Scientific Papers. Series A. Agronomy, Vol. LIX, 2016
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

INFLUENCE OF DIFFERENT LEVELS OF WATER SUPPLY ON PRODUCTION AND ECONOMIC EFFICIENCY UNDER MAIZE CULTIVATED IN DOBROGEA REGION OF ROMANIA

Cristian Laurentiu DRAGOMIR[1], Elena PARTAL[2]

[1]Agricultural Research and Development Station Valu lui Traian, Constanța, County,
[2]National Agricultural Research Development Institute, Fundulea

Corresponding author email: cl.dragomir@yahoo.com

Abstract

Profitability is one of the most important economic parameters taken into account in any economic activity. The aim of the paper was to establish maize productivity and profitability of some hybrids with different precocity under several levels of water, in the conditions of Romanian Dobrogea region. Economic efficiency was evaluated using specific economic indicators (production cost, net profit and net profit rate) in order to establish which hybrids perform better. Identification, establishment and improvement of technological links to determine and maintain the achievement of high yields in order to reduce costs per hectare, we must determine as specialists, to grant a real influence of technological parameters and climatic conditions. In this study, the main technological parameters are: application of irrigation, the origin of germplasm (hybrids) and the early hybrids.

Key words: *hybrid, maize, yield, irrigation, productivity, profitability.*

INTRODUCTION

Economic efficiency and the yield in irrigated agriculture depend in part on the irrigation regime applied to each crop.

Establishing and applying a rational irrigation regime is aimed at controlling of soil water supply in accordance with plant requirements. The evolution of the thermal and rainfall regime, in the southeast area of Romania causes an increased moisture deficit, while the average annual values of heat are high (Botzan, 1972).

For optimal irrigation of maize, it is imperative to know when to intervene with watering and how much water to use for every watering (Muresan, 1970).

The hybrid genetic qualities participate decisively in the evolution of plants and thier productivity (Jadav and Shelke, 2006).

In irrigated crop, maize secures approximately 70-80% of necessary water from superficial layer located between 0-80 cm depth.

After irrigation, the yields increase with 60-70% and irrigation also reduces variability of yields from 40-45% to 10-15%: the profitability of irrigated crops compared to non-irrigated crop is clear (Luca, 1996).

MATERIALS AND METHODS

The research was conducted under the conditions of Agricultural Research and Development Station Valu lui Traian - Constanta, on the verma chernozem soil, using the method of split plots:

Factor A - irrigation regime: a1 - irrigated, a2 – irrigated at 50% of recommended amount ($350m^3$/ha), a3 - full irrigation ($700m^3$/ha).

Factor B - germplasm, including hybrids: b1 - Turda 145; b2 - Severo, b3 - PR37D25, b4 - Oituz, b5 - Kamelias, b6 - PR36D79, b7 - Rhapsody, b8 - KWS 1394; b9 - PR35F38.

Experience was placed in plots in three repetitions, with the protection zone of 24 m between the variants regime. Water management has been sprinkler irrigation. Measuring the amount of water was performed using rain gauges placed on the column of sprinkler. The technology used in these experiments with corn hybrids was that recommended for the climatic conditions of Dobrogea area.

The preceding crop was: in 2010 - wheat, in 2011 - pea, in 2012 - corn. Complex fertilizer was applied in the autumn: 200 kg/ha of NPK 20:20:0 type, and in the spring, at the seedbed

preparation: 200 kg/ha NPK 28:28:0 type. During the growing season, the nitrogen dose was supplemented with 40 kgN/ha. Results have been calculated statistically.

The year 2010 was a particularly rainy year, with a total of 662.8 mm rainfall recorded, respectively with 230.7 mm more than the annual average.

The year 2011 in contrast to the previous one, was particularly dry with a total rainfall of 368.9 mm to 62.7 mm rainfall less than the annual average, and 2012 was dry, to 393.4 mm rainfall recorded at Valu lui Traian and 38.2 mm less than the annual average (Figure 1).

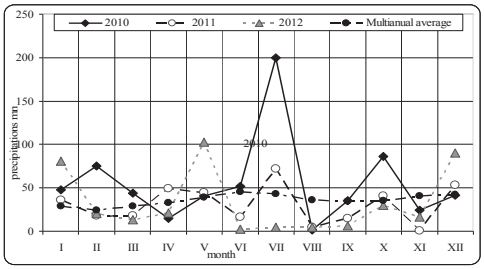

Figure 1. Recorded rainfall in SCDA Valu lui Traian during the years 2010-2012

During the period June-July, when the maize crop is achieved highest water consumption, have been recorded different amounts of water from rainfall: in 2010 to 251.3 mm, in 2011 to 88.1 mm, and in 2012 by 6.9 mm under the annual average.

Deviations from the average mutianuală (71years) of rainfall recorded at Valu lui Traian had large variations, with a peak in 2010 of 156.7 mm in July. The minimum level of rainfall was recorded in June 2012 with a deficit of 43.3 mm.

The average temperature in 2010 was 12.3°C, by 1.3°C above the annual average. Also, the temperatures exceeding average were recorded in June (+1.5°C), July (+1.8°C), august (+4.4°C) and September (+1.9°C).

The average temperature in 2011 was 11.2°C with 0.2°C above the annual average. Temperatures above average were recorded in June (+1.2°C), July (+1.8°C), august (+2.3°C) and September (+3.3°C).

Temperatures recorded in 2012 demonstrates once again increased aridity trend in this area of the country, with temperatures of 2.4°C above the annual average. Deviations from the annual average temperature recorded at Valu lui Traian, showed high variations both on a monthly and annually.

These values confirm that, in Dobrogea, the rainfall is insufficient and unevenly distributed for maize crop (Figure 2).

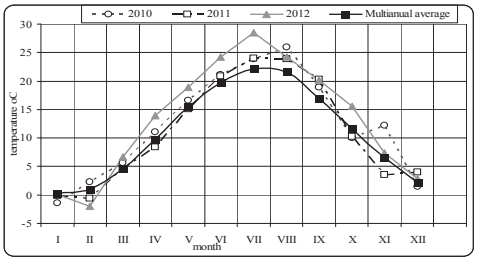

Figure 2. Temperatures recorded in Dobrogea during the years 2010-2012

RESULTS AND DISCUSSIONS

Variation of the climatic conditions from the period of experimentation combined with the influence of technological factors have contributed to production results between very wide limits.

Thus, we can make a real comparison and to establish the best technological variants.

Analyzing the productions obtained was found that cultivated hybrids were different in terms of production capacity depending on the norm of watering and precocity.

The highest yields were recorded for PR35F38-Pioneer hybrids (b9) with 13 901 kg/ha, followed by Rapsodia (b3) with 13 183 kg/ha and KWS-1394 (b8) with 12 970 kg / ha, with full irrigation and late precocity (Figure 3).

The lower productions have realized without irrigation, the hybrid Turda 145 (b1) with 1509 kg/ha under the average. For irrigated with 350 m^3/ha the hybrid KWS Severo (b2) was placed with 1143 kg/ha under the average and for full-time irrigation (700 m^3/ha),

Turda 145 hybrid obtained a production of 9750 kg/ha, with 2460 kg/ha below the average of the testing.

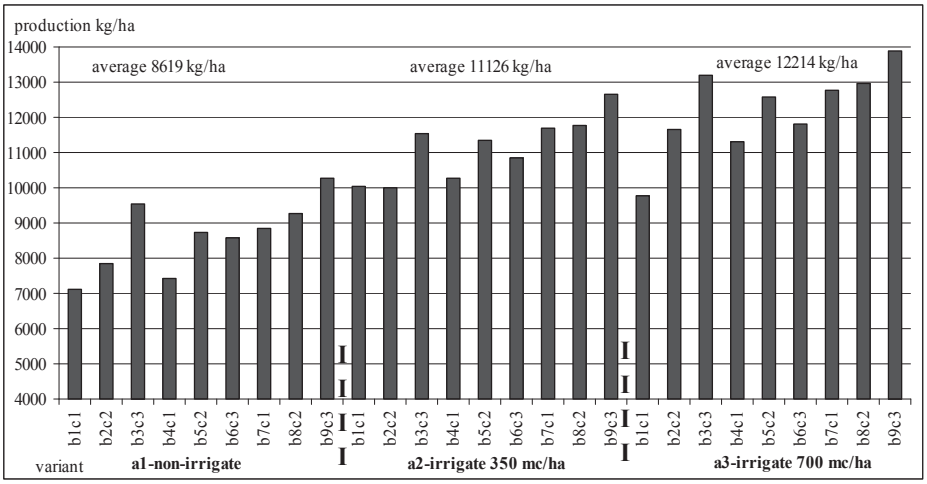

Figure 3. Production obtained according to the technological variants

These results are confirmed by other researcher, who emphasize that the most important tehnological elements is the irrigation, germplasm and precocity (Hall et al., 1982; Năescu şi Alionte, 2008; Ouda et al., 2008; Samakande et al., 2004).

The recorded rainfall and irrigation norms applied, both the 700 m^3/ha and the reduced with 50% (350 m^3/ha) have partially attenuated the effects of drought and contributed decisively to ensure production, particularly in 2012, considering the deficiency rainfall recorded from the annual average of the area.

Analyzing the main elements determining the economic efficiency respectively the profit, profit rate and production, as the average for the entire experimental period, results that the highest profit values were recorded at the hybrid Pionier PR35F38 with late precocity, with 10.590 RON/ha in irrigated full-time (700 m^3/ha) (Table 1).

For irrigation on part-time (350 m^3/ha) were recorded averages of 9678 RON/ha, at the hybrid Pionier PR35F38 with late precocity, compared with non-irrigated variant, at which were obtained lower values with 2144 RON/ha.

Regarding the profit rate, the highest values were recorded at the variant irrigated part-time (350 m^3/ha) with 438 % and the variant irrigated full-time (700 m^3/ha) with 428 %, both at the hybrid Pioneer PR35F38 with late precocity.

The rate of profit indicates a higher profitability for all hybrids, regardless of precocity, with the application of irrigation. This shows that, depending on the source of genetic material, it is necessary to apply the watering (Figure 4).

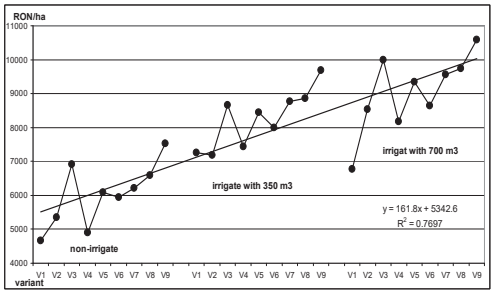

Figure 4. The comparation of profit between variants

The variants with the lowest profit rate was achieved without irrigation, with values between 230-340% for Romanian hybrids, with 235-288 % for KWS hybrids and 295-356 % for Pioneer hybrids, compared with similar variance from full irrigation (700 m^3/ha) who obtained values ranging between 282 to 415% for romanian hybrids, 332-378 % for KWS hybrids and 391-428 % for Pioneer hybrids (Figure 5).

Table 1.The classification of experimental variants under the influence of the profit realized (average 2010-2012)

Class.	Tehnological variants	Production (kg/ha)	Total profit (lei/ha)	Semnification
1	a3b9c3	13901	10590	A
2	a3b3c3	13183	9984	A
3	a3b8c2	12970	9738	AB
4	a3b7c1	12780	9567	AB
5	a2b9c3	12647	9678	AB
6	a3b5c2	12560	9336	ABC
7	a3b6c3	11827	8940	ABC
8	a2b9c2	11767	8854	ABC
9	a2b7c1	11673	8764	ABCD
10	a3b2c2	11637	8535	ABCD
11	a2b3c3	11543	8657	ABCD
12	a2b5c2	11343	8446	ABCDE
13	a3b4c1	11313	8171	ABCDE
14	a2b6c3	10857	7987	ABCDE
15	a2b4c1	10273	7540	BCDE
16	a1b9c3	10267	7534	BCDE
17	a2b1c1	10047	7257	BCDEF
18	a2b2c2	9983	7191	CDEFG
19	a3b1c1	9753	6966	DEFG
20	a1b3c3	9523	6915	DEFG
21	a1b8c2	9263	6598	EFG
22	a1b7c1	8843	6209	FG
23	a1b5c2	8717	6080	GH
24	a1b6c3	8573	5946	GH
15	a1b2c2	7853	5347	HI
26	a1b4c1	7417	4892	HI
27	a1b1c1	7110	4657	I
(Theoretic SD values) RON/ha		2560.2	2890.5 3080.3	

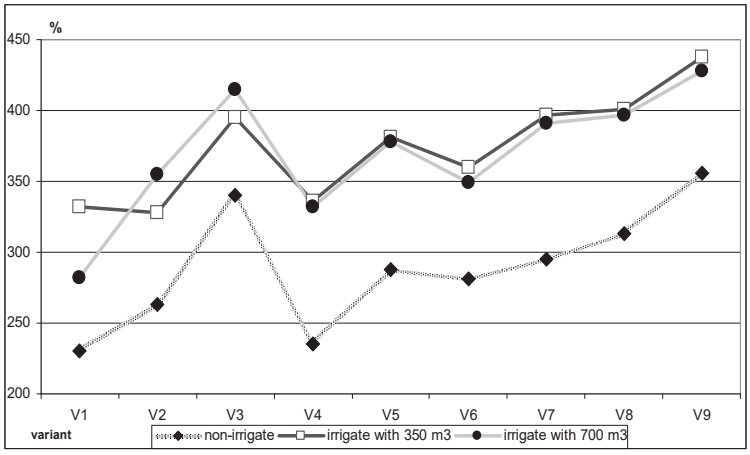

Figure 5. The comparison of profit rates between variants

CONCLUSIONS

1. The rainfall recorded during the experiment confirms that the Dobrogea they are insufficient and unevenly distributed for maize culture.
2. Irrigation rules applied, the norm of 700 m^3/ha and the the norm of 350 m^3/ha have contributed decisively to ensure production, given the deficit of rainfall and drought.
3. The maize crop profitability is dependent on the climatic conditions of the year, agrophytotechnical factors and genetic particuliarities of hybrid (drought tolerance).
4. The economic results underlines productivity and profitability of some variants that show the posibility to cut the watering norm by 50 % (from pedological norm of 750 m^3/ha).
5. In terms of economic perspective, in the climatic conditions existing in the study area, is important the genetic value of the hybrids and the irrigation in the key moments of the plants development.
6. In conclusion, the hybrid selection and application of watering should be done judiciously, depending on the culture and climatic conditions, so that the maize can efficiently exploit the climate and increase economic efficiency.

REFERENCES

Botzan M., 1972. Bilanțul apei în solurile irigate. Ed. Acad. Bucuresti.

Hall A.J., Vilella F., Trapani N., Chimenti C., 1982. The effects of water stress and genotype on the dynamics of pollen-shedding in maize. Field Crops Res., 5:349-363.

Jadav V.T., Shelke D.K., 2006. Growth, yield and yield attributes of maize as influenced by land layouts, hybrids and fertilizer levels in kharif. Journal of Maharashtra Agricultural Universities, 31: 231-232.

Luca E., 1996. Irigarea porumbului în zona subumedă a Transilvaniei. Ed.Grand, Bucureşti

Mureşan, D., 1970- Curs de îmbunătăţiri funciare. Vol. II, Tipo. Agronomia Cluj

Năescu V., Alionte E., 2008. Importanţa irigării, la principalele culturi de câmp, în condiţiile unui an cu secetă accentuată. AN. I.N.C.D.A. Fundulea, LXXVI: 87-100.

Ouda S.A., El-Fetouh Mohamed S.G., Khalil F.A., 2008. Modeling the Effect of Different Stress Conditions on Maize Productivity Using Yield-Stress Model. International Journal of Natural and Engineering Sciences, 2 (1): 57-62.

Samakande I., Senzanje A., Manzungu E., 2004. Sustainable water management in smallholder irrigation schemes: Understanding the impact of field water management on maize productivity on two irrigation schemes in Zimbabwe. Physics and Chemistry of the Earth, Parts A/B/C, Vol. 29, Issues 15-18: 1075-1081.