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EVALUATION OF THE ROLE OF CRITICAL AGROTECHNICAL FACTORS IN SUNFLOWER CULTIVATION

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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. Regarding the average of the hybrids the highest yield 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 4,000 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

1. Introduction

Due to the increase of the sowing area of sunflower production (600,000 ha in the country), sunflower got into the forefront of domestic field crop production. Despite the increase of the sowing area, the development of the technology was neglected. On more than half of the sowing area of sunflower, even nowadays, extensive or unreasonable agrotechnique is applied, despite the fact that 80% of the hybrids in cultivation needs intensive or at least average technology. The weather conditions of the recent years showed considerable differences, the extremes were frequent (unequal distribution of precipitation during the vegetation period, droughty periods, low temperature, etc.), that increased the risk of production to a considerable extent. The plant physiological, phenological, plant health, etc. studied will reveal the plant physiological relationships of the effects of agrotechnical methods.

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The cropyear and agrotechnical factors significantly influence the successfulness of sunflower production. We cannot influence the climatic factors, but the effects can be considerably reduced by the application of reasonable agrotechnique. The application of the sowing technological, nutrient supply and plant protection methods adequate for the hybrid, the production region and cropyear decrease the injuries caused by the diseases, increase yield amount and improves quality. The crucial element of sunflower production is the increased sensitivity of hybrids to fungal diseases. The appearance and injuries caused by the stalk and head diseases are lower during dry cropyears and more significant in moist ones. The prognosis of the climatic conditions of the vegetation period is currently not possible, but the significant reduction of the infections and injuries caused by the unfavourable weather can be possible by harmonic nutrient supply and plant protection operations applied by adequate timing.

According to Ragasits [1] 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 [2].

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 [3].

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 [4].

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 [5]. According to Geleta et al. [6] 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 [7].

2. Material and methods

The small-plot field experiment was carried out in the year 2016 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: Sy Excellio, NK Alego, NK Neoma. The effect of unilateral N, just as PK supply and harmonic NPK nutrient supply 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 2) Fertilizer treatments applied in the experiment (Debrecen-Látókép, 2016)

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 2015-2016

Significantly higher amount of precipitation fell in October 2015 (86.6 mm) than the several years' average value (30.8 mm). November can be considered as rather average. But in December far lower amount of precipitation fell than the average value. Precipitation amount in January (58.6 mm) was also higher than the 30 years' average (37 mm) and February (78.8 mm) showed similar tendency as well (long-term average value: 30.2 mm). Overall, autumn and winter months were significantly wetter and warmer than the average. The amount of precipitation during the spring was also higher than the average. Thus later sunflower had favourable conditions for vegetative and generative development. All summer months were characterized by significantly higher amount of precipitation than the average value. Consequently weather circumstances were favourable for both sunflower development and the occurrence of fungal diseases of the population. Average temperature vales proved to be higher than the several years' average values as well. (Figure 1).

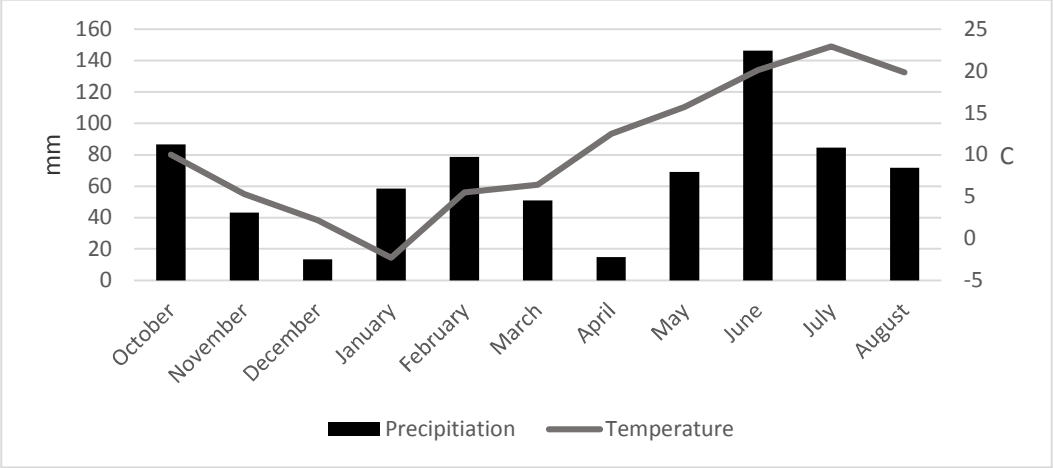

Fig. 2. Precipitation end temperature in the examined year (Debrecen-Látókép, 2015-2016)

3. Results and discussions

Critical factors of sunflower production among agrotechnical production factors are balanced nutrient supply, sowing technology and the application of adequate fungicide plant protection measurements. Results of the present research work confirmed the yield amount determining effect of nutrient supply and fungicide treatment in case of all three studied sunflower hybrids. Regarding the average of the applied nutrient supply levels it can be stated that fungicide treatment of the studied hybrids resulted in significant yield amount increment in case of all three studied plant densities (Figure 2).

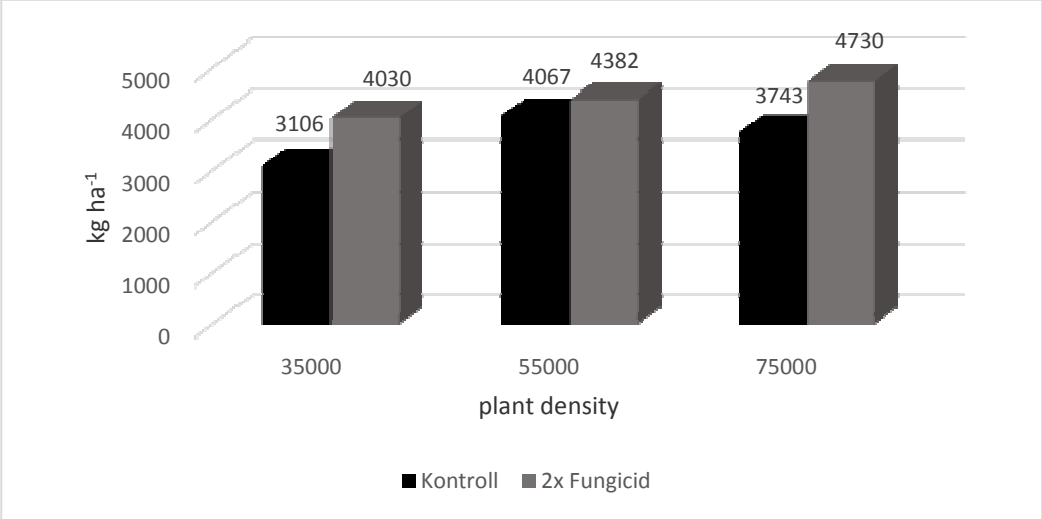

Fig. 3. Yield amount in different plant densities models and in fungicide treatment models regarding the average of hybrids and nutrient supplies (Debrecen-Látókép, 2016)

Hybrids produced the highest yield amounts in case of the application of harmonic nutrient supply. The highest yield amount was produced in treatment models of two-times fungicide application and NPK nutrient supply in case of all three studied hybrids. The highest yield was registered in case of the hybrid NK Neoma (4,428 kg ha^{-1}) regarding the average of the treatments (Figure 6). Regarding the average of the studied hybrids the highest yield amount (4,932 kg ha^{-1}) was produced in plots treated with two-times fungicide application and balanced nutrient supply by the application of a plant density of 75,000 plants ha^{-1}. Regarding the plots not treated with fungicides yield amounts remained below 4,250 kg ha^{-1} in case of the application of both unilateral N and PK supply and balanced nutrient supply as well. Changes in the applied plant density affected yield amounts significantly too. Fungicide treatments affected the possibility of plant density increase of the studied hybrids to a significant extent. The highest reaction towards fungicide treatment was observed in case of the hybrid

NK Neoma. Due to the balanced nutrient and fungicide treatment of the hybrid NK Neoma the extent of yield increment exceeded 1,000 kg ha^{-1} in case of the plant density of 55,000 plants ha^{-1}, while in case of 75,000 plants ha^{-1} it was over 2,000 kg ha^{-1} respectively (Figure 3).

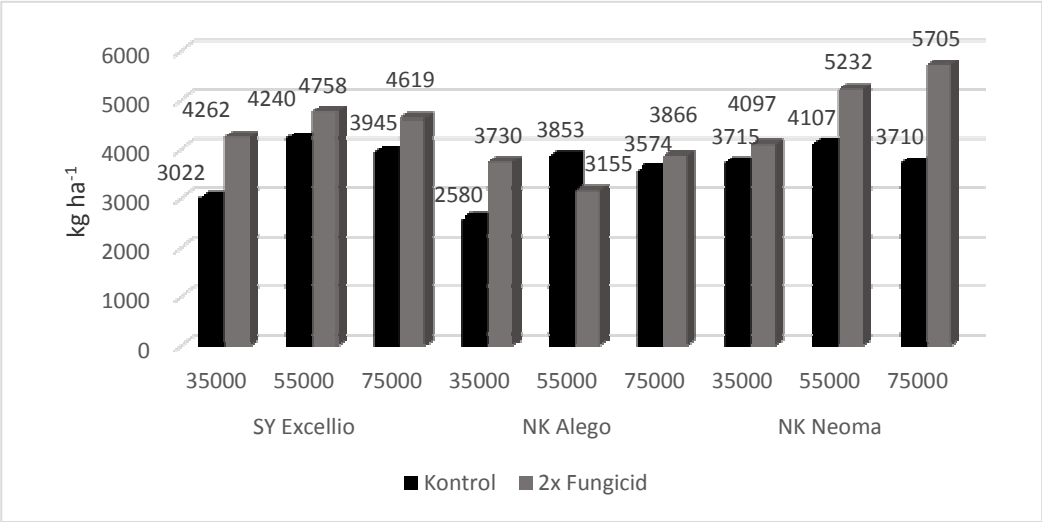

Fig. 4. Yield amount of the hybrids in different plant densities models and in fungicide treatment models regarding the average of nutrient supplies (Debrecen-Látókép, 2016)

Regarding the average of the studied hybrids and nutrient supply levels yield increasing effect of fungicide treatments was 987 kg ha^{-1} in case of the application of a plant density 75,000 plants ha^{-1} that was higher than the increment in case of the plant densities 35,000-55,000 plants ha^{-1} (Figure 4).

In treatments without fungicide application the highest yield (4,240 kg ha^{-1}) was produced in plots of a plant density 55,000 plants ha^{-1} – regarding the average of the studied hybrids. In case of the plant densities 35,000 and 75,000 plants ha^{-1} yield amounts remained below 4000 kg ha^{-1} by the application of all nutrient supply levels. In populations with two-times fungicide treatments yield amounts reached maximal values by the application of a plant density 75,000 plants ha^{-1} at all three studied nutrient supply models. In treatment combinations of balanced NPK supply yield amount was 4,932 kg ha^{-1} in case of a plant density of 75,000 plants ha^{-1}. However, yield results were higher than 4,500 kg ha^{-1} even in treatment combination of unilateral N and PK supply. As an effect of fungicide treatments yield amounts were higher than 3,700 kg ha^{-1} in case of the plant densities 35,000 and 55,000 plants ha^{-1} in all studied treatment combinations (Figure 4 and 5).

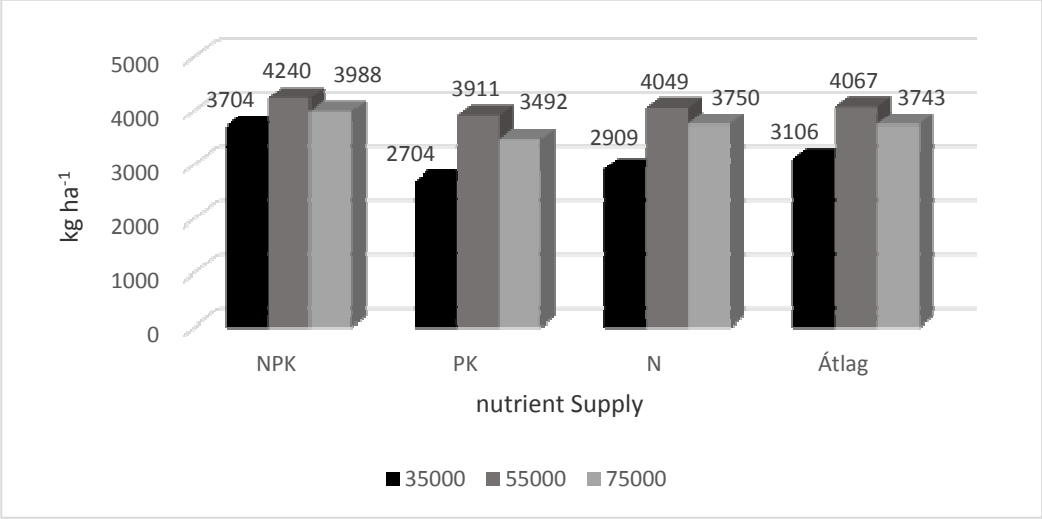

Fig. 5. Yield amount in different sowing technology and nutrient supply models in without fungicides treatment and regarding the average of the hybrids (Debrecen-Látókép, 2016)

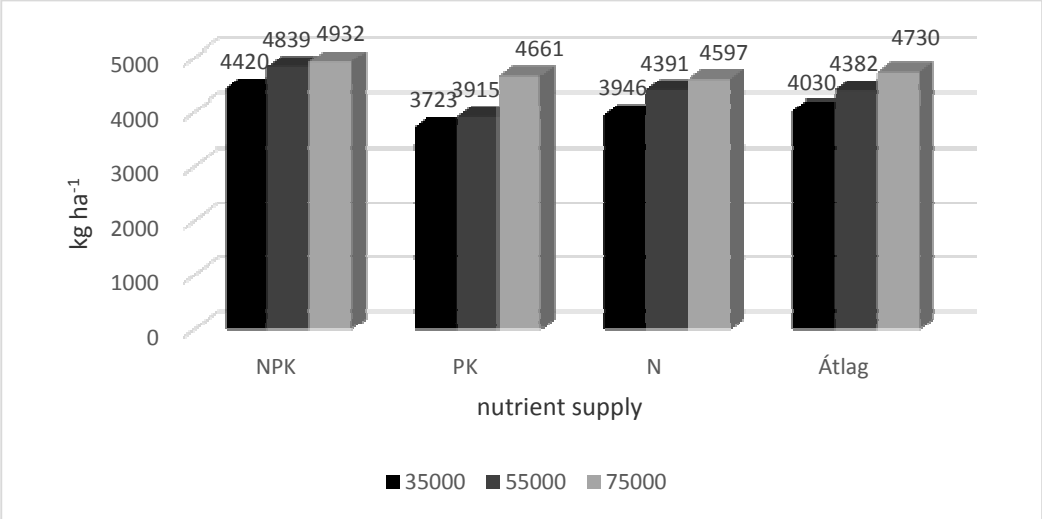

Fig. 6. Yield amount in different sowing technology and nutrient supply models in two times fungicides treatment and regarding the average of the hybrids s (Debrecen-Látókép, 2016)

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.

Regarding the average of the hybrids the highest yield (4,240 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 4,000 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}.

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