Effect of Some Agrotecnical Factors on Phytopathogenic Characteristics and Yield of Sunflower Hybrids

Adrienn Novák

***Abstract*—** The field research was carried out at the Látókép AGTC KIT research area of the University of Debrecen in Eastern-Hungary, on the area of the aeolain loess of the Hajdúság. We examined the effects of the plating time and the fungicide treatment on the phytopathogenic characteristics and yield production of two different genotypes of sunflower hybrids (NK Neoma, NK Ferti) in 2012. The various planting times significantly affected the degree of infections and the amount of yield. The degree of infection decreased in the cases of Sclerotinia, Diaporthe, Alternaria and Phoma by the prolongation of the planting times. As for the yield, late planting turned out to be the optimal in both the cases of the two hybrids and the three planting times. Pearson's correlation proved that planting time decisively determined infections [Sclerotinia (0.603**), Diaporthe (0.688**), Alternaria (0.762**), Phoma (0.812**)] and yield (0.696**).

***Keywords*—** fungicide treatment, genotypes, planting time, sunflower

I. Introduction

BESIDES straw cereals and corn, sunflower has the largest cropland in Hungary [1]. Aside from smaller changes, today it varies between 520,000 to 560,000 hectares. Sound knowledge of agroecological conditions and adequate application of recent hybrids and its arogtechnical elements are crucial to enhance the efficiency of sunflower production [2]. Adequately applied planting technologies (i.e. planting time and plant density) and optimized, reasonable pest control have an outstanding role in decreasing risk factors of sunflower production [3]. Planting time and the specie have a great effect on plant development and the amount of yield [4]. Refernce [5] found a positive correlation between late planting and the degree of yield. Planting applied too early or too late compared to the optimum are both unfavorable for the vegetative and the generative development of the sunflower [6]. Reference [7] showed that the time of planting had an effect on both the degree of Diaporthe infections and the yield.

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In respect of the amount of yield, earlier planting turned out to be the optimal, however, the degree of infection was the largest at that period as well. In dry, droughty years average planting time (April) is the optimal, while in years with regular rainfalls, when the presence of stem and flower diseases is more enhanced, late planting should be considered [8]. Stands planted too early are more exposed to Diaporthe helianthi, Phoma macdonaldii and Alternaria species. When planting too late, rot diseases (Sclerotinia) may damage stands due to late harvesting [9].

II. Materials and Methods

The research was set up on chernozem soil with lime patches at the Látókép AGTC KIT research area of the University of Debrecen. The research area is located in Eastern-Hungary, 15 km far from Debrecen, on the area of the aeolain loess of the Hajdúság. Soil of the research area is of good agricultural condition, medium hard and loamy with medium humus content and neutrality. Water supplies of the soil are favorable and it has good water retention and conductivity.

We examined the effects of planting times and the fungicide treatments on the phytopathogenic characteristics and yield production of two different genotypes of sunflower hybrids (NK Neoma and NK Ferti). Hybrid NK Neoma is an imidazolin resistant, traditional oil sunflower while NK Ferti is hybrid with a high oleic acid content and conventional weed control.

Parcells of the research were set up in four repetitions. Previous crops were peas. Three different planting times were applied: early (23 March), average (10 April) and late (5 May). The number of seedlings at the time of planting was 95 000 ha^{-1} and was later optimized to a stock density of 55 000 ha^{-1}. Plants received uniform agrotechnical treatments applied generally in practice. Two different levels of fungicide treatments were used. Besides the control stand (no treatment applied) we set up a double-treated one for which we used fungicide Pictor (substances: boscalid and dimoxistrobin) in a dose of 0.5 l ha^{-1} two times (at the time of the 8-10-leaf stages and blooming). Harvesting took place in 10 September (early and average planting) and 19 September (late planting).

Phytopathogenic data of the hybrids were recorded in four repetitions. The table contains the average of the repetitions. During the recordings, fifteen plants of average maturity were chosen in each parcel. During the researches we determined the degree of infections (%) in the critical phenophases of the crop year for the most important phytopathogenics (Sclerotinia sclerotiorum, Diaporthe helianthi, Alternaria helianthi, Phoma macdonaldii). At harvest we measured the raw plant and its moisture content. We standardized the results to an 8% moister content.

The weather of 2012 (Table I) was unfavorable for the sunflower's early vegetative and generative development and its yield production. Due to dry April (20.7 mm rainfall compared to the long term average of 42.4 mm), the initiative development of the sunflower plants lagged behind the average. Besides significant rainfalls in May (71.9 mm) and June (91.7 mm), temperature above the average (June: 20.9 °C, July: 23.3 °C) was also favorable. Average precipitation in July (65.3 mm compared to the long term average of 65.7 mm) could only partially satisfy the water demand of the huge vegetative stands. Sunflower stands could only partially tolerate the unfavorable and warm flowering and fertilization period. Extremely dry (4.1 mm) and hot (22.5 °C) August weather had an adverse effect on achene filling processes.

TABLE I
THE AMOUNT OF METEOROLOGICAL PARAMETERS IN THE EXAMINED GROWING SEASON (DEBRECEN, 2012)

Precipitation (mm)/ Temperature (°C)	April	May	June	July	August	Total/Áverage
30 year's average	42.4	58.8	79.5	65.7	60.7	307.1
2012	20.7	71.9	91.7	65.3	4.1	253.7
Difference	-21.7	13.1	12.2	-0.4	-56.6	-53.4
30 year's average	10.7	15.8	18.7	20.3	19.6	17.0
2012	11.7	16.4	20.9	23.3	22.5	19.0
Difference	1.0	0.6	2.2	3.0	2.9	1.9

III. RESULTS AND DISCUSSION

During our research, the application of various planting times greatly determined the degree of infections. By prolonging the planting times, the degree of infections decreased in the cases of the examined hybrids (Sclerotinia, a Diaporthe, Alternaria and Phoma) except for NK Neoma in the control parcels as Sclerotinia infection reached its maximum in the average planting time. In the cases of Sclerotinia infections we found significant differences in all two treatments regarding both early and late and both average and late plantings.

Regarding hybrid NK Neoma, the degree of infection was 52.1% less in the control and 31.0% less in the double-treated parcels compared to the early planting. As for NK Ferti, infections decreased in a greater degree by prolonging the planting time in both the control (56.7%) and the double-treated stands (42.9%). Fungicide treatments had significant roles in decreasing the degree of infections in all three planting times. As for the average of planting times, Sclerotinia infections in the control parcels were 7.8% (NK Neoma) and 7.3% (NK Ferti). These results were 51.3% (NK Neoma) and 52.1% (NK Ferti) less in the double-treated parcels. Diaporthe infection was greater in the early and average stocks in the case of NK Neoma and in the late stock regarding NK Ferti. The degree of infection decreased by more than 50% between the early and the late planting times of NK Neoma (the volume of the decrease was 67.5% for the control parcels and 69.4% in the case of the double-treated ones). On the contrary, the level of decrease was less significant in the case of NK Ferti as it was 30.4% in the control parcels and 46.1% in the double-treated ones. The degree of infections decreased by 41.1% (NK Neoma) and 38.0% (NK Ferti) due to the fungicide treatment.

As for Alternaria, there was a significant difference in the level of infections between planting times. Similarly to Diaporthe, as for early and late planting, the most notable decrease was experienced in the case of hybrid NK Neoma (control: NK Neoma: 62.3%, NK Ferti: 47,8%; double-treated: NK Neoma: 68.6%, NK Ferti: 55.3%). The fungicide treatment resulted in a similar extent of decrease for both hybrids (34.8% and 32.2%).

Decreases in Phoma infections by prolongation of the planting times were only significant between early and late and average and late plantings, and also between early and average planting times as for the double-treated parcels. The degree of decrease was almost the same for both hybrids and both treatments (NK Neoma: control: 69.5%, double-treated: 68.6%; NK Ferti: control: 64.6%, double-treated: 63.7%). Fungicide treatments resulted in a 36.4% (NK Neoma) and a 34.1% (NK Ferti) decrease of infections.

The weather of 2012 was unfavorable regarding the sunflower's early vegetative and generative development and its yield production, therefore yield results ended up being average. The application of various planting times not only affected the degree of infections but yields as well. Significant differences were observed between early and late parcels for both hybrids and both treatments. The degree of yield growth by prolongation of the planting time (late instead of early) was

smaller for NK Neoma (control: 8.0%, double-treated: 7.2%) than in the case of NK Ferti (control: 14.8%, double-treated: 15.1%). As for the amount of yield, late planting was found to be the optimal for both hybrids and both treatments (control: Nk Neoma: 3619 kg ha^{-1}, NK Ferti: 4242 kg ha^{-1}; double-treated: NK Neoma: 4326 kg ha^{-1}, NK Ferti: 4970 kg ha^{-1}). Fungicide treatments resulted in enhanced yields for both hybrids and in the cases of all three planting times. As for the average of planting times, this means a 18.9% yield growth for hybrid NK Neoma and a 15.5% increase for NK Ferti (Table II).

TABLE II
PHYTOPATHOGENIC CHARACTERISTICS AND YIELD OF SUNFLOWER HYBRIDS (DEBRECEN, 2012)

Fungicide protection		Control					Double fungicide protection				
Hybrids (A)	Planting time (B)	Sclerotinia (%)	Diaporthe (%)	Alternaria (%)	Phoma (%)	Yield (kg ha^{-1})	Sclerotinia (%)	Diaporthe (%)	Alternaria (%)	Phoma (%)	Yield (kg ha^{-1})
NK Neoma	Early planting time	9.4	77	86.3	59.7	3126	4.2	49	58.7	37.6	3742
	Average planting time	9.5	67	81.4	54.3	3381	4.3	34	52.8	34.7	3968
	Late planting time	4.5	25	32.5	17.9	3619	2.9	15	18.9	11.8	4326
Average		**7.8**	**56**	**66.7**	**44.0**	**3375**	**3.8**	**33**	**43.5**	**28.0**	**4012**
NK Ferti	Early planting time	9.7	56	81.4	55.9	3142	4.2	39	60.9	36.9	3619
	Average planting time	8.1	54	67.9	50.1	3437	4.0	34	41.8	32.4	3910
	Late planting time	4.2	39	42.5	19.8	4242	2.4	21	27.2	13.4	4970
Average		**7.3**	**50**	**63.9**	**41.9**	**3607**	**3.5**	**31**	**43.3**	**27.6**	**4166**
$LSD_{5\%}$ (A = Hybrids)		3.2	8	27.8	9.9	617	2.6	10	8.8	8.5	956
$LSD_{5\%}$ (B = planting time)		2.0	5	4.5	6.1	382	1.6	6	4.3	4.1	298
$LSD_{5\%}$ (A x B)		2.8	7	6.4	8.7	541	2.3	9	6.1	5.8	422

We applied Pearsons's correlation to determine the degree and course of the relationships between the examined hybrids, agrotechincal factors (i.e. planting time, fungicide treatment) and phytopathogenic infections (Sclerotinia, Diaporthe, Alternaria and Phoma). As shown in Table III., values of correlations below 0.3 were considered small, values between 0.3 - 0.5 were medium, values between 0.5 - 0.7 were strong and correlations above 0.7 were considered very strong. Based on the result, we found that planting time significantly determined phytopathogenic infections. We saw strong and reverse correlations in the cases of Sclerotinia (0.603**) and Diaporthe (0.688**) and very strong and reverse correlations in the cases of Alternaria (0.762**) and Phoma (0.812**). However, the correlation between Phoma infections and fungicide treatments was medium and reverse. According to the results of our research we found that planting times significantly determined the amount of yield due to the strong and positive correlation between these two factors (0.696**). The amount of yield was also affected by the hybrid (-0.375**) and the fungicide treatment (0.385**). Phytopathogenic infections largely decreased yields in our research. Alternaria (-0.754**) and Phoma (0.724**) infections presented a greater risk to yields in 2012 which fact was underpinned by a strong and reverse relationship. We experienced strong and reverse correlations between yields and Sclerotinia (0.650**) and yields and Diaporthe (0.655**) infections.

TABLE III
CORRELATION BETWEEN THE ANALYSED PARAMETERS (DEBRECEN, 2012)

	Sclerotinia	Diaporthe	Alternaria	Phoma	Yield
Hybrids	0.05	-0.128	0.083	-0.11	-0.375(**)
Planting time	-0.603(**)	-0.688(**)	-0.762(**)	-0.812(**)	0.696(**)
Fungicide protection	-0.559(**)	-0.539(**)	-0.521(**)	-0.402(**)	0.385(**)
Sclerotinia		0.798(**)	0.830(**)	0.801(**)	-0.650(**)
Diaporthe			0.868(**)	0.892(**)	-0.655(**)
Alternaria				0.884(**)	-0.754(**)
Phoma					-0.724(**)

** Correlation is significant at the 0.01 level

IV. CONCLUSION

The application of different planting times significantly affected the degree of infections and the amount of yield. The degree of Sclerotinia, Diaporthe, Alternaria and Phoma infections was decreased by the prolongation of the planting time but the decrease was not always significant. We found great differences between the yields of the early and late plantings for both hybrids and both treatments. In terms of the amount of yield, late plating turned out to be the optimal in the cases of both hybrids and both fungicide treatments (control: NK Neoma: 3619 kg ha-1, NK Ferti: 4242 kg ha^{-1}; double-treated: NK Neoma: 4326 kg ha-1, NK Ferti: 4970 kg ha^{-1}). The fungicide treatment not only decreased phytopathogenic infections significantly but resulted in enhanced yields as well (NK Neoma: 18.9, NK Ferti: 15.5%). Pearson's correlation proved that planting time decisively determined infections [Sclerotinia (0.603**), Diaporthe (0.688**), Alternaria (0.762**), Phoma (0.812**)] and yield (0.696**). We found that the yield was not only affected by the planting time but thy hybrid (-0.375**) and the fungicide treatment as well (0.385**). Phytopathogens decreased yields significantly. Alternaria (-0.754**) and Phoma (0.724**) infections presented a greater risk to yields in terms of the examined phytopathogens. Sclerotinia (0.650**) and Diaporthe (0.655**) infections decreased yields in a lesser degree.

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