

## STUDY ON IDENTIFICATION AND IMPLICATION OF PEST AGENTS ON PHYSIOLOGY AND PRODUCTIVITY OF SOME MAIZE HYBRIDS GROWN ON SANDY SOILS

Reta Drăghici<sup>1\*</sup>, Iulian Drăghici<sup>1</sup>, Diaconu Aurelia<sup>1</sup>, Mihaela Croitoru<sup>1</sup>, Ana-Maria Andrei<sup>2</sup>

<sup>1</sup>Research – Development Center for Field Crops on Sandy Soils, Dăbuleni

<sup>2</sup>Research - Development Institute for Plant Protection, Bucharest

\*correspondence address:

Research – Development Center for Field Crops on Sandy Soils, Dăbuleni

Phone: +40251334402 / +40251334347

e-mail: [ccdcpendabuleni@yahoo.com](mailto:ccdcpendabuleni@yahoo.com) ; [retadraghici@yahoo.com](mailto:retadraghici@yahoo.com); <http://www.ccdcpendabuleni.ro>;

**Abstract:** The sandy soil agroecosystems constitutes an unfavorable environment for the natural enemies of pest agents, because of the high degree of disequilibrium as a result of perturbations and anthropogenic interventions (Emilia Baniță et al., 2002, Cojocaru Doina et al., 1996, P. Nampala et al., 1999). The use of hybrids and varieties of resistant plants represents a method ideal and full ecological, creating a natural barrier against the pathogens and pests aggression, without negative consequences on the environment. In this sense, research conducted during 2008-2010, on plant protection in some genotypes of maize grown on sandy soils, showed an statistically correlations between microclimate, biological material and pesting agent, for the purposes the implication of attack produced by pathogens on the development of plant physiological processes and the production results. The results obtained at maize, showed a positive correlations between plant perspiration process and degree / frequency attack produced by *Fusarium moniliforme* ( $r = 0.948 *$ ), by *Ustilago maydis* ( $r = 0.996 *$ ) and by *Ostrinia nubilalis* ( $r = 0.898 **$ ). The Olimpius and Olt maize hybrids they had the best stability of production in the area of sandy soils climatic conditions (standard deviation = 366.8-403.1 kg/ha).

**Keywords:** pathogen, attack, plant, transpiration, photosynthesis, yield

### INTRODUCTION

It is known that the emergence and development pathogen agents are determined by the coexistence of three factors: host plant, the pathogen and the external environment. The climatic conditions are significantly modified, compared with the data recorded by weather stations and together with the soil conditions constitutes the external environment which influence significantly the infections and the attack degree of pest agents to plants (Kostandi SF & G. Geisler, 2008, Newton A.C. et al., 2010). Thus, due to plant transpiration and large capacity of leaves to absorb sunlight at the level of leaves, humidity and temperature are higher than the values recorded in the rest of the atmosphere or soil, significantly influencing the plant development and receptivity, towards pathogen infection produced by them.

The yields concerning quantity and quality obtained of maize may be affected in 23%, due to pests attack so, the cultivation of resistant hybrids with specificity for a certain area of culture, plays an important role in promoting of a sustainable agriculture (Trotuş Elena, 2007, Haş Vochița et al., 2010). The use of hybrids and varieties of resistant plants, represents an ideal method and in full ecological, creating a natural barrier against pathogens and pests aggression, without negative consequences for the environment. In this sense, during the 2008-2010 period, at Research - Development Center for Field Crops on Sandy Soils, Dăbuleni was carried out a study in order to identify damaging agents and evaluate the involvement degree / frequency the attack on the physiological processes in plants and the production obtained to maize grown on sandy soils.

## MATERIAL AND METHOD

The researches were carried during the 2008-2010 period, at Research - Development Center for Field Crops on Sandy Soils, Dabuleni, to five maize hybrids cultivated under conditions of irrigation on a sandy soil, with low natural fertility (0.57 to 0.65% humus) and  $\text{pH}_{\text{H}_2\text{O}} = 6, 9$  to 7.3. Has been determined the degree of attack pathogens, in according to frequency and intensity. The appreciation behavior of hybrids to diseases and pests attack was achieved according to the grading scale elaborated by Ionescu C. et al. in 1989: 0 = VR (very resistant) 1-10 = R (resistant) 11-25 = MR (medium resistant) 26-50 = S (sensitive), 51-100 = VS (very sensitive). The physiological determinations were performed during the forming maize grain using device LCpro + Portable Photosynthesis System. The results were calculated and interpreted point of view statistical using the mathematical functions and variance analysis.

## RESULTS AND DISCUSSIONS

The hydric resources achieved in soil, by the rainfall amount of 266.1 mm, registered in the vegetation period of maize, were insufficient to the plant consumption of 7760 m<sup>3</sup> water / ha, necessary for the growth and development of the maize plants cultivated in sandy soil conditions (Marinica Gh & Nicolescu M., 1977) and it is necessary covering the water deficit through irrigation. Analysis of thermal and hydric resources in the period taken into study, compared with the average multi annual, has highlighted the installation of a dry periods in July and an accentuation of drought in August (Fig. 1). The maximum temperatures from 37.8 to 38.5 °C, associated with a small amount of rainfall recorded, have led to a reduction of relative humidity, which had a significant influence on the functional relationship between the plant physiology and degree / frequency attack of pathogen identified of maize.

The pathogens identified in maize hybrids studied in sandy soil conditions were: *Ustilago maydis* and *Fusarium moniliforme* and of pests: *Ostrinia nubilalis* and *Rhopalosiphum maidis* (Fig. 2, 3). The infection by *Ustilago maydis* have occurred in August, at an average temperature of 23.9°C in air and at a high relative humidity created by the irrigation of culture. Tumors produced by *Ustilago maydis* have appeared in all aerial organs of the plant to milk ripening grain phase, degree of attack is between 0-9%. The observations made to cobs in the mature stage, showed symptoms of infection with *Fusarium moniliforme*, under the chapped grain aspect, colored in pink, which were then covered with white mycelium, the degree of attack ranging within the limits from 2.4 to 11.4%. On sandy soils the application of high doses of nitrogen may constitute an intensification factor of attack produced by *Fusarium moniliforme*, that is why the nitrogen must be applied fractionated and in moderate amounts, depending on the plants requirements. The conditions of drought created as a result of higher average monthly temperatures and reduced precipitation recorded at the end of June until the end of August, have led to the stagnation of growth and development of plants, to the inhibition of plant physiological processes and to create a favorable conditions for conducting biological cycle of the pest *Ostrinia nubilalis*, whose attack frequency was from 11.1 to 22.7%.

The physiological determination carried during blossoming period have shown a plant transpiration rate of maize from 1.38 to 4.28 mmol H<sub>2</sub>O m<sup>-2</sup>s<sup>-1</sup>, differentiated according to genetic resistance to the dry conditions of the hybrid. Mathematical analysis of the results has highlighted a positive correlations between the plant transpiration process and degree / frequency attack produced by *Fusarium moniliforme* ( $r = 0.948 *$ ), by *Ustilago maydis* ( $r = 0.996 *$ ) and by *Ostrinia nubilalis* ( $r = 0.898 **$ ) (Fig. 2). The loss of an as high quantity of water, through plant transpiration, has led to debilitation of plants and, accordingly, to reducing the resistance to infection with pathogens. Of the five hybrids studied, a single maize hybrid (Danubian) were medium resistant to infection caused by *Fusarium moniliforme*, the others being resistant and very resistant to attack of pathogens.

The determinations carried out in grain formation phase, showed the presence the pest *Rhopalosiphum maidis* on leaves, on stem and on cob, which registered a frequency of attack of between 9.3 to 17.3% (Fig. 3). Analyzing the trend frequency of attack produced on plant maize by *Rhopalosiphum maidis* is observed that the hybrid has a coefficient of determination of 77% in attack frequency. In the conditions of registration at the level leaf surface of some temperatures of 31.5 to 37 °C and of an photosynthesis active radiation by 1426 to 1603 micromol m<sup>-2</sup>s<sup>-1</sup>, the quantity of CO<sub>2</sub> assimilated by the plant photosynthesis process, was differentiated from 14.98 to 37.37 micromol CO<sub>2</sub> m<sup>-2</sup>s<sup>-1</sup>, depending on the maize hybrid cultivated. Analysis of the functional relationship between the degree / frequency attack of agents the pesting and the plant photosynthesis rate (Fig. 4), has highlighted a negative correlations, distinct significantly influenced by the attack frequency produced by *Ostrinia nubilalis* ( $r = -0.968^{**}$ ) and insignificantly influenced by other pest agents ( $r = -0.822$ ,  $r = -0.868$ ).

The photosynthesis process of the maize plant had a significant distinct influence on the production results obtained at harvest, in the sense that with increasing the CO<sub>2</sub> assimilation rate the grain yield has increased (Fig. 5). A maximum production, of 8434 kg / ha, was recorded by Olt hybrid, to which the carbon assimilation rate was of 37.37 micromol CO<sub>2</sub> m<sup>-2</sup>s<sup>-1</sup>, followed by the Olimpius hybrid, with a production of 7964 kg/ha. Of those five maize hybrids experienced, Olt and Olimpius hybrids showed the best stability of production, the production standard deviation obtained in the three years were by 366.8 to 403.1 kg / ha (Table 1). Thousand grain weight (TGW) and hectoliter weight (HW) were differentiated according to hybrid (TGW = 278-321g, HW = 71.2 to 74 kg) and were correlated with the yields obtained.

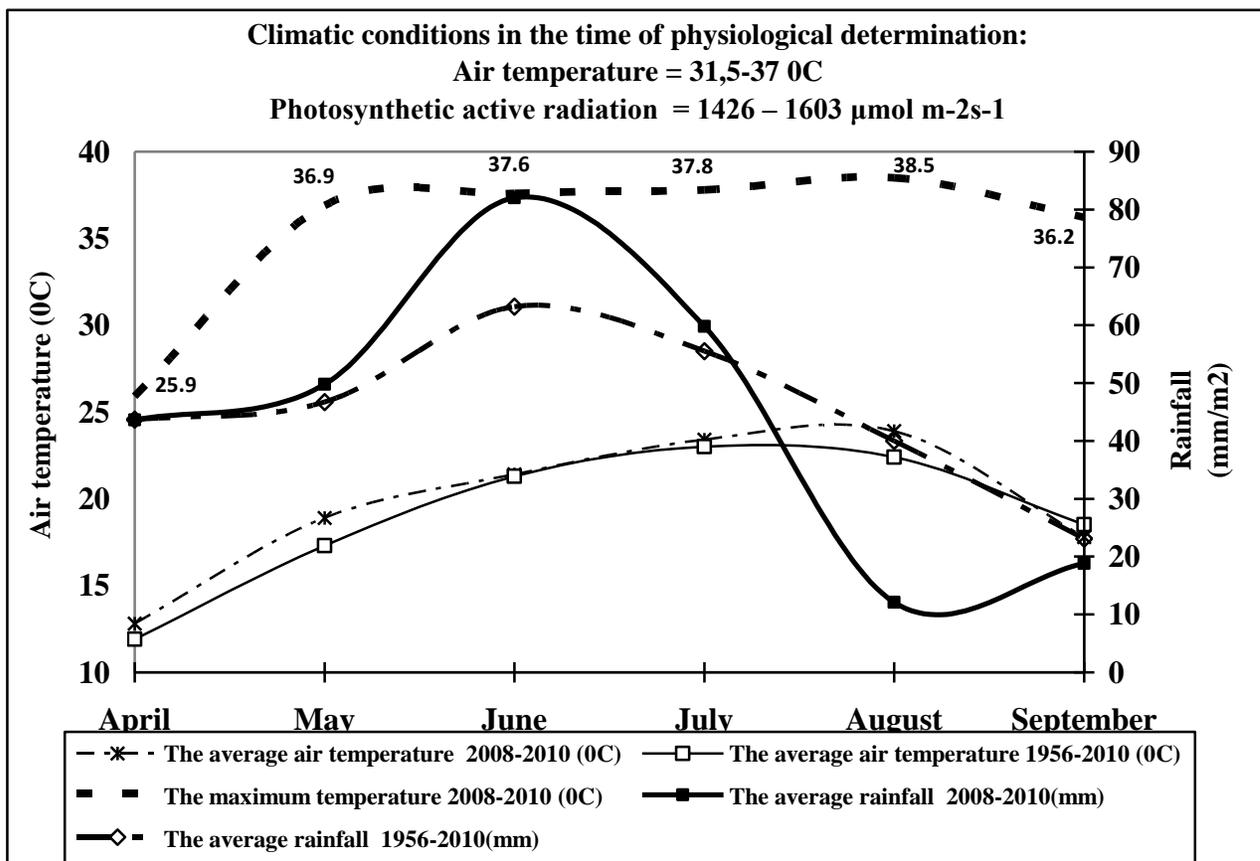


Fig. 1. Climatic conditions registered at the meteorological station of RDCFCS Dăbuleni

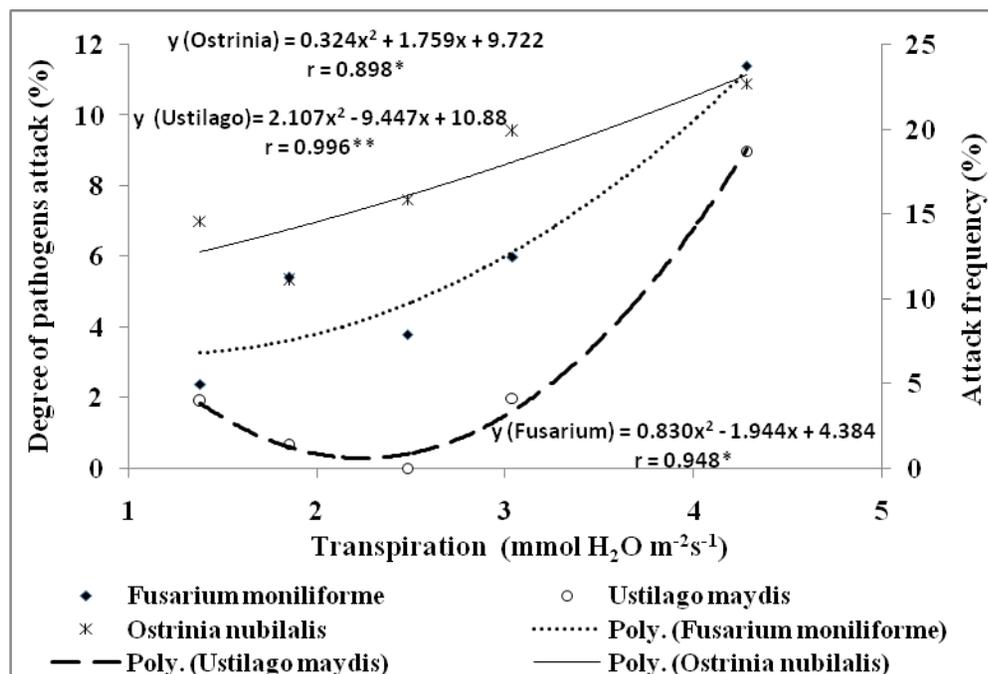


Fig. 2. The implications of pest agents attack in the plant transpiration process to some maize hybrids

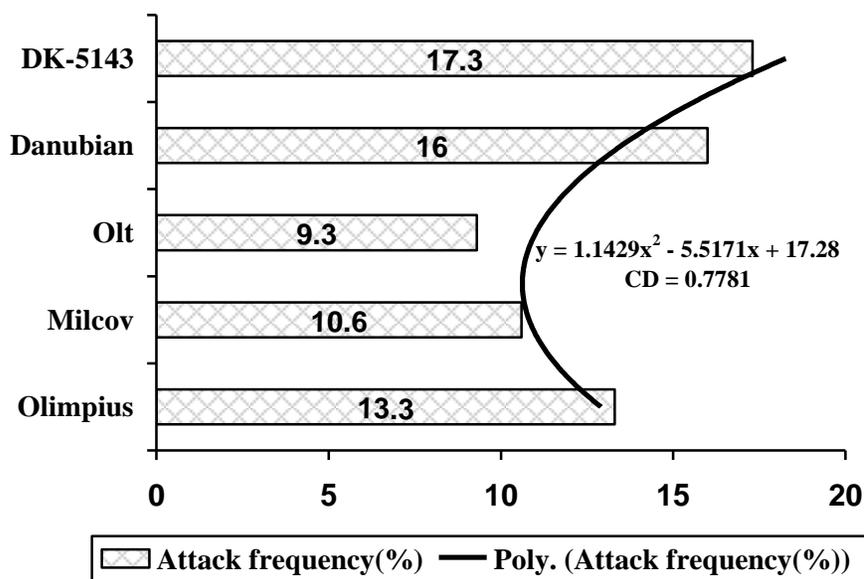


Fig. 3. The frequency of attack produced by *Rhopalosiphum maidis* to some maize hybrids

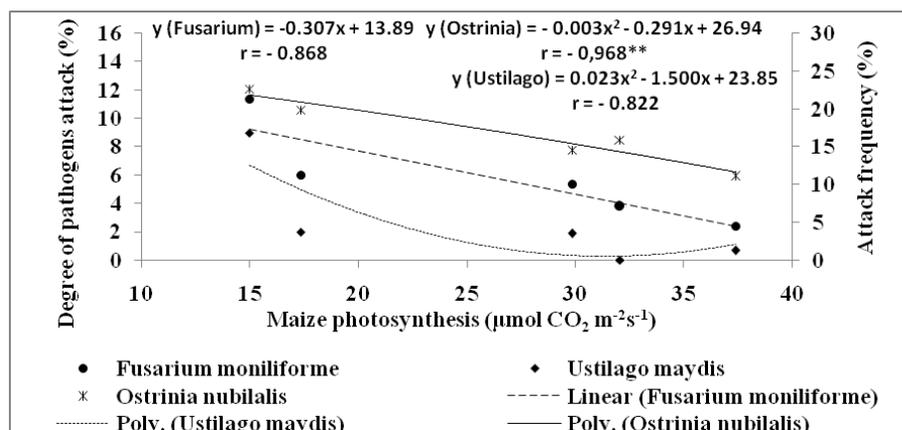


Fig. 4 The implications of pest agents attack in process of the plant photosynthesis to some maize hybrids

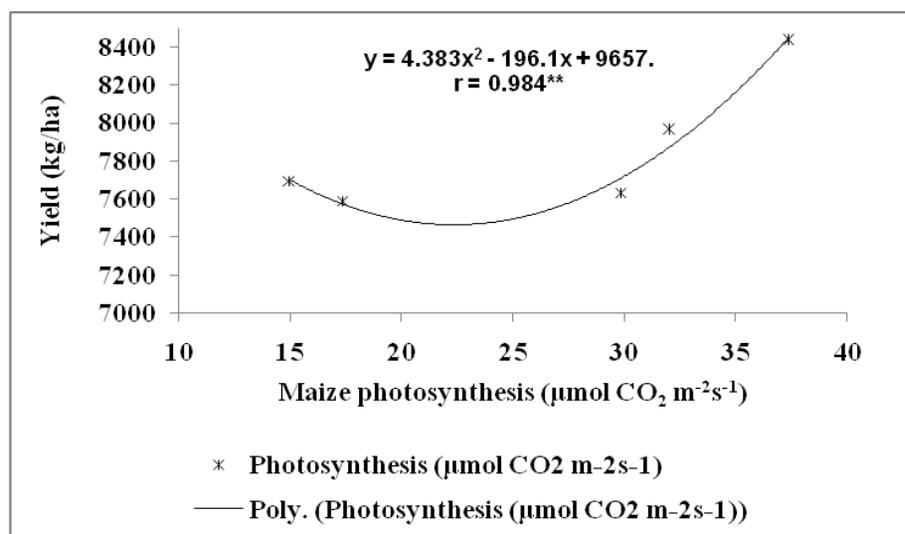


Fig. 5 The correlation between the plant photosynthesis rate and grain yield obtained at some maize hybrids

Table 1

Production results recorded at some maize hybrids grown on sandy soils

No.	Hybrid	Grain yield						Significance
		TGWg	HW kg	Standard deviation (σ)	kg/ha	%	± kg/ha from control	
1	Olimpius	321	71.2	366.8	7964	101	101	-
2	Milcov	296	74	1515.1	7632	97	-231	-
3	Olt	316	73.5	403.1	8434	107	569	-
4	Danubian	278	72	1029.5	7696	98	-167	-
5	DK-5143	306	72.2	1687.1	7589	96	-274	-
Yield average					7863	100	control	

LSD 5% = 857 kg/ha  
 LSD 1% = 1209 kg/ha  
 LSD 0.1% = 1678 kg/ha

## CONCLUSIONS

- The results obtained have showed a positive correlations between the quantity of water lost through transpiration process of plant and degree / frequency attack produced by *Fusarium moniliforme* ( $r = 0.948 *$ ), by *Ustilago maydis* ( $r = 0.996 *$ ) and by *Ostrinia nubilalis* ( $r = 0.898 **$ );
- The maize hybrids studied in sandy soils conditions were infected in phase of grain formation with the pest *Rhopalosiphum maidis*, whose frequency of attack was between 9.3 to 17.3%;
- Analysis of the functional relationship between the degree / frequency attack of agents the pesting and the rate of accumulation of CO<sub>2</sub> through the photosynthesis process of plants, were highlighted a negative correlations distinct significantly influenced by the attack frequency produced by *Ostrinia nubilalis* ( $r = - 0.968 **$ ) and insignificantly influenced by *Fusarium moniliforme* and *Ustilago maydis* ( $r = - 0.822$ ,  $r = - 0.868$ );
- The best behavior to the pathogens attack have registered to the maize hybrids Olt and Olimpius, who achieved the highest grain yields (7964-8434 kg / ha) and the highest stability of production in climatic conditions of the area of sandy soils (standard deviation = 366.8 to 403.1 kg / ha).

## REFERENCES

- Baniță Emilia, Păunescu Gabriela, Luca Emilia, Oana Maria, Oncică Fraga, Naidin C., 2002 - Foliar diseases of wheat in Oltenia. Ed. Alma Craiova, page 70-91;
- Cojocaru Doina, Nicolaescu Maria, Severin V., Stancescu C., Bleoju Maria, 1996 – Mosaic and bacterial cowpea sunburn. Testing Means of Plant Protection, vol. XXIV, page 65 – 70
- Haș Vochița, Haș I., Antohe I., Copândeana Ana, Nagy Elena, 2010. The variability in production capacity and quality of grain maize hybrids from different FAO maturity groups). Anals N.A.R.D.I. Fundulea, București, vol. LXXVIII, no. 1.
- Ionescu C., Munteanu I., Sesan Tatiana, Gheorghies C., Stanescu C., Stroia Ioana, 1989- Behaviour of some varieties of cereals in the main pathogens attack during the period 1986-1988, Cereals and technical plants, no. 7, 41-48
- Kostandi S. F., G. Geisler, 2008. Maize Smut Induced by *Ustilago maydis* (D. C.) Corda – Reaction of Maize Hybrids and Lines to Smut Disease. Journal of Agronomy and Crop Science. Article first published online: 22 APR 2008, DOI: 10.1111/j.1439-037X.1989.tb00702.x
- Marinică Gheorghe, Nicolescu Mihai, 1977. Experimental results on water consumption and irrigation regime at maize grain on sands modeled. Scientific Papers CRSFCSS Dabuleni
- Nampala P., E. Adipala, M W Ogenga -Latigo, S. Kyamanywa, J. E. Obuo, 1999. Effect of cowpea monocultures and polycultures with sorghum and greengram on predatory arthropods. Annals of Applied Biology. Voll 135, issue 2 1999 28 JUN 2008 | DOI: 10.1111/j.1744-7348.1999.tb00874.x
- Newton A.C., C. Gravouil & J.M. Fountaine, 2010 Managing the ecology of foliar pathogens: ecological tolerance in crops, Annals of Applied Biology ISSN 0003-4746. doi:10.1111/j.1744-7348.2010.00437.x., Scotland, UK
- Trotuș Elena, 2007. Maize crops protection against specific pests and pathogen agents through sustainable methods of protection – Anniversary volume – Agricultural Research and Development Station of Secuieni, Neamț County, Romania, 1962-2007- 45 years of scientific activity. Edit. Ion Ionescu de la Brad, Iași, 90-97.