SWEET CORN EARLIER

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Abstract

In our trial we tried to find out how the time of propagation and transplanting influenced the growing season of sweet corn along with some major properties relevant to quality. The following technological variations were compared: transplanted plants with floating row cover (with 2 planting dates); transplanted plants with no row cover; direct seeded plants with no row cover. The transplant growing period reduced the growing period by 16 to 28 days, compared to the technology used in the existing practice of production. Earliness had a negative influence on ear weight, nonetheless it is worth while to attempt since the market is not so exacting with new products in the early period. In our trial the effect of earliness had a favourable influence in case of reducing- and total sugar content accumulation of seeds.

Key words: *earliness, sweet corn, seedlings, fleece covering*.

INTRODUCTION

Currently, Hungary is not considered as an influential country of the market considering the majority of the vegetables. The only exception is the sweet corn. Although the yield fluctuated, the growing area have grown continuously, in 2002 we gone before French and Hungary became the European leader in sweet corn growing. The impulsive force of great growth, was the canning and freezing industry. Based on its present growing area, the sweet corn is the vegetable which is grown on the greatest area in Hungary and after the sudden and sharp decline in 2003 this plant returned in a rise after 2006. With a growing area of over 30,000 hectares Hungary is presently the first in the EU (Tömpe, 2006). Our export is threatened seriously by Thailand with its low prices, which is possible through 3 times pro year harvesting. This threat was limited for the moment with an anti dumping moratorium accepted by EU for five years. In the case of the former, however, the increase in fresh consumption partly counterbalanced the rate of decrease. In order to promote fresh consumption, as well as to maintain and increase the sweet corn exports, it is necessary to promote investigations so as to be able to ensure a further increase in the growing area and yields of sweet corn with the help of the experiences. Of the production technology elements, a number of researchers studied or are currently studying the sowing time of sweet corn. Ripening can occur earlier when sowing earlier and using high quality seeds, as compared to normal or late sowing. I'só (1969) after their multi-year sowing date trial, concluded the following: in the case of an earlier sowing seed germination will be more protracted, but from the point of view of ear ripening it was more favourable than late sowing. Early sowing is also recommended by Aldrich (1970) for the reason that the roots will penetrate deeper this way, from where they can get water even in periods of drought and the more intensive vegetative

growth also takes place during the period of shorter daytime and this way the plants will be smaller and will be less prone to lodge. Several techniques are known in the art for the purpose of early fresh market shipments: seedling growing or direct seeding with temporary plant cover (Kurucz 1998; Hodossi 2004). Direct seeded sweet corn under fleece cover showed earlier ripening and gave better yields in the experiments of Kassel (1990). The plots under fleece cover reached harvest maturity 12 days earlier as compared to the plots with no cover. Besides, a greater number of missing plants was observed in the plots with no cover. As a result of the greater plant number and the better ear set per plant yields were much higher in the plots with fleece cover. According to another solution in use, the seeds are sown in 10 to 14 cm deep seed trenches and the latter are covered with floating row cover. The cover is removed 22 to 24 days after sowing. This gives 4-6 day earliness in emergence and 8 to 10 day advantage in growth and development (Hodossi&Kovács, 1996). The most widespread method of seedling production is the use of soil blocks (Pereczes, 1999) which can also significantly increase earliness. According to the trials of Kurucz (1998) seedling growing advanced harvest by 2 weeks. According to Hodossi (2004) 10 to 12 day earliness can be achieved by planting seedlings grown in soil blocks and 6 to 8 day earliness by seedlings grown in trays. The measurements of Kassel (1990) revealed that the ears of direct seeded corn plants under floating row cover could be harvested 10 days earlier as compared to the plots planted with seedlings and having no cover. The combined application of seedling growing and floating row cover can advance harvest by three weeks as compared to the traditional technology and can give farmers a three to four times greater income (Kurucz, 1998; Pereczes, 1999). Arun Kumar *et al*. (2007) found the grains to have a reducing sugar level of 2,3-3,2 %, the non reductive sugar content range between 17,01-24,38 %. In point of sugar content, after Herrmann (2001) notification 100g fresh kernels contents about 1g reductive sugar (glucose+fructose) and on average 2,16g (1,6-2,7) g sucrose.

MATERIAL AND METHODS

The experiments were set up in years 2006 and 2007 on an area equipped for irrigation at the Experimental Farm of the Faculty of Horticulture of the Corvinus University of Budapest.

For the basic material of the experiment I choose a normal sweet corn variety of short growing period (Spirit) which is broadly used, reliable and sufficiently known among Hungarian growers. Under our climatic conditions the most important requirement for early varieties from the point of production to have, besides a short growing period, as high a tolerance as possible to ground frosts in late spring and to the great fluctuations in temperature occurring in this period.

The variety Spirit is a very early one, has a growing period of 85 days, its grains are yellow in colour. Average height is 159 cm, ear height is 37 cm, average ear length 19.6 cm as measured in the variety comparison trials carried out by the Central Agricultural Office (earlier National Institute for Agricultural Quality Control), average ear weight 245 g. The variety was granted official recognitions in 1988 and has been the dominant variety of the early ripening category till now.

The variety is used as a reference variety in the variety comparison trials of the Central Agricultural Office.

For the frame structure of the treatments with cover we used Ø 4.2 mm zinc coated wire coils.

The fleece, 60 cm in width, was stretched over a small tunnel of 40 cm in height and then its edges (25-25 cm, respectively) were covered with soil using a hoe and the its ends were tied to the stakes hammered down at making the frame structure. The construction of the frame structure and the setting out of the fleece cover were carried out at the same day as direct seeding and outplanting.

The following treatments were applied during the experiment

P1 = covered plants grown from transplants (Apr 6th 2006 and Apr 4th 2007)

P2 = uncovered plants grown from transplants (Apr 20th 2006 and Apr 19th 2007)

P3 = covered plants grown from transplants (Apr 20th 2006 and Apr 19th 2007)

P4 = uncovered direct sowing (Apr 20th 2006 and Apr 19th 2007) (Control)

For the purpose of seedling growing, the seeds were sown on March 16th and March 30th in 2006 and March 13th and March 30th in 2007, in trays with rigid walls having 11x7 holes of 3x3x7 cm in size. For growing the seedlings we used a commercial mix made of white peat 10-20 mm, PG Mix 1 kg/m3 + micro nutrients, bentonite 40 kg/m^3, pH 5,5-6,5. The seedlings were grown for 3 weeks in both cases and were planted out at the 3 to 4 leaf phenological stage. At the two propagation times the treatments P1 and P3 were covered with Novagryl floating row cover, having a weight of 19 g/m^2, (using the small tunnel technique) in order to enhance earliness. In the year prior to the experiment the area was under lacy phacelia (*Phacelia tanacetifolia*). The floating row cover was removed on May 16th in 2006 and May 11 in 2007. The stand was created to contain 60,607 plants per hectare, according to the recommendations of the owner of the variety, at a spacing of 110+40x22 cm in twin rows. Each plot had an area of 6x7m (8 parallel rows and 30 seeds sown in each row). Sowing depth was 2-3 cm. The edge was the respective outer rows of the 4 twin rows of the plot. Four repeats were carried out in parallel. Each plot had an area of 6x7 m. The edge was the outer twin rows of the 4 twin rows of the plot. The plots were marked out in the same place in both experimental years. No farmyard manure was applied.

The NPK requirement according to the soil test was determined in the already mentioned fertilization system, with a (planned) unhusked ear yield of 16 tons per hectare. The soil samples for analysis collected at the beginning of 2006 from the trial area. The soil nutrient content analysis was carried out using the AL (ammonium-lactate) method. Accordingly, a nutrient dose of 222.5 kg/ha N, 22.5 kg/ha P_2O_5 and 143 kg/ha K_2O active ingredient was applied in the form of ammonium nitrate (34%), superphosphate (19.5%) and potash chloride (60%). Approximately half of the N rate (10 g/m^2) and the total of the P and K rates were applied as starter fertilization (about one week before the first propagation time), while the rest of the N dose was applied on two occasions, at the 6-7 leaf stage and at tasseling, in the form of top dressing. The starter fertilizer application was worked into the soil with a rotary hoe.

In the application of the N top dressing rates (34% ammonium nitrate), in 6-7 leaves and tasseling stages, we were careful not to apply an active ingredient dose of over 50 kg/ha in order to prevent salt damage. During harvest the ears, together with the husks, were collected from the two central twin rows. After that, 20 ears of average appearance were selected from each row and the following measurements were carried out:

- unhusked ear weight (gram)
- total ear length (cm)
- reducing sugar content (%)
- total sugar content (= compound sugars, chiefly sucrose) (%).

For sugar content determination was used the Luff-Schoorl method. The statistical analysis was carried out by using the programme RopStat 1.1 with the help of which we performed one-way comparison of repeated measures. The differences between the homogenity of variances were tested with Levene test (Balog *et al.* 2007). $P < 0.01$ confidence limits are considered as statistically significant differences (Balog *et al.* 2008b). When the standard deviations were identical, the mean

values were compared by pairs using the Tukey-Kramer test, while in the case of the non identical standard deviations the means were compared using the Games-Howell test (Vargha, 2007).

RESULTS AND DISCUSSIONS

The results of the analysis of the soil sample collected from the trial area are contained in Table 1.

Table 1. Soil analysis results.

pH_{H2O}	Salt %	Humus %	K_A	P_2O_5 mg/kg	K_2O mg/kg	$CaCO_3$ %
8,03	0,035	1,31	<30	293	205	<1

The pH of soil was considered calcarous. The nutrient content of soil in nitrogen was low, in phosphorus very good and in potash good.

Harvesting time of the experimental years are presented in Table 2.

Table 2. Time of harvesting.

Treatments	**Starting harvest (days after transplanting)**	
	2006	**2007**
P1	77 (VI.22)	67 (VI.11)
P2	67 (VI.26)	63 (VI.22)
P3	67 (VI.26)	63 (VI.22)
P4	83 (VII.12)	80 (VII.9)

The absolute growing season (measured in days) was the shortest in the treatments P2 and P3, merely 67, respectively 63 days, i.e. the corns became ready for harvest 16, respectively 17 days earlier than those of P4 (control), which were propagated at a time, around Apr 20th, and in a way according to the existing practice of production (by direct seeding). Though the absolute growing season measured in days was 10, respectively 4 days longer (77 days) in the treatment P1, of early planting and provided with floating row cover, as compared to the treatments P2 and P3, at the same time, as planting was carried out 14, respectively 15 days earlier, the result was that it was the cobs from these corn plants that we managed to put first on the market.

One of the major characteristics in connection with yield rating, unhusked ear weight, are summarised in Figure 1.

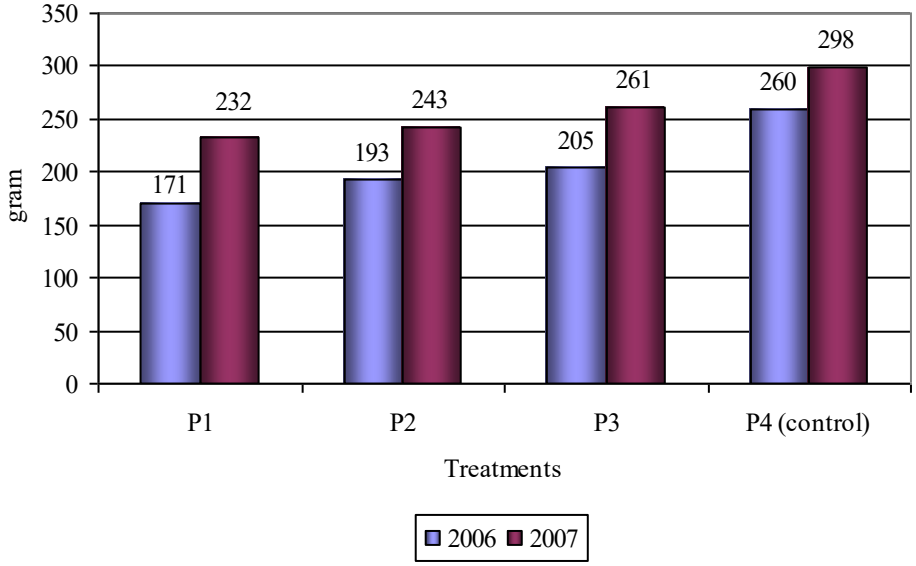

Fig. 1. Unhusked ear weight (g).

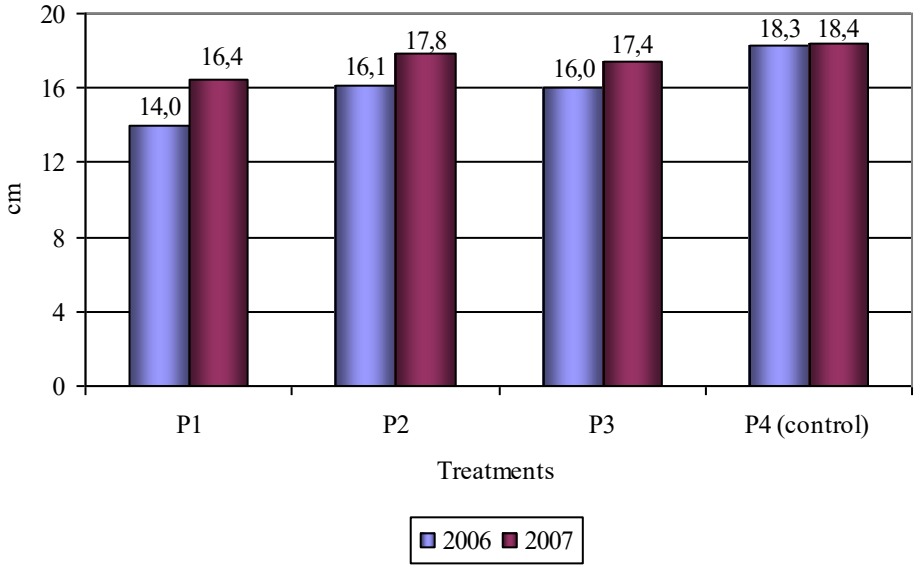

Fig. 2. Total ear length (cm).

Analysing the data measured for unhusked ear yield, we saw that the average weight of the ears of the treatment P1 was significantly (at $p<0.01$ level) lower as compared to the treatments P2 and P3, as well as to the treatment P4 (control). The greatest average unhusked ear weight was measured with the ears of the control treatment P4. Though there was some difference between the plants of the treatments P2 and P3 in unhusked ear weight, statistically this was not significant.

The data concerning, an important characteristics for market appeal (total ear length) are contained in Figure 2.

When studying the data relative to total ear weight, we found that the lengths of the direct seeded (control) treatment P4 were also statistically significantly (at $p<0.01$ level) superior to the sizes of the transplanted treatments (P1, P2 and P3).

The length of the earlier transplanted treatment P1 was also significantly (at $p<0.01$ level) inferior to the ear length of the latter transplanted treatments (P2 and P3).

No statistically demonstrable difference was found between the ear length of the treatments P2 and P3.

The effect of applicated technologies on reductive sugar content of kernels is presented on figure 3.

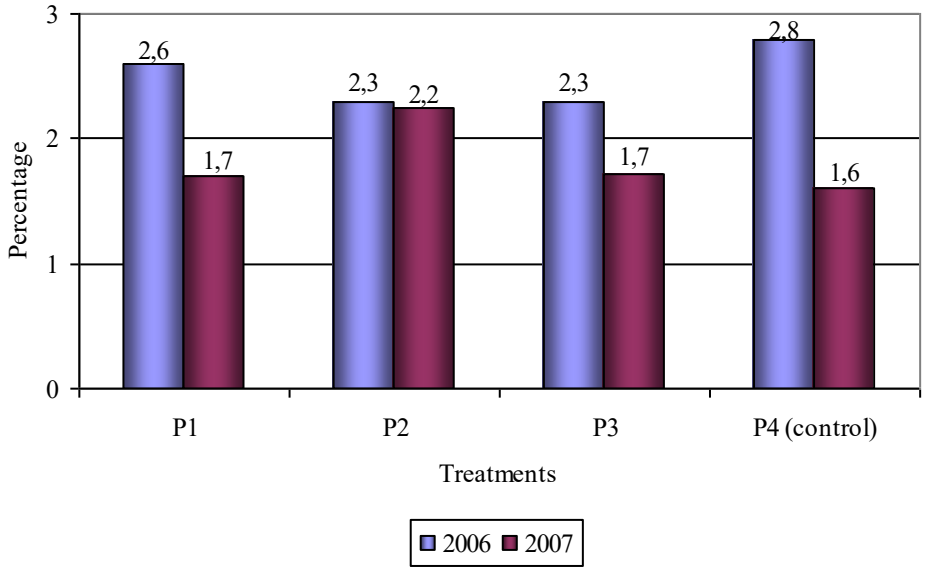

Fig. 3. Reductive sugar content (%).

After the first experimental year (2006), which was considered as less favourable for early sweet corn production the measured reductive sugar content was significantly higher (at $p<0.01$ level) in case of P1 (covered plants grown from transplants) and P4 (uncovered direct sowing) treatments, and higher in case of the P2 and P3 treatments in comparison to the similar treatments in the next (considered favourable) experimental year 2007. According to literary dates we measured higher values, but we didn't know, that the compared varieties were the same or not.

The total sugar content is summarized in figure 4.

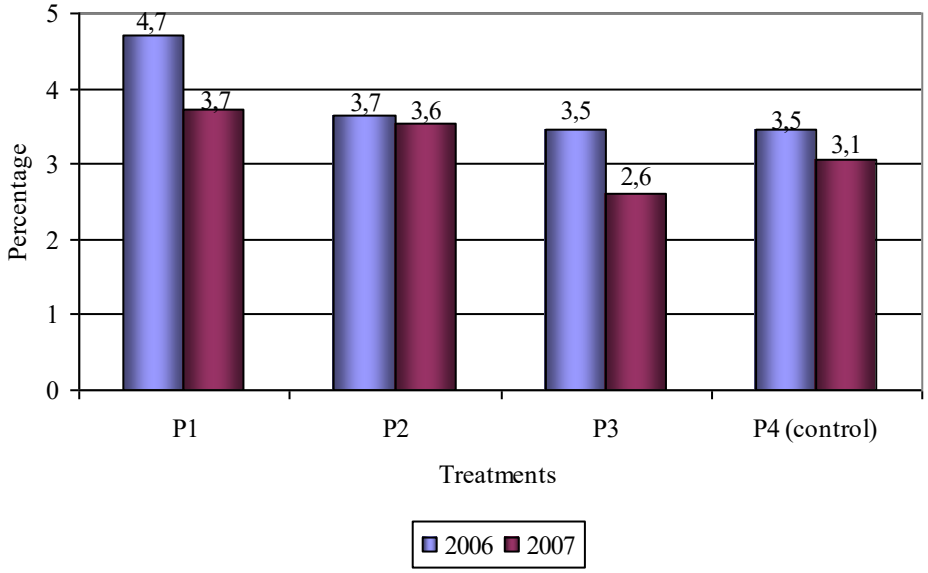

Fig. 4. Total sugar content (%).

Analyzing the total sugar content of kernels we have seen the same trends as in case of reducing sugar content in both experimental years. The highest sugar contetnt values were measured in kernel of P1 treatment in both years, but this differences between the experimental years and among the other treatments statistically was not significant.

CONCLUSIONS

Based on the 2006 and 2007 year's results of the experiments, the following conclusion can be made:

The growing season was significantly reduced in the transplanted treatments compared to the direct seeded (control) treatment. Harvest time occurred in 2006 with 20 days, and in 2007 with 28 days earlier in the case of the treatment of early transplanting and with floating row cover (P1), with 16 days in 2006 and 17days in 2007 earlier in the case of the treatments of later transplanting and with and without cover (P2 and P3). At the same time the floating row cover did not produce any shortening in the growing season in the treatments P2 and P3.

The average ear length of the early transplanted treatment P1 was significantly inferior compared to the other treatments. There was no significant difference in total ear length between the 2 treatments (P1 and P3) which were transplanted two weeks later.

Compared to the data by Hermann (2001), according to our findings, the concentration of the reducing sugars were superior to 1 g. Relative to the reducing sugar content, such data as published by Arun Kumar *et al*. (2007) (2,3-3,2%) were encountered as well, but only in first experimental year 2006. In case of total sugar content we have not find such as high values.

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