

WHEAT AND MAIZE YIELD VARIATIONS IN THE BROD-POSAVINA AREA

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Abstract

In general, wheat and maize yields in the Brod-Posavina County (BPC) were about 15% lower (10-year means 1981-1990) in comparison with their yields in the region. Wheat yield variations in the region among the years were higher in comparison with maize yield. For example, the highest yield of wheat and maize were higher than the lowest yield for 61% and 34%, respectively. Analogic comparison for Slav. Brod and N. Gradiska municipalities were 78% and 41% (wheat), as well as 41% and 24% (maize), respectively. In the last 8-year period, mean wheat yields in the region were for 17% lower and maize yield for 4% higher in comparison with mean yields of 80ies. These differences in level of BPC were 10% lower and 12% higher, for wheat and maize, respectively. We presume that low or absence effects of tile drainage because of their inadequate servicing could be expanlation for wheat yield decreasing. The lower yields of wheat are mainly in connection with oversupplies of water. However, low maize yields are in connection with water shortage and the higher air-temperatures. Low supplies of P and K are additional factors of low yields of field crops in the hydromorphic soils of the BPC.

Key words: maize, wheat, yield variation, the Brod-Posavina area, weather characteristics

Introduction

Weather characteristics, mainly precipitation and temperature regimes, are important factors of the field crop yields. Aim of this study was testing yield variations of wheat and maize among the years in the Eastern Croatia with emphasis on Brod-Posavina area. This area characterizing hydromorphic soils and yield variation were especially high in the period before improvement of soils by reclamation and drainage (Kovacevic and Basic 1997, Petosic et al. 2001, 2003). Yield variations among the years for the Eastern Croatia was elaborated in the previous studies (Kovacevic 2005, Kovacevic and Josipovic 2005).

Material and methods

Collection of the data and description of the area

The data of State Bureau for Statistics (from 1981 to 2003) and internal data of the state farms "Jasinje" Slav. Brod and "Nova Gradiska" Nova Gradiska were used as the source of grain yields data (from 1976 to 1990; the later data are not available because of restructuration and destruction of state farms). Weather Bureau Slavonski Brod was source of meteorological data. Until end of 1992 the eastern Croatia region was territorial divided in 14 municipalities of total area 11090 km². Due to war escalation in Croatia in the period from 1991 to 1995, the official statistics represent uncomplete data. Also, wheat and maize yields in this period were low mainly due to war-induced factors. Therefore, only data for the 1996-2003 period were shown. Since 1992, according to the new territorial division the Eastern Croatia includes five counties of total area 12454 km². Brod-Posavina County (BPC) covering areas of former Slav. Brod and Nova Gradiska municipalities (total 2034 km²). BPC is narrow belt (longitude

approximately 110 km and width from 7 to 25 km in west-eastern direction) delimited by river Sava toward south and by Psunj, Pozeska gora and Dilj Mountains toward north, while Slobostina river is border toward west. Part of the Vukovar-Sirmium Country (former Zupanja municipality) is the border toward east. Relief of this area is typically lowland and latitude between 80 and 100 m above sea level. There are three ways dampening of soils as follows: by surface water, underground water and by their combination. Dominant are different types of hydromorphic soils (Petosic et al. 2003).

Climatic characteristics

The eastern Croatia, including Sava valley (Brod-Posavina area), has moderate continental climate characterizing low horizontal changes of temperature and specific distribution of rainfall (more rainfall in the warmer part of year, from April to September). The mean amplitude of temperatures in lowland area of the region is about 22°C.

Results and discussion

In general, wheat and maize yields in the Brod-Posavina area were about 15% lower (10-year means 1981-1990) in comparison with their yields in the region. Wheat yield variations in the region among the years were higher in comparison with maize yield variations. For example, the highest yield of wheat (1990: 6.50 t/ha) was for 61% higher than the lowest yield (1981: 4.03 t/ha). This difference for maize yields was 34%. Analogic comparison for Slav. Brod and N. Gradiska municipalities were 78% and 41% (wheat), as well as 41% and 24% (maize), respectively (Table 1).

Table 1. Wheat and maize harvested areas (ha), grain yields (t/ha) and precipitation

Year of harvest	The harvested area (ha) and grain yields (t/ha)						Precipitation in Slavonski Brod (mm)	
	The Eastern		Brod-Posavina area*					
	Croatia		Slav. Brod m.		N. Gradiska m.			
	ha	t/ha	ha	t/ha	ha	t/ha		
	Winter wheat						Nov- Dec	Oct- June
1981	122538	4.03	8690	3.40	6862	3.75	185	661
1982	146980	4.49	10832	3.48	8227	3.84	140	483
1983	145549	5.27	9571	4.22	8952	4.52	146	467
1984	143874	5.58	9430	4.53	9178	4.31	36	503
1985	124065	5.32	8623	4.13	7808	4.73	60	534
Mean	136601	4.94	9429	3.95	8205	4.24	113	531
1986	124395	5.16	9336	4.46	8730	3.57	174	605
1987	146235	5.22	10907	4.43	9608	4.44	41	469
1988	148954	5.85	11745	4.92	9935	4.55	136	578
1989	146266	5.15	9812	4.75	9793	4.40	58	513
1990	148908	6.50	10472	6.04	9778	5.30	43	349
Mean	142952	5.58	10454	4.92	9569	4.46	90	502
	Maize						May- Aug.	July
1981	214 301	5.72	11328	4.44	12498	5.36	289	74
1982	201 268	6.40	12222	4.75	12595	5.13	334	108
1983	209 305	6.40	12766	4.65	12491	5.72	251	45
1984	206 779	7.08	12148	5.84	11671	5.50	335	56
1985	221 395	6.26	13496	4.60	13259	4.63	295	32
Mean	210610	6.37	12392	4.87	12503	5.28	151	63
1986	217 788	6.59	15658	5.55	12721	5.07	324	105
1987	197 149	5.33	15031	3.94	11942	4.85	223	40

1988	209 768	4.78	14395	2.91	12253	4.45	175	27
1989	208 312	5.46	15353	4.83	12874	5.69	324	61
1990	234 148	4.31	17974	4.91	12726	5.17	197	62
Mean	213433	5.29	15682	4.43	12503	5.05	249	60

Table 2. Wheat and maize harvested areas (ha), grain yields (t /ha) and precipitation

Year	The harvested area (ha) and grain yields (Y in t/ha) in the Eastern Croatia (ECr) and Brod-Posavina County (BPC) and precipitation (mm in Slav. Brod)									
	<i>Winter wheat</i>					<i>Maize</i>				
	ECr		BPC	mm		ECr		BPC	mm	
	ha	Y	Y	a	b	ha	Y	Y	a	b
1996	99473	4.21	3.89	155	504	154 202	6.30	6.15	243	47
1997	107613	4.57	4.16	192	553	159 770	7.01	6.37	315	106
1998	136652	4.80	4.46	161	437	169 935	6.20	5.48	276	88
1999	98690	3.62	3.34	133	525	177 353	6.50	5.62	403	210
2000	144680	5.00	4.75	222	420	180 182	4.31	4.30	151	88
Mean	117421	4.51	4.12	173	488	168 288	6.06	5.58	278	108
2001	145365	4.70	4.09	127	609	190 136	6.63	5.77	310	57
2002	141835	4.73	4.05	153	477	185 651	7.21	6.42	334	78
2003	127747	3.30	3.13	102	324	184 270	4.49	3.98	219	61

* the municipality (m.) Slav. Brod and Nova Gradiska (until 1990) and Brod-Posavina County (since 1996)

** Wheat: November + December of the previous year (a) and October - June (b); Maize: May-August (a) and July (b)

Table 3. Maize and wheat harvested areas yield variations in the state farms "Jasinje" and "Nova Gradiska" (internal data of the state farms)

The harvested area (ha) and grain yield (Y in t/ha) in the period from 1976 to 1990														
	Wheat		Maize			Wheat		Maize			Wheat		Maize	
	ha	Y	ha	Y		ha	Y	ha	Y		ha	Y	ha	Y
The state farm "Jasinje" Slav. Brod														
1976	3180	4.58	4049	2.59	1981	3070	4.44	3610	6.53	1986	4041	5.43	3525	7.72
1977	1914	3.36	3646	5.00	1982	3600	4.52	3320	5.55	1987	4525	5.71	3173	5.42
1978	4615	3.42	1566	3.70	1983	3743	5.61	3253	6.32	1988	4850	5.73	2963	4.35
1979	3142	5.20	2710	5.66	1984	3943	6.03	3220	7.81	1989	4564	5.65	2781	7.02
1980	2950	3.63	2390	5.31	1985	3852	5.38	3851	6.12	1990	4700	7.37	3115	6.87
	3160	4.04	2872	4.45		3642	5.20	3451	6.47		4536	5.98	3111	6.28
The state farm "Nova Gradiska" Nova Gradiska														
1976	2648	4.48	1864	3.95	1981	1752	4.78	3292	7.04	1986	3270	4.74	2296	6.30
1977	3318	4.32	2962	5.15	1982	2622	4.60	2895	5.25	1987	2860	5.40	2117	6.37
1978	3288	4.15	2565	5.20	1983	3244	5.58	2798	6.05	1988	2554	5.41	2880	5.85
1979	5475	4.55	2692	7.10	1984	3106	5.12	2328	6.81	1989	3555	5.79	2349	7.23
1980	3050	4.69	2008	5.46	1985	2447	5.56	2950	5.30	1990	3665	6.70	2630	6.39
	3556	4.44	2418	5.37		2634	5.13	2851	6.09		3181	5.61	2594	6.43

In the last 8-year period, mean wheat yields in the region were for 17% lower and maize yield for 4% higher in comparison with mean yields of 80ies. These differences in level of BPC were 10% lower and 12% higher, for wheat and maize, respectively (Tables 1 and 2). These differences are impossible to explain by wether factors only. We presume that low or absence effects of tile drainage because of their inadequate servicing (Petosic 1994, Petosic et al. 2001) could be explanation for wheat yield decreasing. Variations of the field crop yield among the years for the short period is possible to explain by specific characteristics of weather (the effects of "year"). With that regard, the lower yields of wheat are mainly in connection with oversupplies of water, especially in the autumn/winter period (Kovacevic, 2005). However, low maize yields are in connection with water shortage and the higher air-temperatures (Kovacevic and Josipovic, 2005), especially in July/August (Table 4). Some nutritional problems in hydromorphic soils in the Brod-Posavina area (low supplies of P and K) are additional factors of low yields of the field crops (Kovacevic and Grgic 1995, Kovacevic et al. 1997, Petosic et al. 2003).

Table 4. Influences of precipitation and temperature regimes on wheat and maize yields in the state farm "Jasinje" Slav. Brod

Precipitation (mm) and mean air-temperature (°C) in the less favorable (LFY), more favorable (MFY) growing season and LTM (long-term means 1971-1990) - the data of Weather Bureau Slav. Brod

Winter wheat (year of harvest)							Maize						
	1980 (LFY)		1984(MFY)		LTM			1988 (LFY)		1989 (MFY)		LTM	
	mm	°C	mm	°C	mm	°C		mm	°C	mm	°C	mm	°C
Oct.	58	9.0	30	10.1	61	10.3							
Nov.	59	6.1	17	2.4	59	4.6	Apr.	48	10.8	72	13.5	58	10.7
Dec.	74	4.2	20	0.3	46	1.2	May	28	16.7	180	14.8	74	15.9
Jan.	44	-2.4	110	0.4	44	-0.6	June	70	18.8	95	17.5	82	18.8
Feb.	60	2.7	40	0.5	39	1.8	July	27	23.3	61	21.0	87	20.1
March	47	5.9	47	5.1	46	6.4	Aug.	50	21.4	88	20.0	71	19.9
April	102	7.8	48	10.2	58	10.7	Sept.	76	16.4	88	15.8	54	15.9
May	139	13.1	125	14.9	74	15.9	Oct.	46	10.4	49	10.2	61	10.3
June	113	18.6	67	17.5	82	18.8							
Total	696		504		509		Total	345		633		487	
Mean		7.2		6.8		7.7	Mean		16.8		16.1		15.9
Yield (t/ha) and harvested area (ha: in the bracket) in the "Jasinje" (LTM: 1981-1990)													
	3.63 (2950)		6.03 (3943)		5.59 (4089)			4.35 (2963)		7.02 (2781)		6.38 (3281)	

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