Summary of the PhD thesis

THE IMPACT OF THE MOST IMPORTANT AGROTECHNICAL FACTORS ON THE AGRONOMICAL TRAITS AND YIELD OF SWEET CORN HYBRIDS

Ádám Lente

Supervisor: **Dr. Péter Pepó**
professor

University of Debrecen
Hankóczy Jenő Doctoral School of Crop Production, Horticulture and Food Sciences

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1. INTRODUCTION

Field vegetable crops are grown on about 2-3% of the arable lands worldwide and this ratio is valid also for Hungary. Regarding sweet corn production, the USA is the most significant country, as almost 25% of the global sowing area of sweet corn is located there (*Table 1*). In Europe, Hungary has the largest sowing area preceding that of France since the beginning of the 2000s. Sweet corn is the first among the field vegetable crops in Hungary as regards the growing area. The success of production is basically determined by agrotechnical and agroecological conditions. Hungary's climate and soil conditions and relief are excellent for sweet corn production in a significant area of the country. Sweet corn has high requirements as regards the soil quality and the culture state of the soil. Successful sweet corn production can be pursued mainly on chernozem-like soils, therefore, the major growing regions are the loess areas of Hajdúság and Békés-Csanád. Sweet corn is grown on the largest area among the field vegetable crops, on 1/3 of the total vegetable growing area. Its growing area had been growing continuously since 1996 (17 000 ha), it exceeded 35 000 ha in 2002 and reached its maximum in 2003 at 38 000 ha, when Hungary had the fourth largest growing area in the world. The reason for this increase was the development of the canning and freezing industry.

Table 1. **Major parameters of the leading sweet corn producing countries**

(USDA data, 2008)

	Sowing area (ha)	Share from the world sowing area (%)	Yield (t)	Average yield (t ha^{-1})
USA	**240 130**	**23.04**	**3 888 080**	**16.2**
Nigeria	162 500	15.59	579 000	3.6
Guinea	116 000	11.13	285 000	2.5
Indonesia	91 000	8.73	332 000	3.6
Ivory Coast	72 000	6.91	250 000	3.5
Mexico	56 363	5.41	610 593	10.8
Peru	41 321	3.96	332 255	8.0
Thailand	38 000	3.65	305 000	8.0
Republic of South Africa	32 500	3.12	310 000	9.5
Hungary	**32 000**	**3.07**	**514 000**	**16.1**
Japan	26 000	2.49	240 000	9.2
France	**25 599**	**2.46**	**521 916**	**20.4**
Papua New Guinea	23 500	2.25	235 000	10.0
Canada	21 080	2.02	216 826	10.3
World	**104 2274**	**100.00**	**918 2177**	**8.8**

2. PRELIMINARIES

In the case of sweet corn, the impact of the year is very strong as compared to other field crops. It is grown on the best soils with controlled and high-level technology and high input use, therefore, the weather parameters of the given year have a decisive effect on the efficacy of sweet corn production. As this crop has a shorter growing season, its dynamic water requirements differ from those of feeding corn, the continuity of water supply has a significant effect not only on the quantity but also on the quality of yield, therefore, the crop is very sensitive to the year, especially to water supply parameters. The key role of water supply is well indicated by the fact that sweet corn production in Hungary is carried out mainly under irrigated conditions, without irrigation, only a hardly determinable optimum combination of the production technology elements can result in successful production.

From among the production technology elements, the selection of sowing time has a double function in the case of sweet corn. The sowing time is determined on the one hand by the early development requirements of the plant (biological optimum) and by the transportation schedule (technological optimum) of the processing industry on the other hand. In the case of sweet corn, the latter determines the actual sowing time in many cases. However, the response of hybrids to sowing time differs, therefore, it is important to determine the hybrid-specific sowing time of the applied hybrids in the given growing region.

Most of the sweet corn hybrids are not of Hungarian origin, therefore, the adaptive ability is an important factor. This ability ensures the proper yield, the responses to the different ecological stress factors determine the amount of yield. In the case of sweet corn, the quality is more complex than in the case of feeding corn, therefore, those quality parameters which are important for the processing industry determine whether their growing is justifiable (carbohdyrate content, sugar/starch ratio, tenderness, corn-cob ratio, colour of the kernels, husk cover, cooking properties, shape of the ear). The interests of the processing industry are the highest kernel ratio, homogeneity and tenderness of different degree for the canning and freezing industry. These qualities are mainly genetically determined, but certain agrotechnical elements (plant density, nutrient supply) can significantly influence them.

From among the production technology elements, plant density is of outstanding importance in the amount of yield, similarly to that in feeding corn. Optimum plant density is determined by the individual yield and the yield of the stand. Due to the physiological traits of the plant (proneness to tillering, lower height) different plant densities are needed than in feeding corn. When determining plant density, the ear size required by the processing industry, the nutrient supply of the soil and sowing time (in the case of second crop) should be considered. At determining plant density, the aim is to create a homogenous stand, as the heterogenous ear size can result in significant economic losses.

When determining the fertilization of sweet corn, several aspects should be considered. The specific nutrient requirements of the crop are given, however, the yield is more influenced by the amount of available nutrients than in the case of feeding corn. Sweet corn has a weaker root, therefore, it is of key importance that the nutrients should be available in a form which is easily uptaken by the plant, which can be achieved in the most simple way by applying fertilizers before and during the season. Nitrogen determines primarily the vegetative growth and the amount of yields, while phosphorus has an important role in fertilization and root growth and potassium has a great impact on sweet corn quality due to its role in carbohydrate synthesis, respectively. The importance of fertilization in sweet corn production is indicated by the fact that suspended fertilizers and fertigation were introduced and widely applied first in this culture in Hungary. In spite of the fact that sweet corn is grown mainly on areas with good nutrient supply (soils with chernozem dynamics) base and top fertilization adapted to the needs of the crop are essential.

My research work focused on the following experiments and areas:

- study of the impact of the year on the yield of sweet corn
- impact of sowing time on sweet corn yield
- impact of genotypes on sweet corn yield
- impact of plant density on sweet corn yield
- impact of fertilization on sweet corn yield
- impact of the studied agrotechnical factors on the agronomical traits of sweet corn (ear weight and length, number of kernels per row)
- impact of the studied agrotechnical factors on the photosynthetic activity and leaf area index (LAI) of sweet corn
- complex study of the above variable factors, and quantification of the interactions between them.

3. MATERIALS AND METHODS

In my PhD thesis, I studied the impact of numerous important agrotechnical factors on the agronomical traits of sweet corn hybrids of different genotypes and their yields on chernozem soil in three years.

3.1. EXPERIMENTAL SITE, SOIL AND WATER MANAGEMENT CHARACTERISTICS

The long-term experiment was set up at the crop production experimental farm of the University of Debrecen, Centre for Agricultural and Applied Economic Sciences, Research Institute and Study Farm at Látókép. The experimental farm is located 15 km west of Debrecen along the highway in the Hajdúság loess region.

The experimental soil is medium-heavy calcareous chernozem with a deep humus layer and good culture state formed on loess. It belongs to the loam category, its plasticity index according to Arany is 43. In the experimental site, the depth of the humus layer is 80-90 cm, the calcareous layer appears in the soil profile at 75 cm depth. The lime can usually be seen as a coating on the soil particles. The lime content varies between 10 and 13% in this layer. The layer of uniform humus content is 40-50 cm deep, its average humus content is 2.8 %. The N supply of the experimental site is medium, the total nitrogen content in the top 50 cm layer is between 0.12-0.15 %. The AL-soluble P_2O_5 content is medium-good on average (133 mg kg^{-1}), while the AL-K_2O content is good (240 mg kg^{-1}). The pH value of the cultivated layer is between 6.3-6.5 (KCl).

The soil of the experimental site belongs to the water management group IV of the Várallyay classification system, which means medium water-absorbing and good water holding capacity. The available water is about 50% of the water capacity, the minimum (field) water capacity is 377 mm and 443 mm in the 0-100 cm and 100-200 cm layer, respectively. The minimum water capacity is 33.65-46 %, the permanent wilting point is 8.5-15.7 %, expressed as volume percentage in the 0-200 cm soil layer. The depth of the ground water table is 3-5 m and it is not above 2 m even in rainy years.

The water management parameters of the experimental soil are presented in *Table 2* based on the tests performed in 1983.

Table 2. **Water management parameters of the experimental soil**

(based on the results of Martin, B. and Győri, Z., Debrecen, 1983)

Soil layer (cm)	Volume weight (g/cm^3)	Pore volume (%)	Capillary-gravitational pore space (%)	Gravitational pore space + air (%)	Capillary pore space (%)	Capillary water capacity (v%)	Minimum water capacity (WC_{min} %)	Wilting point (WP %)
5-25	**1.34**	**49.6**	**17.9**	**0.9**	**30.8**	**31.7**	**30.8**	**15.55**
27-33	**1.53**	**42.2**	**3.9**	**1.2**	**37.1**	**38.3**	**37.1**	**15.70**
47-53	**1.31**	**50.5**	**12.0**	**3.1**	**35.4**	**38.5**	**35.4**	**14.75**
72-78	**1.45**	**45.4**	**6.4**	**3.3**	**35.7**	**39.0**	**35.7**	**11.13**
97-103	**1.57**	**40.8**	**3.7**	**1.5**	**35.6**	**37.1**	**35.6**	**9.38**
122-128	**1.6**	**39.8**	**2.6**	**1.1**	**36.1**	**37.2**	**36.1**	**9.03**
147-153	**1.65**	**37.7**	**1.3**	**0**	**36.4**	**36.4**	**36.4**	**8.50**

3.2. EXPERIMENTAL SETUP

The long-term experiment was set up in the autumn of 1983. After the first-year, so-called blind experiment, a standardised experiment was set up and evaluated. From the year of 1996-97, half dosages of fertilizers were applied as compared to the previous doses. The experiment was set up in four repetitions in a strip plot design. There were 384 plots in the experiment. The applied plot size was: 2.28 m x 5 m that is 11.4 m^2.

Four major production technology factors were examined in the long term experiment and we evaluated their interactive effects in the different years.

The first agrotechnical element was the sowing time. Two sowing dates were applied:

- early sowing (around 20 April)
- late sowing (20 May)

The next tested agrotechnical element was plant density. The experiment was set up using four plant densities in 2009 and two plant densities in 2010 and 2011.

Sowing was performed using a Gaspardo SP 540 6-row precision sowing machine.

The applied plant densities were:

- 2009: - 45 thousand plants ha^{-1}
  - 55 thousand plants ha^{-1}
  - 65 thousand plants ha^{-1}
  - 75 thousand plants ha^{-1}
- 2010-2011: - 45 thousand plants ha^{-1}
  - 65 thousand plants ha^{-1}

The third studied production technology element was fertilization. The full doses of P and K and 50% of the N were applied in the autumn before the ploughing using a complex fertilizer *Kemira Optima* (10:15:18), while the remaining N (50 %) was applied by hand as ammonium nitrate (N 34 %) before the seedbed preparation in the spring (*Table 3*).

Table 3. **Fertilization treatments applied in the experiment**

(Debrecen, 2009-2011)

Treatment	**Fertilizer, kg ha^{-1}**		
	N	**P_2O_5**	**K_2O**
0	0.0	0.0	0.0
1	30.0	22.5	26.5
2	60.0	45.0	53.0
3	90.0	67.5	79.5
4	120.0	90.0	106.0
5	150.0	112.5	132.5

3.3. TESTED HYBRIDS

In the first year of the experiment (2009) two hybrids were grown, while in the second and third years four hybrids were sown. These were as follows:

- 2009: - Jumbo
  - Enterprise
- 2010/2011: - Jumbo
  - Enterprise
  - Prelude
  - Box-R

3.4. EVALUATION METHODS

The experimental data were evaluated using *Microsoft Excel®*, and *SPSS for Windows 13.0* programmes. The results were evaluated by a two-way analysis of variance (SVÁB, 1973). The correlation between the different factors was analysed with Pearson's correlation analysis. The effect of the different production technology elements and the year on the yield was determined by partitioning variance componens.

3.5. WEATHER CHARACTERISTICS IN THE EXPERIMENTAL YEARS

The three years of the experiment had very different weather characteristics. The season of 2009 was very dry and warm. This weather was favourable for the early crop, as the stand could utilize the water stock stored in the chernozem soil. However, the stand with late sowing suffered from the dry, warm weather as there was a water deficiency during the period of silking and ear development. On the contrary, the season of 2010 was extremely wet as the amount of precipitation (891.8 mm) was 66% higher than the thirty-year average. In this year, average or lower yields were obtained at the two applied sowing dates depending on the applied treatment. As opposed to 2010, the weather of 2011 was dry for sweet corn production. In spite of that, it had only a moderate effect on the vegetative and generative development of sweet corn, as the water stock of the chernozem soil could satisfy the increasing water demand of sweet corn in the first third of the season and there was abundant precipitation in July which is the critical period of yield formation in sweet corn.

4. RESULTS AND DISCUSSION

4.1. CHANGES IN THE MOISTURE CONTENT OF SOIL LAYERS IN THE EXPERIMENTAL YEARS

Water and water supply has a major role in crop production, water supply determines the efficacy of the different production factors and the success of production. Water deficiency and excess water could both have an unfavourable effect on the crop.

The results of the two sowing times showed opposite trends in 2009. In the case of the early sowing, a slightly increasing trend could be observed in soil moisture content (the moisture content of the top 60 cm soil increased to 24 v % from 18.8 v % by the third sampling date in mid-July), while in the case of late sowing, a reducing trend was detected (from 20.5 v % in the beginning of June to 13.2 v % in August). In the lower soil layers, the moisture content increased in the early sowing treatment from 19.8 v % to 21.6% in the 60-120 cm layer and from 20.5 v % to 24.0 v % in the bottom layer. The soil moisture content was positively influenced by the almost 100 mm precipitation in July, which ensured the increased water demand of the early crop at the beginning of July at flowering. On the contrary, the soil moisture content values were decreasing in the bottom soil layers similarly to the top 60 cm layer in the case of the late sowing treatment. This reduction had an unfavourable effect on the stand of the late sowing treatment, which was manifested in the harvested yield.

In the rainy season of 2010, the soil moisture content showed an increasing trend in the different soil layers in both sowing treatments. In the early sowing treatment, the highest soil moisture content in the top soil was measured at the sampling of early July, the 0-60 cm layer was saturated with water at that time, the moisture content reached the field capacity. However, these favourable water supply conditions were accompanied by a weather which was colder than the average and this was not favourable for sweet corn. The soil moisture content of the 60-120 cm layer increased to 21.6 v % by mid-July from 15.9 v %. In the early sowing treatment, the smallest fluctuation was measured in the bottom soil layer, the soil moisture content values varied between 18.1 and 19.4 v %. In the late sowing treatment, the highest soil moisture content values were measured at the end of the season in mid-August, when the soil was saturated with water due to the high amount of precipitation, which was not favourable for the root system of sweet corn.

In the season of 2011, a slight increase could be observed in the moisture content of the top soil (0-60 cm). The maximum values were measured at the beginning of August (early sowing: 22.8 v %, late sowing: 21.9 v %), which could be explained by the large amount of precipitation in July. This positive water supply satisfied the increased water demand of the intensive ear growth in the early stand and of the main flowering in the late stand. The same trend could be observed in the 60-120 cm soil layer. In the case of the early sowing treatment, the soil moisture values varied between 19.5 v % and 21.9 v %. In the late sowing treatment, the soil moisture content increased to 23 v % by harvest in mid-August.

The soil moisture content values of the three years proved the excellent water management and water-permeating ability of the chernozem soil. This favourable water management eased the unfavourable water supply conditions and reduced the climate effects unfavourable for the crop. The largest differences in soil moisture dynamics were measured in the late sowing treatment of 2009, when the soil moisture content decreased from 23.5 to 13.2 v % by the end of the season in the 0-60 cm layer. The highest soil moisture value was measured in the 120-200 cm layer (25.4 v %), in the extremely wet year of 2010 at the harvest of the late sowing treatment.

4.2. THE IMPACT OF SOWING TIME AND FERTILIZATION ON THE LEAF AREA INDEX OF SWEET CORN HYBRIDS

Leaf area index (LAI) is the photosynthetically active leaf area per unit soil area. The instrument we used, LICOR LAI-2000 determines the active leaf area of the plant by an indirect measurement (the difference between direct irradiation and the radiation on the soil surface due to the radiation absorbed by the leaves. In the case of sweet corn numerous foreign and Hungarian literature sources indicate that LAI has a positive correlation with the yield and in our treatments also with fertilization.

In the experiment, we examined the LAI at different sowing times and at different fertilization levels (control and N_{120}+PK) in the case of the hybrids Jumbo and Enterprise.

In 2009, a dynamic increase of LAI was observed in all treatments which was primarily due to the characteristics of the year. In spite of the fact that there was no significant precipitation from the end of June as for the yield formation of sweet corn, the chernozem soil with excellent water management characteristics ensured the conditions necessary for the intensive vegetative growth. This was not limited by the temperature, as the measured temperatures were near the optimum of corn.

The dynamics of LAI increase was similar for both hybrids. The increment was significant in the N_{120}+PK treatment as compared to the control for both hybrids and both sowing times. A stronger response was observed for this parameter in Jumbo, while the maximum LAI value was 1.33 m^2 m^{-2} higher in the N_{120}+PK treatment, this value was 0.92 m^2 m^{-2} in the case of the hybrid Enterprise. In total, it can be concluded that fertilization resulted in a considerable LAI increase at all tested dates under the experimental conditions in 2009 for both tested hybrids. The LAI values were almost the same for the tested hybrids at both sowing times in the control treatment. However, higher values were measured for Jumbo in the N_{120}+PK treatment, while in the late sowing treatment, the LAI values were higher at all sampling dates in the case of the hybrid Enterprise.

The significant effect of the year on LAI was proved by the fact that a more moderate LAI increment was measured in sweet corn stands in 2010. The water supply conditions were more favourable than in 2009, accordingly, favourable leaf area index values were measured (Jumbo: 3.28 m^2 m^{-2}; Enterprise: 2.99 m^2 m^{-2}). Due to the favourable water supply the differences between the treatments and genotypes were moderate. The amount of precipitation during the season was 313.3 mm and 286.5 for the early and late sowing time, respectively. However, the temperatures were heterogenous as compared to the previous year, there were significant temperature fluctuations between the sampling dates. Under these conditions, the stand had a stable, but less dynamic growth. Similarly to 2009, fertilization resulted in a significant LAI increment in the tested hybrids irrespective of the sowing time. The largest difference in the increments was observed in the early stage of vegetative growth (first measurement) for both hybrids (1.22-2.04 $m^2 m^{-2}$).

Similarly to 2009, the more intensive fertilizer response was observed in the case of the hybrid Jumbo. The LAI increment was 0.68 $m^2 m^{-2}$ for Jumbo and only 0.27 $m^2 m^{-2}$ for Enterprise at the main flowering in the late sowing treatment. As a result of the N_{120}+PK treatment, a significant vegetative growth was observed irrespective of the sowing time in spite of the fact that the experiment was carried out on a calcareous chernozem soil formed on loess with good nutrient supply having excellent nutrient dynamics, which indicated a variety-specific nature of fertilization. There were considerable differences in LAI between the studied sowing times in the non-fertilized treatments. When comparing the sowing times, there were no significant differences in LAI in the same phenophase in the N_{120}+PK treatment. However, the leaf area index values measured in the control in the late sowing treatment were higher than those of the early sowing treatment, especially in the second half of the vegetation period.

Based on the experimental year of 2011, it can be concluded that high LAI values were measured in the stands (*Figure 1*) as a result of the weather conditions favourable for sweet corn (high amount of precipitation during the season and near optimum temperatures. The amount of water available on the soil with good water providing capacity was satisfactory for sweet corn and it can be stated based on the temperature values, that the weather parameters did not hinder the development of the plants. As a result of the high amount of precipitation in July-August (121.5 mm), the lowest water deficiency was measured in both sowing time treatments (30 and 18 mm) as compared to the previous years, which enabled a dynamic development of the stands irrespective of the sowing time and the fertilization treatment. As a result of the fertilization, higher LAI values were measured in all treatment combinations. However, the LAI increment due to fertilization as compared to the control was much smaller in the case of the late sowing treatment for both hybrids. This can be explained mainly by the fact that a large amount of precipitation fell in the vegetative and generative phases of intensive growth in the late stand, which somewhat moderated the effect of fertilization on the growth of leaf area, therefore, the fertilizer response was smaller than in the previous years. Similarly to the previous years, the highest LAI values were measured for the hybrid Jumbo. At the third measurement date, the maximum leaf area measured was 4.23

m^2 m^{-2}. However, the differences between the two tested hybrids were small both in the control and in the N_{120}+PK treatment due to the favourable amount of precipitation. There were no significant differences between the hybrids at the different sowing times, but a more favourable fertilizer response was measured in the case of Jumbo in the early sowing treatment (increment of +1.12 m^2m^{-2}).

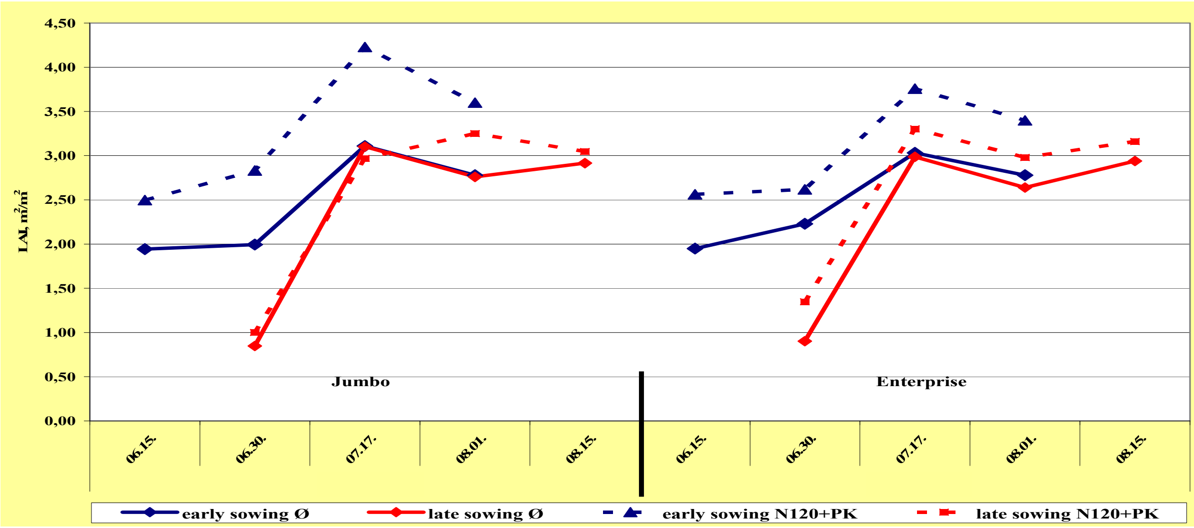

Figure 1. **Changes in the LAI values in different sweet corn hybrids**

(Debrecen, 2011)

From among the applied sowing dates, the LAI increment due to fertilization was higher in the case of the early sowing. In the late sowing treatments, the values measured during flowering were 0.5-1.2 m^2m^{-2} lower as compared to the early sowing in the N_{120}+PK. However, the differences between the sowing times were much smaller in the control.

4.3. THE EFFECT OF SOWING TIME AND FERTILIZATION ON THE PHOTOSYNTHETIC ACTIVITY OF SWEET CORN HYBRIDS DURING THE SEASON

Besides leaf area, photosynthetic activity is another determining physiological factor as regards the assimilation. However, it should be stated that the photosynthetic activity is influenced by many very different ecological, biological and agrotechnical elements, therefore, their evaluation is also a complex task. In 2009, the photosynthetic activity was even in the first period of the season (30 µmol/m^2/secCO_2). This parameter showed a steep increase only at the last sampling date directly before the harvest. As a result of the unfavourable conditions at germination in the late sowing date, the values were very low at the first measurement date. However, the values measured at mid-July (before the flowering) were much higher for both hybrids in both the control and the fertilized plots (N_{120}+PK: Jumbo: 33.4 µmol/m^2/secCO_2; Enterprise: 47.3 µmol/m^2/secCO_2). The maximum values were obtained at the measurement before harvest for both hybrids. From among the agrotechnical parameters, none had a significant effect on photosynthetic activity in the experimental year.

In the extremely wet season of 2010, the photosynthetic activity values were even, similarly to LAI values, in both sowing time treatments under both fertilized and non-fertilized conditions (25-40 µmol/m^2/secCO_2). There were minimal differences between the hybrids, while in the case of the fertilization treatments sowing time proved to be the determining factor. In the case of the early sowing treatment, a higher photosynthetic activity was measured in the period of the vegetative development (31.16-37.18 µmol/m^2/secCO_2), than in the same phenophase in the late sowing treatment (20.82-25.79 µmol/m^2/secCO_2). The photosynthetic activity values were higher in the fertilized plots and in the non-fertilized control plots, in the early and late sowing treatments, respectively.

In 2011, the trends were almost the same at both sowing dates for both hybrids, Jumbo and Enterprise (*Figure 2*). The measured maximum photosynthetic activity values were higher than those of the previous two years in both sowing time treatments. It can be observed that the photosynthetic activity values were higher in the fertilized plots in the early sowing treatment and in the control in the late sowing treatment, however, the differences were not significant. When studying the genotypic effect, it was found that the higher photosynthetic activity values were measured in the case of the hybrid Jumbo both in the early (66.05 µmol/m^2/secCO_2) and the late sowing treatments (56.23 µmol/m^2/secCO_2).

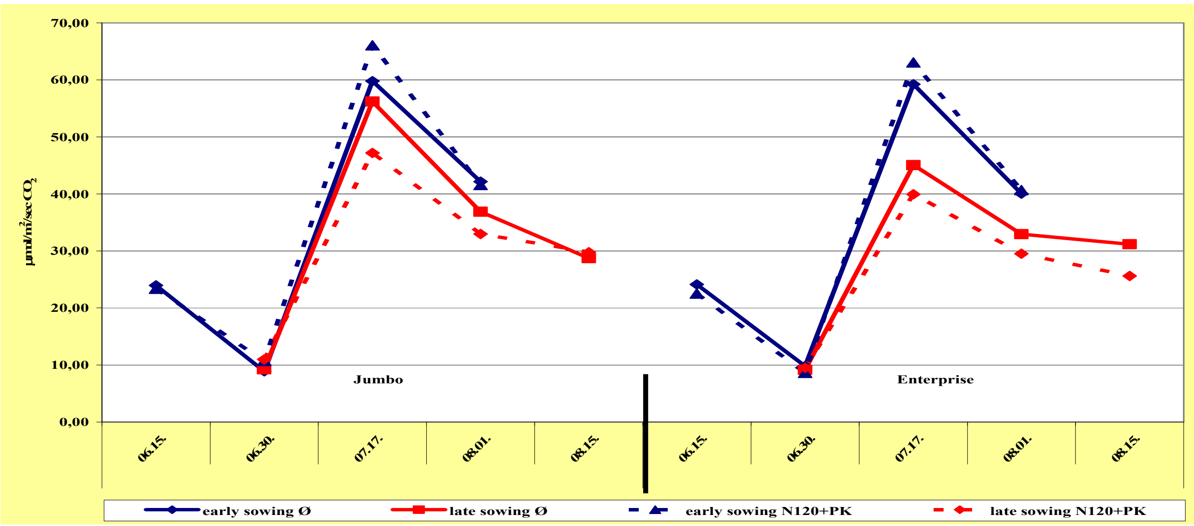

Figure 2. **Changes in the photosynthetic activity during the vegetation period in different sweet corn hybrids**

(Debrecen, 2011)

4.4. EFFECTS OF THE STUDIED PRODUCTION TECHNOLOGY ELEMENTS ON SWEET CORN YIELDS

4.4.1. Evaluation of yields in 2009

Among the elements determining yield, biological base is of special importance, which means the grown hybrids in the case of sweet corn. In domestic production, mainly hybrids of foreign origin are used, therefore, it is important to know the yielding ability and the responses to production technology inputs in the case of these hybrids in the largest growing region of Hungary.

In the experiment, the hybrids Jumbo and Enterprise were applied at different sowing dates and at different fertilization levels. Based on the results of 2009, it can be stated that both hybrids gave high yields. In the early sowing treatment, most of the fertilization treatments resulted in a considerable and even significant yield increment as compared to the control. In this sowing treatment, the maximum yields were obtained at the N_{60}–N_{120}+PK fertilization level. In the majority of the treatment combinations, the higher yields were achieved by Jumbo, however, the hybrid Enterprise had a considerably higher yield in the late sowing treatment in both the control and the optimum NPK fertilization treatment as an average of the plant densities. This indicates that the response of Jumbo to delayed sowing is stronger, it is more sensitive to sowing time (*Figure 3*). When comparing the sowing time, the yield-decreasing effect of delayed sowing can be seen in the studied year.

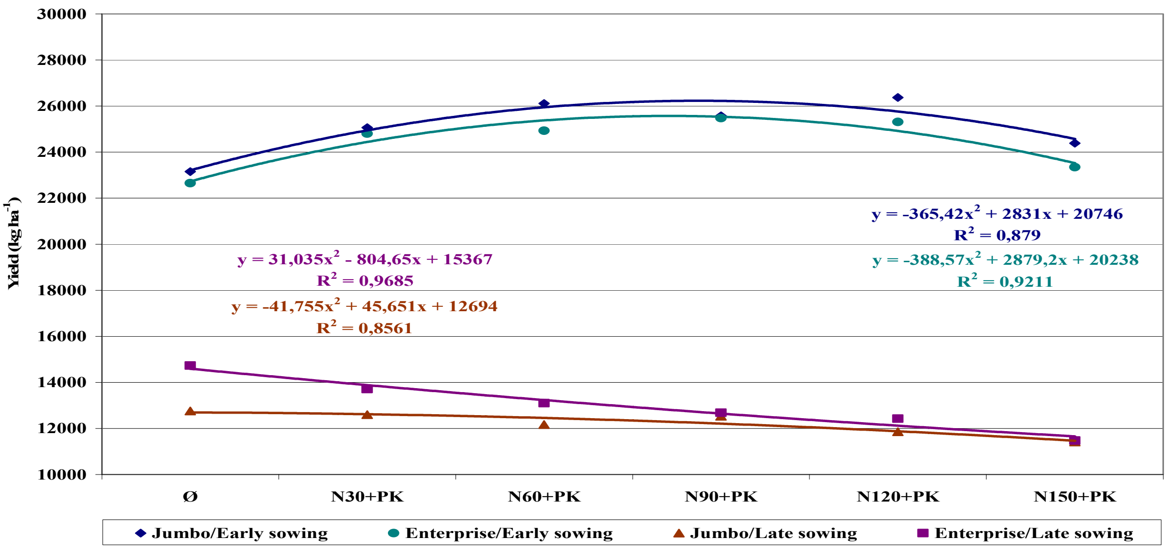

Figure 3. **Fertilization response curves of sweet corn hybrids with different genotypes as an average of plant densities**

(Debrecen, 2009)

The yield-decrease was high as an average of hybrids (5 154 kg ha $^{-1}$) in the late sowing treatment. In this treatment, fertilization had no yield-increasing effect, there was no significant positive difference at either plant density. However, fertilization resulted in a yield reduction at all plant densities in the late sowing treatment as compared to the control. The obvious explanation for this is that there was a period of strong drought at the intensive vegetative growth and generative development of late stands, which had a negative influence on yields as represented by the fertilization response curves of the tested hybrids. The water requirements of the intensive foliage growth due to the increasing fertilizer doses – as supported by the measured LAI values – could not be ensured from the soil moisture, therefore, it caused a yield reduction indirectly. Neither the increasing fertilization levels, nor the changes in plant density resulted in a significant difference in yield, which clearly indicates the effect of the extreme weather of the year.

4.4.2. Evaluation of yields in 2010

In 2010, changes were made in the experimental setup based on the results of 2009. The four studied plant densities of the previous year (45 thousand plants ha^{-1}, 55 thousand plants ha^{-1}, 65 thousand plants ha^{-1}, 75 thousand plants ha^{-1}) were reduced to two (45 thousand plants ha^{-1}, 65 thousand plants ha^{-1}). With the 45 thousand plants ha^{-1} plant density, the reduction of plant number can be simulated as a result of deficient emergency due to a potential unfavourable weather condition (cold effect, drought) or damage by pests (larvae of maybug, soilborne pests, etc.) Two additional hybrids were included in the experiment besides the hybrids (Jumbo and Enterprise) tested in 2009. Prelude is a hybrid of Australian breeding from the medium maturity group, while Box-R is of American breeding and belongs to the medium-late maturity group.

Weather in 2010 was very different from that of 2009. This year was characterized by an extremely high amount of precipitation (66 % higher than the average of 30-years) and cold weather, which was unfavourable for the generative development of sweet corn, therefore a medium-level yield was obtained.

When studying the fertilizer response curves of the hybrids as an average of the plant densities, it can be seen that the yields of Enterprise were significantly higher than those of the other three hybrids (*Figure 4*). When analyzing the yields of the control, the highest yields were also obtained in the case of Enterprise (16 579 kg ha^{-1}). These results show the excellent natural nutrient-utilizing effect the hybrid Enterprise. The control yields of the other three hybrids ranged from 12 771 kg ha^{-1} to 14 079 kg ha^{-1}. The fertilizer responses of Jumbo and Box-R were very similar, no significant differences could be observed. As an average of plant densities, the highest and lowest yield-increments were obtained in the case of Enterprise (6 537 kg ha^{-1}) and Prelude (5 905 kg ha^{-1}), respectively.

From among the tested hybrids, the fertilizer response of Prelude could be described by a nearly linear function, which indicates its high nutrient requirements under good water supply conditions. At the same time, the yields of this year were lower as the high amount of precipitation was accompanied by a cold weather, which was unfavourable for the sweet corn stand. Due to the excess precipitation, the aeration of soils was not suitable for sweet corn. The high R^2 values indicate the close fit of functions.

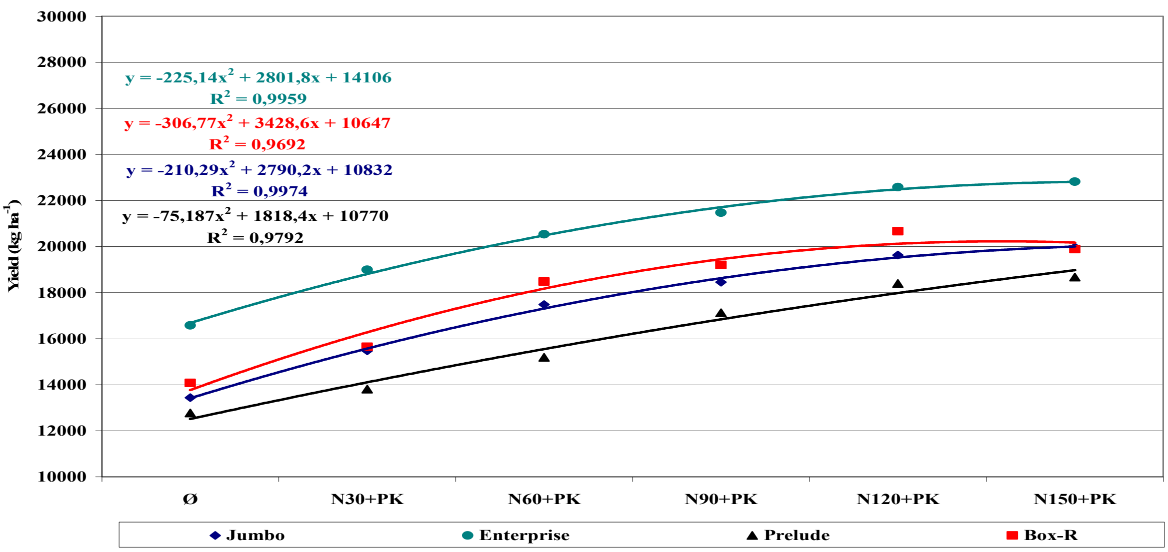

Figure 4. **Fertilizer response curves of sweet corn hybrids of different genotypes as an average of plant densities in the early sowing treatment**

(Debrecen, 2010)

In the late sowing treatment, the fertilizer response curves were similar to those of early sowing (*Figure 5*). As an average of plant densities, the highest yield was given by the hybrid Enterprise also at the second sowing date in the control (18 701 kg ha^{-1}) and at all fertilization levels. The yield of this hybrid increased with increasing fertilizer doses, the maximum yield of 20 436 kg ha^{-1} was obtained in the N_{150}+PK treatment. The curves of Prelude and Box-R were almost similar, there were no significant differences at either fertilization levels. Similarly to the early sowing treatment, the yield increment of Enterprise (3 792 kg ha^{-1} as compared to the control) was the highest also in the late sowing treatment, while the yield of Prelude was 2 636 kg ha^{-1} higher in the N_{120}+PK treatment than that of the control.

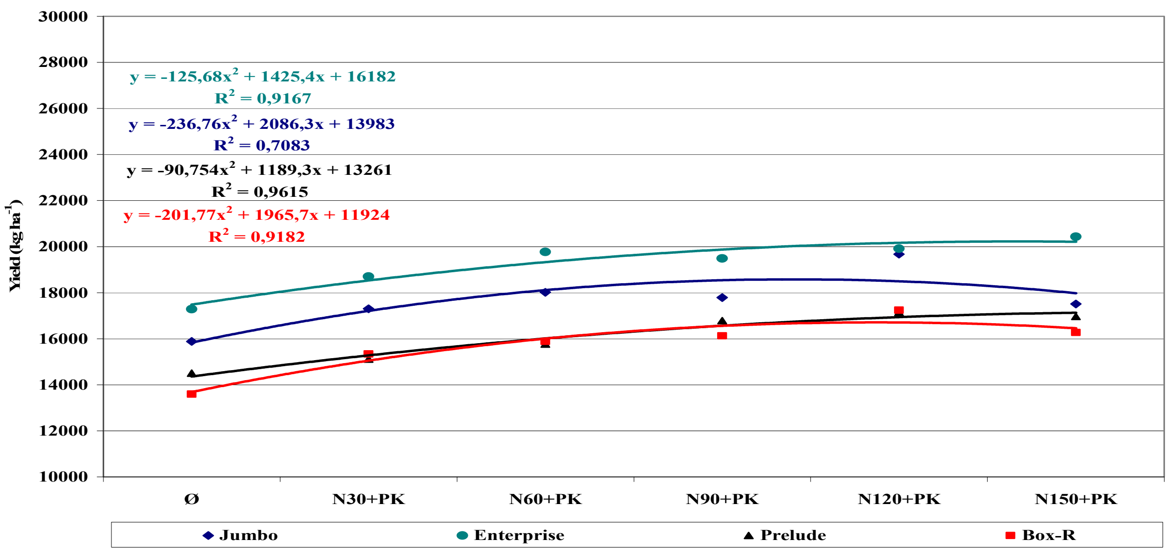

Figure 5. **Fertilizer response curves of sweet corn hybrids of different genotypes as an average of plant densities in the late sowing treatment**

(Debrecen, 2010)

4.4.3. Evaluation of yields in 2011

The season of 2011 was very favourable for sweet corn as regards the environmental conditions. As opposed to the extremely rainy year of 2010, it was a basically dry year, still it had only a very moderate effect on the vegetative and generative development of sweet corn, because the water stock of the chernozem soil could satisfy the increasing water demand of sweet corn in the first third of the season and there was abundant precipitation in July, which is the critical period in the yield formation of sweet corn.

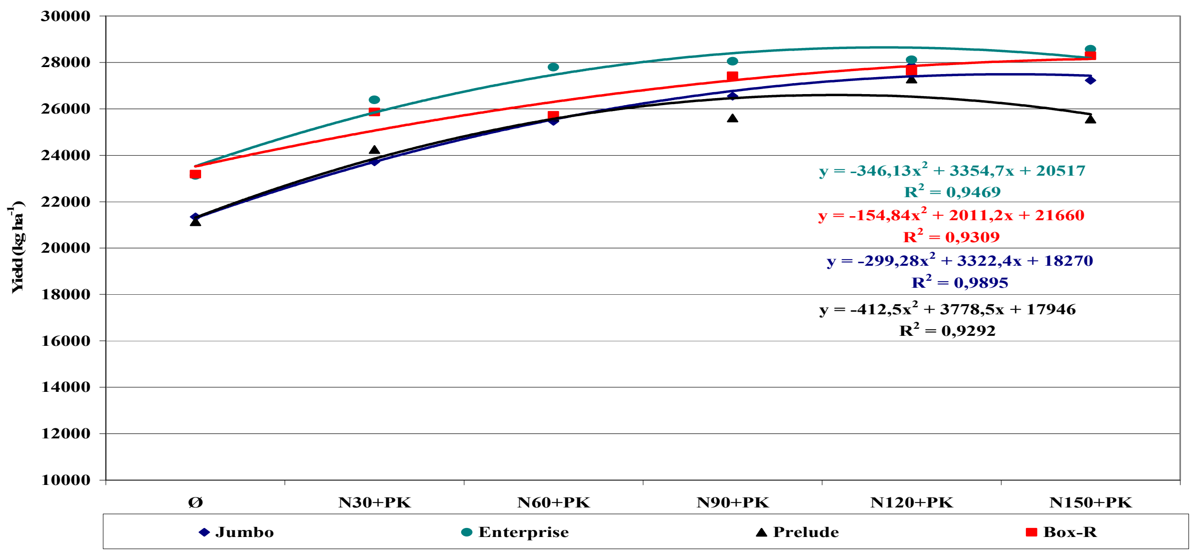

Figure 6. **Fertilizer response curves of sweet corn hybrids of different genotypes as an average of plant densities in the early sowing treatment**

(Debrecen, 2011)

When analyzing the fertilizer response curves of 2011, it can be seen that there were great differences between the two sowing dates. In the early sowing treatment, the hybrids Box-R (23 191 kg ha^{-1}) and (23 133 kg ha^{-1}), Jumbo (21 340 kg ha^{-1}) and Prelude (21 135 kg ha^{-1}) gave almost similar yields in the control as an average of plant densities (*Figure 6*). In the fertilized plots, the highest yields were achieved by Enterprise at all fertilization levels, however, the best fertilizer response was measured in the case of Jumbo.

When studying the fertilizer response curved of the late sowing treatment, it can be observed that the differences between the yields of the hybrids increased with increasing fertilizer doses (*Figure 7*). In the control, the difference between the minimum and maximum values of hybrids was 1 246 kg ha^{-1}, while at the highest fertilization level of N_{150}+PK the difference reached 4 990 kg ha^{-1}. The lowest yield was given by Prelude at all fertilization levels. Similarly to the early sowing treatment, the most intensive fertilizer response was measured in the case of Jumbo, it gave the maximum yield of 27 335 kg ha^{-1} at the highest fertilization level. This proved that the hybrid Jumbo can excellently utilize the applied fertilizers under favourable weather conditions.

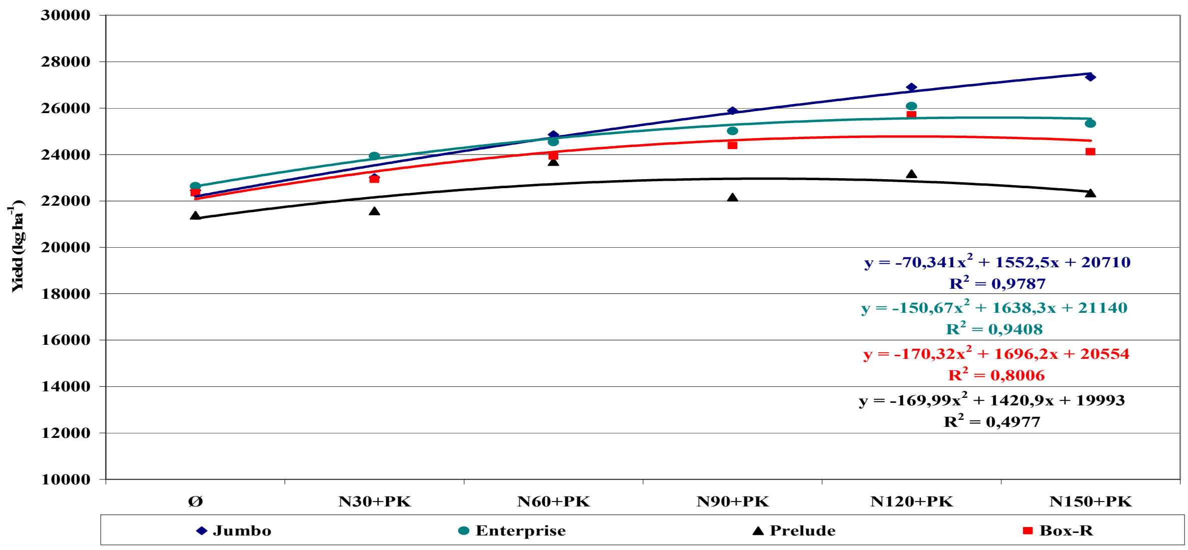

Figure 7. **Fertilizer response curves of sweet corn hybrids of different genotypes as an average of plant densities in the late sowing treatment**

(Debrecen, 2011)

4.4.4. Study of the efficacy of the applied fertilizer doses

Based on the amount of harvest yield, the efficacy of fertilization and precipitation was studied in the different years. The efficacy of the applied fertilizer doses is strongly influences by the weather of the given year, with special regards to the amount of precipitation influencing the uptake of nutrient and the available water stock of the soil. From among the production technology elements, fertilizer response is one of the major economic indices, which can be easily quantified as the amount of yield per 1 kg NPK active ingredient and by the specific yield increment as compared to the non-fertilized conditions (yield increment per 1 kg NPK active ingredient). In the season of 2009, there were no significant differences in these indices between the studied plant densities either as an average of fertilization levels or sowing dates. The calculations were made as an average of plant densities, as plant density had the lowest influence on the yields from the studied factors in the three experimental years. The yield increment per 1 kg NPK active ingredient was peculiar in 2009 (*Table 4*). In the early sowing treatment, the yield increment per 1 kg NPK fertilizer decreased (but not linearly) with increasing fertilizer doses. In the N_{30}+PK treatment, the yield increment per unit fertilizer amount was 17 kg, while at the highest fertilization level (N_{150}+PK) the yield increment was only 2 kg in the tested hybrids and there were no significant differences between the hybrids. In the late sowing treatment, the applied fertilization resulted in a yield depression as a result of the unfavourable, very dry weather, therefore, the yield increment values were negative.

Table 4. **Yield increment per 1 kg NPK active ingredient in the early and late sowing treatments**

(Debrecen, 2009-2011)

Year	**Sowing time**	**Hybrid**	**Fertilization**				
			N_{30}+PK	***N_{60}+PK***	***N_{90}+PK***	***N_{120}+PK***	***N_{150}+PK***
2009	**Early sowing**	**Jumbo**	16	12	7	7	2
		Enterprise	18	10	8	6	1
	Late sowing	**Jumbo**	-2	-4	-1	-3	-3
		Enterprise	-13	-10	-9	-7	-8
2010	**Early sowing**	**Jumbo**	26	26	21	20	17
		Enterprise	31	25	21	19	16
		Prelude	13	15	18	18	15
		Box-R	20	28	22	21	15
	Late sowing	**Jumbo**	18	14	8	12	4
		Enterprise	18	16	9	8	8
		Prelude	8	8	10	8	6
		Box-R	22	15	11	12	7
2011	**Early sowing**	**Jumbo**	30	26	22	21	15
		Enterprise	41	30	21	16	14
		Prelude	39	29	19	19	11
		Box-R	34	16	18	14	13
	Late sowing	**Jumbo**	7	15	14	14	12
		Enterprise	16	12	10	11	7
		Prelude	2	15	3	6	2
		Box-R	7	10	9	11	4

The study of the efficacy of fertilization was also performed for the year of 2010. The yield increment per 1 kg NPK fertilizer as compared to the control was calculated as an average of plant densities. The obtained results were very different from those of the previous year, which can be explained by the extreme meteorological characteristics of the year (lower yields resulting from cold weather.

The yield increment per 1 kg NPK active ingredient was the highest in the case of the hybrids Jumbo and Enterprise at the lower fertilization levels in the early sowing treatment, while it showed a decreasing trend with increasing fertilization levels. As opposed to that, the reduction was smaller in the case of Box-R, while almost similar values were obtained in Prelude (13-18 kg kg^{-1}). In the late sowing treatment, similar trends could be observed as in the early sowing treatment, however, the values were lower (6-22 kg kg^{-1}) than those of the early sowing treatment.

In the season of 2011, the yield increments decreased with increasing fertilizer doses in the early sowing treatment, in the case of Jumbo, the yield increment reduced from 41 kg kg^{-1} to 14 kg kg^{-1}. This proved that the efficacy of additional fertilizer doses was reduced.
In the case of the late sowing treatment, the values were lower (2-16 kg kg^{-1}) already at the N_{30}+PK level as compared to the early sowing treatment, which can be explained by the high yields of the control. However, no intensive reduction can be observed with increasing fertilization levels up to the N_{120}+PK.

4.4.5. Water utilization in sweet corn and the influencing factors

The amount of water available for the plants basically determines the success of production. It is influenced on the one hand by the amount of the precipitation in the season and outside of the season and on the other hand by the water-holding capacity and available water stock of the soil. Sweet corn is especially sensitive to proper water supply, the yield is much determined by the amount of water available at the time of flowering. Regarding the amount of yield per 1 mm precipitation in the season, higher values (122-185 kg mm^{-1}) were observed as compared to the studied years in the different treatment combinations, which was primarily due to the dry year and the resulting higher yields (*Table 5*). From among the studied factors, sowing time had the greatest effect on this index, in spite of the fact that there was only 11 mm difference in the amount of precipitation during the season between the two sowing times (145.2 mm in the early and 156.3 mm in the late sowing treatment). The explanation for this is that the calcareous chernozem soil of the experiment eased the lack of precipitation in the early sowing treatment due to its excellent water-holding capacity. As an average of plant densities, the yield per 1 mm precipitation during the season was higher in all treatment combinations in the early sowing treatment (156-185 kg mm^{-1}) than in the late sowing treatment (122–142 kg mm^{-1}).

Table 5. **The amount of yield per 1 mm precipitation in the different fertilization treatments**

(Debrecen, 2009-2011)

Year	Hybrid	Sowing time and fertilization			
		Early sowing		Late sowing	
		Ø	NPKoptimum.	Ø	NPKoptimum.
2009	Jumbo	159	185	122	128
	Enterprise	156	177	141	142
2010	Jumbo	26	40	38	47
	Enterprise	32	45	41	49
	Prelude	25	36	35	41
	Box-R	27	40	33	42
2011	Jumbo	73	95	87	106
	Enterprise	79	100	88	101
	Prelude	72	93	91	95
	Box-R	79	97	87	100

Due to the high amount of precipitation during the season, the yields per 1 mm precipitation were considerably lower than those of the very dry year of 2009. In the season of the early and late sowing treatment, the amount of precipitation was 513.8 mm and 418.4 mm, respectively. Similar trends could be observed in both sowing time treatments in all four hybrids. However, the hybrid Enterprise should be mentioned, which had more favourable values in all treatment combinations as compared to the other three hybrids, its yield per 1 mm precipitation varied between 32 and 49 kg mm^{-1}.

The yields per 1 mm precipitation represented well the relationship between precipitation and yield of the given year. The difference between the two sowing time treatments in the amount of precipitation was 35.9 mm, the amount of precipitation during the season in the early and late sowing treatment was 292.8 mm and 256.9 mm. A large increment could be observed in all hybrids in the optimum NPK treatment as compared to the control. The difference between the control and the optimum NPK treatment as regards the yield per 1 mm precipitation was higher in the early sowing treatment in all hybrids (ranging between 18 kg mm^{-1} and 22 kg mm^{-1}). However, the applied fertilization resulted only in a 4 kg mm^{-1} yield increment in the late sowing treatment.

4.5. THE EFFECT OF GENOTYPE AND PLANT DENSITY ON THE EAR PARAMETERS IN SWEET CORN

In the case of sweet corn, the yield elements, that is the parameters of the ear also have an important role in addition to the yield. In the practice, the grower delivers unhusked ears for the processing firm, therefore, the knowledge of the ear parameters can serve as a basis for direct efficacy studies. For the processing industry, the husked ear weight is determining, the leaves are by-products for them. Numerous foreign and Hungarian literature sources deal with the number of kernels per row, which determines the number of valuable (from the economic aspect) kernels per ear, which is the most frequent form of distribution as an end product.

When comparing the different ear parameter variables, we found that plant density had the largest impact on them irrespective of the year(*Table 6*).

In the early sowing treatment of 2009, the largest unhusked ear weight values were measured at 45 thousand plants ha^{-1} plant density for both hybrids with 446.5 g for Jumbo and 466 g for Enterprise. However, there were no significant differences between the two hybrids in this parameter. As opposed to that, in the case of ear length, the hybrid Enterprise has significantly higher values at the plant density level of 55-75 thousand plants ha^{-1} (21.6 cm and 21.4 cm), while in the case of the lowest plant density (45 thousand plants ha^{-1}), the hybrid Jumbo had significantly larger ear length (25.2 cm). The number of kernels per row were significantly higher for both hybrids at the lowest plant density of 45 thousand plants ha^{-1} as compared to the other plant densities. In the late sowing treatment, a considerable reduction was observed both in the unhusked (40.6-26.5 cm) and the husked (33.4 cm) ear weight. As opposed to these, the earl length and the number of kernels per row did not change significantly in this sowing treatment, which indicates that these parameters are primarily genetically determined and the environmental effects have a lower influence on them.

In the season of 2010, the effect of plant density proved to be decisive for ear weight, but this effect was greatly modified by the tested hybrids. An obvious trend could be identified that the increasing plant density resulted in a reduction of ear weight, however, its degree varied with the hybrid. The increase of plant density from 45 thousand plants ha^{-1} to 65 thousand plants ha^{-1} did not result in a significant reduction either in the unhusked ear weight or in the husked ear weight in the hybrids Jumbo and Box-R (the reduction in unhusked ear weight due to increasing plant density was 13.6 g in the early and 6.3 g in the late sowing treatment in the case of Jumbo). In the case of Enterprise and Prelude the ear weight reduction due to increasing plant density was higher in the early sowing treatment, but these values were moderated in the late sowing treatment. As regards ear length and the number of kernels per row, the genotype was the determining factor in this year also, the plant density did not have a significant modifying effect on these values.

The year of 2011 was an excellent year for sweet corn, which was manifested also in the ear weight parameters. When comparing the three years, it can be stated, that the highest ear weight values (unhusked: 510.7 g, husked: 365.8 g) were obtained in this year in all treatment combinations. The favourable effect of the year weakened the ear weight reducing effect of the increasing plant density, a non-significant trend could be observed. As regards ear length and the number of kernels, the year also had a favourable effect, the largest ear length values were measured mainly in the late sowing treatment, while the number of kernels per row was the best in this year. It was obvious in this year also, that ear length and the number of kernels per row is mainly genetically determined and the environmental and production technology parameters cannot modify them greatly. From among the tested hybrids, Box-R had the highest ear length (23.3 cm).

Table 6. **The effect of the genotype and plant density on the studied ear parameters of sweet corn in the early and late sowing treatments**

(Debrecen, 2009-2011)

Year	Sowing time	Plant density	Parameters			
			Unhusked ear weight (g)	Husked ear weight (g)	Ear length (cm)	Number of kernels (number/row)
2009	Early sowing	45 thousand ha^{-1}	426.2	319.5	23.6	39.8
		65 thousand ha^{-1}	438.7	319.9	20.3	38.5
	Late sowing	45 thousand ha^{-1}	405.9	302.8	21.9	39.9
		65 thousand ha^{-1}	342.7	257.2	20.6	38.1
LsD5%			20.6	18.5	0.8	1.8
2010	Early sowing	45 thousand ha^{-1}	411.4	306.9	21.4	40.2
		65 thousand ha^{-1}	370.8	286.3	21.3	39.8
	Late sowing	45 thousand ha^{-1}	450.5	328.2	20.9	39.1
		65 thousand ha^{-1}	434.2	317.7	20.8	38.4
LsD5%			9.1	7.2	0.3	0.7
2011	Early sowing	45 thousand ha^{-1}	501.7	357.6	21.5	42.4
		65 thousand ha^{-1}	484.6	347.9	21.7	42.2
	Late sowing	45 thousand ha^{-1}	473.7	357.4	23.3	40.6
		65 thousand ha^{-1}	476.9	357.9	23.2	39.9
LsD5%			10.8	7.6	0.5	0.7

4.6 COMPLEX EVALUATION OF THE EFFECTS OF ECOLOGICAL AND AGROTECHNICAL FACTORS ON SWEET CORN HYBRIDS

In our experiment, the effects of the tested production technology factors on yields were quantified by partitioning variance components. This procedure enabled us to find those variables hidden behind the data which were supposed to be non-correlated. When determining the significance of the studied production technology parameters, the minimum yield harvested in the control was considered as the basis and the yield increment belonging to the maximum yield obtained as a result of the combination of the studied production technology factors was divided between the studied production technology factors.

Based on the annual evaluation of the studied production technology factors, it can be concluded that the different years had a great impact on the weight of the different factors. In 2009, the control yield of 17 187 kg ha^{-1} increased to 27 253 kg ha^{-1} as a result of the applied production technology factors. In the very dry season of 2009, the sowing time had the largest effect on the amount of yield as there was a great difference in yield between the two sowing time treatments. Sowing time had a 78 % (7 851 kg ha^{-1} yield) influence on the yield. Plant density and fertilization had a smaller significance in this year (11 and 10 %) corresponding to 1 107 and 1 007 kg ha^{-1} yield, respectively. The genotype was of minor significance in this year, it had 1 % influence on yield (107 kg ha^{-1}).

In the extremely rainy year of 2010, the influence of the studied factors was totally different from that of the previous year. The minimum yield in the control plot was 11 628 kg ha^{-1}. This yield increased to 23 437 kg ha^{-1} in the most favourable combination of the production technology factors. In this year, fertilization had the greatest impact on yield with 49 % (5 786 kg ha^{-1}). In this rainy year, the genotype had a significant effect on yield with 26 % weight accounting for 3 070 kg ha^{-1}. Plant density had a smaller role among the studied agrotechnical elements (20 %=2 362 kg ha^{-1}). Sowing time only had a 5 % weight in the yield with 590 kg ha^{-1} yield increment.

In the season of 2011, the yield of the control was the highest among the three years with 19 523 kg ha^{-1}. This value increased to 29 885 kg ha^{-1} in the optimum treatment combination. Fertilization was the most important yield-determining factor in 2011 also. This production technology factor increased the yield by 44 % that is by 4 559 kg ha^{-1} as compared to the control plot. Similarly to 2010, the hybrid had a 26% influence on yield (2 694 kg ha^{-1}). Sowing time was also a significant yield-determining factor in 2011, it increased the yield by

22 % that is by 2280 kg ha^{-1}. The effect of plant density was moderate in this year (8 %=829 kg ha^{-1}).

Based on the yields of the three years, the average of control yields was 16 113 kg ha^{-1} which increased to 26 858 kg ha^{-1} (average of maximum yields) as a result of the applied production technology elements (*Figure 8*). From among the studied factors, the year effect was the most significant with 44 %. This proved the sensitivity of sweet corn to ecological factors. From among these factors, water supply is of outstanding importance, consequently, it can be concluded that irrigation is justifiable in the case of sweet corn also on chernozem soils with excellent water management properties.

From among the studied agrotechnical factors, fertilization and genotype contributed to the yield increment with 18 % and 15 %, respectively. The yield increments were 1 934 kg ha^{-1} for fertilization and 1 612 kg ha^{-1} for genotype. Sowing time had a 12 % influence on the amount of yield corresponding to 1 289 kg ha^{-1} yield. Plant density had the lowest yield-influencing effect among the studied factors (1 182 kg ha^{-1}) with 11 % as an average of the three years.

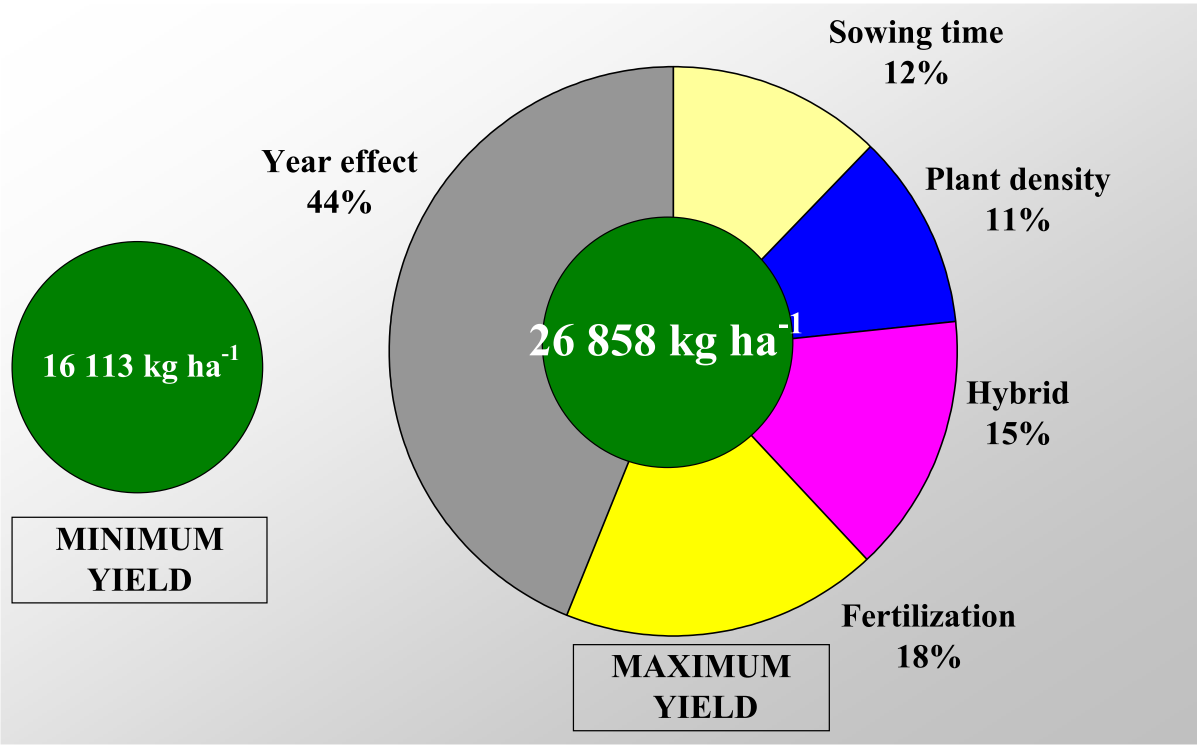

Figure 8. **The significance of the studied production technology factors in determining sweet corn yields**

(Debrecen, average of the period 2009-2011)

5. NOVEL SCIENTIFIC RESULTS

1. Sweet corn has a high agroecological sensitivity. Therefore, high yields of good quality can only be planned at optimal growing sites with production procedures performed at optimum level. The most dynamic changes in the water stock were measured in the 0-60 cm soil layer on chernozem soil in sweet maize. The reason for this is that most of the roots can be found in the soil layer of 0-60 cm.

2. The yield of sweet corn is basically determined by the photosynthetic activity and leaf area index (LAI) values of the stands, which were modified by the year effect. In a favourable year, the LAI values ranged between LAI_{max} 3.3 and 4.2 $m^2\ m^{-2}$ and the photosynthetic activity values were between 56.2 and 66.1 $\mu mol/m^2/secCO_2$, while in the unfavourable year, these values were 3.0-3.3 $m^2\ m^{-2}$ and 36.0-40.5 $\mu mol/m^2/secCO_2$, respectively. Using Pearson's correlation analysis, tight correlations (0.629**-0.929**) were found between fertilization, sowing time and the LAI values in sweet corn also.

3. The water utiilization, the fertilizer and agrotechnical response of sweet corn hybrids was modified by the genotype. According to our research, the yield of the sweet corn hybrids as an average of the experimental years was 26.6 t ha^{-1}, the yield fluctuation was 10 %. The fertilizer response of sweet corn hybrids can be described with great precision by a parabolic regression curve. The optimum fertilizer dose of the hybrids was influenced by the year. The fertilizer response of the sweet corn hybrids was modified by the interaction of sowing time and plant density. The agroecological fertilizer optimum was N_{60-150}+PK and N_{30-120}+PK in the early and the late sowing treatments, respectively.

4. There is a tight interaction between the water and nutrient supply in sweet maize. Under non-irrigated conditions in the optimum fertilization treatment of N_{120}+PK, the amount of yield per 1 mm precipitation (93-106 kg mm^{-1}) was much higher than the water utilization values in the nutrient-deficient (control) treatment (72-91 kg mm^{-1}).

5. The year and the growing operations determined the husked and unhusked ear weight. The ear length and the number of kernels per row were basically determined by the genotype.

6. According to our data, the sweet corn hybrids are specifically sensitive to the year effect (year effect 44 %). The effect of agrotechnical elements varied between the years. As an average of the years, the excess yield was determined by fertilization (18%), the hybrid (15%), the sowing time (12 %) and the plant density (11 %).

6. SCIENTIFIC RESULTS UTILIZABLE IN THE PRACTICE

1. Our research results proved thet the weather, climate and soil conditions of Hajdúság are excellent for sweet corn production. Under the experimental conditions, the maximum yield was almost 30 t ha^{-1}. Sweet corn has high requirements regarding the ecological conditions. The extensive technology strengthened, while the optimum agrotechnique moderated the yield fluctuation at high yield levels (17.1-29.9 t ha^{-1}).

2. According to our experiment, the hybrids differ in their yielding capacity and adaptation ability. The results of our multifactorial experiments assist the selection of the hybrids at a given growing site. Sweet corn hybrids responded differently to the studied agrotechnical elements (fertilization, sowing time, plant density) that is the genotype-specific production technology is important sweet maize also. However, the hybrid-specific agrotechnical response was more moderate in sweet corn hybrids than in rain maize hybrids

3. From among the studied agrotechnical elements, the fertilizer dose of N_{120}+PK, the sowing time at the end of April and the plant density of 65 thousand plants ha^{-1} proved to be optimal.

4. Our research proved that the optimum sowing time of sweet corn as a main crop ranged within a wide interval (20 April- 20 May). However, it is very important to optimize the other production technology factors (hybrid selection, fertilization, plant density) in parallel to the changing of the sowing time. It is an important research result for the practice that the agrotechnical optimum values are the same for the highest quantity and best quality yield.

5. Our study proved for the practice that, in spite of its ecological sensibility, sweet corn can give huge biomass and outstanding ear yields and based on that it can be effective in improving the cropping system and the turnover of a given farm.

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