

RESISTANCE OF WINTER WHEAT CULTIVARS TO PRE-HARVEST SPROUTING

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SUMMARY

In Croatia, in the last six years, the most important cultivars of winter wheat are Žitarka, Marija, Sana, Ana, Demetra and Srpanjka. Cultivars Ana and Demetra belong to wheat improvers and Žitarka is good bread wheat cultivar. Cultivars Marija and Srpanjka have lower bread-making quality while cultivar Sana is suitable to biscuit. Cultivar Žitarka has resistance to lodging and many wheat diseases while Marija and Sana have higher yielding capacity than Žitarka, but minor resistance to powdery mildew (*Erysiphe graminis*) and fusarium (*Fusarium* sp).

By reason of long rain period in 1997 wheat harvest, what is unusually in Croatia, these cultivars had different shattering and sprout damage grain in spike. At cultivars Žitarka and Srpanjka had no shattering and sprout damage grain in spike even after twenty days from beginning harvest. Cultivar Marija had shattering but not sprout damage, while at other cultivars were established shattering and sprout damage grain in spike. Resistance on sprout damage grain in spike of these cultivars showed Falling number after rainfall that ranged for Žitarka 272, Srpanjka 350, Ana 71 and Demetra 92. Sprout damage grain in spike decreased breadmaking quality of cultivar Ana and Demetra.

Considering that these the most grown wheat cultivars in Croatia were basis of breeding program at Agricultural Institute Osijek, these results have been useful for wheat selection. New OS winter wheat cultivars Super Žitarka and Barbara (Žitarka is one of the parents) have higher yielding capacity than Žitarka. They retained good properties of Žitarka such as resistance to lodging, low winter temperatures, wheat diseases, shattering, rainless, sprout damage grain in spike and good breadmaking quality. The Falling number of cultivar Super Žitarka and Barbara were not change two weeks after rainfall.

Key words: wheat, sprout damage grain in spike, bread making quality

INTRODUCTION

In Croatia, in the last six years, the most important cultivars of winter wheat were Žitarka, Marija, Sana, Ana, Demetra and Srpanjka. About 90% areas under winter wheat in Croatia in these years were sowed with cultivar Žitarka (33%), Marija (28%), Sana (12%), Ana (11%), Demetra (5%) and Srpanjka 1% in 1993 to 12% in 1997.

Many cloudy days until maturity with lower air temperature and long rain period after ripening of wheat in 1997 year, caused shattering and sprout damage grain in spike in some cultivars and lower expected grain yields and deteriorate flour and bread quality.

From that reason there is a strong demand for the introduction of new cultivars in production with better and more stable agronomic and technological characteristics.

The aim of this study was examined all breeding materials in wheat selection on sprout damage grain in spike because of long rain period in 1997.

MATERIALS AND METHODS

In the field experiments and in the laboratory at the Agricultural Institute Osijek (1993-997), some important agronomic and technological characteristics of the most important winter wheat cultivars in Croatia and two new OS winter wheat cultivars were analyzed.

Žitarka, Ana, Demetra and Srpanjka and two new cultivars Barbara and Super Žitarka are cultivars belong to Agricultural Institute of Osijek. Cultivars Marija and Sana belong to Institute for Plant Breeding and Seed Production in Zagreb.

Visual evaluation of grain sprouting and shattering resistance of analyzed cultivars has been done at two locations Osijek and Orahovica, two to three weeks after ripening.

Analytical determination hectolitre mass and thousand kernel mass were measured by standard methods. Falling number, sedimentation value and crude protein were determined according to AACC methods (AACC, 1983). Wet gluten and Gluten Index were determined using a Glutomatic 2200 system and Glutomatic 2015 centrifuge, essentially according to the manufacturer's instructions (Operating manual, 1996).

RESULTS AND DISCUSSION

Žitarka, Marija, Sana, Ana, Demetra and Srpanjka occupied about 90% areas sown under winter wheat in Croatia in the last six years. Representation of these cultivars according to sold quantities were shown in Figure 1.

Figure 1. Representation (%) of the most grown winter wheat cultivars in Croatia (1992-1997)
 Slika 1. Zastupljenost (%) najuzgajanih kultivara ozime pšenice u Hrvatskoj (1992-1997)

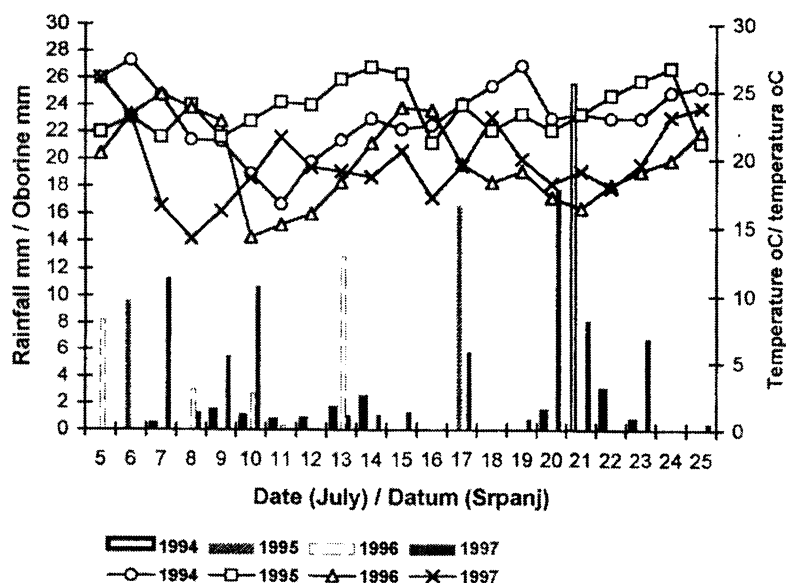


Table 1. Agronomic und technological parameters of the most grown winter wheat cultivars in Croatia, field trials at Agricultural institute Osijek (1994-997)

Tablica 1. Agromomski i tehnološki pokazatelji najuzgajanih kultivara ozime pšenice u Hrvatskoj, poljski pokusi na Poljoprivrednom institutu Osijek (1994-1997)

Cultivar	*Grain yield %	Date of earing (May)	Plant height cm	Hectolitre mass kg	1000 kernel mass g
Kultivar	*Urod %	Datum klasanja (svibanj)	visina stabljike cm	Hektolitarska masa kg	Masa 1000 zrna g
Žitarka	100.0	16.2	76.5	80.8	41.3
Marija	104.3	13.2	78.0	77.4	38.4
Sana	109.1	15.3	81.2	77.7	42.2
Ana	110.0	13.0	72.5	78.5	36,3
Demetra	107.2	12.3	73.5	78.4	37.5
Srpanjka	104.3	10.5	63.5	79.5	36.0

*Žitarka: 86.2 dt/ha=100.0%

These cultivars have mostly differently genetic basis and good agronomic and/or technological performances (Table 1-3). Cultivars Ana and Demetra are wheat improvers and Žitarka is good bread wheat cultivar (Jurković et al., 1996). Cultivars Marija and Srpanjka had lower bread-making quality while

cultivar Sana was suitable to biscuit. Cultivar Žitarka had resistance to lodging and many wheat diseases while Marija and Sana had higher yielding capacity than Žitarka, but minor resistance to powdery mildew (*Erysiphe graminis*) and fusarium (*Fusarium* sp).

Figure 2. Weather conditions during July in period from 1994 to 1997
 Slika 2. Vremenske prilike u Srpnju u razdoblju od 1994. do 1997. godine

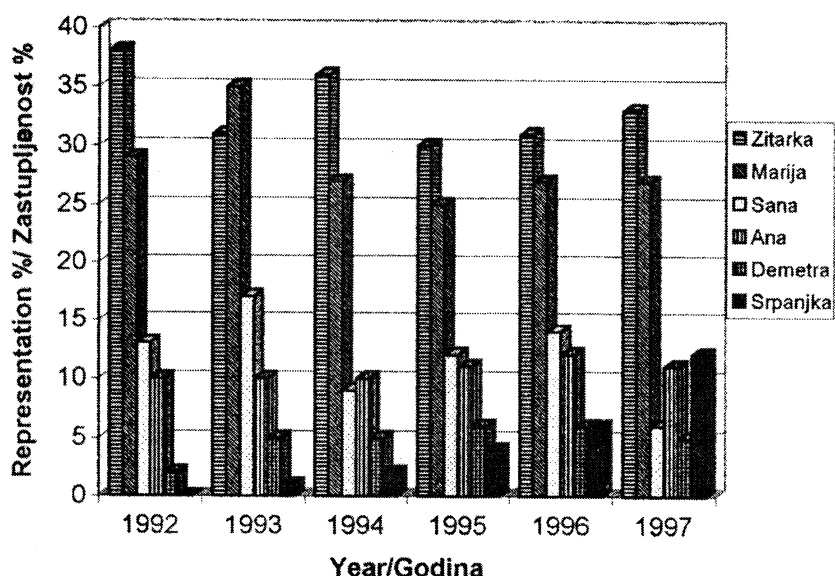


Table 2. Shattering and sprout damage grain in spike two week after mature of the most grown winter wheat cultivars in Croatia, field trials at Osijek and Orahovica localities (1997)*

Tablica 2. Osipanje i klijanje zrna u klasu dva tjedna poslije zrenja kod najuzgajanih kultivara pšenice u Hrvatskoj, poljski pokusi na lokalitetima Orahovica i Osijek (1997)*

Cultivar Kultivar	Osijek		Orahovica	
	Shattering Osipanje	Sprout damage grain in spike Klijanje zrna u klasu	Shattering % Osipanje%	Sprout damage grain in spike % Klijanje zrna u klasu %
Žitarka	No	No	0	0
Marija	Yes	No	20	0
Sana	Yes	Yes	50	40
Ana	Yes	Yes	10	5
Demetra	Yes	Yes	10	>5
Srpanjka	No	No	1	0

*visually evaluation

Grain sprouting in spike and shattering in some cultivars was in connection with long rain period after ripening (Figure 2, Table 2). Such climatic conditions are more a like to climatic conditions of north-western Europe that are constant threat to wheat crop there (Pomeranz, 1978).

Table 3. Quality parameters of the most grown winter wheat cultivars in Croatia, field trials at Agricultural institute Osijek (1997)

Tablica 3. Pokazatelji kakvoće najuzgajanijih kultivara ozime pšenice u Hrvatskoj, poljski pokusi na Poljoprivrednom institutu Osijek (1997)

Cultivar	Protein %	Sedimentation	Wet gluten	Gluten	Falling number	
		value ml	%	index	Broj padanja	
Kultivar	Bjelančevine %	Sedimentacijska	Vlažni	Gluten	before rain	after rain
		vrijednost ml	gluten %	indeks	prije kiše	poslije kiše
Žitarka	13.21	54	35.28	67	291	272
Marija	10.83	30	20.31	98	353	
Sana	11.13	28	24.71	76	173	
Ana	11.23	46	24.26	98	198	71
Demetra	11.64	50	25.18	99	185	92
Srpanjka	11.43	34	22.83	94	351	350

Dormancy or sprouting resistance depends on several factors of genetically nature including those physiological: embryo development, a state of the seed-coat and presence of inhibiting substances in the glumes that are prolong activity of enzymes breaking starch and proteins in embryo and scutellum (Peterson, 1965).

There are some confusing results that wheat cultivars of dark-red kernels have better dormancy from those with pale-red and white kernels (Mc Caig, 1992).

Although this problem is not accentuated in Croatia, analyses of wheat flour of newly created wheat cultivars from 1997 year indicate (Table 4) that there is a reason to devote greater attention to grain sprouting and shattering resistance combined with better bread-making quality in long-term wheat breeding programs.

All breeding materials in selection on sprout damage grain in spike were examined because long raining period in 1997.

Long cloudy period from anthesis to maturity in 1997 year, what is unusually in Croatia, and lower air temperatures than the averaged, were not favorable for synthesis of highly valuable wheat proteins (Table 3).

Table 4. The important properties of new OS winter wheat cultivars, field trials at Agricultural Institute Osijek (a:1994-1997; b: 1997)

Tablica 4. Važna svojstva novih OS kultivara ozime pšenice, poljski pokusi na Poljoprivrednom institutu Osijek (a: 1994-1997; b: 1997)

Properties-Svojstva	Super žitarka	Barbara	Žitarka
a)			
Grain yield - Urod	105.7	107.1	100.0
Plant height (cm) - Visina stabljike (cm)	77.8	81.5	76.5
Resistance to: - Otpornost na:			
lodging - polijeganje	excellent - izvrsna	excellent - izvrsna	excellent - izvrsna
low winter temperature	very good	very good	very good
niske zimske temperature	vrlo dobra	vrlo dobra	vrlo dobra
diseases – bolesti	good - dobra	good - dobra	very good
(<i>E. graminis</i> , <i>P. recondita</i> , <i>Septoria</i> sp.)			vrlo dobra
rainless - sušu	good-dobra	good-dobra	good-dobra
shattering - osipanje zrna	excellent - izvrsna	excellent - izvrsna	excellent - izvrsna
sprout damage grain in spike	excellent - izvrsna	excellent - izvrsna	excellent - izvrsna
klijanje zrna na klasu			
Date of earing (May)	15.8	16.3	16.2
Datum klasanja (svibanj)			
Hectolitre mass (kg/hl)	82.8	82.6	80.9
Hektolitarska masa(kg/hl)			
1000 kernel mass (g)/masa 1000 zrna (g)	44.5	44.2	41.3
b)			
Protein (%) - Bjelančevine (%)	12.13	12.46	13.21
Sedimentation value (ml)	47	54	54
Sedimentacijska vrijednost (ml)			
Wet gluten (%) - Vlažni gluten (%)	31.1	32.84	35.28
Gluten Index - Gluten indeks	66	61	67
Falling number: - Broj padanja:			
before rainfall - prije oborina	275	366	291
two week after rainfall	285	369	272
dva tjedna poslije oborina			
Amilogram (AU): - Amilogram (AU):			
before rainfall - prije oborina	1100	1410	885
two week after rainfall	620	1410	825
dva tjedna poslije oborina			
Hectolitre mass (kg/hl)			
Hektolitarska masa(kg/hl)			
before rainfall-prije oborina	82.7	83.8	80.7
two week after rainfall	81.8	80.8	80.3
dva tjedna poslije oborina			

CONCLUSIONS

Žitarka, Marija, Sana, Ana, Demetra and Srpanjka are the most important winter wheat cultivars grown in Croatia from 1992-1997 year.

In 1997 year cultivar Sana, Ana and Demetra had lower grain sprouting and shattering resistance and as consequence very low flour and bread quality.

New winter wheat cultivars Barbara and Super Žitarka characterized by relatively stable and good agronomic and technological performances, greater grain sprouting and shattering resistance. Because of that these new wheat cultivars can improve flour and bread quality in Croatia.

OTPORNOST KULTIVARA OZIME PŠENICE NA KLIJANJE PRIJE ŽETVE

SAŽETAK

U zadnjih šest godina u Hrvatskoj su najznačajniji kultivari ozime pšenice Žitarka, Marija, Sana, Ana, Demetra i Srpanjka. Kultivari Ana i Demetra spadaju u skupinu poboljšivača dok je Žitarka dobra krušna pšenica. Kultivari Marija i Srpanjka imaju nižu pekarsku kakvoću dok je Sana pogodna za biskvite.

Kultivar Žitarka je otporna na osipanje i na mnoge bolesti pšenice dok Marija i Sana imaju veći urod zrna od Žitarke, ali manju otpornost na pepelnicu (*Erysiphe graminis*) i fusarijum (*Fusarium* sp).

Zbog dugog razdoblja oborina tijekom žetve pšenice 1997 godine, što je neobično u Hrvatskoj, ovi kultivari pšenice su imali različito osipanje i klijanje zrna u klasu. Kod kultivara Žitarka i Srpanjka nije bilo osipanja i klijanja zrna u klasu ni nakon dvadeset dana od početka žetve. Kultivar Marija se osipala ali nije zrno klijalo u klasu, dok je kod ostalih kultivara bilo osipanja i klijanja zrna u klasu. Otpornost ovih kultivara na klijanje u klasu pokazuje Broj padanja poslije kiše, koji je bio kod Žitarke 272, Srpanjke 350, Ane 71 i Demetre 92. Klijanje zrna u klasu smanjilo je pekarsku kakvoću kultivara Ane i Demetre.

S obzirom da su ti najzastupljeniji kultivari pšenice u Hrvatskoj uglavnom temelj oplemenjivačkog programa Poljoprivrednog instituta Osijek, navedeni rezultati su korisni u selekciji pšenice. Novi OS kultivari ozime pšenice Super Žitarka i Barbara (Žitarka je jedan od roditelja) su rodniji od Žitarke. Oni zadržavaju dobra svojstva Žitarke kao što su otpornost na polijeganje, niske zimske temperature, bolesti pšenice, osipanje, sušu, klijanje u klasu i dobru pekarsku kakvoću. Broj padanja kultivara Super Žitarka i Barbara ostao je isti i dva tjedna nakon oborina.

Ključne riječi: pšenica, klijanje zrna u klasu, pekarska kakvoća

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