INFLUENCE OF DIFFERENT WAREHOUSE TYPES ON THE QUALITY OF MAIZE SEED

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ABSTRACT

Adequate storage of maize hybrid seed is very important for preserving required quality of seed material. Inadequate storage conditions in warehouse like changes in temperature and relative humidity can induce depletion in seed viability. The objectives of these investigations were to determine changes in quality of maize seed over the three years storage, and in two genetically different hybrids, OSSK-596 and OSSK-602. The experiment was set up in two warehouse types (concrete-made – newer type, and brick-made – older type) at the Agricultural Institute Osijek. Both hybrids were tested to untreated seed, and seed treated in three variants: 1. fungicide Vitavax 200 FF; 2. fungicide Maxim 035 XL; and 3. fungicide Vitavax 200 FF + insecticide Gaucho 600 FS. Significant loss in quality of maize seed was observed during three-year-storage in both types of warehouse. The highest quality loss was determined with the seed varieties of both hybrids treated by the suspension of fungicide and insecticide (Vitavax 200 FF + Gaucho 600 FS). On the basis of the obtained results, the seed treated by the suspension of fungicide and insecticide was found to be inadequate for storage longer than 12 months. Such seed should be sieved in the year of treatment.

Key words: maize seed, hybrids, warehouse type, storage conditions, storing period, seed quality

INTRODUCTION

Production of maize hybrid seed is considered the most important part of complex primary agricultural production. In some seasons, due to the specific production, the seed output exceeds required needs. Therefore, the seed surplus is determined to be preserved as a supply for the next year. Storage of seed surpluses is important in terms of preserving required quality (energy of germination, standard germination, storing period, seed viability and seed moisture). Inadequate storage conditions can induce loss in seed quality [1, 2, 3, 4]. Method of storage (warehouse type, maize treatment, storing period, temperature and air humidity), type and dose of the applied fungicides and

insecticides, as well as conditions of packing (rate of contaminants, packaging material) should provide seed quality as longer as possible [5]. Advanced technological processes would preserve maize seed quality for longer period and significantly reduce quantities of low-quality maize seed to be written off [6].

MATERIALS AND METHODS

Maize seed of two genetically different hybrids produced at the Agricultural Institute Osijek; OSSK-596 and OSSK-602 were used in our research. Maize seed was investigated in four treatment variants:

„T1"-non-treated seed (control)

„T2"-seed treated with Vitavax 200 FF (active substance karboksin+tiram) at the dose of 500 ml/100 kg

„T3"-seed treated with Maxim XL 035 (active substance fludioksonil+M-metalaksil) at the dose of 100 ml/100 kg

„T4"- seed treated with Vitavax XL 035 (active substance karboksin+tiram) at the dose of 500 ml/100 kg and with insecticide Gaucho FS 600 (active substance imidakloprid) at the dose of 0.6 l/100 kg.

After the treatment, seed was packed in plastic bags being made from the same material as jumbo bags that are in use for storing maize hybrid seed. Packed seed was stored in two different warehouse types: „S1"- concrete-made (thermo-insulated warehouse) and „S2"- brick-made (warehouse having no thermo-insulation).

We investigated seed quality over the three years storage:

„V0"- starting time of storage

„V12"- after 12 months of storage

„V24"- after 24 months of storage

„V36"- after 36 months of storage

The quality was determined in accordance with worldly recognized methods of ISTA (International Seed Testing Association) [7].

RESULTS AND DISCUSSION

By investigating influence of warehouse types on seed quality we observed influence of the two types (newer – concrete-made and older – brick-made) on energy of germination and standard germination of OSSK-596 and OSSK-602 hybrids.

From the values of temperature and relative humidity in thermo-insulated concrete-made warehouse over the three-year observation average temperature of 14.08 °C, and relative humidity of 63.27% were obtained (Table 1).

Table 1. Values of temperature and relative humidity in concrete-made warehouse over the three-year storing of maize seed

	2004		2005		2006	
	air temp.	rel. hum.	air temp.	rel. hum.	air temp.	rel. hum.
max	26.5	72.8	25.9	70.1	26.4	71.0
min	-0.4	49.5	2.2	58.9	0.6	61.2
average e	14.49	60.63	13.43	63.45	14.32	65.73
Three-year average					air temp. °C	14.08
					rel. hum. %	63.27

Table 2. Values of temperature and relative humidity in brick-made warehouse over the three-year storing of maize seed

	2004		2005		2006	
	air temp.	rel. hum.	air temp.	rel. hum.	air temp.	rel. hum.
max	26.9	70.6	25.6	74.5	24.1	65.8
min	1.8	52.9	3.4	62.7	3.0	50.8
average	14.76	60.09	14.84	67.67	15.86	60.08
Three-year average					air temp. °C	15.15
					rel. hum. %	62.61

Non-insulated brick-made warehouse over the three-year observation showed average temperature of 15.15 °C, and relative humidity of 62.61% (Table 2).

By comparing temperature and relative humidity in both warehouse types, three-year observation showed higher average temperature in brick-made warehouse, but higher relative humidity in the concrete-made one.

Influence of warehouse type on energy of germination

Average energy of germination of seed in both warehouse types for hybrid OSSK-596 was 75.89%, and 75.98% for OSSK-602 hybrid (Table 2). Influence of warehouse type on energy of germination was very significant for hybrid OSSK-596, while warehouse type showed no influence on energy of germination for hybrid OSSK-602. In both hybrids very significant influence of storing period and seed treatment was found. OSSK-596 hybrid seed showed energy of germination of 77.39% on average in concrete-made warehouse, with energy of germination in brick-made warehouse of 74.39%. OSSK-602 hybrid seed showed energy of germination of 75.37% in concrete-made warehouse, with

energy of germination in brick-made warehouse of 76.59%. At the beginning of storing period average energy of germination for OSSK-596 was 85.68%, and after 36 months of storage it decreased to 66.96%, which means fall of 21.8%. At the beginning of storing period average energy of germination for OSSK-602 was 86.62%, and after 36 months of storage it was 63.68%, which means fall in energy of germination of 26.5%. By observing seed treatment for hybrid OSSK-596 the highest energy of germination was recorded in treatment T3=81.18%, and the lowest in the treatment T4=64.31%. By observing seed treatment for hybrid OSSK-602 the highest energy of germination was recorded in treatment T3=82.18%, and the lowest in the treatment T4=64.40%.

Table 3. Influence of two warehouse types (S1; S2), seed age (V_0; V_{12}; V_{24}; V_{36}), and seed treatments (T1; T2; T3; T4) on energy of germination (%)

Ossk-596									
S1 (concrete-made warehouse)					S2 (brick-made warehouse)				
	V_0	V_{12}	V_{24}	V_{36}		V_0	V_{12}	V_{24}	V_{36}
T1	87.00	73.25	70.00	76.50	T1	87.00	81.25	79.25	70.25
T2	87.00	82.00	83.25	76.75	T2	87.00	78.50	78.25	67.25
T3	88.25	80.50	87.00	73.50	T3	88.25	80.50	79.75	71.75
T4	80.50	63.50	68.50	60.75	T4	80.50	73.25	48.50	39.00

Both warehouses average					
Average S (warehouse)		Average V (seed age)		Average T (seed treatment)	
S1	77.39	V_0	85.68	T1	78.06
S2	74.39	V_{12}	76.59	T2	80.00
		V_{24}	74.31	T3	81.18
		V_{36}	66.96	T4	64.31
				Total average	75.89

Ossk-602									
S1 (concrete-made warehouse)					S2 (brick-made warehouse)				
	V_0	V_{12}	V_{24}	V_{36}		V_0	V_{12}	V_{24}	V_{36}
T1	87.25	83.25	72.00	72.75	T1	87.25	82.50	80.50	70.25
T2	88.75	86.75	66.75	69.25	T2	88.75	83.75	73.00	66.00
T3	87.75	86.75	83.50	65.75	T3	87.75	90.50	82.00	73.50
T4	82.75	72.00	53.25	47.50	T4	82.75	74.00	58.50	44.50

Average S (warehouse)		Average V (seed age)		Average T (seed treatment)	
S1	75.37	V_0	86.62	T1	79.46
S2	76.59	V_{12}	82.43	T2	77.87
		V_{24}	71.18	T3	82.18
		V_{36}	63.68	T4	64.40
				Total average	75.98

LSD-test for OSSK-596 hybrid showed high significant difference (P<0.01) in energy of germination between concrete-made and brick-made warehouse.

LSD-test for OSSK-602 hybrid showed high significant difference (P<0.01) in energy of germination between concrete-made and brick-made warehouse.

Influence of the two warehouse types to energy of germination of the hybrid OSSK-596 was very significant, with no influence exhibited to energy of germination of the hybrid OSSK-602. Higher energy of germination of the hybrid OSSK-596 that was recorded in concrete-made warehouse was significantly high. This makes seed preservation in concrete-made warehouse more adequate for maintaining seed quality of the hybrid OSSK-596.

In both hybrids seed quality was significantly reduced during three-year research. Influence of treatment to seed quality in both hybrids was highly significant, while seed treated with an insecticide exhibited the lowest energy of germination.

Influence of warehouse type on standard germination

Average value of standard germination in both warehouse types with hybrid OSSK-596 was 81.71%, while hybrid OSSK-602 showed average value of 87.54% (Table 4). No influence of warehouse types was determined on the standard germination of the both hybrids tested. Very significant influence of storing period, as well as very significant influence of the seed treatment was observed in both hybrid types. Seed of OSSK-596 hybrid had average standard germination of 82.04% in concrete-made warehouse, while standard germination in the brick-made one reached 81.37%. Seed of OSSK-602 hybrid had average standard germination of 87.53% in concrete-made warehouse, while standard germination in the brick-made one reached 87.56%. At the beginning of storing period average standard germination for OSSK-596 was 88.62%, and after 36 months of storage it decreased to 73.5% which means fall of 17.1%. At the beginning of storing period average standard germination for OSSK-602 was 93.12%, and after 36 months of storage it decreased to 77.5% which means fall of 16.8%. By observing seed treatment for hybrid OSSK-596 the highest standard germination was recorded in treatment T3=86.59%, and the lowest in the treatment T4=70.96%. By observing seed treatment for hybrid OSSK-602 the highest standard germination was recorded in treatment T3=90.65%, and the lowest in the treatment T4=78.37%.

Table 4. Influence of two warehouse types (S1; S2), seed age (V_0; V_{12}; V_{24}; V_{36}), and seed treatments (T1; T2; T3; T4) on standard germination (%)

Ossk-596									
	S1 (concrete-made warehouse)					S2 (brick-made warehouse)			
	V_0	V_{12}	V_{24}	V_{36}		V_0	V_{12}	V_{24}	V_{36}
T1	89.75	79.75	76.00	81.50	T1	89.75	83.00	86.75	83.50
T2	91.00	89.25	84.75	77.75	T2	91.00	88.00	85.50	77.00
T3	89.00	90.00	89.50	77.00	T3	89.00	88.50	88.50	81.25
T4	84.75	74.50	73.75	64.50	T4	84.75	80.50	59.50	45.50

Both warehouses average					
Average S (warehouse)		Average V (seed age)		Average T (seed treatment)	
S1	82.04	V_0	88.62	T1	83.75
S2	81.37	V_{12}	84.18	T2	85.53
		V_{24}	80.53	T3	86.59
		V_{36}	73.50	T4	70.96
				Total average	75.89

Ossk-602									
	S1 (concrete-made warehouse)					S2 (brick-made warehouse)			
	V_0	V_{12}	V_{24}	V_{36}		V_0	V_{12}	V_{24}	V_{36}
T1	94.25	92.00	89.25	84.75	T1	94.25	92.75	91.00	86.00
T2	96.25	94.75	88.25	83.00	T2	96.25	95.50	90.50	80.50
T3	93.75	94.00	93.00	80.50	T3	93.75	95.50	91.75	83.00
T4	88.25	84.75	80.75	63.00	T4	88.25	83.50	79.25	59.25

	Average S (warehouse)		Average V (seed age)		Average T (seed treatment)
S1	87.53	V_0	93.12	T1	90.53
S2	87.56	V_{12}	91.59	T2	90.62
		V_{24}	87.96	T3	90.65
		V_{36}	77.50	T4	78.37
				Total average	87.54

LSD-test for OSSK-596 hybrid showed high significant difference ($P<0.01$) in standard germination between concrete-made and brick-made warehouse.

LSD-test for OSSK-602 hybrid showed no significant difference (ns) in standard germination between concrete-made and brick-made warehouse.

Influence of warehouse types on standard germination in both hybrids showed no significant difference.

Influence of the treatment on seed quality of both hybrids was highly significant, while seed treated with insecticide showed the lowest standard germination.

Comparing with the control, i. e. non-treated maize hybrid seed, seed treated with one of the insecticides (Vitavax 200 FF, Maxim 035 FS) showed higher quality. Improvement in quality of fungicide-treated seed was exhibited at the beginning of storing period, but in time this positive trait deteriorated, and after 36 months of storing the treated seed showed lower quality than non-treated seed. Seed treated with the suspension of the fungicide and insecticide (Vitavax 200 FF+Gaucho FS 600) showed the lowest quality. Difference in quality between non-treated seed and seed treated with suspension of fungicide and insecticide was the lowest at the beginning of the research, and after 36 months of storing significant fall in quality of seed treated with the suspension was recorded.

CONCLUSIONS

In consequence to the research results influence of warehouse types on energy of germination was recorded for Ossk-596 hybrid, with no influence exhibited on energy of germination for hybrid Ossk-602. Higher energy of germination in concrete-made warehouse for OSSK-596 hybrid was statistically significant. This makes seed preservation in concrete-made warehouse more adequate for maintaining seed quality of the hybrid OSSK-596, which could be ascribed to the genetic properties of the hybrid.

Influence of warehouse types to standard germination in both hybrids was not statistically significant; i. e. quality of standard germination of the both hybrids stored seed did not depend on investigated warehouse types.

Obtained results showed that both warehouse types, though differently built, had almost similar values of temperature and relative humidity, which made them inadequate for storing maize hybrid seed longer than 24 months.

Seed treated with both standard fungicide and insecticide showed the highest fall in quality over the storing period which made them inadequate for storing longer than 12 months.

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