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RESEARCH ON DROUGHT TOLERANCE OF PIONEER AND FUNDULEA INSTITUTE TOP COMERCIAL CORN HYBRIDS TESTED IN DIFFERENT PEDO-CLIMATIC ZONES OF THE SOUTH EASTERN OF ROMANIA

Viorel DINCĂ[1], Ionel JINGA[2], Gabriela-Mariana STOICA[2], Gabriela VÂLSAN[1], Valentin MANDACHE[1], Marina UBERTI[3], Angheluș FIERBINȚEANU[1], Lucian MELUT[2]

[1]Pioneer Hi-Bred Seeds Agro SRL, DN2, km 19.7, Găneasa-Şindrilița, cod 077104, county Ilfov, Romania, Tel: 021.303.53.07, Fax: 021.303.53.41, Mobile: 0723613894
E-mail: viorel.dinca@pioneer.com
[2]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Boulevard, District 1, 011464, Bucharest, Romania, Phone: +40 21 318 25 64, E-mail: gabriela_mary25@yahoo.com
[3]State Institute for Variety Testing and Registration, 61 Mărăşti Blvd., district 1, Bucharest, Romania, cod. 011464. CP. 32 - 35, Tel: 4021.318.43.80

Corresponding author email: viorel.dinca@pioneer.com

Abstract

The experiment was conducted over three years: 2009, 2010 and 2011, in five locations: Fundulea, Calaraşi county; Valu lui Traian, Constanta county; Sarichioi, Tulcea county; Cazasu, Brăila county and Caracal, Olt county. These locations were selected as being representative for corn cropping area from South Romania. Eight corn hybrids (F475M, Olt, Paltin, F376 from Fundulea Institute and PR35F38, PR37Y12 , PR36V74, PR37F73 from Pioneer) were tested using two levels of water regime: irrigated with 800 ^{3}/ha and non-irrigated. The study showed that the 2009 was less favorable for corn crop in all testing areas, comparing with 2010 and 2011 which were favorable for corn crop. In the case of non-irrigated corn trials the yield was influenced by the climatic conditions of the year, while in the case of irrigated corn trials, the yield was much higher and stable. The hybrid PR36V74 had the highest yield in all irrigated and non irrigated testing locations. Average yield of the hybrids over three years varied between 93.8 q/ha (F475M) and 130,3 q/ha (PR36V74) in non-irrigated conditions, while in irrigated conditions average yield increased significantly by applying of 800 m^3/ha varying between 101.2 q/ha (F475M) and 155,9 q/ha (PR36V74).

Keywords: corn yield, cropping areas, drought tolerance, irrigation, Zea mays L.

INTRODUCTION

Corn plant is the most surprising system present in nature for energy accumulation. From a kernel weighting about one third of a gram, a plant tall of two-three meters emerges and develops in approximate nine weeks, and after about eight following weeks this plant will produce 600-1000 kernels [2].
Corn (*Zea mays* L.) an outstanding generous species, by its yielding potential, large diversity of utilization as food and feed, and raw material for industrial processes, grown worldwide on large areas, as well as in Romania, occupies a primary place in creation and development of a modern and performing agriculture market and consumer requirements lead corn breeding research towards more and more performing hybrids in terms of yielding capacity [5]. Till 2020, 20% from the total of the fuel used in European Union should be biofuel and the most important source from an economical point of view to achieve this objective is represented by corn crop. Thus, increasing of corn cropping area is stimulated [4].
Research on water consumption in connection with corn irrigation represents also a major objective aimed to increase the contribution of corn to vegetal material supplying.
At global level the drought and the desertification affects about 47% of the dry land, with varying degrees of the aridity.
In the past 15 years there is a tendency to expand the areas affected by drought in most

parts of the country and a reduction in irrigation water resources.

Given that our country became a member of the European Union and in the current market economy, the worldwide financial crisis is crossed by broad, obtaining high yields and stable economic efficiency and environmental protection is an urgent necessity.

Corn occupies third place among the world's crop, totaling, according to statistics from 2005, area 147.0 million ha, with 3587 kg / ha The largest areas are in U.S. corn 30.8 million hectares, as following China (25.2 million hectares), Brazil (11.4 million ha), Mexico (8.0 million hectares), India (7.4 million ha). Obtain high yields Italy (10063 kg / ha), USA (9315 kg / ha), France (8095 kg / ha) [1].

Our country has significant weight between corn-growing countries. In 2001, 3.1 million hectares cultivated, resulting in a lower average yield of only 2419 kg / ha and in 2005 we have grown mil.ha 2662, with an average of 3743 kg / ha.

The objective of this study is to characterize eight top commercial hybrids grown in Romania in terms of yielding capacity parameters in connection with their water stress tolerance.

For South East Romania, an average irrigation rate of 800-1500 m^3/ha is recommended. If irrigation is not applied in the period of maximum water consumption of the corn plants, water deficit will affect significantly the grain yield [3].

MATERIAL AND METHOD

Research was performed in five locations in a factorial field trial, designed as split-split-plot with the following factor graduations:

Factor A – water stress level: a1-non irrigated (drought tolerance), a2-irrigated with a pedological rate of 800 m^3/ha of water, using small sprinklers;

Factor B – hybrid: b_1 F475M, b_2 Olt, b_3 Paltin and b_4 F376 from Fundulea institute, the main local corn breeding company and b_5 PR35F38, b_6 PR37Y12, b_7 PR36V74 and b_8 PR37F73 from Pioneer;

Factor C – pedoclimatic area: c_1 Valu lui Traian, Constanţa county, c_2 Sarichioi, Tulcea county, c_3 Cazasu, Brăila county, c_4 Fundulea, Călăraşi county and c_5 Caracal, Olt county, between 2009-2011.

The experiment was three times replicated in both irrigated and non irrigated conditions. Soils from all locations where the trials were performed are typical for corn cropping area from Romania.

In all three years, in graduation a2, an irrigation of 800 m^3/ha was applied. In 2009 due to abundant rainfall no significant differences were registered between irrigated and non-irrigated.

Grain weight was measured in each experiment plot and yield at 14% grain moisture was computed. ANOVA applied to a three factorial split-split-plot was used to process and interpret yield data.

RESULTS AND DISCUSSIONS

It is well know, that corn is affected by drought at anthesis-silking interval – beginning with the second part of July till towards the end of August. Additional irrigation water supplying in this period contributes to corn grain yield increasing.

Data from this study (ANOVA, not presented) showed that water stress levels represented by irrigated and non-irrigated testing conditions and genotypes represented by corn hybrids, as well as all possible interactions between the two factors and between experimental factors and environmental condition represented by years and locations produced significant variations of the grain yield. Specific hybrid reactions to water stress levels were noticed.

The influence of the location on corn grain yield (averaged over years, water stress levels and hybrids), Fig.1, shows that the high yielding potential of the corn cropping from South-East of Romania, enhanced by irrigation, could satisfy the current increasing requests for agriculture products.

Thus, the influence of the irrigation regime on corn grain yield is presented in Fig.2 Application of irrigation resulted in a significant average yield increasing of 16.2 q/ha versus non irrigated conditions.

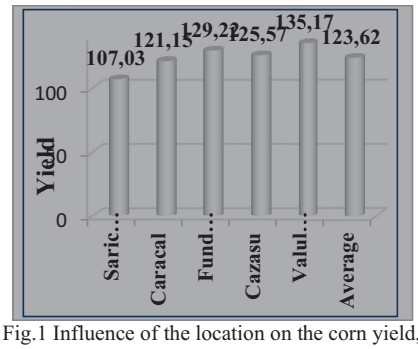

Fig.1 Influence of the location on the corn yield, averaged over 8 hybrids and 3 years

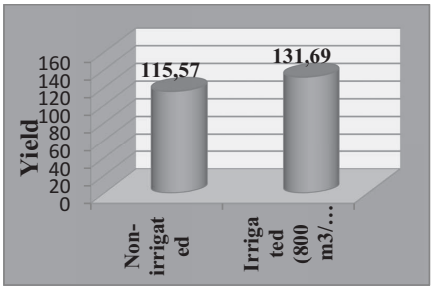

Fig 2. Influence of the irrigation regime on corn grain yield averaged over 8 hybrids, 5 locations and 3 years

Average grain yield of the tested hybrids varied between 107.7 q/ha (F475M) and 124.5 q/ha (PR36V74) in non irrigation conditions (Table 1).

Table 1. Influence of the hybrid on the yield in non-irrigated conditions, 2009-2011

Hybrid	Yield q/ha, Non-irrigated	Difference	Signification
(b)	(a1)		
b1 – F475M	107.0	-8.4	0
b2 - Olt	119.0	3.5	-
b3 - Paltin	117.4	1.8	-
b4 –F376	107.5	-7.9	0
b5 – PR35F38	119.1	3.5	-
b6 – PR37Y12	110.6	-4.9	-
b7 – PR36V74	124.5	8.9	**
b8 – PR37F73	119.1	3.5	-
Average (control)	115.5		-

DL 5% = 5.28 q/ha DL 1% = 6.97 q/ha DL 0,1% = 9.02 q/ha

The best performing hybrids in non-irrigated conditions were Olt, PR35F38 and PR37F73 and particularly PR36V74 which significantly over passed the control represented by the hybrids mean (124.5 q/ha PR36V74 versus 115.5 q/ha hybrid mean).

Significant lower yield versus hybrid mean in non irrigation conditions were registered at F376 and F475M from Fundulea. PR37Y12 had also a lower grain yield but mostly due to its remarkable earliness. In irrigation conditions (Table 2) grain yield of the tested hybrids, averaged of over locations and years, varied between 119.7 q/ha (F376) and 145.2 q/ha (PR36V74). Similarly to non irrigated conditions, F376 and F475M had the lowest performances.

Table 2. Influence of the hybrid on the yield in irrigated conditions, 2009-2011

Hybrid	Yield q/ha, Irrigated	Difference	Signification
(b)	(a_2)		
b_1 – F475M	121.1	10.5	0
b_2 - Olt	137.7	6.9	*
b_3 - Paltin	130.3	-1.3	-
b_4 –F376	119.7	-11.9	0
b_5 – PR35F38	135.3	3.6	-
b_6 – PR37Y12	128.2	-3.4	-
b_7 – PR36V74	145.2	13.6	***
b_8 – PR37F73	135.8	4.1	-
Average (control)	131.6	Mt	-

DL 5% = 5.28 q/ha DL 1% = 6.90 q/ha DL 0,1% = 9.02 q/ha

Irrigation produced a general significant grain yield increasing of 16.1 q/ha (average over hybrids); Olt had the best performance from local hybrids and PR36V74 gave the highest yield increasing in irrigated conditions versus non irrigated conditions (20.7 q/ha) (Table 3).

Table 3. Yield in irrigation and non-irrigation, conditions, average over years and locations

Hybrid	Yield q/ha, Irrigated	Yield q/ha, Non-irrigated	Difference	Signif.
(b)	(a2)	(a1)	(q/ha)	Dif.a2-a1
b1 – F475M	121.1	107.0	14.0	***
b2 - Olt	137.7	119.0	18.6	***
b3 - Paltin	130.3	117.4	12.8	***
b4 –F376	119.7	107.5	12.1	***
b5 – PR35F38	135.3	119.1	16.2	***
b6 – PR37Y12	128.2	110.6	17.6	***
b7 – PR36V74	145.2	124.5	20.7	***
b8 – PR37F73	135.8	119.1	16.7	***
Average (control)	131.6	115.5	16.1	***

DL 5% = 5.28 q/ha DL 1% = 6.97 q/ha DL 0,1% = 9.02 q/ha

Hybrid mean grain yield averaged over environmental factors (year and location) and water stress levels (Table 4) outline several superior products for cropping area from South-East of Romania such as Olt from local hybrids

and PR35F38, PR37F73 and PR36V74 from Pioneer.

Table 4. Influence of the hybrid on corn grain yield , 2009-2011 average

Hybrid	Yield		Difference q/ha	Semnif.
(b)	q/ha	%		
b_1 – F475M	114.0	100	-	-
b_2 - Olt	128.4	112.5	14.3	***
b_3 - Paltin	123.8	108.5	9.7	***
b_4 –F376	113.6	99.6	-0.4	-
b_5 – PR35F38	127.2	111.5	13.1	***
b_6 – PR37Y12	119.4	104.6	5.3	**
b_7 – PR36V74	134.9	118.2	20.8	***
b_8 – PR37F73	127.4	111.7	13.3	***

Dl 5%=3.37 q/ha Dl 1%=4.45q/ha Dl 0,1%=5.73q/ha

CONCLUSIONS

Results of this study underline that irrigation is one of determinant factor of the expression of the high yielding ability of both local and Pioneer hybrids. In non-irrigated conditions, the local hybrid Olt and the Pioneer hybrid PR35F38 and PR37F73 and particularly PR36V74 had a better performance.

For specific conditions of the corn cropping area from Romania, obtaining of high and stable yield requires irrigation, particularly in the South of the country as one of the most important factors of corn cropping technology.

In irrigated conditions, both local and Pioneer hybrids could express better yield with Olt and PR36V74 performing outstanding in such favorable conditions. Although, moderate to no stress occurred in the experimental years 2009-2011, the consistent yield differences obtained for all local and Pioneer hybrids in irrigation conditions versus non-irrigated proved the superiority of irrigated technology for reaching the outstanding yielding potential of modern corn hybrids.

The regime of water applied in addition, in the limits of possibility to each farmer, it brings usually a very significant increase in the production capacity of any used maize cultivar, of course translated into a bigger profit to the unit of area.

REFERENCES

[1] Axinte M., Borcean I., Roman V.GH., Muntean S.L., *Fitotehnie*, Editura „Ion Ionescu de la Brad", Iaşi, 2006.

[2] Cristea M, Cabulea I, Sarca T, 2004. *Porumbul*. Studiu monografic Editura Academiei Române, Bucureşti, 39-42.

[3] Jinga I.,Cîmpeanu S.Cîrnaru Cătălina, 2000. *Evoluţia producţiei de porumb şi a caracteristicilor solului brun roşcat.* Sesiunea ştiinţifică a cadrelor didactice, USAMV Bucureşti.

[4] Institutul Naţional de Statistică, *Anuarul statistic al României*, 1990-2008.

[5]Sarca T., Cosmin O., Ciocazanu I., Bica N.and Bagiu C. 1996. *Maize breeding for drought tolerance.* Pag 1-11, Romanian Agricultural Research number 5-6.