SECOND CROP BUCKWHEAT IN NYÍRSÉG REGIONS

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Abstract
Buckwheat is an alternative plant in Hungary and it has been grown from 16th century. Buckwheat has a high potential in Nyírség region as there is sufficient land area to increase crop production under both organic and traditionally managed agriculture. In organic agriculture, it is frequently sown before vegetables to eradicate weeds. Buckwheat also improves soil aggregation through secretions from its extensive network of fine roots and in this way proceeding crop can be grown in an ecologically pure and uncontaminated environment. Due to the climatic condition, the incidence of crop diseases is low and most organic farmers use farmyard manure to improve soil fertility. Many parts of the Nyírség region have the proper climate to grow buckwheat. These are places where the summer evenings are cool, but frost comes relatively late in the fall. Buckwheat has short vegetation period, but the root system is small and adequate soil moisture must be available during the time the crop is flowering and producing seed. It is easily managed organically and it can be grown with equipment available on most farms and requires little attention during the growing season. Current experiment has been planed to determine sowing time, row distance and plant density, which allows good seed set in flower clusters and high yield in Nyírség region, were buckwheat can be grown as a second crop.

INTRODUCTION

Buckwheat (Fagropyrum esculentum Moench) is a psuedo-cereal belongs to the Polygonaceae family (Björkman 2002). It was introduced in Nyírség regions in the beginning of 16th century and used for human food and animal feed. Buckwheat has also been used as a second crop green manure to suppress weeds. In the 21st century, it has high value in organic agriculture as it improves soil condition and controls weeds economically. Buckwheat is a broadleaf plant native to northern Asia (Tsuzuki and Dong 2003). Seeds are brown in colour, irregularly shaped, with triangular surfaces (Marshall and Pomeranz 1982). When planted in warm, moisture soil, the seeds germinate and emerge rapidly (Oplinger et al. 1989).
Flowering begins 3-5 weeks after planting, and proceeds prolifically for a few weeks. At the peak of flowering, a buckwheat field is a striking sea of white petals. After a flower is pollinated, a full-sized seed will form within 10 days, although that seed will need another week or two to reach maturity. Seeds appear and mature earlier on the lower stem. The prolific flowers on buckwheat have made the crop a good nectar source for honey bee keepers (Myers and Meinke 1994). When planted on low-fertility soils, buckwheat may outperform most small grains. When another crop failed, buckwheat can be grown as a catch crop. It mellows the soil and suppresses most weeds (Bowman et al. 1998).

MATERIALS AND METHODS

A field experiment was designed to study the effect of sowing time on buckwheat cv. ‘Hajnalka’ at row intervals and plant density in Nagykálló, Eastern part of Hungary characterised by sandy soils. The field experiments were performed at the experimental

farm of the research Centre of Debrecen University, on a sandy loam. Soil parameters of the experimental site are in table 1. The study was carried out during the years 2003, 2004, 2005 and 2006 and five sowing dates with 2 weeks intervals were applied from late April to late June. In the study 4Rrw distance 12 cm, 24 cm, 36 cm and 48 cm were included. Plant density varied from 125 plant/m2 to 500 plant/m2 with 125 plant/m2 increments. The trial was laid out in a split plot design with four replications. Plot size was 12 m^2 having row density in main plots and plant density in sub-plots. Standard dose of NPK fertilizer (112-84-0 kg/ha) was applied as blanket application. Germination percentage of the applied seed lots was 94-96 %. The effect of difference in sowing time was evaluated in 3 weeks after establishment of the experiments. The differences in sowing time, row and plant density was analyzed by ANOVA using the GLM of SPSS-13 program package.

RESULTS AND DISCUSSION

Buckwheat grows well in Nyírség region under a wide range of soil conditions. It is sensitive to spring and fall frost, drying winds and drought. Stress factors can reduce yield, especially if they occur during the blooming period. Excessive soil nitrogen, wind and heavy rainfall can cause buckwheat to lodge. Buckwheat should be planted when danger of spring frost has passed and it requires 10 to 14 weeks after planting to reach maturity in Nyírség region. Buckwheat has an indeterminate growth habit, with the top of the plant flowering while seed at the base of the plant already may be mature. Buckwheat grows best on soils that are neither too compacted, nor too sandy. It can tolerate wet soils where drainage is adequate. Due to its reported soil-improving properties, a cash crop, such as wheat or legumes, may benefit by being grown after buckwheat. The root system of buckwheat is small and adequate soil moisture must be available during the time the crop is flowering and producing seed.

Date of sowing

Sowing to reduce the likelihood of damaging weather is critical to success with buckwheat (Badiyala and Saroch, 1995). Summer sowing should be timed to avoid flower blasting during the hottest part of summer, and to allow the crop time to mature before frost. There should be no hot weather (>30^{o}C) after flowering begins and at least ten weeks of frost-free growing weather. In the Northeast, mid-June through mid-July is the best time to sow.

Table 1

Effects of sowing time* on yield of Buckwheat in Nyírség region.

Sowing time	Subset 1	Subset 2	Subset 3	Subset 4
Late April	1 614			
Early May		1 756		
Early June		1 820	1 820	
Late May			1 921	
Late June				2 052

*Turkey test, means for groups in homogeneous subsets based on type III sum of squares.

Buckwheat is not a frost tolerant plant and cannot be planted in early spring. To study optimal sowing date, plant density and row distance a series of experiments was set up in Nagykálló. Based on the results of the experiment for maximum grain yield, buckwheat should be planted in late June (Table 1). This sowing date resulted 2052 kg/ha seed yield, which is significantly different from earlier sowing date (Figure 1). Young seedlings are very sensitive to frost, so seeding should be delayed until all danger of spring frost is past. Buckwheat seed germinates best when the soil temperature is about 14 ^{o}C, but will germinate at any temperature between 5 and 45 ^{o}C. To minimize flower blasting, sowing

should be timed for vegetative growth during the warmer part of the summer, and flowering and set seed during the cooler late summer seeding from late May to early June is suggested. Although flowering lasts for several weeks, virtually the entire crop is normally set during the first 10 days of flowering (6-8 weeks after sowing). During this critical flowering period, flowers are sensitive to temperatures over 30 ^{o}C, with the optimum being 20 ^{o}C. For the crop to mature, it needs ten to twelve weeks between sowing and frost, and during this time it needs about 1300 Growing Degree Days. Sowing can be done when the soil at least 10 ^{o}C, with good emergence only above 8 ^{o}C. The seedlings are quite sensitive to crusting and to muddy conditions.

Due to cool soil temperatures in Nyírség region it is sometimes hard to obtain uniform stands, when buckwheat is sown in late April or early May (Figure 2). Seeding in second part of May or early June 25 allows additional time for weed control tillage and the soil also become warmer. Buckwheat seeding should be timed to allow plant growth to take place in warm weather and seed to form in relatively cool weather in late summer. Drought stress at flowering time can result in a poor seed set, but delayed seeding does increase risk of frost damage in Nyírség region. Later dates of planting result in a shorter growth period, shorter plants, lower thousand grain weights and reduced seed yield. The downside of planting in July is the risk of experiencing a dry August during buckwheat establishment. In Nyírség region, buckwheat can be planted in early August. The later buckwheat is planted, the faster it will mature. When seeding is delayed beyond late June or buckwheat is grown as a second crop severe yield reductions may occur as a result of drought.

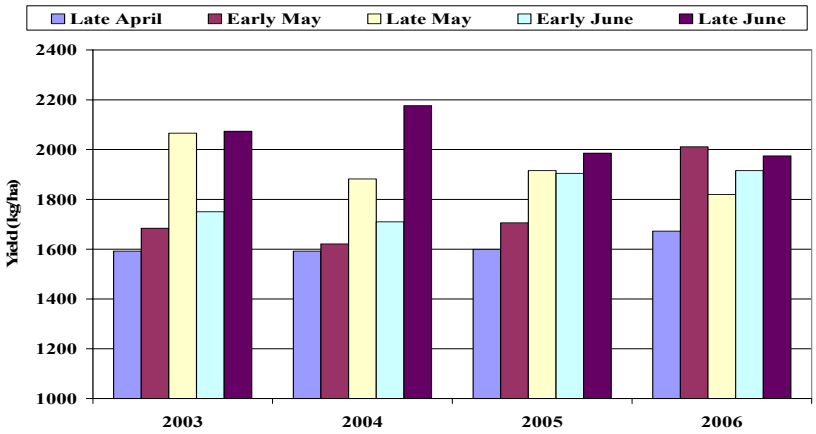

Fig. 1: Effects of sowing time on yield of buckwheat in 2003-2006 periods

Buckwheat is established most easily on a well-prepared, firm seedbed similar to that for other small seeded crops. Early to mid-June planting permits adequate control of several weed seedling prior to seeding. Under good growing conditions, buckwheat will germinate and shade the ground quickly. Cultural control of weeds is especially important in organic agriculture. The reason to plant buckwheat relatively late is to push flowering into a period when nights are starting to cool down, which will normally be the case in late August or early September. The percentage of flowers that develop into seeds increases if flowering occurs during cooler periods. Night temperatures appear to be more important for yield than day temperatures.

Seedbed preparation and row distance

Seedbed preparation and row distance are two important aspects for productive buckwheat crops. Seedbed quality is influenced by the tillage method and timeliness, and includes

conventional and direct seeding methods. False seedbed in combination with intensive weed control may be a way to reduce the soil seed reserve in organic agriculture. Buckwheat does not tiller; each seed produces a single stem that branches toward the top as field space permits. Since the buckwheat plant has a fine root system, it requires a good seedbed. The seedbed should be firm to obtain uniform establishment, rapid plant growth. Buckwheat usually is sown with a grain drill at a row distance 12-36 cm. Good stands help prevent lodging. Row distance, in this experiment, varied between from 12 cm to 48 cm, but we have found no significant differences between the treatments in respect of grain yield.

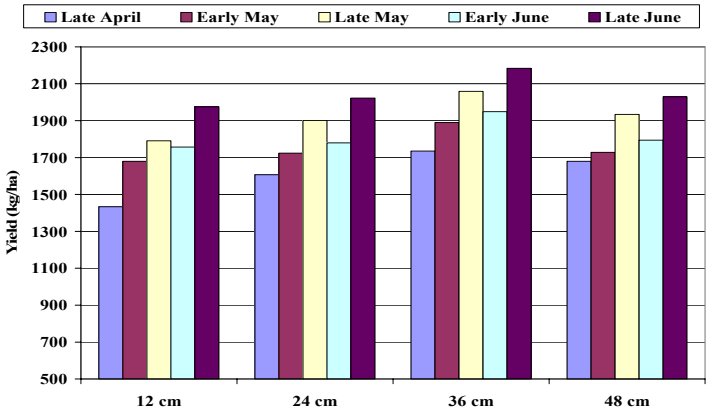

Fig. 2: Effects of row density on yield of buckwheat using different sowing time

In the experiment the differences were not significant, when the row distance varied between from 12 cm to 48 cm (Figure 2 and 3). Unfortunately, this might suggest that buckwheat planting requires little attention. On the contrary, we paid attention to seedbed preparations. Ploughing was usually done in the previous fall. The soil should then be cultivated periodically to improve its physical condition, retain moisture, and destroy weeds. Since second crop buckwheat is planted late, it is often valuable to disk in early to mid-June in order to retain soil moisture and assists mineralization of plant nutrients. If the previous crop as peas or other small grain, or the soil has already been prepared for another crop in the spring, ploughing was replaced with harrowing with a field cultivator. Sowing in wet soil has always been avoided. Seeding was considered as an important operation before harvest, which was worth doing well.

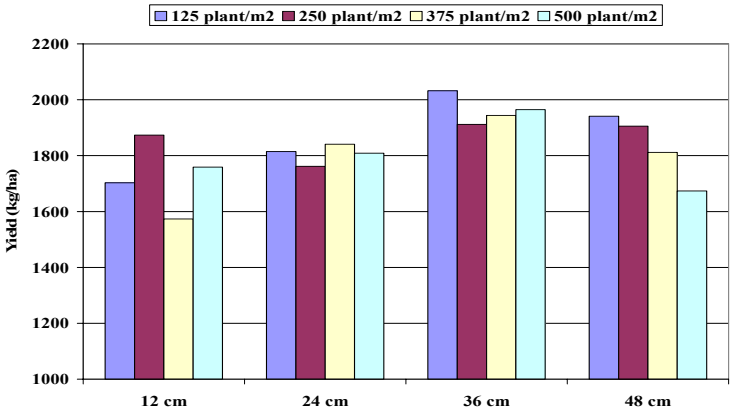

Figure 3: Effects of row distance on yield of buckwheat using different plant density

Crop rotation and plant density

Crop rotation is an ancient agronomic practice, which is very complex in its effects and not fully understood (Eskelsen and Crabtree, 1995). It is influence yield significantly and a cornerstone of farm management in organic agriculture. The benefits of crop rotation are numerous and long-term experiments, such as Westsik's crop rotation experiment are needed to exclude short-term influences of weather, soil productivity and management changes. Good crop rotation has a beneficial impact on weeds, diseases and insects (Wall and Smith, 1999). Rotating crops tends to reduce pest build-up (Lazányi, 2003). When a crop is grown continuously, pest populations adapted to that crop increases (Iqbal, et al. 2003). Buckwheat usually is not included in a regular rotation. Buckwheat stubble adds little organic matter. It is a heavy feeder of mineral fertilizers, especially phosphate, and this should be considered in fertilizing the crop following buckwheat. Avoid planting buckwheat on canola, mustard or sunflower ground because these crops readily produce volunteer plants that are impossible to control in growing buckwheat (Li et al. 2006). Buckwheat drops seed readily before harvest and volunteer growth can occur in the following crop. Buckwheat volunteers are not a significant challenge and that they are eliminated by normal practices. Disease problems are rarely encountered in Nyírség region. As a precaution, however, a minimum of three years should be left between successive buckwheat crops in a rotation.

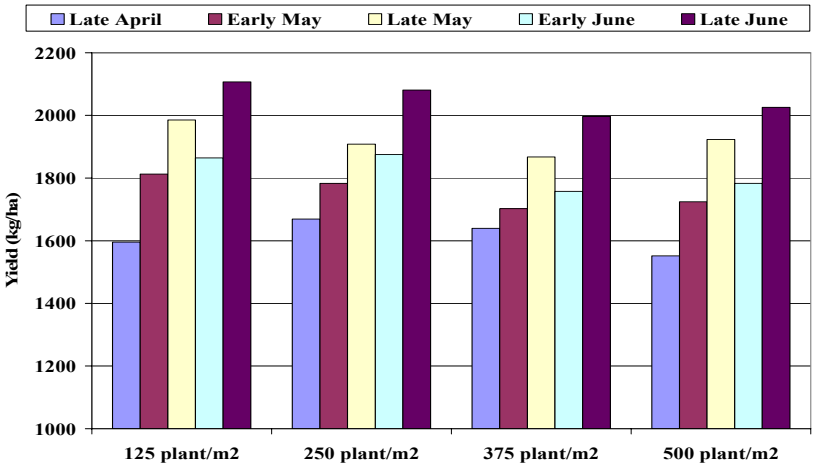

Fig. 4: Effects of plant density on yield of buckwheat using different sowing time

Highest yield (1963 kg/ha) was resulted form a stand of 375 plants/m2, which is significantly different from 125, 250 plant/m2 and 500 plant/m2 density (Figure 4). As a result of larger plants, on good land, lower rate can be used. Higher rates are needed if plant growth is likely to be slow, for example if the soil is cold, wet or poorly prepared at sowing (Sucrvoro and KoEsninnyo, 2001). Large-seeded varieties also require higher rates. Germination can decline quickly in common storage, so a germination test is worthwhile if the seed is not from the most-recent harvest.

Table 3

Effects of plant density on yield* of buckwheat in Nyírség region.

Plant density	Subset 1	Subset 2	Subset 3
125 plant/m2	1 727		
250 plant/m2	1 807	1 807	
500 plant/m2		1 833	
375 plant/m2			1 963

*Turkey test; means for groups in homogeneous subsets based on type III sum of squares.

Buckwheat is generally a good competitor as it germinates rapidly and the dense canopy that it produces soon shades the soil. Traditionally owing to the lack of good herbicides, buckwheat was used as a smother crop for broad-leaved weed control. Even today, growers often increase the seeding rate in areas where they expect more weed competition so that the canopy is developed more quickly. This rapidly smothers out most weeds, especially broadleaved ones, but if the weed growth gets above the buckwheat canopy, buckwheat becomes a poor competitor.

DISCUSSIONS

Buckwheat is susceptible to frost, high heat and/or low moisture conditions, so to gain best benefits; it should be planted at least 60 days before the first expected frost or before the hot and dry season. Buckwheat should be drilled into a well-managed, clean field. If the buckwheat crop is to follow a winter cereal, perform additional tillage to eliminate volunteers before planting buckwheat.

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