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EFFECT OF SEED DETERIORATION, SEED DRESSING AGENTS AND SEED VIGOUR PARAMETERS IN MAIZE (ZEA MAYS L.) HYBRIDS

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ABSTRACT

Seed dressing agents could limit the number of abnormal or low vigorous seedlings.In the case of emergence time, the percentage of emerged plants depended to the greatest extent on the genotype, butseeddressingalsocouldsubstantialeffectontheemergencepercentage. In spring 2019 ,seed lots of seven maizegeno types, - which had been stored for various lengths of time – were studied in laboratory and field experiments (in Martonvásár and Keszthely).The seedling root weight were consistently and significantly higher in case of seed dressing with fludioxonil and metalaxyl-Mfungicides,than seed dressing with fludioxonil+tiabendazol+metalaxil-M+azoxistrob in fungicides.After five years seed storing, the ratio of non-germinated seed swas significant higher in case of all hybrids. The highest seed storing period eliminating the seedling emergence and kernel yield.The importance of the maternal crossing combination effect could be enormous,- be side the seed storing time.Correlations between the seed vigour, fresh shoot weight, fresh root weight and kernel yield are close-in case of Mv 06 hybrid-corn.

Keywords: Seed Dressing, Seed vigour, Storing time.

1. INTRODUCTION

The use of satisfactory storage conditions may help to lengthen the lifespan, while storage under suboptimal conditions may lead to a substantial reduction in the genetic potential or vigour of the seeds (Berzy et al., 2007;Marcos-Filho, 2015; Berzy et al. 2017). Following ripening and after-ripening, aging processes begin in the seeds, as the result of which there is a gradual decline in viability. High temperature and atmospheric moisture lead to an acceleration in respiration, thus promoting aging. The reduction in the vigour of aging seeds is indicated by the fact that they have a higher temperature requirement for germination than young seed lots. The germination vigour declines, while the germination time is lengthened (Blacklow, 1972; Marton and Szundy, 1997; Lovato et al., 2001; Mavi et al., 2010; Matsushima and Sakagami, 2013). There may also be changes in the size and weight of the seedlings. The aim is thus to create storage conditions that inhibit respiration and the decomposition of nutrient reserves. As storage is primarily designed to preserve seeds as a source of germplasm, or hereditary material, only mature, undamaged seeds can be stored for any length of time (Goodsell et al., 1955; Tang et al., 2000; FAO, 2018). Injuries to the seed-coat have a negative effect on the physiological processes of the seed, which can be more easily attacked by bacteria and fungi, leading to the development of abnormal seedlings. Under stress conditions these abnormal seedlings (twisted stem, cracked

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hypocotyl) may not survive (Fessel, et al. 2001). In the course of aging the seed may darken and the seed-coat may shrink. These changes chiefly affect the cell membranes, which serve to protect the nutrient reserves of the cells (Matthews and Bradnock, 1968; Barnabás et al., 2008).

The aging process may differ with the genotype. It depends on the seed-coat structure, the size of the nutrient reserves and the storage conditions. If the metabolism (respiration) is retarded during storage, it is possible to prevent the rapid decline in germination ability. In the case of maize, storage temperatures above 43°C or below freezing point may cause a considerable reduction in germination ability (in the case of 12–13% grain moisture content). If the storage time is longer than a year, it is advisable to maintain a storage temperature of 21°C with 55% relative humidity (RH). The microorganisms present on the seed surface are capable of multiplying even at 4–10°C and at RH values of 65–70%. A grain moisture content higher than 14% is also favourable for the activity of insect pests (Christeller, 1984;Deuner et al., 2014; Dansoetal., 2017).

Effect of seed size and genotype on the laboratory and field emergence could be different in case of grain and sweet corn (Gubbels, 1974; Bennett et al. 1988).

If storage losses are to be kept to a minimum, chilled storage is advisable, at a temperature of 4-5°C with a humidity of 45-50%. If the moisture content of the stored seed is below 11-12%, the seed may retain its viability under such conditions for years.

Different seed dressing agents could limit the number of abnormal or low vigorous seedlings .Záborszky et al. (2002) four inbred lines with different levels of chilling tolerance were studied in the experiments. The seeds of these lines were treated with three different dressing agents (TMTD WP, Carboxin + TMTD, TMTD FS, with an untreated control) and the seeds were sown in two types of soil: 1. infected maize soil; 2. heat-sterilised soil (control).It was found that of the three factors tested, the number of days to emergence was only influenced by the genotype. None of the interactions caused a significant modification of the emergence time.As in the case of emergence time, the percentage of emerged plants depended to the greatest extent on the genotype, but seed dressing also had a substantial effect on the emergence percentage. The emergence percentage was significantly increased by the seed treatments compared to the undressed control, however the dressing agents was not statistically significant.

The object this experiment, determine the best seed amounts, point of view the seed vigour, seed emergence, and yielding ability.

2. MATERIALS AND METHODS

In spring 2019, seed lots of seven maize genotypes (the hybrids MV01, MV02, MV03,MV04, MV05, MV06, and MV07), which had been stored for various lengths of time (10 ºC, 60 % RH storing), were studied in laboratory and field experiments (in Martonvásár and Keszthely).

The seed amounts in every hybrid– except, MV06, MV07 – were divided two parts:

1. Seed treating with fludioxonil +metalaxil-M(A type) anddoses of the seed dressing were 1 ml/kg seed.

2. Seed treating with fludioxonil, tiabendazol, metalaxil-M, azoxistrobin (B type)and doses of the seed dressing were 1 ml/kg seed.

Laboratory experiments

Germination ability

After preliminary and basic cleaning, the seeds were divided 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 Fito-Klima germination chamber at 25°C and 70% RH for seven days.

Complex stressing vigour test (CSVT)

During the first 96 hours of the test, the seeds (8×25) were exposed to a combination of stress factors that may occurin nature in the case of unfavourable weather conditions in spring (hypoxia and cold stress) and that represent complex stress for the seedlings (Barla-Szabó and Berzy, 1989). 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 were classified as abnormal or non-germinated.

Field experiments

The experiments were carried out in the nursery of the Georgikon Faculty, University of Pannonia, in Keszthely, and Martonvásár. The soil was a Ramann's brown forest soil with sandy loam texture and low humus content (1.65%), with a pH(H_2O) value of 6.3, slightly increasing with depth. The soil was moderately well supplied with phosphorus (P_2O_5=130 ppm), poorly supplied with potassium (K_2O=50 ppm), and had good water permeability.

The genotypes were sown in a split-plot design in four replications, with the maize genotypes in the main plots and the treatments (A. two-component seed dressing chemical, B.four-component seed dressing chemical) in the subplots.The plots measured 2.25×6 m, with two rows of 30 plants per plot.

Sowing was carried out with a hand-held seed drill on 26 ofApril. Records were made of the number of plants emerging, the dates of 50% tasselling and silking, the grain moisture content at harvest (Grainer, Japan), the appearance of the black layer, and stalk lodging.

The plants were harvested manually on 10 October. The fresh ear yield was weighed, and the kernel yield was recorded after drying at 38°C and shelling. Due to the diverse grain moisture contents of the genotypes, the results were converted to 14% moisture content and the data were evaluated using single- and two-factor analysis of variance (Sváb, 1981).

3. RESULTS

Seed vigourand hybrids

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An analysis of the effect of genotype on the characters tested shows that the order of the hybrids was not the same for ratio of high vigour seedlings and 8 days old seedlings fresh weight. The ratio of high vigour seedlings, and 8 days old seedlings fresh weight were the best in case of MV01 and MV05 hybrids. The seedling fresh weight results also indicated the highest biological value of MV01 hybrid (Table1).

It is significantly proven that the longest storage time decreases both the root length, the percentage emergence and the yield, but increases the ratio of non-germinated (rotten) seeds and the number of days BBCH14 stage (Table 5).

The complex stressing vigour test results obtains for seed lots of the grain maize hybrid MV06 stored for six years dropped to half, and the vigour determined to a third of the values recorded after four years of storage (Table 2). This was confirmed by both the shoot and root weight measurements and the grain yields (Table 2 and Table 3). The biological value of seeds of MV06 was thus found to be drastically reduced by storage for more than five years.

The seedling root weight were consistently and significantly higher in case of seed dressing with A type (fludioxonil and metalaxil-M), than the seed dressing with B type (fludioxonil+tiabendazol+metalaxil-M+azoxistrobin)fungicides(Table 2).

Seed dressing and kernel yield

Despite the less vigouros and stress sensitive seedlings of seed amounts ofhybrid MV05 (2-year-old, 2017 seeds), had better emergenceand significantly higher kernel yield in Keszthely- in case of fludioxonil and metalaxil-M seed dressing(Table 3).

The sowing time and weather conditions were optimal for the seedlings, the germination ability could be more important, than the seed vigour.

There was not differences between the seed dressings at MV02, and MV03.

Thebest hybrid results mainly experimented in case of the shortest, or middle short storing period – irrespective of genotypes(Table 5).

Seed storing and seed dressing, kernel yield

Despite the less vigorous and short storing(2 years) seed amounts of hybrid MV05, had better emergence and kernel yield,- because of the excellent germination ability. The seedling emergence effect was significant for kernel yield - in case of experimental field conditions at Keszthely .(Table 2 and Table 3) There wasno difference between the seed amounts during optimal environmental conditions. Reciprocal crossing type seed amounts of 3-year-old MV05 hybrid (seed dressing "A" type) were more sensible for the seedling emergence- during suboptimal weather conditions.

The highest seed storing period (8 years) caused significant eliminating the seedling emergence and kernel yield - in case of hybrid MV04 (Table 2 and Table 3).

Seed biological value of six years old storing seed amounts were worst, -compared with 7- and 3-year-old seed storing. The moderate eliminating at seed vigour (67%) could cause the lowest kernel yield in case of hybrid MV02.

The reciprocal crossing type seed amounts -at MV03 hybrid - had similar sensibility at seed vigour, like hybrid MV05.

The maternal effect for seedling sensibility for suboptimal emergence conditions of H68 line(MV03) similar to the H71(MV05) line. We emphasize the importance of reciprocal maternal crossing combinations effect, - beside the seed storing time.

The moderate seedling vigour and seedling weight could cause poor emergence and significant low kernel yield (Table 2, Table 3).

A close correlation was found between the vigour of stressed seedlings (CSVT) and the grain yield for highest stress sensible hybrid MV06 (r^2= 0.805).

The correlation between fresh shoot weight (SW) and the grain yield was also obviousfor MV06, and MV07 (r^2= 0.840 and 0.660, respectively), while the correlation between the fresh root weight (RW) and kernel yield was enormous in case ofMV06 (r^2= 0.830).

The following equations were obtained from linear regression analysis between the kernel yield (Y') and the seedling parameters.

Y'= 6.32+0.017 CSVT (MV06)

Y'= 11.40+0,750 SW (MV06, MV07)

Y'= 11.63+1.190 RW (MV06).

4. CONCLUSIONS

After five years seed storing, the ratio of non-germinated seeds was significant higher in case of all hybrids. The highest seed storing period eliminating the seedling emergence and kernel yield.

The seedling root weight were consistently and significantly higher in case of seed dressing with fludioxonil + metalaxil-M.

The moderate seedling vigour and seedling weight could cause poor emergence and low kernel yield in case of suboptimal environmental conditions (MV04).

The importance of the maternal crossing combination effect could be enormous, - beside the seed storing time.

The highest stress sensible hybrid for more than 5 years seed storing is: MV06. Correlations between the seed vigour, fresh shoot weight, fresh root weight and kernel yield are close - in case of MV06.

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Table 1. Effect of genotype on the characters examined, averaged over seed dressing and storage time (Martonvásár, 2019)

Genotypes	*Hight vigour (pc)*	*Rotten seeds (pc)*	*Seedling fresh weight (g)*
MV01	17.25	3.71	1.95
MV02	13.33	6.17	1.56
MV03	16.54	4.08	1.21
MV04	12.75	6.33	0.87
MV05	17.71	2.71	1.83
***LSD** $_{5\%}$*	2.33***	1.25***	0.32***

Table 2. Seed biological value, seed storing and seed dressing (Atype=fludioxonil+metalaxil-M, B type=fludioxonil+tiabendazol+metalaxil-M+azoxistrobin) (Martonvásár, 2019)

Hybrid	Crossing combination	Storing year	Germination (%)		Vigour (%)		Emergence (%)		Germination weight (g)		Root weight (g)		Germination lenght (cm)		Root lenght (cm)	
			A type	B type	A type	B type	A type	B type	A type	B type	A type	B type	A type	B type	A type	B type
MV01	Direct	2011	95.00	96.00	84.00	73,00	85.75	87.50	6.11	1.35	3.35	0.84	9.00	3.14	12.00	9.06
MV01	Direct	2013	95.00	96.00	96.00	80,00	81.50	95.75	7.04	3.85	5.88	3.09	10.10	7.45	12.80	7.58
MV01	Direct	2015	96.00	97.00	93.00	90,00	79.50	90.50	6.16	0.65	5.31	0.59	11.00	3.06	12.80	6.88
MV02	Direct	2012	90.00	90.00	73.00	66,00	73.25	84.75	5.00	0.79	5.04	0.91	7.50	2.00	11.50	4.51
MV02	Direct	2013	90.00	91.00	67.00	73,00	79.00	88.50	4.32	1.78	4.41	1.80	7.50	4.15	11.70	7.50
MV02	Direct	2015	91.00	91.00	79.00	79,00	86.75	76.75	5.02	2.10	4.62	1.47	8.25	5.69	11.20	9.94
MV03	Direct	2013	94.00	94.00	91.00	77,00	99.25	91.75	6.20	1.56	6.35	1.18	9.50	5.59	11.30	9.34
MV03	Reciprocal	2016	92.00	93.00	84.00	74,00	78.50	87.00	4.80	0.91	6.52	0.74	8.25	3.64	12.40	8.91
MV03	Direct	2017	97.00	97.00	95.00	78,00	98.25	84.50	7.67	1.16	7.95	1.19	10.60	4.28	12.70	8.39
MV04	Direct	2011	95.00	94.00	74.00	67,00	76.00	78.00	2.95	0.55	1.80	0.50	6.75	2.39	10.30	8.11
MV04	Direct	2016	94.00	96.00	94.00	73,00	93.25	95.25	7.27	1.23	7.25	0.99	9.43	5.24	11.60	11.76
MV04	Direct	2017	94.00	96.00	94.00	77,00	100.00	86.75	3.62	0.83	5.95	0.81	5.95	3.56	10.95	9.21
MV05	Direct	2014	98.00	98.00	77.00	75,50	95.50	82.00	4.38	1.40	1.12	1.15	7.07	3.71	8.76	6.56
MV05	Reciprocal	2016	93.00	93.00	78.00	82,00	83.50	91.75	6.66	2.00	2.02	1.08	8.71	4.71	9.25	6.71
MV05	Direct	2017	100.00	99.00	59.00	56,00	99.50	93.00	4.10	2.08	1.05	1.33	8.70	4.90	9.80	7.16
	LSD$_{5\%}$		**ns**	**ns**	**ns**	**ns**	**21.40***	**ns**	**ns**	**0.55*****	**3.63****	**0.46*****	**ns**	**1.66*****	**ns**	**1.45*****
MV06	Direct	2013	72.00	No Data	19.00	No Data	63.00	No Data	1.01	No Data	0.72	No Data	5.55	No Data	3.20	No Data
MV06	Direct	2017	97.00		59.00		94.00		3.13		2.15		3.85		3.78	
MV07	Direct	2013	87.00	No Data	16.00	No Data	54.00	No Data	0.76	No Data	0.44	No Data	3.27	No Data	2.85	No Data
MV07	Direct	2017	98.00		85.00		95.00		3.42		1.38		6.63		6.55	
	LSD$_{5\%}$		**14.17***		**25.55****		**25.30***		**1.75****		**0.91***		**3.24***		**3,29***	

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Table 3 .Effect of genotype, length ofstorage time and seed dressing with fludioxonil + metalaxil-M on the characters (Keszthely and Martonvásár, 2019)

Hybrid	Dressing type	Storing year	Keszthely (2019)		Martonvásár (2019)	
			Yield (kg/plot)	Seed moisture content (%)	Yield (kg/plot)	Seed moisture content (%)
MV01	fludioxonil + metalaxil-M	2011	10.24	21.25	11.51	24.26
		2013	9.55	21.33	11.17	24.51
		2015	9.64	21.63	10.92	24.55
MV02		2012	11.26	21.55	9.61	26.90
		2013	9.35	21.45	9.64	27.02
		2015	11.29	21.73	10.16	25.82
MV03		2013	10.84	19.10	9.89	21.90
		2016	9.74	19.03	9.77	22.35
		2017	11.17	18.80	10.31	21.77
MV04		2011	8.22	19.23	9.23	22.61
		2016	11.23	19.88	10.63	21.43
		2017	10.37	19.58	11.57	22.26
MV05		2014	10.40	21.48	10.08	24.50
		2016	9.87	20.92	7.36	23.95
		2017	11.96	21.75	9.76	23.65
		LSD $_{5\%}$	***2.08****	***ns***	***2.26****	***ns***
MV06	fludioxonil + metalaxil-M	2014	10.26	19.22	No Data	
		2017	13.59	19.38		
MV07		2014	12.04	20.42		
		2017	14.28	20.57		
		LSD $_{5\%}$	***2,42*****	***ns***		

Table 4 .Effect of genotype, length of storage time and seed dressing with fludioxonil + tiabendazol + metalaxil-M + azoxistrobinon the characters (Keszthely,2019)

Hybrid	Dressing type	Storing year	Keszthely (2019)	
			Yield (kg/plot)	Seed moisture
MV01	fludioxonil + tiabendazol + metalaxil-M + azoxistrobin	2011	10.48	20.43
		2013	10.05	19.98
		2015	10.72	20.20
MV02		2012	10.60	21.78
		2013	11.42	21.18
		2015	10.70	21.13
MV03		2013	11.02	18.83
		2016	10.04	18.88
		2017	11.35	18.58
MV04		2011	8.98	19.45
		2016	10.79	19.78
		2017	10.04	19.28
MV05		2014	10.40	20.38
		2016	10.28	20.86
		2017	10.34	20.94
		LSD $_{5\%}$	***0,81****	***ns***

Table 5. Effect of seed storing period on the characters examined, averaged over genotypes and seed dressing (Martonvásár, 2019)

Examined characters	Seed storing period			***LSD*** $_{5\%}$
	The longest storage time	Middle storage time	The shortest storage time	
Rotten seeds (pc)	5.80	3.60	4.40	0.97***
Root lenght (cm)	7.52	8.49	8.32	0.65**
Plant number (pc)	51.48	52.85	54.00	1.23***
Stage of BBCH 14 (days)	25.45	23.83	23.65	0.55***
Plant number before harvesting (pc)	51.63	52.43	53.95	1.30**
Yield (kg/plot)	10.41	10.27	10.78	0.36*