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STRESS TOLERANCE OF YOUNG MAIZE SEEDLINGS OF DIFFERENT RECIPROCAL CROSSING COMBINATIONS IN CASE OF SOME MV CORN HYBRIDS

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ABSTRACT

An experiment was set up on straight and reciprocal crossing combinations of six maize (Zea mays L.) genotypes, to study the effects of cold stress tolerance and the correlation between seedling parameters and field kernel yield in the years of 2016-17. A laboratory analysis was followed by field trials, where emergence, plant development, flowering time, seed moisture content at harvest, and kernel yield were scored. The shoot mass of seedlings,- developing in a cold oxygen deficient environment, was greater than the fresh root mass .A close correlation was found between fresh shoot weight of stressed seedlings and the kernel yield – in case of Danietta, Classil, and Mv 223 hybrids – in 2016 experiments. The correlation was the same in case of Classil hybrid –in 2017 experiments. Avoiding the hot summer conditions at flowering etap, need early sowing and repairing the cold tolerance of young maize seedlings, with selecting the best reciprocal crossing combinations of d different and sensible corn genotypes.

Keywords: seedling vigour, maternal effect, yielding ability

INTRODUCTION

Because of the global warming, and extreme changes at weather conditions year by year, the importance of early maize sowing, became high. If we want to avoid sowing to the dry (less and less water content) soil conditions, we need earlier spring sowing dates.

Sowing the seeds at cold and oxygen deficiency content soil, only possible with the best cold tolerant, and healthy seed amounts – from different crossing combinations. These seed amounts are able to create high vigorous seedlings during unfavourable circumstances.

One of our main task , to eliminate or avoiding the outfield stress factors point of view to different corn genotypes.

The cold tolerance at germination is not obvious, depending from the crossing type, and maternal genotypes. Correlation between the maize seedlings length – during osmotic stress, suboptimal emergence temperature and hypoxia – are high (Berzy, 2017).

If the soil temperature is below 10 degree Centigrade, the germination is slow. There is a high correlation between the filed emergence, coleoptiles length of the maize seedlings, depending

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from the soil temperature (George et al. 2003, Shieh, 1982, TeKrony et al. 2005)).The cold test method is one kind of soil vigour test method simulating the field emergence. The cold test without soil(Complex Stressing Vigour Test) is reproductive, easy methode and could be more suitable for cold tolerance imitation (Berzy et al. 2015).

The physiological seed vigour of the commercial hybrids is different (Nagy, 2016).
The location of production and maternal parentage on seddling vigour can be different (Burris, 1977, Espinosa-Calderon, 2004). The germination vigour declines, while the germination time is lengthened (Lovato et al. 2001).
Because of these hypothesis we need examine not only the hybrids genetically determination, and agro –ecological factors, - but the maternal effects – depending from the crossing combination. Selecting the best combinations could be more efficient; point of view the corn breeding.

MATERIAL AND METHODS

In the spring of 2016, the seed lots of six maize genotypes (Danietta, Classil, Kadricorn, Millacorn, Ivola, Mv 223);[Table 1.] with different normal and reciprocal crossing combination were studied in the laboratory and field experiments (in Keszthely and Kabaand Martonvásár). There was a very early - first sowing date in Keszthely,- to simulate the oxygen poor wet sowing conditions. The second sowing time in Keszthely, and the other experimental fields (Kaba and Martonvásár) were during optimal weather conditions. The seed biological value of normal and reciprocal crossing combinations were examined at laboratory of the Agric. Res. Cent. of Martonvasar.
In the spring of 2017, the seed lots of the same hybrids, and two more genotypes (Lenacorn,Mv 2233) were sown in Keszthely and Kaba at the same sowing time (22 nd of April).

Laboratory experiments

Germination ability

After preliminary and basic cleaning, the seeds were divides into fractions and germinated according to the Hungarian standard(MSZ 6354,3-82) between layers of crepe filter paper moistened with 1,6-1,7 g water per g paper. Four rolls, each containing 50 evenly distributed seeds, were placed vertically in each of two plastic bags and kept in a Conviron germination chamber at 25 degree Centigrade and 70% RH for seven days.
Complex stressing vigour test(CSVT)

During the first 96 hours of the test, the seeds(8x25) were exposed to a combination of stress factors that may occur in nature in the case of unfavourable weather conditions in spring (Berzy et al.,2007). The stress period was followed by 96 hours germination. The developing seedlings were divided on the basis of shoot length into high- and low vigour groups, or classified as

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abnormal or non-germinated. The weight of eight days old seedlings (GW) and roots(RW), seedlings length (GL), root length (RL) were measured too.
The hypothesis: the stress tolerance some of the different maternal crossing combinations can be different –depending from the physiological seed vigour (Berzy 2017, Záborszky and Berzy 2016) in case of single cross type crossing combinations(SC hybrids).

Field experiments

The experiments were carried out inthe nursery of the Georgikon Faculty, University of Pannonia,in Keszthely – with two sowing dates.
The soil was a Ramann"s brown forest soil with sandy loam texture and low humus content(1,65%), with a pH(H2O) value of 6,3, slightly increasing in depth. The soil was moderately well supplied with phosphorus (P2O5= 130 pm), poorly supplied with potassium (K2O= 50 ppm) and had good water permeability.
The soil of the experimental field in Kaba was a chernozhem soil well supplied with phosphorus(P2O5= 220 ppm) and potassium(K2O= 180 ppm).
The nursery of Maronvásár soil was similar to Kaba, but dry environmental weather conditions especially at late spring and summer.
The seed lots were sown in random block design with four replications. The plots measured 2,25 x 6 m, with two rows of 30 plants per plot.
Sowing was carried out with hand –held seed drill on 4 th of April and 25-26 th of April.
Records were made of the number of plants emerging, the dates of 50% tasseling and silking, the seed moisture content at harvest, stalk lodging, appearance of black layer.
The plants were harvested manually on October 10. The fresh ear yield was weighed, and the kernel yield was recorded after drying 35 C and shelling. Due to the reverse grain moisture contents of the reciprocal crossing genotypes, the results was converted to 14% moisture content and the data were evaluated using single and two –factor analysis of variance.

RESULTS AND DISCUSSION

After two year experimentation and three different environmental – we can emphasize: there are differences between the different crossing combinations.
The vigour of the seed lots resulting in retarded germination and the development of significantly smaller, shorter seedlings under stress conditions (**H 71 x H 49; GL x H 49, H 71 x H 72).**
The fresh shoot weight of seedlings developing in a cold, oxygen poor environment was greater than the fresh root weight for all the genotypes. regardless of the crossing method.
Int the field experiment, the plants developing from seeds with greater vigour exhibited better emergence, faster ripening and lower grain moisture at harvest **(H 49 x GL, H 71 x H85**), than those developing from less vigorous seeds.
The correlation between the fresh shoot weight of the seedlings and the kernel yield was more significant than that between fresh root weight and grain yield for plants developing from seed lot from reciprocal crossing combinations.(Danietta, Classil,Mv 223).

The importance of early seed vigour (CSVT) could be determinant considering of the different maternal crossing type.
A close correlation was found between the vigour of stressed seedlings (CSVT) and emergence with an r2 value of 0,96 (H 72 x H 1) - and kernel yield (Y') with an r2 value of 0,97.
In 2017 - the correlation values between the seedling shoot weight (GW), and kernel yiled (Y') – are:

H 05 x H 71; Y'= 9,81 + 0,24 GW, r2= 0,37
H 49 x GL; Y'= 6,89 +2,04 GW r2= 0,96
H 70 x RPK; Y'= 8,31 + 0,96 GW r2= 0,67

In contrast with data found in the literature, the satisfactory field germination was recorded under optimum soil temperature and moisture conditions in the case of similar initial germination percentages, even of the differences observed were greater for vigour parameters. The importance of early seed vigour parameters could be determinant (TeKrony 2003) considering the circumstances of the storing time, and maternal effect of reciprocal crosses.

Hybrid	Crossing	Germ (%)	Vigour (%)	GW (g)	GL (cm)	RW (g)	RL (cm)	emerg 1 (növény)	Keszthely 1 (kg/parc)	SMC (%)	emerg 2 (növény)	Keszthely 2 (kg/parc)	SMC (%)	Kaba (kg/parc)	Mv (Kg/parc)
Danietta	H 71xH 05	90	47	1.82	4.45	1.05	6.85	129	11.91	15.2	117	10.37	22.26	9.59	12.66
	H 05 xH 71	97	**95*** **	**7.57*** **	**10.32** **	**3.9** **	**11.5** **	**135**	**12.41**	**15**	**126**	**11.06**	**23.6**	**10.71***	12.71
	LSD 5%													1,11	
	LSD 1%				5.72	2.82	4.33								
	LSD 0,1 %		29.9	5.25											
Classil	GL xH 49	88	64	1.82	3.75	1.25	6.5	122	11.18	16.1	94	10.25	27.13	9.93	11.95
	H 49 x GL	98*	**88***	**3.02***	**4.6**	**2.05**	8.5	142*	**13.31***	16.53	**133** **	**12.35***	**24.36** **	**12.78** **	**13.54***
	LSD 5%	8.6	17.5	1.15				16.7	1.49			1.38			1.55
	LSD 1%										27.8		2.66	2.57	
Millacorn	H 68x RPK	99	85	3.82	7.2	3.11	10.35	135	12.01	15.06	125	12.26	23.86	12.77	11.85
	RPK xH 68	98	62	2.27	5.05	1.75	7	138	12.48	15.2	125	11.44	22.96	13.74	12.68
	LSD 5%		21.6	1.49		1.31	2.67					NS		NS	NS
Kadricorn	**H 70 xRPK**	99	**95** **	**4.45***	**6.8**	**4.00** **	**10.45**	135	11.66	14.91	**129***	**12.25***	22.73	9.76	**12.49**
	RPKx H 70	94	68	2.36	4.8	1.7	9.4	132	11.56	14.63	111	10.03	22.33	11.32	11.57
	LSD 5%			1.68							16.4	1.78		NS	NS
	LSD 1%		22.7			2.08									
Ivola	H 68 x H 88	95	82	2.54	4.4	1.05	5.7	141	10.66	15.03	138	11.36	20.53	11.55	11.76
	H 88 x H 68	95	87	4.9	**7.7**	3.85	**11.2** **	122	10.5	14.8	127	10.52	19.56	10.51	12.37
	LSD 1%						5.45	NS				NS		NS	NS
Mv 223	**H 72 x H 71**	93	**95*** **	**4.82***	**6.85**	**4.27** **	**9.75** **	**135** **	**11.86** **	14.33	**129***	**10.96***	19.3	**13.33***	**12.34***
	H 71 xH 72	88	41	2.32	4.85	0.65	5	110	9.47	14.26	108	9.15	19.8	11.6	10.79
	LSD 5%			1.77							18.2	1.8		1.45	1.53
	LSD 1%					3.15	4.35	24.5	2.32						
	LSD 0,1%		33.6												

CSVT : high vigour seedlings
GW : eight days old seedling germ weight (25 seedlings)
RW : eight days old seedling root weight (25 seedlings)
GL : eight days old plumula length
RL : eight days old radicula length
SMC : seed moisture content

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Table 1 Seed biological values and yield parameters of normal and reciprocal crossing combinations(2016)

Hybrid		Cross comb	Germ (%)	Vigour (%)	GW (g)	GL (cm)	RW (g)	RL (cm)	Emerg 1 plant/parc	Yield 1 (kg/parc)	SMC (%)	Emerg 2 plant/parc		Yield 2 (kg/parc)	SMC (%)
Danietta		H 71x H 05	89	73	2.8	5.12	2.15	10.3	142	11.53	20.79	129		8.76	18.22
		H 05 x H 71	97	**94***	**6.55****	7.07	**4.28***	10.9	152	**13.52***	20.24	**144***		9.16	18.19
		LSD 5%		18.7			2.04			1.65		14.4			
		LSD 1%			3.45										
Mv 2233		H 85 x H 71	91	86	3.6	4.1	2.51	9.47	185	11.21	16.63	133		7.6	15.32
		H 71 x H 85	99	80	3.95	3.9	2.55	9.72	172	10.74	14.58*	118		7.14	16.9
		LSD 5%									1.82				
Classil		GL x H 49	91	52	1.61	4.4	2.65	9.4	171	12.43	27.42	98		8.8	
		H 49 x GL	99	**97*****	2.7	4.93	**4.47***	11.4	179	13.41	25.92	**142*****		**10.13***	
		LSD 5%					1.64							1.27	
		LSD 0,1%		28.4								35.8			
Kadricorn		**H 70 x RPK**	97	**88*****	**4.35****	5.65	**3.48****	**11.5*****	193	13.32	19.45	**151***		8.97	17
		RPK x H 70	91	13	0.95	2.47	0.65	3.95	180	12.43	19.34	129		8.48	18.1
		LSD 1%			2.36		2.69					19.2			
		LSD 0,1%		34.4				6.79							
Lenacorn		H 68 x H 88	91	49	1.95	4.27	0.85	6.42	166	13.44	17.22	143		8.29	16.87
		H 88 x H 68	99	**98****	**5.55****	**8.9 ***	**4.1****	**12.2****	172	13.84	17.26	158		8.41	16.81
		LSD 5%													
		LSD 1%			3.25	3.88	2.74	5.12							
		LSD 0,1%		32.4											
Mv 223		**H 72 x H 71**	98	**83****	2.87	4.65	1.1	6.35	183	10.16	17.18	145		7.85	15.55
		H 71 x H 72	94	52	2.75	4.51	1.15	6.42	179	10.72	16.75	133		8.44	16.52
		LSD 1%		28.7											

Table 2Seed biological values and yield parameters of normal and reciprocal crossing combinations (2017)

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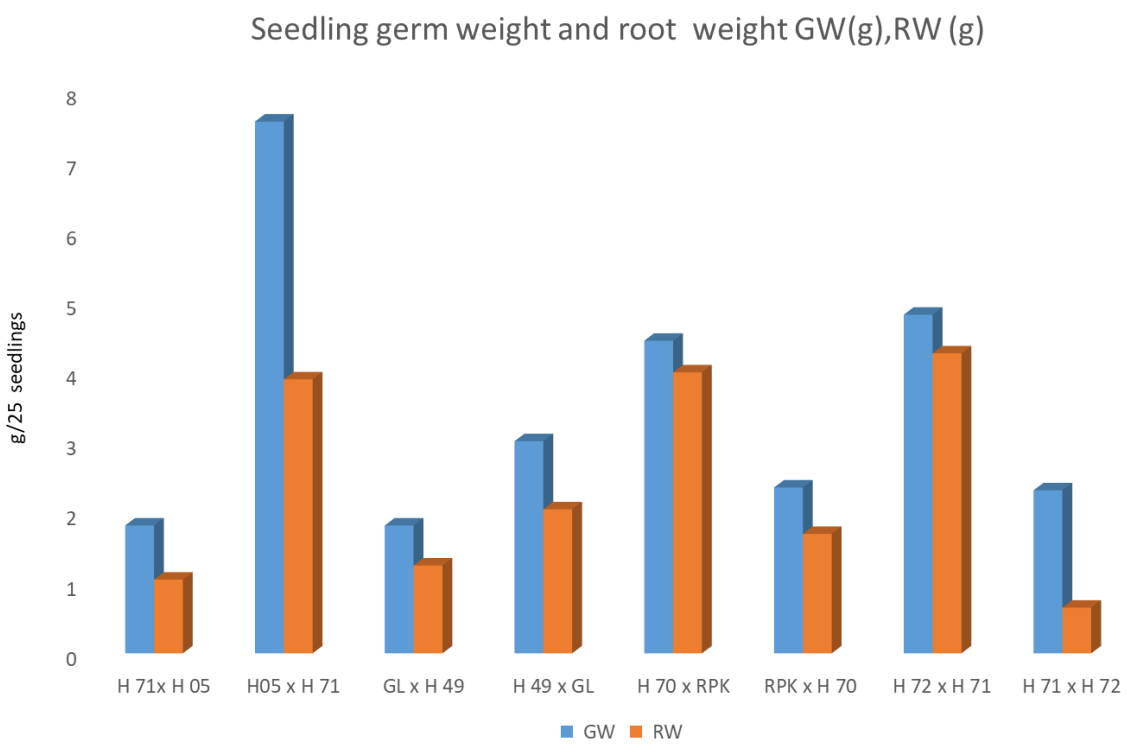

Figure 1Plumula weight (GW) and radicula weight (RW) of reciprocal crossing combinations at eight days old seedlings

Finally we can make a conclusion: selecting the best crossing combinations (depending from the hybrid) is useful for the seed producers and for corn breeders too. The seed yield quality and quantity is important, for the seed production. Depending from the weather conditions and locations, years – the seed yield amount can be different.

Stress tolerance of the crossing combination could result rapid and uniform seedling emergence, less seed moisture content at harvest and finally higher kernel yield.

Avoiding the dry, hot summer conditions at flowering etaps, the seed producer need the earlier sowing. The term of early sowing are the cold tolerant seedlings. The early sowing is very hazardous.

To eliminate this damage effect: we need repairing the cold tolerance of young maize seedlings, and selection of the best reciprocal crossing combinations of different corn genotypes. With the help of different seed vigour tests, selection the most adaptable hybrid combinations- could be easier.

We hope this experimental work can be very useful for the seed producers, and breeders too. In a future we should like to continue our experiments with other hybrids.

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