

Dział: Rolnictwo

ISSN 1897-7820

http://www.npt.up-poznan.net/tom2/zeszyt2/art_11.pdf

Copyright ©Wydawnictwo Uniwersytetu Przyrodniczego w Poznaniu

PIOTR SZULC, HUBERT WALIGÓRA, WITOLD SKRZYPCZAK

Department of Soil and Plant Cultivation
Poznań University of Life Sciences

SUSCEPTIBILITY OF TWO MAIZE CULTIVARS TO DISEASES AND PESTS DEPENDING ON NITROGEN FERTILIZATION AND ON THE METHOD OF MAGNESIUM APPLICATION

Summary. Studies were carried out in order to investigate the reaction of two types of maize cultivars to the infection by diseases and pests depending on nitrogen fertilization and on the method of magnesium application. Both in case of diseases and pests, only the number of plants was recorded which were damaged or infected by a given pathogen and the result was expressed by the percentage of damage or infestation. The two studied maize cultivars showed different susceptibility to infestation by pathogens. It was found that the size of the applied nitrogen dose modified the infection of maize plants by fusariosis disease and exerted an effect on the extent of feeding by frit fly and European corn borer. The use of magnesium and the method of its application did not exert any effect on maize reaction to diseases or pests.

Key words: maize, cultivar types, diseases, pests, nitrogen, magnesium

Introduction

Not long ago, maize was regarded as a plant not much threatened by diseases and pests. The increase of maize cultivation range and the extended acreage of its culture including the area where it is grown for grain, are among the reasons why diseases and pests play an increased economic importance. The intensified threat by agrophages certainly remains under the influence of the recently observed rise of the mean air temperature in the vegetation period contributing to the increasing numbers of thermophilous pathogens causing greater maize damages which already exist on the area of our country. In maize, similarly as in case of many other cultivated plants, the occurrence of pests causes significant losses in the yields. It resulted among others from the fact that because of the small number of plants per area unit, a mass occurrence of pathogens decreases the yield-creating possibilities of this plant (KRUCZEK 1997). The maize dis-

eases most frequently occurring in Poland include fusarioris and common smut, while among pests, there dominate: frit fly and European corn borer (ADAMCZEWSKI et AL. 1997, LISOWICZ and TEKIELA 2004). Since several years, the “stay-green” maize type has been introduced into the culture because it is characterized by a greater resistance to pathogens in comparison with other hybrids.

The above mentioned reasons induced us to undertake the presented studies in order to investigate the reaction of two maize cultivar types to the infection by diseases and pests depending on the nitrogen fertilization level and on the method of magnesium application.

Material and methods

Field studies were carried out in the Didactic and Experimental Farm in Swadzim, near Poznań in the years 2004-2007. Results of the studies carried out in 2006 were disqualified because of a prevailing drought in the period of maize growth and development. Experiment was carried out in a “split-plot” design with three factors in four field replications. Two cultivars were studied: ‘Anjou 258’ and ‘LG 2244’ (“stay-green” type), six nitrogen doses per 1 ha were used: 0 kg N, 30 kg N, 60 kg N, 90 kg N, 120 kg N, 150 kg N and doses of magnesium per 1 ha: 0 kg MgO, 25 kg MgO (in rows) and 25 kg MgO (broadcasting), in the form of kieserite. Fertilization with P and K was performed before the sowing of maize in the doses per 1 ha: 80 kg P₂O (35.2 kg P) in the form of Polifoska 6 and 120 kg K₂O (99.6 kg K) in the form of 60% potassium salt.

For maize sowing a single seed drill Monosem was used which was equipped with a fertilizer applicator for magnesium distribution together with seed sowing. Fertilizer coulters were set in relation to seed coulters in such a way that fertilizer was placed in the soil 5 cm to the seed side and 5 cm below the seed. Seeds were sown 5-6 cm deep.

Both in case of diseases and pests, only the number of plants was recorded which were damaged or infected by the given pathogen and the result was expressed by the percentage of damage or infestation.

Results of the studies were subject to one-variable analysis of variance and then, synthesis of multiple experiments was carried out. Significance of differences was estimated at the level of $\alpha = 0.05$.

Experiment was carried out on grey-brown podsolic soil of coarse sandy soil type shallowly lying on light loam and belonging to good rye complex. Abundance of nutrients in the soil and its acidity are shown in Table 1.

Thermic and moisture conditions during vegetation in the years of studies were favourable for the growth and development of maize. Rainfall sum in the months of April-September amounted to 301.0 mm in the year 2004, 305.4 mm in 2005 and 332.9 mm in 2007. Hydrothermal coefficients indicating in a complex way both the air temperature and atmospheric precipitations permitted to state that in the period of studies, both the sum of rainfalls and their distribution were favourable for the growth and development of maize. Insignificant deficit of moisture was found in the soil during maize sowing (April 2004, April 2005 and April 2007) as well as in June 2005.

Table 1. Soil conditions at Swadzim
Tabela 1. Warunki glebowe w Swadzimiu

Specification	Years		
	2004	2005	2007
N-NH ₄ (mg per 100 g of soil d.m.)	0.13	0.12	0.14
N-NO ₃ (mg per 100 g of soil d.m.)	0.45	0.31	0.32
P (mg P ₂ O ₅ per 100 g of soil)	12.5	16.4	19.0
P (mg P per 100 g of soil)	5.5	7.2	8.3
K (mg K ₂ O per 100 g of soil)	14.6	20.7	20.5
K (mg K per 100 g of soil)	12.1	17.2	17.1
Mg (mg Mg per 100 g of soil)	9.5	5.6	7.3
pH (in 1n KCl)	5.87	5.55	6.22

Results and discussion

None of the investigated experimental factors showed any effect on the number of plants infested by common smut. On the other hand, the occurrence of plants infected by fusariosis disease depended on maize cultivar type and on the dose of nitrogen fertilization. No effect of nitrogen fertilization dose on the percentage of plants infected by common smut was found in the studies carried out by other authors (KRUCZEK et AL. 2007, MACIEJEWSKI and PALUSZKIEWICZ-FLAK 2008, SZULC et AL. 2007). A higher (by 3.5 point %) plant infection by fusariosis disease was found for the hybrid 'Anjou 258' as compared with 'LG 2244' ("stay-green" type) cultivar. The result obtained in our own studies was confirmed by the earlier studies carried out by HARTMANN et AL. (2000). Those authors informed also that the cultivars of "stay-green" type show a higher resistance to diseases evoked by fungi from *Fusarium* genus. It is mainly caused by the fact that in case of the occurrence of drought or another stressing factor, the risk of an untimely drying of plants in these cultivars is definitely smaller. Thanks to this fact, their tissues are continuously in a full turgor, they are not damaged and they create a natural barrier against infection. The least infection of plants by fusariosis disease was found for the nitrogen dose of 0 kg N per 1 ha (4.41%) (Table 2). Nitrogen fertilization in the range of doses from 30 to 150 kg N per 1 ha gave a significant increase of plants infected by this pathogen only in comparison with the control object without nitrogen fertilization.

Damages of maize by frit fly and European corn borer depended on the cultivar type and on the dose of nitrogen fertilization (Table 3). On the other hand, SZULC et AL. (2007) showed in their earlier studies that the dose of applied magnesium did not exert any effect on the damages of maize caused by frit fly and European corn borer.

Significantly greater damages of maize by pests were found for the "stay-green" type cultivar, as compared with 'Anjou 258'. The differences were respectively: 1.5 point % for frit fly and 0.58 point % for European corn borer. As reported by SZULC

Table 2. Infestation of maize by diseases (2004-2007)
Tabela 2. Porażenie kukurydzy przez choroby (2004-2007)

Specification		Common smut (%)	<i>Fusariosis ssp.</i>	
			%	Bliss' °
Cultivars	'Anjou 258'	13.85	7.99	14.43
	'LG 2244'	12.94	4.49	11.42
	LSD _{0.05}	n.s.	–	1.057
Dose of N (kg/ha)	0	12.70	4.41	10.60
	30	13.83	6.34	13.15
	60	12.05	6.37	13.11
	90	13.70	6.35	13.17
	120	14.40	6.51	13.59
	150	13.68	7.46	13.92
	LSD _{0.05}	n.s.	–	1.915
Dose of MgO (kg/ha)	0	13.90	6.00	12.51
	25 in rows	12.81	6.27	13.09
	25 broadcasting	13.48	6.45	13.18
	LSD _{0.05}	n.s.	–	n.s.

n.s. – non significant differences.

Table 3. Infestation of maize by insect pests (2004-2007)
Tabela 3. Uszkodzenie kukurydzy przez szkodniki (2004-2007)

Specification		Frit fly		European corn borer	
		%	Bliss' °	%	Bliss' °
Cultivars	'Anjou 258'	19.39	23.30	1.11	4.63
	'LG 2244'	20.82	24.27	1.69	6.10
	LSD _{0.05}	–	0.783	–	1.255
Dose of N (kg/ha)	0	18.91	23.10	1.11	4.48
	30	19.91	23.67	1.29	5.17
	60	20.01	23.77	1.26	4.98
	90	19.91	23.59	1.29	5.10
	120	19.38	23.31	1.76	6.31
	150	22.51	25.26	1.67	6.15
	LSD _{0.05}	–	1.181	–	1.285
Dose of MgO (kg/ha)	0	20.14	23.79	1.42	5.41
	25 in rows	19.93	23.70	1.41	5.37
	25 broadcasting	20.24	23.86	1.36	5.32
	LSD _{0.05}	–	n.s.	–	n.s.

n.s. – non significant differences.

et AL. (in print), maize cultivars of “stay-green” type are characterized by a higher vigor in the initial growth (greater dynamics of dry matter accumulation) in comparison with other hybrids. On the other hand, in the autumn period, thanks to the still active photosynthetic vegetative plant parts (KOWALIK and MICHALSKI 2006), they are more susceptible to the feeding by pests.

Damages of maize caused by frit fly and by European corn borer were the smallest on the control object (0 kg N per 1 ha) and they amounted to 18.91% and 4.48%, respectively (Table 3). In case of frit fly, the application of the highest dose of nitrogen fertilization (150 kg N per 1 ha) caused a significant increase of the plant percentage showing symptoms of feeding by this pathogen, as compared with the remaining N doses. Damages of maize plants by European corn borer were increasing in the range of nitrogen doses from 30 to 150 kg N per 1 ha, whereby this increase had the character of 1^o equation (Table 3).

Conclusions

1. Maize cultivar ‘LG 2244’ “stay-green” type was more resistant to the infection by fusariosis disease in comparison with the hybrid ‘Anjou 258’. On the other hand, in case of European corn borer, the reactions of the two maize hybrids were different.

2. The least plant infection by fusariosis disease was shown by plants fertilized with 0 kg N per 1 ha. In the range of N doses from 30 to 150 kg/ha, the infection of maize by fusariosis disease was statistically on the same level.

3. Increased level of nitrogen fertilization in the range from 0 kg to 150 kg N per 1 ha increased the percentage of plants with symptoms of both insects feeding.

4. Maize cultivar, level of nitrogen fertilization, dose size of magnesium and Mg application method did not show to exert any effect on the infestation of maize by common smut.

References

- ADAMCZEWSKI K., SKRZYPCZAK G., LISOWICZ F., 1997. Aktualne problemy ochrony kukurydzy w Polsce. *Zesz. Probl. Post. Nauk Roln.* 450: 63-78.
- HARTMANN A., PRESTERL T., GEIGER H.H., 2000. Bestimmung des optimalen Erntezeitpunktes in silomaisorten mit langsamer versus schneller Restpflanzenabreife. *Landbauforsch. Völknerode*. 217 (Tagungsband: “Zum Futterwert von Mais”): 86-93.
- KOWALIK I., MICHALSKI T., 2006. Wpływ niektórych czynników agrotechnicznych na parametry jakościowe kiszonki z kukurydzy odmiany „stay-green”. *Pam. Puław.* 142: 201-224.
- KRUCZEK A., 1997. Wpływ czynników meteorologicznych i nawożenia azotowego na porażenie przez choroby i szkodniki oraz wylęganie kukurydzy (*Zea mays* L.). *Rocz. AR Pozn.* 295, *Roln.* 50: 63-71.
- KRUCZEK A., MICHALSKI T., BARTOS M., 2007. Wpływ sposobu nawożenia azotem na zdrowotność kukurydzy. *Progr. Plant Prot. / Post. Ochr. Rośl.* 47, 1: 56-60.
- LISOWICZ F., TEKIELA A., 2004. Szkodniki i choroby kukurydzy oraz ich zwalczanie. In: *Technologia produkcji kukurydzy*. Ed. A. Dubas. *Wiś Jutra*, Warszawa: 52-64.

- MACIEJEWSKI T., PALUSZKIEWICZ-FLAK H., 2008. Wpływ deszczowania i nawożenia azotem na porażenie kukurydzy zwyczajnej przez *Ustilago zea* Unger w zależności od sposobu jej użytkowania. In: *Problemy agrotechniki oraz wykorzystania kukurydzy i sorgo*. Ed. T. Michalski. Katedra Uprawy Roli i Roślin UP, Poznań: 143-145.
- SZULC P., WALIGÓRA H., SKRZYPCZAK W., 2007. Występowanie chorób i szkodników na kukurydzy w zależności od nawożenia magnezem. *Progr. Plant Prot. / Post. Ochr. Roślin* 47, 1: 146-149.
- SZULC P., WALIGÓRA H., SKRZYPCZAK W., in print. Reaction of two maize cultivars expressed by dry matter yields depending on nitrogen fertilization level and on magnesium application method. *Acta Agrophysica*.

PODATNOŚĆ DWÓCH TYPÓW ODMIAN KUKURYDZY NA CHOROBY I SZKODNIKI W ZALEŻNOŚCI OD POZIOMU NAWOŻENIA AZOTEM I METODY APLIKACJI MAGNEZU

Streszczenie. Przeprowadzone badania miały na celu poznanie reakcji dwóch typów odmian kukurydzy na porażenie przez choroby i szkodniki w zależności od poziomu nawożenia azotem i sposobu aplikacji dawki magnezu. Zarówno w przypadku chorób, jak i szkodników notowano wyłącznie liczbę roślin, które zostały uszkodzone lub porażone przez dany patogen, a wynik wyrażono w procentach porażenia, nie uwzględniając stopnia porażenia lub uszkodzenia. Wykazano różną podatność dwóch typów odmian kukurydzy na porażenie przez patogeny. Stwierdzono również, iż wielkość dawki azotu modyfikuje porażenie roślin kukurydzy przez choroby fuzaryjne oraz wpływa na wielkość żerowania ploniarki zbożówki i omacnicy prosowianki. Nie wykazano wpływu wielkości dawki magnezu oraz sposobu jej aplikacji na porażenie kukurydzy przez choroby i żerowanie przez szkodniki.

Słowa kluczowe: kukurydza, typy odmian, choroby, szkodniki, azot, magnez

Corresponding address – Adres do korespondencji:

Piotr Szulc, Katedra Uprawy Roli i Roślin, Uniwersytet Przyrodniczy w Poznaniu, ul. Mazowiecka 45/46, 60-623 Poznań, Poland, e-mail: pszulc@up.poznan.pl.

Accepted for print – Zaakceptowano do druku:

14.05.2008

For citation – Do cytowania:

*Szulc P., Waligóra H., Skrzypczak W., 2008. Susceptibility of two maize cultivars to diseases and pests depending on nitrogen fertilization and on the method of magnesium application. *Nauka Przyr. Technol.* 2, 2, #11.*