Latvia	10700		11100	
Bhutan	8780		8105	
Republic of Korea	2410		2447	
Canada	2000		2300	
Moldova	1165		437	
Czech Republic	1000	F	2000	F
South Africa	1000	F	300	F
Hungary	800		400	F
Slovenia	800	F	1500	F
Estonia	270		337	
Slovakia	215		150	
Kyrgyzstan	163		195	
Georgia	100		100	
Croatia	45	F	140	F
Total	2 721 725		2 014 742	

F = FAO estimate

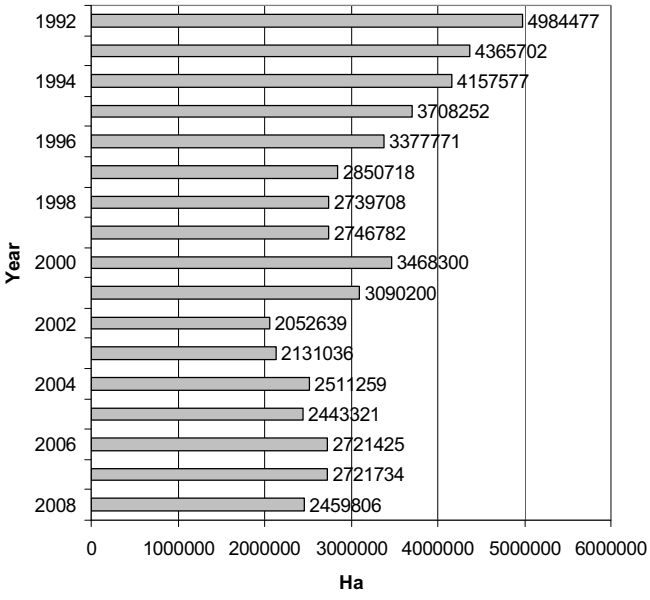

Fig. 1 Trend of world area planted to buckwheat 1992–2008.

In Europe, the biggest buckwheat producers are the Russian Federation, Ukraine, Poland, France, Lithuania, Belarus and Latvia. Buckwheat is grown on smaller areas in the Czech Republic, Hungary, Slovenia, Estonia and Croatia (FAOSTAT 2010).

In Hungary, the production area of buckwheat rarely exceeded 500 ha (Láng 1976). According to the database prepared by FAO, the harvested area of buckwheat in Hungary varied between 278 and 1857 ha during the period from 1992 through 2008 (**Fig. 2**). In 2008 it was cultivated on about 350 ha in Hungary. The average yield of buckwheat was about 900 kg/ha. The amount of production varied between the levels of 205 and 1279 tonnes/year in Hungary (FAOSTAT 2010).

In France, the total production area of organic buck-

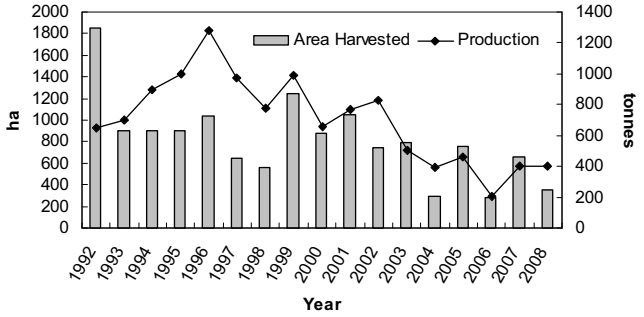

Fig. 2 Buckwheat production in Hungary 1992–2008.

wheat was 2799 ha in 2008 (l'agriculture biologique, chiffres clés, Edition 2008). The quantity of organic buckwheat was 888,55 tonnes in the Czech Republic in 2007 (Yearbook on organic farming in the Czech Republic 2008). In Hungary, the cultivated area of organic buckwheat was 71,64 ha including the areas under conversion (Annual report of Biokontroll Hungária Nonprofit Ltd. 2007). On the basis of the available data, in the Czech Republic about 44% of the produced buckwheat was grown organically in 2007. In Hungary, about 9% of the production area of buckwheat was under organic cultivation in 2007. According to the examined statistics, it can be stated that buckwheat is a favoured crop among organic farmers in these countries.

UTILIZATION

Besides being used for human consumption buckwheat can be utilized in many other ways. Almost all part of the crop can be used for different purposes.

The hulled *buckwheat seed* is used primarily for *human consumption.* In Europe groats are used to make porridge and soup (Campbell 1997), and buckwheat flour is often mixed with wheat meal to make pasta products (Antal 2005) and bread (Józsa 1985). It was used instead of rice to make chitterlings in Hungary (Westsik 1928). Buckwheat is widely consumed in Russia as a mush called kasha or as ingredient of other kinds of food. For a better taste the groat can be roasted or pan-fried before boiling (Matz 1991). In America buckwheat flour has numerous uses such as pancakes, biscuits and noodles. In Japan, buckwheat is used to make soba that is a kind of noodle. In the Indian Subcontinent it is grown as a *leafy vegetable crop* (Campbell 1997). *Buckwheat sprouts* are rich in amino acids, minerals and crude fiber, and its rutin content is notably higher than those of buckwheat seeds. It has an attractive fragrance and a very soft and mild flavour. Because of its favourable nutritional value and attractive characteristics buckwheat sprouts can be a new source of vegetable (Kim *et al*. 2001). Buckwheat can be used to make *alcoholic drinks* too. In China it has been reported that buckwheat is used for the production of *vinegar* (Campbell 1997).

Buckwheat grain is used as *livestock feed* primarily for feeding poultries and also for horses. Buckwheat hull, as well as the leaf and stem, contains fagopyrin that is a photodynamic agent and can cause fagopyrism in sheep and cattle. The hulled seed is free from fagopyrin. Buckwheat can be used as *green fodder*, but since animals do not really like it, it is fed mixed with tastier green fodders such as canola or alfalfa (Antal 2005). Buckwheat is recommended to grow mixed with other fodder crops to reduce fagopyrism. Mustard, oats, serradella, corn spurrey are appropriate to be sown mixed with buckwheat (Geisler 1988).

Buckwheat is useful as a *green manure crop* thanks to its rapid growth and ability to grow on soils with low productivity. The plant material decays quickly after ploughing under (Campbell 1997). Buckwheat can be used as a *cover crop* because the allelochemicals released from the living or decaying plant material can effectively reduce the growth of various co-occurring weeds (Iqbal *et al*. 2003). The flowers of buckwheat are excellent nectar providers, so its usage as a *bee pasture* is also popular. The reason why buckwheat is interesting for bee keepers is that its honey production comes late in the season when other nectar sources are scarce (Campbell 1997). The buckwheat *hull* is used as a *filling material* for pillows and as a packing material and also as a fuel. Buckwheat can be utilized for *medical purposes* because of its rutin (Gocs 2004) and other flavonoid content (Havsteen 1983). Rutin is used in preventing edema, haemorrhagic diseases and stabilizing high blood pressure (Couch *et al.* 1943; Havsteen 1983). The tea made of buckwheat seed was applied against high blood pressure (Gocs 2004). Buckwheat seeds and leaves have higher antioxidant activity than those of oats, barley, buckwheat hulls and straw. Antioxidant activity of buckwheat derives primarily from methanol soluble substances (Holasova *et al*. 2002).

ENVIRONMENTAL REQUIREMENTS

Buckwheat is an undemanding crop, although its adaptability is only moderate. It can be grown under extensive production systems. In Hungary, the appropriate areas for production are the southern and south-western parts of the country (Antal 2005).

Soil requirements

Buckwheat grows well on a wide range of soil types, except the too compact and heavy soils or those that have high lime content. It tolerates well acid soils (Láng 1965). It can also be grown on peat soils and sandy soils (Grábner 1948), however sandy soils low in organic matter and windblown sandy soils should be avoided (Antal 1992).

Light requirements

Buckwheat is generally considered to be a facultative short-day plant. In fact, the French-bred variety 'La Harpe' is a facultative short-day plant (Quinet *et al.* 2004).

Temperature requirements

Buckwheat is a warm-weather crop. It requires steadily warm temperature during the growing season from sowing until harvest. It is susceptible to frost and low temperature at emergence and at the end of the growing season (Láng 1965). 8-10°C soil temperature is needed for buckwheat to emerge. It starts to grow rapidly, when the temperature reaches 15-20°C (Varga 1966).

Water needs

Buckwheat requires high amount of precipitation. It needs to get sufficient precipitation at emergence. It provides the best yield in areas where the distribution of rainfall is balanced (Varga 1966). Buckwheat does not tolerate drought because of its shallow root system, and it has high water demand especially at the blooming period (Antal 2005).

DEMAND FOR THE PRECEDING CROP, PLACE IN CROP ROTATION

Buckwheat is not demanding as for the preceding crop. It is grown primarily as a second crop in Hungary. The best results can be obtained if it is sown after forage crops harvested at the end of May or at the beginning of June. Among cereals winter barley and rye are the best, and winter wheat is also appropriate as a preceding crop (Grábner 1948). Buckwheat can be sown as substitute of damaged crops if there are no chemical residues in the soil (Antal 1992).

Buckwheat is a good preceding crop for autumn and spring crops depending on the date of harvest (Láng 1965). It is reasonable to sow legumes, stoop crops or winter wheat after buckwheat (Józsa 1985).

VARIETY SELECTION

Currently there are four buckwheat varieties on the National List of Varieties of Hungary, including two Hungarian-bred varieties, one German- and one French-bred variety (**Table 2**). These varieties are marketable in the whole territory of the EU. 'Hajnalka' is a Hungarian-bred variety that was registered on the National List of Varieties in 1991. Its permission was renewed in 2008 (National List of Varieties 2008).

TILLAGE SYSTEM

Buckwheat can be cultivated under reduced tillage and no till farming systems. It is a relatively low input plant (Edwardson 1996) therefore it is well-adapted to be grown organically.

Buckwheat requires a small crumb textured, firm seedbed. The operations of seedbed preparation depend on the type of production. If buckwheat is sown as a *main crop*, the soil preparation is similar to that of cereals.

As a *second crop*, it should be sown as quickly as possible after the main crop has been harvested. Particular attention should be paid to the preservation of soil moisture (Láng 1965). After the main crop is removed, dicing, rolling, seedbed combining and again rolling it is necessary to prepare the seedbed (Józsa 1985).

SOWING

The date of sowing, the amount of sowing seed and the presowing operations depend on the type of the production. As a *main crop*, buckwheat is sown from the end of April, or the beginning of May. As a *second crop*, buckwheat must be sown until the end of July (Varga 1966). Buckwheat is particularly susceptible to frost, that is why it is worth sowing only if it will presumably ripen before autumn frosts (Geisler 1988).

Row spacing is 12 cm when it is grown as a green fodder crop and 24 cm when it is grown for the grain. 60 seeds have to be sown in the first case and 42 seeds in the latter per running metre. Thus the seed rate of buckwheat is 60 kg/ha and 80 kg/ha as the 1000-grain weight is 20 g (Antal 1992). The depth of sowing is 2-3 cm on compact soils and 3-4 cm on loose soils (Varga 1966). It can be sown into 12-15 cm deep ploughed soil under reduced tillage system (Geisler 1988).

NUTRIENT SUPPLY

Nutrient requirements of buckwheat are fairly low (Geisler 1988). In conventional farming system 44 kg N, 30 kg P_2O_5 and K_2O are needed for producing 1 tonne of buckwheat seed (Antal 1992). Buckwheat is usually not fertilized directly. The artificial fertilizer is given primarily to the preceding crop, and with this the nutrient needs of buckwheat are met, too (Láng 1965). On infertile sandy soils nitrogenous and phosphorous fertilizers are recommended to be given to the main crop that precedes buckwheat (Grábner 1948). The application of potassium artificial fertilizers rarely results in a higher yield. When using potassium-chloride leaf spot can be noticed that causes yield reduction (Gocs 2004).

If buckwheat is grown on fertile soil lodging may occur, especially if subjected to high winds and heavy rains. The buckwheat plant does not have the ability to recover from lodging (Campbell 1997). On soils high in nitrogen, buckwheat grows rapidly but badly sets seed. Therefore buckwheat should not been sown on parcels that were fertilized with manure in the previous two years. As a second crop, the best solution is to place it 3-4 years after fertilizing the area with manure (Grábner 1948).

PLANT PROTECTION

Weed control, weed management

Buckwheat emerges 5-6 days after sowing in a well-prepared seed-bad that has optimal temperature and contains sufficient moisture. It grows rapidly and suppresses weeds except when the weather becomes cold. In such cases, rolling is needed if the soil has become cracked. In case of 24 cm row spacing, light harrowing after the emergence can reduce weeds effectively.

In conventional farming systems, weed control by herbicides is possible until the plant reaches 10 cm in height but is rarely necessary (Gocs 2004). Desmedipham proved to be the most promising postemergence broadleaf herbicide for use in buckwheat (Wall and Smith 1999).

Diseases (viruses, bacteria, fungi)

Virus diseases often result in reduced growth and/or distorted plants. These plants may well present the symptoms of the particular virus disease. Mosaic symptoms are caused most frequently by cucumber mosaic virus (*Cucumber mosaic cucumovirus*) (Gocs 2004). *Turnip mosaic virus* (TuMV) can also infect buckwheat (Nyvall 1999). Aphids have a significant role in transmitting viruses. In order to prevent infection, the use of virus-free seed and the eradication of the virus vectors are necessary.

Among bacteria, *Pseudomonas syringae* may cause the destruction of seedlings (Gocs 2004).

Among fungi *Ascochyta fagopyri* causes spots 5-7 mm in diameter that have dark edges. *Cercospora fagopyri* also produces spots on the leaves. *Sclerotinia fuckeliana* and *Rhizoctonia solani* may also occur on buckwheat as weak parasites. Grey mold (*Botrytis cinerea*) attacks the above-ground parts of the plant. First brown spots emerge on the infected area then grey layer appears. The disease is favoured by wet weather. Seed treatment can reduce the rate of infection. The symptoms of downy mildew (*Peronospora fagopyri*) appear first on the adaxial surface of the leaves as yellow, transparent spots then grey mildew layer turns up on the abaxial surface of the leaves. In case of favourable external environmental conditions infection spreads over the flowers and may cause the destruction of them. Warm and wet weather favours the spread of the disease. It is important to observe the amount of sowing seed in order to develop optimal microclimate. *Fusarium* diseases (*Fusarium* spp.) can be caused by different species belonging to the *Fusarium* genus. The symptoms occur first on the top of

Table 2 Buckwheat varieties listed in the National List of Varieties of Hungary in 2008.

Variety denomination	Code	Year of listing	Applicant	Representative	Maintainer
'Hajnalka'	001602	1991	legal predecessor of the University of Debrecen, Centre of Agricultural Sciences and Engineering, Research and Innovation Centre, Research Institute of Nyíregyháza, Hungary		University of Debrecen, Centre of Agricultural Sciences and Engineering, Research and Innovation Centre, Research Institute of Nyíregyháza, Hungary
'Rutina'	002284	1994	FINK Ltd, Herrenberg, Germany		FINK Ltd, Herrenberg, Germany
'La Harpe'	007649	1999	I.N.R.A., Agri-Obtention S.A. Chemin de la petite Miniére Guyancourt Cédex, France	SA'TU Ltd. Budapest, Hungary	I.N.R.A., Agri-Obtention S.A. Chemin de la petite Miniére Guyancourt Cédex, France
'Oberon'	010763	2006	Cereal Research Non-profit Ltd., Szeged, Hungary		Cereal Research Non-profit Ltd., Szeged, Hungary

the plant, it starts to wilt, then the entire plant from up to down and the roots perish too. Infected plants can be easily pulled from the ground. The rate of the infection can be reduced by sowing at an optimal date and by appropriate nutrient management (Gocs 2004). *Phytophtora parasitica* causes growing brown spots on the stem that can lead to the reduction of growth or plant death (Nyvall 1999).

Pests

Buckwheat has no special monophagous pest in Hungary because of its rare spread. Emerging plants are damaged by flea beetles. The worms of cotton bollworm (*Helicoverpa armigera*) and pollen beetle (*Meligethes aeneus*) do harm on the plant by gnawing it. Aphids (*Aphis* spp.) suck sap from the above-ground parts of the plant that can lead to the weakening of the plant and the spread of viruses. The larvae of cockchafers (*Melolontha* spp.) may cause damage by gnawing the roots of the plant (Gocs 2004).

Other pests of buckwheat are thripses (*Thrips* spp.) (Antal 2005) and dune chafer (*Anomala dubia* Scop.) (Varga 1966). Protective measures are rarely taken against pests. With regard to the continuous blooming of buckwheat bee-friendly pesticides should be applied (Gocs 2004).

MAINTENANCE WORKS

Buckwheat generally does not require maintenance works because of its quick growth. However, a harrowing is advisable on weedy plots early in the season. If the emergence is delayed and the soil is cracked due to chilly weather, a rolling is necessary before emergence (Varga 1966).

HARVEST

As a *green fodder*, buckwheat is ready to be mowed 6-7 weeks after sowing. It provides the best quality fodder at the beginning of the blooming period. It can be mowed for a longer period because it does not lignify. Buckwheat is difficult to dry therefore it is not recommended to produce hay from it (Varga 1966).

Because of the indeterminate flowering habit, *buckwheat seeds* mature over a long period (Láng 1965). Seeds mature successively from bottom to up, and therefore flowers are often present at the top of the plant with already mature seeds at the lower parts. Buckwheat seeds mature 10-12 weeks after sowing. The best date for harvest is when the seeds on the lower lateral branches are well-matured and they start to mature on the middle lateral branches. If harvest is delayed, seeds can shatter and the most valuable seeds may be lost (Varga 1966).

Buckwheat was traditionally harvested in two steps. It was first cut and some days later threshed after the seeds and stems have dried (Grábner 1948).

Nowadays buckwheat can be either direct combined or harvested in two stages. It is advisable to dessicate the plant before *direct combine harvesting*. The optimal time for spraying is when the seeds on the middle lateral shoots start to mature. Buckwheat can be combine harvested 3-4 days after the treatment by setting the threshing drum on lower speed.

In case of *two-stage harvest*, buckwheat is first windrowed and then let dry in the windrows for some days. After that it is threshed with combine equipped with pick up heads (Józsa 1985).

The *yield* of buckwheat *green fodder* varies between 10 and 14 t/ha. The *seed yield* of buckwheat can be more than 2 t/ha under optimum soil and especially climate conditions, however, under unfavourable conditions it will remain below 1 t/ha (Varga 1966). According to FAO data the seed yield of buckwheat ranged from 0.35 (1992) to 1.5 t/ha (1997) in Hungary during the period from 1992 to 2008 (FAOSTAT 2010).

STORAGE

As the grain often has high moisture content at the time of harvesting, drying is necessary (Michalova 2001). The mature seeds should be dried as soon as possible otherwise seeds mould quickly. The drying temperature should not exceed 30°C. Underdeveloped seeds and weed seeds should be removed during cleaning. With the moisture content reduced to a maximum of 13 %, seeds can be well-stored until hulling (Antal 2005). The seeds are stored with the hulls on and are hulled shortly before use to prevent development of rancidity (Campbell 1997).

PROCESSING, CERTIFICATION OF THE FINAL PRODUCT

Primary processing of buckwheat includes cleaning, hulling, and milling. The aim of hulling is to separate the groats from the hulls by impact or abrasion of seed against emery stones or steel followed by air or screen separation of groats and hulls (Mazza 1993). The groats are then ground to smaller-sized particles. The flour yield is about 60 to 80% (Matz 1991).

The most important quality attributes of buckwheat groats are colour and flavour. The colour is light green in freshly harvested seed but gradually changes to reddish brown during storage. The colour change is accompanied by the loss of desirable flavour, and nutrients, along with the formation of brown pigments (Mazza 1993).

SEED PROPAGATION

Those fields, where the same or similar species were produced are not suitable for sowing seed production of buckwheat. As buckwheat is a cross-fertilized plant, the parcels of sowing seed production have to be well-isolated from

Table 3 Seed propagation: Detailed requirements of field inspection and certification of buckwheat.

Subject of inspection	Unit	Basic	C1	C2
			Category	
Minimum distance of isolation from other varieties or similar species	m		1000	
Maximum weediness	Qualifier number		2	
Minimum maturity	Value number		3	
Minimum uniformity				
Minimum cultivated state				
Maximum alien species, varieties in the average of the sample area	Plant (pcs)	1	2	4
Maximum alien cultivated and weed species in the average of the sample area (*Polygonum* sp.)		10	20	20
Polygonum convolvulus				
Maximum fungal diseases altogether, in the average of the sample area	Qualifier number	2	2	2
Phytophtora parasitica				
Cercospora fagopyri				
Fusarium sp. B				
Botrytis cinerea				
Fusicladium fagopyri				

Table 4 Seed certification: requirements for quantity of samples.

Weight of lots, maximum (tonnes)	Weight of prepacked packing units, maximum (kg)	Basic sample, minimum (kg)	Laboratory sample, minimum (g)	Sample for purity analysis, minimum (g)	Sample for alien seed analysis (g)
10	10	5	600	60	600

Table 5 Hungarian Standards for buckwheat seed certification.

Category	Germination, minimum (%)	Purity, minimum (%)	Stranger seed content, maximum (pcs/sample)		Moisture content, maximum (%)	Sample size (g)
			Total of other plant species	Weed seeds difficult to clean*		
Pre-Basic, Basic	85	98	3	-	14.5	600
C1, C2**			7			

* *Brassica* spp., *Sinapis* spp., *Setaria* spp., *Hibiscus trionum*, *Echinochloa crus-galli*.
**C1: certified seed of the first generation, C2: certified seed of the second generation

other parcels of buckwheat. The minimum distance from other buckwheat parcels is at least 1000 m according to the standards. Field inspection is carried out twice during the growing season, the first time at blooming stage and the second time prior to harvest. The size of the sample area is 100 m^2. The number of the sample areas is 4 until 20 ha and 2 after every inchoate 10 ha beyond 20 ha. In case of Pre-Basic category the values have to be met at least the requirements of Basic category. The subjects of the inspections are listed in **Table 3**. The amount of grain required in a particular sample is indicated in **Table 4**, and the Hungarian Standards for buckwheat seed certification are shown in **Table 5** (48/2004. (IV. 21.) FVM rendelet).

The depth of sowing is 2-4 cm and the row spacing is 10-15 cm in case of the production of buckwheat sowing seed (Geisler 1988).

CONCLUSION

Buckwheat can be utilized in many different ways. In human consumption buckwheat seed is used to make porridge, soup and flour. Other possibilities of utilization are livestock feed, green fodder, green manure and bee pasture. Buckwheat grows fast, which makes it suitable to grow as a second crop. It is a low input plant which, in most of the cases does not require direct fertilization and plant protection measures, therefore it is suitable for use in organic farming. The date of harvest is one critical point of buckwheat production, because the grains mature successively. It must also be taken into consideration that buckwheat requires high amount of precipitation after sowing and it is extremely sensitive to frost. Buckwheat can be readily inserted in the crop rotation, and it may be a viable alternative for both organic and conventional farmers when expanding the production.

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