EFFECT OF CRITICAL AGROTECHNICAL FACTORS ON THE YIELD OF SUNFLOWER GENOTYPES

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Abstract

Today, cropyears with extreme weather conditions are becoming more and more frequent and increase the risk of sunflower production. The objective of researches into plant production is to minimize these effects as much as possible. In this sense, the optimization of agrotechnological factors is of high importance. Therefore, appropriate cropping technologies (crop density), nutrient supply and optimized, rational crop protection are highly important especially in highly sensitive sunflower cultures. The highest yield amount was measured in the treatment models treated two-times with fungicide and fertilized with NPK substances in case of all three hybrids. The highest yield amount was harvested in all treatments in case of the hybrid NK Ferti.

Regarding the average of the hybrids the highest yield (3,896 kg ha^{-1}) without any fungicide treatment was measured in the treatment with harmonic nutrient supply with plant density of 55,000 plants ha^{-1}. When applying the plant density of 35,000 plants ha^{-1} and 75,000 plants ha^{-1} yield amounts were below 2,500 kg ha^{-1} in case of all nutrient supply levels. Treatments with two-times fungicide treatment resulted maximal yield amounts in case of all three nutrient supply levels by the highest plant density, i.e. 75,000 plants ha^{-1}.

Keywords: sunflower, plant density, nutrient supply, fungicide treatment, yield

INTRODUCTION

Oil seed crops are present all around the world; they can be produced in almost every climatic zone. 57 different oil plant species are registered in Europe. Four of the oil plants (rapeseed, sunflower, oil palm and soybean) have become of economical significance in the past 50 years (Barbara-Franz, 2004). Sunflower is produced on 600 thousand hectares, however its importance have become significant more than twenty years ago.

According to Ivány et al. (1994) sunflower was categorized as one with low demands and it was produced mainly on weak soil types. At first only some rows were sown on the edge of maize or potato fields. Later – according to the government regulations – fields that were unsuitable for any other field crop were utilized with it. After hybrids have become common and production was well equipped with machines this previous approach totally disappeared and sunflower has become one of the most important industrial crops lately.

The effect of crop year among agroecological factors is the opposite of other plant's demands. Apart from extreme occurrences, favourable yield and oil content can be expected in rather dry and warm crop years, which is corresponding to the excellent adapting ability of sunflower (Pepó, 2010).

Due to the fact that production circumstances seem to be favourable sunflower production may be promising for many producers, however several expensive technological and unexpected plant protection aspects need to be considered during the vegetation. A crop year, in which every production factor is favourable, is rare, so sunflower production is always a risk (Nagy, 2002).

Dry springs have become more frequent; however, the amount of precipitation during the vegetation period shows significant deviances in different crop years. Drought crop years have become two-times as frequent in contrast to the previous decades, but it is rather favourable for sunflower than unfavourable, because pathogens cause higher infection in wet crop years.

Biological factors in production technology cover the variety, in particular the hybrid. The very wide palette of currently available hybrids in Hungary is world-class both regarding yield amount and yield quality. The number of hybrids and varieties registered in the national plant variety catalogue is 87, which offer a wide range of choices. However, yield safety of hybrids is not that uniform, which primarily refers to the resistance against abiotic (weather conditions and soil properties), biotic (pathogen organisms), just as against agrotechnical stress factors. Critical elements among agrotechnical factors shall be emphasized, that shall be ensured to an optimal input extent, while in case of other factors a minimal supply is essential which enables the effective, positive contribution of the critical elements. Critical production technology elements of sunflower production are the right choice of the hybrid, just as nutrient supply, sowing technology and plant protection. Genotype (hybrid) affects the effectiveness of sunflower production both directly and in an indirect way. Genetically determined productivity and oil content are determinant in a direct way, while resistance of hybrids against plant diseases, just as their adaptability (to both ecological and agrotechnical circumstances) and stem stability are determining from the aspect of yield (Pepó, 2007).

Regarding nutrient supply harmonic NPK-supply needs to be implemented since it is of high importance in sunflower production. Nitrogen demand shall be supplied properly from the aspect of both yield amount and yield quality development, since the lack of nitrogen results in yield decrement, while overdosing it can lead to decreasing oil content. According to the previous studies nitrogen decreases the oil content, but it increases yield per hectare. Phosphorous promotes the accumulation of dry matter substance

and increases oil content. Potassium enhances drought tolerance and pathogen resistance (Frank, 1999). According to Geleta et al. (1997) the realized sunflower grain yield amount depends on nitrogen- and phosphorous supply, temperature and water-supply, just as its distribution in the vegetation and the genetic potential of the applied hybrid.
Most of the about 70 pathogens that occur on sunflower are fungi. Fungal diseases reduce produced sunflower yields drastically each year, because the assimilation area of the infected plants decreases and thus less oil will be incorporated (Rikk, 2007).

MATERIAL AND METHODS

The small-plot field experiment was carried out in the year 2015 at the Látókép Research Site of the University of Debrecen CAS. The experimental soil is a lowland calcareous chernozem type with deep humus layer based on loess. This soil is in a good agricultural condition, medium set (plasticity value acc. to Arany: 43), regarding its soil physical conditions it can be classified as a loam soil type. Three hybrids were involved into the experiment: NK Neoma, NK Ferti and NK Alego. The effect of unilateral N, just as PK supply and harmonic NPK nutrient supply (Table 1.). were investigated by different plant densities of 35000, 55000 and 75000 plants per hectare (*Table 1.*). The investigated acrotechnical factors have been evaluated in case of treatments without any fungicide plant protection (control treatment), just as of treatments with two-times fungicide application (in the plant development state of 8-10 leaves and flowering).

Table 1.

Fertilizer treatments applied in the experiment (Debrecen-Látókép, 2015)

1. treatment (N)	60 kg ha^{-1} N + 0 kg ha^{-1} P_2O_5+0 kg ha^{-1} K_2O
2. treatment (PK)	60 kg ha^{-1} N + 45 kg ha^{-1} P2O_5+0 kg ha^{-1} K_2O
3. treatment (NPK)	60 kg ha^{-1} N + 45 kg ha^{-1} P_2O_5+75 kg ha^{-1} K_2O

Evaluation of the weather conditions of 2015

An amount of precipitation of 39.5 mm fell in January 2015, while in February it was 18.6 mm. Due to the low amount of precipitation during the autumn and winter months soil water stock was filled only to a low extent. The amount of precipitation was 10.2 mm in March, which did not even reach the long-term average value (33 mm). The monthly average temperature was 6.2 °C that was similar to the long-term average. The amount of precipitation was 21.9 mm in April and 52.9 mm in May. This amount in April was lower than the long-term average (42.4 mm), while in May it was slightly over the average value (58.8 mm). Lack of precipitation was not observed in these months, the average temperature values were similar to the long-term average values. The monthly average temperature was 10.1 °C in April and 15.8 °C in May respectively. 60.5 mm precipitation fell in June and the average temperature was 19.9 °C. This amount of precipitation was 19 mm lower than the 30-years average value. The significant amount of precipitation in August (84.0 mm) was favourable for the development of fungal diseases; however pathogens could not cause any serious damage in the population then (Figure 1).

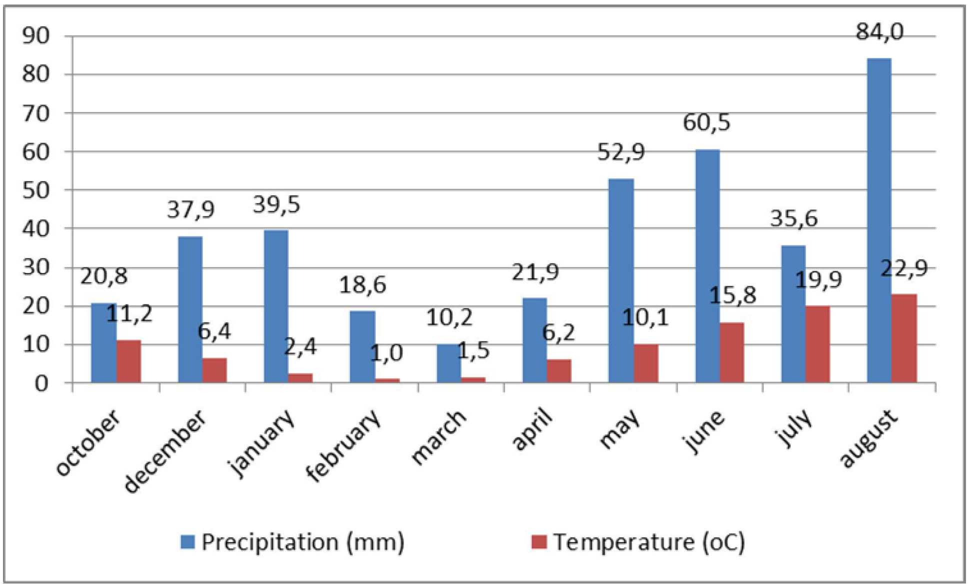

Fig. 1. Precipitation end temperature in the examined year (Debrecen-Látókép, 2015)

RESULTS AND DISSCUSIONS

Critical factors of sunflower production are sowing technology, harmonic nutrient supply and the adequate fungicide plant protection measurements. The results of the present experiment confirm the yield determining effect of nutrient supply and fungicide treatments in case of all three studied hybrids. Regarding the average of the different plant densities it can be stated that fungicide treatments resulted in significant yield increment in case of all three nutrient supply models. The highest yield amount was measured in the treatment models treated two-times with fungicide and fertilized with NPK substances in case of all three hybrids. The highest yield amount was harvested in all treatments in case of the hybrid NK Ferti. Regarding the average of the hybrids the highest yield amount (5,242 kg ha^{-1}) was measured in the 2-times fungicide treated plots with a harmonic nutrient supply level. In the treatments without fungicide yield amount was below

2,800 kg ha^{-1} both in unilateral N and PK treatments and by harmonic nutrient supply as well. The most explicit reaction towards fungicide treatment was observed in case of the hybrid NK Alego. The extent of its yield increment was 100% in all nutrient supply models (Figure 2.).

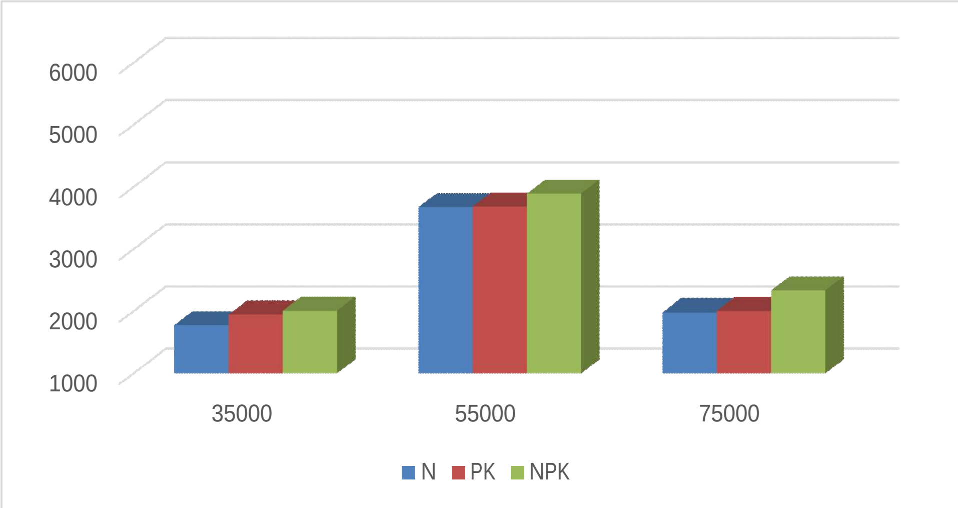

Fig. 2.Yield amount in different sowing technology and nutrient supply models in treatments without fungicides and regarding the average of the hybrids (Debrecen-Látókép, 2015)

The change of plant density proved to be significant yield affecting factor as well. Fungicide treatments affected the applicability of higher plant densities significantly. Regarding the average of the hybrids the highest yield (3,896 kg ha^{-1}) without any fungicide treatment was measured in the treatment with harmonic nutrient supply with plant density of 55,000 plants ha^{-1}. When applying the plant density of 35,000 plants ha^{-1} and 75,000 plants ha^{-1} yield amounts were below 2,500 kg ha^{-1} in case of all nutrient supply levels. Treatments with two-times fungicide treatment resulted maximal yield amounts in case of all three nutrient supply levels by the highest plant density, i.e. 75,000 plants ha^{-1}. In case of treatments with harmonic NPK supply yield result was 5,943 kg ha^{-1}, but in case of those with unilateral N and PK supply yield exceeded 5,400 kg ha^{-1} as well. As an effect of fungicide treatments yield amount was higher than 4,500 kg ha^{-1} even in case of the plant densities of 35,000 and 55,000 plants ha^{-1}in all treatment combinations (Figure 3.).

Fig. 3.Yield amount in different sowing technology and nutrient supply models in two times fungicides treatment and regarding the average of the hybrids (Debrecen-Látókép, 2015)

CONCLUSIONS

Critical factors of sunflower production are sowing technology, harmonic nutrient supply and the adequate fungicide plant protection measurements. The results of the present experiment confirm the yield determining effect of nutrient supply and fungicide treatments in case of all three studied hybrids.

The highest yield amount was measured in the treatment models treated two-times with fungicide and fertilized with NPK substances in case of all three hybrids. The highest yield amount was harvested in all treatments in case of the hybrid NK Ferti.

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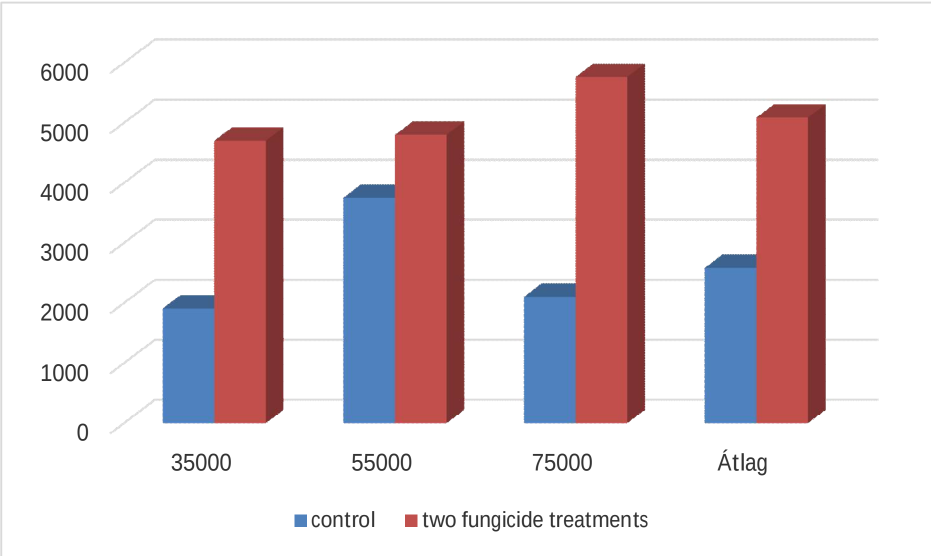

Fig. 4.Yield amount in different plant densities, and in fungicide treatment models regarding the average of hybrids and nutrient supply models
(Debrecen-Látókép, 2015)

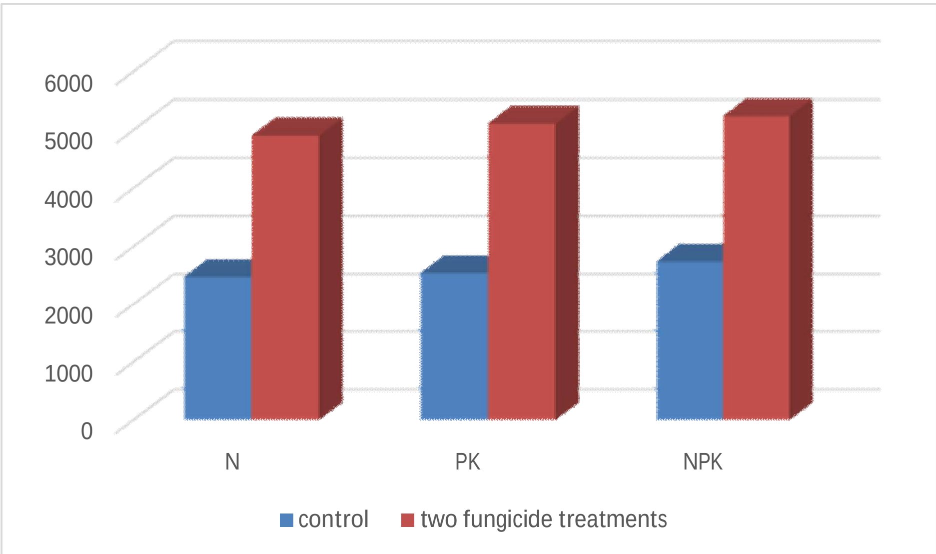

Fig. 5.Yield amount in different nutrient supply models and in fungicide treatment models regarding the average of hybrids and plant densities
(Debrecen-Látókép, 2015)

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