RESEARCH REGARDING THE INFLUENCE OF CROP TECHNOLOGY, WATER SUPPLY AND CULTIVATED GENOTYPE ON MAIZE ECONOMICAL EFFICIENCY IN MOSTISTEA PLAIN

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Abstract: *Aim of studies and researches - Normally, any result achieved in experimental fields must be followed by an economical estimation which clearly highlights the economical advantages of new variants in crop technologies. The economical calculation allows the elaboration of a budget of expenses and incomes specific to each unit, so that, it takes into consideration the production cycle and the determination of production cost and possible incomes/area unit or tone of products. Stage of research - Similar researches were also performed in Mostistea Plain, for soybean, following the same aspects. Materials and methods - The researches were performed during 2005-2007, in Mostistea plain, by a tri-factorial experiment, and the achieved results were technical-economically processed. For a beter relevance of the results, the calculation was achieved for the three years of experiment, in Euro, the utilization price being represented by Chicago's quotation. It was also taken into consideration the value of subsidies from state budget, VAT difference, which increased the expenses in maize. All economical results were finally statistically processed. Novelty degree - Within the research, a parallel between classical maize irrigation method (overhead irrigation) and modern one (drip irrigation) was performed. Stage of achievements - The researches, on the world plane, proved that drip irrigation is economically superior to overhead one. Limits of the research - There were no similar researches in other areas of the country. Practical implications of the research - The results allow, to farmers, to efficiently dose their efforts, based on principle "much more with much less" under the context of global crisis. Paper originality - The paper presents high originality degrees, there are no similar researches, till present, in Mostistea Plain. Importance of the paper - Having in view the high cost of irrigation water, the diminution of irrigation norm, by the most "high-tech" methods, has direct implications on economical indicators (production cost, benefit).*

Key words :*limited water supplying; watering rate; irrigation norm; water consumption,drought*

INTRODUCTION

The relatively high frequency of drought and heat periods from June, July and August, in the South, South-east and South-west of the country determined alongside the enlargement of irrigation, the using of some genotypes resistant to drought and heat too, or those which allow the avoidance of drought, especially during critical stages, due to their developmental cycle. The tolerance to drought of genotypes currently cultivated presents a special importance under natural conditions of Romania, because the critical stages for water, during vegetation period, correspond to droughts with variable intensities and times. Tolerance to drought and heat is a complex feature, and the researches performed under natural and artificial conditions of drought and heat emphasized that there are large differences between genotypes, as regards the reaction to these ecological stresses. Under conditions of both joining to European Union and current context of market, the obtainment of high and stable yields under economical efficiency and environment preservation is of great importance.

Normally, any result achieved in experimental trials must accomplished by an economical calculation which should clearly underline the economical advantages of a new crop technology variant. The economical calculation allows the elaboration of a budget

(expenses and incomes) specific to each economic unit, which must be taken into account before production cycle, as base for yield costs and possible incomes per area unit or ton of product.

MATERIALS AND METHODS

The researches were performed during three years (2005 - 2007), in Mostistea Plain, by a tri-factorial experiment, in which, the factor A was represented by crop technology, the factor B was irrigation regime and the factor C was cultivated genotype.

The economical efficiency was estimated based on yields results and inputs of all variants under testing.

To better emphasize the values, the calculation was done in Euro, at RNB currency exchange of 3.6772 ron/euro in 2008; implications in production costs of factors allocated for various experimental variants were determined.

To establish the incomes per area unit, the reference prices for the two crops were used, namely the quotation of Chicago Commodity Market with average price/1 ton of maize of 122.1 euro and 245.1 euro/ton in soybean.

Also, to really establish the production costs the value of subsidies and State Aids given by UE and also by Romanian Government were taken into consideration:

According to Order of the ministry no 485/2008 and Government Decision no 804/2008, which amends the Government Decision no 220/2008 and the Order no 174/2008 as regards the subsidizing the price for fuel utilized to develop crops, the farmers will receive fuel subsidized with 1 ron/liter, till the limit of 39 liters/ha, and for whole area under exploitation will also receive 48 liters /ha, subsidized with 0.65 ron, meaning 193.654 euro/ton, the difference of 0.65 ron/liter representing the difference of reduced rate applied to fuels utilized in agriculture.

In the 2008 campaign, the SAPS consisted of 60.75 euro/ha, payable in Ron, at current exchange of 3.7413 Ron/euro, according to provisions of art.4, Government Decision no 1560/2008.

CNDPs consist of supplementary payments/area for crops under legislation, respectively 46.71 euro/ha, payable in Ron, at currency exchange of 3.7413 Ron/euro, according to the above mentioned legislation.

Also, the payment scheme for energetic crops according to Governmental Decision no 1574/2007, with a subsidy of 45 euro/ha was taken into consideration. So, for these two crops, total subsidies of 152.45 euro/ha were taken into calculation, according to the three subsidy schemes.

The maximum envelope/ha, unitary at national level, of subsidies from the state budget applied in irrigation, for 2007, was 700 Ron/ha limit.

To establish the mechanical works, one can start from normal plowing price/ha, which involves the fuels, lubricants, maintenance costs, earnings, redemption, other expenses and VAT value, of 19%.

To better assess the current economical conditions, the difference in VAT value between material acquisition for the two crops, mechanical works and VAT value of yield commercialization was taken into calculation.

Thus, the budget of expenses and incomes faced to two obvious situations: need to pay VAT difference towards State or to collect it.

The determination of yield expenses for each variant was done based on elements of economical calculation of Agro-Economical Institute and the results were statistically processed by ANOVA.

RESULTS AND DISCUSSION

Table 1

Total expenses (euro / ha)

Variant		a_1 - $N_{100}P_{60}$ 40.000 pl/ha			Average a_1	a_2 - $N_{180}P_{60}$ 70.000 pl/ha			Average a_2	Average a_1 - a_2
		2005	**2006**	**2007**		**2005**	**2006**	**2007**		
b_1- dryland	c_1 - F 475 M	713.5	676.3	582.1	657.3	852.4	783.2	708.7	781.5	719.4
	c_2 - Paltin	724.6	697.4	592.7	671.6	900.6	814.0	726.0	813.5	742.5
	c_3 - Campion	732.1	713.5	601.0	682.2	889.0	822.6	737.6	816.4	749.3
	Media	**723.4**	**695.7**	**591.9**	**670.3**	**880.7**	**806.6**	**724.1**	**803.8**	**737.1**
b_2- irrigated on 0-80 cm at Pmin 50%AMI with 800 m^3 ha by overhead	c_1 - F 475 M	726.1	1159.2	1302.5	1062.6	866.2	1302.0	1419.0	1195.7	1129.2
	c_2 - Paltin	709.4	1164.9	1327.1	1067.1	901.4	1313.3	1460.9	1225.2	1146.2
	c_3 - Campion	809.1	1174.8	1349.2	1111.0	902.7	1322.5	1489.7	1238.3	1174.7
	Media	**748.2**	**1166.3**	**1326.3**	**1080.3**	**890.1**	**1312.6**	**1456.5**	**1219.7**	**1150.0**
b_3- irrigated on 0-40 cm at Pmin 50%AMI with 400 m^3 ha by overhead	c_1 - F 475 M	745.0	1189.4	1323.2	1085.8	856.8	1310.6	1460.0	1209.1	1147.5
	c_2 - Paltin	725.0	1194.8	1361.3	1093.7	899.6	1334.7	1495.0	1243.1	1168.4
	c_3 - Campion	711.4	1205.0	1406.6	1107.7	907.6	1343.0	1513.8	1254.8	1181.2
	Media	**727.1**	**1196.4**	**1363.7**	**1095.7**	**888.0**	**1329.4**	**1489.6**	**1235.7**	**1165.7**
b_4- irrigated on 0-80 cm, at Pmin50%AMI with 400m^3 ha by drip	c_1 - F 475 M	728.2	934.2	1017.6	893.3	892.0	1048.0	1133.2	1024.4	958.9
	c_2 - Paltin	734.4	948.2	1043.2	908.6	909.9	1112.1	1167.9	1063.3	986.0
	c_3 - Campion	713.2	974.7	1071.0	919.7	882.8	1115.2	1190.9	1063.0	991.3
	Media	**725.3**	**952.4**	**1043.9**	**907.2**	**894.9**	**1091.8**	**1164.0**	**1050.2**	**978.7**
b_5- irrigated on 0-40 cm, at Pmin50%AMI with 200m^3 ha by drip	c_1 - F 475 M	729.4	926.1	995.5	883.7	862.9	1029.4	1119.2	1003.8	943.8
	c_2 - Paltin	728.5	948.6	1034.5	903.9	912.8	1094.9	1158.0	1055.3	979.6
	c_3 - Campion	726.5	964.1	1063.9	918.2	887.3	1078.2	1190.6	1052.1	985.1
	Media	**728.1**	**946.2**	**1031.3**	**901.9**	**887.7**	**1067.5**	**1155.9**	**1037.1**	**969.5**
average	c_1 - F 475 M	728.5	977.0	1044.2	916.6	866.1	1094.6	1168.0	1042.9	979.7
	c_2 - Paltin	724.4	990.8	1071.8	929.0	904.9	1133.8	1201.6	1080.1	1004.5
	c_3 - Campion	738.5	1006.4	1098.4	947.7	893.9	1136.3	1224.5	1084.9	1016.3
MEDIA	**GENERALA**	**730.4**	**991.4**	**1071.4**	**931.1**	**888.3**	**1121.6**	**1198.0**	**1069.3**	**1000.2**

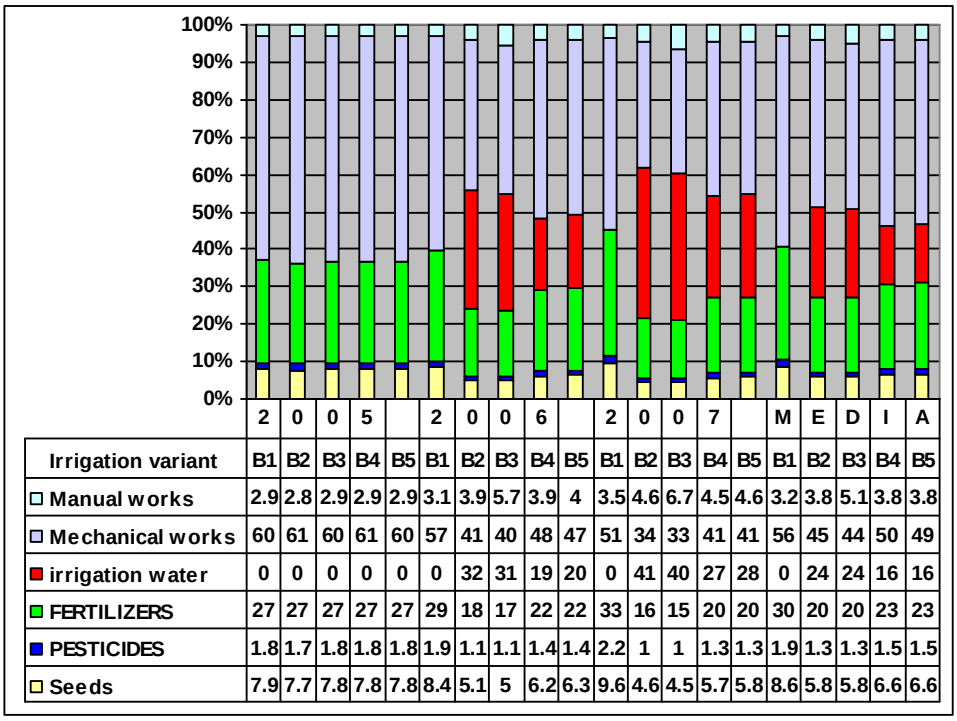
LSD value	LSD 5 %	LSD1%	LSD0,1%
For comparison between technological variants	42.37	97.85	311.40
For comparison between irrigation variants	190.09	261.82	360.45
For comparison between genotypes	9.48	12.68	16.67

The table 1 presents the synthesis of values regarding the total expenses/area unit. Thus, the technological variant a_2-$N_{180}P_{60}$ 70.000 pl/ha vs. check one a_1-$N_{100}P_{60}$ 40.000 pl/ha has registered a very significant gain, of 138 Euro/ha, 11.5%. In irrigated variant, the total value of expenses/ha increases very significantly in overhead irrigation and significantly in drip irrigation, vs. dryland variant; there were no statistically ensured differences between irrigation variants.

So, the values of total expenses per area unit, under irrigated variants vs. dryland ones were higher with 57%, respectively 31.5%, under overhead irrigation and drip one. By cultivation of the hybrids paltin and Campion vs. check F 475M, very significant differences between total expenses per area unit, 2.5% and 3.5%, were registered.

The differences between experimental variants were registered especially due to high value of fertilizers, irrigation water, with a price at Fundulea of 600 RON in 2007 and yielding differences between hybrids under study.

Figure 1 shows that, under dryland conditions, as three years experimentation average, the volume of mechanical works had the highest weight (56%) followed by the expenses made with fertilizers (30%). Under irrigation, the weight of mechanical works decreased to values which ranged between 44 and 50%, and the fertilizer expenses to 20-23%. The structure of maize under irrigation showed an important weight of irrigation water, 16-24%, depending on irrigation variant.



	2	0	0	5		2	0	0	6		2	0	0	7		M	E	D	I	A
Irrigation variant	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5	B1	B2	B3	B4	B5
Manual works	2.9	2.8	2.9	2.9	2.9	3.1	3.9	5.7	3.9	4	3.5	4.6	6.7	4.5	4.6	3.2	3.8	5.1	3.8	3.8
Mechanical works	60	61	60	61	60	57	41	40	48	47	51	34	33	41	41	56	45	44	50	49
irrigation water	0	0	0	0	0	0	32	31	19	20	0	41	40	27	28	0	24	24	16	16
FERTILIZERS	27	27	27	27	27	29	18	17	22	22	33	16	15	20	20	30	20	20	23	23
PESTICIDES	1.8	1.7	1.8	1.8	1.8	1.9	1.1	1.1	1.4	1.4	2.2	1	1	1.3	1.3	1.9	1.3	1.3	1.5	1.5
Seeds	7.9	7.7	7.8	7.8	7.8	8.4	5.1	5	6.2	6.3	9.6	4.6	4.5	5.7	5.8	8.6	5.8	5.8	6.6	6.6

Figure 1 Structure of expenses per area unit in maize for kernels, depending on irrigation variant, during 2005-2007

In droughty years, as 2007, the value of irrigation water could represent 27-40%of total amount of expenses per area unit and of manual works including manual manipulation of irrigation equipment, at 4.5-6.7%, fact that determined the diminution of mechanical works to 33-41% and of fertilizers to only 15-20%.

Between irrigation variant b_2-irrigated on 0-80 cm, at Pmin-50% AMI, with 800m^3 ha by overhead irrigation and irrigation variant b_3-irrigated on 0-40 cm, at Pmin-50% AMI with 400m^3 by overhead irrigation, a higher value of expenses was registered, which increased from 3.8% to 5.1%, reaching 6.7% in extremely droughty years, as 2007 one, under b_3-irrigated on 0-40 cm, at Pmin-50%AMI with 400m^3 by overhead irrigation.

Table 2

Net benefit per hectar (euro / ha)

Variant		a_1 - $N_{100}P_{60}$ 40.000 pl/ha			Average a_1	a_2 - $N_{180}P_{60}$ 70.000 pl/ha			Average a_2 **2006**	Average a_1 - a_2 **2007**
		2005	**2006**	**2007**		**2005**	**2006**	**2005**		
b_1- dryland	c_1 - F 475 M	466.4	338.0	-73.1	243.8	512.0	273.7	-98.6	229.0	236.4
	c_2 - Paltin	504.6	410.7	-50.5	288.3	678.0	379.8	-61.8	332.0	310.1
	c_3 - Campion	530.4	466.1	-32.6	321.3	637.8	409.4	-37.0	336.7	329.0
	Average	500.4	405.0	-52.1	284.5	609.3	354.3	-65.8	299.3	291.9
b_2- irrigated on 0-80 cm at Pmin 50%AM with 800 m^3 ha by overhead irrigation	c_1 - F 475 M	509.8	374.5	13.0	299.1	559.4	420.4	-21.8	319.3	309.2
	c_2 - Paltin	452.3	394.1	143.0	329.8	680.5	459.3	171.1	437.0	383.4
	c_3 - Campion	411.2	428.0	219.4	352.8	685.2	490.8	270.3	482.1	417.5
	Average	457.7	398.9	125.1	327.2	641.7	456.8	139.9	412.8	370.0
b_3- irrigated on 0-40 cm at Pmin 50%AM with 400 m^3 ha by overhead irrigation	c_1 - F 475 M	574.6	330.6	-182.3	241.0	527.1	292.1	-72.4	248.9	245.0
	c_2 - Paltin	506.0	349.2	18.8	291.3	674.6	375.1	95.5	381.7	336.5
	c_3 - Campion	459.0	384.3	223.8	355.7	702.1	403.9	160.1	422.0	388.8
	Average	513.2	354.7	20.1	296.0	634.6	357.0	61.1	350.9	323.4
b_4- irrigated on 0-80 cm, at Pmin50%AMI with 400m^3 ha by drip irrigation	c_1 - F 475 M	516.9	477.4	112.3	368.8	648.3	429.7	218.9	432.3	400.6
	c_2 - Paltin	538.2	525.6	339.1	467.6	710.1	650.8	338.2	566.4	517.0
	c_3 - Campion	465.2	616.8	435.0	505.7	616.7	661.4	417.3	565.2	535.4
	Average	506.8	539.9	295.5	447.4	658.4	580.6	324.8	521.3	484.3
b_5- irrigated on 0-40 cm, at Pmin50%AMI with 200m^3 ha by drip irrigation	c_1 - F 475 M	521.1	447.3	51.7	340.0	548.2	363.9	124.0	345.4	342.7
	c_2 - Paltin	517.9	524.7	255.1	432.6	720.0	589.6	301.7	537.1	484.9
	c_3 - Campion	510.9	578.2	405.6	498.2	632.2	532.0	413.9	526.0	512.1
	Average	516.7	516.7	237.5	423.6	633.5	495.2	279.9	469.5	446.6
average	c_1 - F 475 M	517.8	393.5	-15.7	298.5	559.0	356.0	30.0	315.0	306.8
	c_2 - Paltin	503.8	440.9	141.1	361.9	692.6	490.9	169.0	450.8	406.4
	c_3 - Campion	475.3	494.7	250.2	406.7	654.8	499.5	244.9	466.4	436.6
General	**AVERAGE**	499.0	443.0	125.2	355.7	635.5	448.8	148.0	410.7	383.2

LSD value	LSD 5 %	LSD1%	LSD0,1%
For comparison between technological variants	176.51	407.61	1297.13
For comparison between irrigation variants	91.84	126.50	174.15
For comparison between genotypes	39.58	52.90	69.56

The three-years experiment average value of manual expenses under drip irrigation b_4-irrigated on 0-80 cm, at Pmin-50% AMI with 400m^3 ha and b_5-irrigated on 0-40 cm, at Pmin-50% AMI with 200m^3 was maintained at value of overhead irrigation b_2-irrigated on 0-80 cm, at Pmin-50% AMI with 800m^3, of 3,8% .

Depending on the irrigation variant during three years of testing, the weight of mechanical works/area unit decreased from 56.3% under dryland to 49.5% under overhead irrigation and to 44.7% drip irrigation (fig.2). The second factor as importance in average expenses structure was represented by the value of fertilizers, which decreased from 30% under dryland to 22.9% under drip irrigation average and respectively 20% under overhead irrigation average.

The third factor as importance in average expenses structure was the value of irrigation water, which increased from 0% under dryland to 15.5% under drip irrigation average and respectively 23.8% under overhead irrigation average.

Due to irrigation variants, the volume of manual works ranged, on three-years testing average, from 3.2% under dryland to3.8% under drip irrigation average and 4.5% under overhead irrigation average.

In 2005, the net benefit in maize was ensured by the fact that there was no need of irrigation, the cost of irrigation water being registered as benefit. In 2006, even under dryland, an average benefit of 405 euro/ha was achieved in technological variant a_1-$N_{100}P_{60}$ 40.000 pl/ha and of 354 euro/ha, in technological variant a_2-$N_{180}P_{60}$ 70.000 pl/ha.

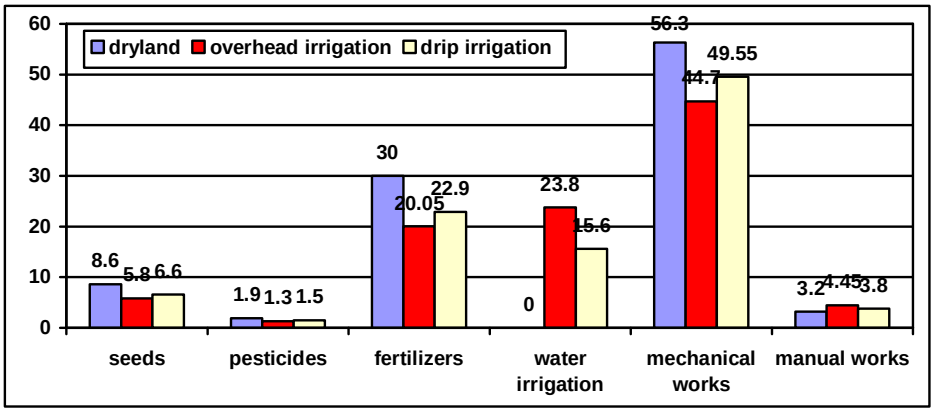


Figure 2. Average values of inputs in maize for kernels

In 2007, under dryland, average losses between 52.1 and 65.8 euro/ha were registered. Also, by incorrect utilization of yield factors, even irrigation did not lead to benefit, when the yield gain, due to synergic effect between irrigation and nitrogen fertilizers, did not cover the price of irrigation water and fertilizers applied to crop.

During the experimentation, the benefit was influenced directly by the amount of applied irrigation rates in 2006 and 2007, so that, on an average, the net benefit/ha ranged from 291.9 euro/ha under dryland to 484.3 euro/ha under irrigation variant b_4-irrigated on 0-80 cm, at Pmin-50% AMI with 400m^3 ha by drip irrigation (tabelul 2).

CONCLUSIONS AND RECOMMENDATIONS

The main productivity elements and costs depending on technological variants (fuel necessary, necessary of mechanization hours and manual works, total expenses with mechanical works, value of material expenses, expenses/area unit, production costs/area unit and per kernel ton at standard value, net benefit/area unit, per ton of kernels and share benefit) demonstrated the increasing of costs in technology $N_{180}P_{60}$ 70 thousands pl/ha, in the case of overhead irrigation, Campion hybrid. The drip irrigation determines the decreasing of production cost with about 150-300 euro/ha. Based on the above mentioned problems, this irrigation method could not be recommended; as net benefit, the highest value, of about 560 euro/ha, is achieved by the cultivation of hybrid Paltin under drip irrigation, with a rate of 400 m^3/ha. Under overhead irrigation, with a rate of 800 800m^3/ha, Paltin hybrid, $N_{180}P_{60}$ 70 thousands pl/ha, a net benefit of 500 euro/ha is assessed. So, the large exploitations should utilize overhead irrigation, while the smallest ones should utilize drip one, if the farmers could afford the adequate equipments. For production, it is not recommended the overhead irrigation with low and frequent rates, because they lead to increasing of expenses/area unit, with decreasing of net benefit. During three years of testing, by the cultivation of hybrids Paltin and Campion, very significant gains of net benefit/ha were achieved, of 99,6 Euro/ha, respectively 129,8 Euro/ha, resulting gains of 43% respectively de 42% vs. the check F 475M, which highlights the importance of superior genetics.

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