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IMPORTANCE OF STORAGE CONDITIONS AND SEED TREATMENT FOR SUNFLOWER HYBRIDS SEEDS GERMINATION

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SUMMARY

In this research we have determined germination energy and germination of seeds of sunflower hybrids 'Luka' and 'Apolon', at the beginning of storage and 6, 12 and 18 months after of storage period (2011-2012) in the floor concrete storage at two different air temperatures and humidity (S-1: air temperature 15-18°C and relative air humidity 65-70%) as well as in climate chamber (S-2: air temperature 10-12°C and relative air humidity 60-65%), stored in four treatments (Control: processed-untreated seed; T-1: treated with A.I. metalaxyl-M; T-2: treated with A.I. metalaxyl-M + A.I. imidacloprid and T-3: treated with A.I. metalaxyl-M + A.I. clothianidin). Based on the obtained results we have determined that sunflower hybrid 'Luka', compared to hybrid 'Apolon', in the given storage conditions and with the same seed treatment has 5-8% higher germination energy and seed germination and that in climate chamber both hybrids have 5-7% higher germination energy. Seed treatment of both sunflower hybrids with A.I. imidacloprid maximally reduced initial germination energy and seed germination in all tested periods and conditions of storage. On the average, natural seed, after 18 months of storage did not have better seed quality compared to seed treated with A.I. metalaxyl-M while other treatments had more significant influence on reduction of germination energy and seed germination, 6-15%. On the average, compared to other variants, seeds treated with A.I. metalaxyl-M after 18 months of storage in both storage conditions had higher germination energy by 4-15%, and seed germination by 2-12%.

Key-words: sunflower, germination energy, germination, storage, seed treatment

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is one of the four most important annual crops grown for vegetable and industrial oils in the world (Ekin et al., 2005). Production of high quality seed is main prerequisite for maximal exploitation of cultivar genetic potential. Yield of sunflower grain varies significantly because of considerable influence of weather conditions, especially precipitation and temperature changes during a growing season. However, sunflower germination can be very susceptible in real conditions of field because of bad seed bed preparation and varying environment (Moghanibashi et al., 2012). Due to the above mentioned producers usually grow more seed than it is necessary leading to creation of grain supplies stored for longer period. Greater and better synchronized germination is crucial for achieving an optimal crop stand and better productivity, but several environmental constraints are great impediments (Wahid et al., 2008). Seed germination and seedling emergence result from a sequence of biological events initiated by water imbibition followed by enzymatic metabolism of storage nutrients, but regulated by the environment and the quality of the seed (Maroufi et al., 2011). According to the literature data the quality of seed is influenced by: weather conditions of production, presence of pests in the field, grain oil content, damage of grains in processing, manner and period of grain storage, packaging, favorable water content, conditions and duration of storage, pesticide influence, temperature seeds are preserved at biochemical degradation of seed tissue, disease and pests incidence and high oil content (Deshmukh et al., 2004; Sisman and Delibas, 2005; Šimić et al., 2009; Dević et al., 2007; Kostić et al., 2009).

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Also it is quite probable that variations in the seeds, due to their position in the whorls of the sunflower head, can affect their germination potential and viability (Munshi et al., 2007). Sajjan et al. (1999) reported decrease in percentage of germination and biomass accumulation in sunflower with increasing osmotic stress in germinating media in water deficit environment. The aim of this research was to determine the influence on seed treatment, i.e. to check the impact of preparation and duration of storage in variable and constant conditions on reduction of germination energy and seed germination of sunflower hybrids.

MATERIAL AND METHODS

In this research germination energy and seed germination of sunflower hybrids 'Luka' and 'Apolon' had been determined at the beginning of storage and after 6, 12 and 18 months of storage (2011-2012). 'Luka' is single cross hybrid with maturity period (110 – 115 days) and genetic grain yield potential of 5–5.5 t ha^{-1}. 'Apolon' is also single cross hybrid of shorter maturity period (100 – 105 days) with genetic grain yield potential of 4–5.5 t ha^{-1}. Seeds of both hybrids were processed after the harvest (selected natural seeds) in processing unit of the Department of seeds at the Agricultural Institute Osijek. Out of both sunflower hybrids 800 kg of seed samples were taken for all conditions and storage treatments. The investigation was carried out under four treatments: 1) Control, processed-nontreated seed, 2) T-1, treated with A.I. metalaxyl-M (0.3 l/100 kg of seed), 3) T-2, treated with A.I. metalaxyl-M + A.I. imidacloprid (0.3 l + 1.7 l/100 kg of seed) and 4) T-3, treated with A.I. metalaxyl-M + A.I. clothianidin (0.3 l + 0.7 l/100 kg of seed). The seed samples were distributed into 4 replications with seed distributor. From each replication 100 grains were randomly selected, placed into filter paper and taken to germination room for germination tests. After four days germination energy (%) was determined by counting germinated seeds, total germination of seeds was determined by counting germinated seeds after seven days (Standard procedure, Law on seeds and planting material, Republic of Croatia, 2005 N.N. 24/05). After that seeds of both hybrids were stored into floor concrete storage (S-1, air temperature 15-18°C and relative air humidity 65-70%) and in climate chamber (S-2, air temperature 10-12°C and relative air humidity 60-65%). Conditions of storage and quality of seeds were monitored for 18 months (2011-2012). Air temperature and humidity were recorded daily with digital thermometer (Oregon scientific, THG-312). Every six months 1.5 kg of seed samples of each treatment were taken from both storage conditions for laboratory analysis (ISTA-Manual on sampling methods and examination of seed quality). Statistical processing of obtained data was done with ANOVA – analysis of variance computer software. Significance of the obtained differences was determined with F test whereas least significant difference of germination energy and seed germination were obtained with LSD test.

RESULTS AND DISCUSSION

Significance of seed treatment and storage conditions was confirmed by analysis of variance and LSD test (Table 1). Germination energy and seed germination were significantly decreased under the influence of seed treatment and storage conditions ($P<0.05$, $P<0.01$). According to F test seed treatment shows the most significant influence on germination energy and total germination rate decrease (F-test: 477.421**, 358.257**).

Dynamics of decrease of value was confirmed by analysis of variance (Table 1). All the obtained values after 18 months of storage significantly decreased under influence of storage conditions, treatments and genotype on level $P<0.01$. According to F test storage conditions had the most significant influence on vigor and germination rate decrease (F-test: 315.562**, 286.156**).

The obtained results show that germination energy and seed germination rate of stored seeds varied significantly depending on storage conditions and the applied seed treatments where decrease of germination energy of sunflower hybrids varied from 6 to 15% and decrease of seed germination rate from 2 to 14% (Table 2).

Total average decrease of germination energy in storage conditions S2 compared to storage S1 for both hybrids was lower, between 2 and 4%, and for seed germination decrease was between 4 and 6%. After 18 months of storing period (C-4) in both storage conditions hybrids lost germination energy and seed germination, except hybrid 'Luka' in the controlled storage conditions (S2) and seed treatment T-1, which does not comply with legal regulations for seed trafficking. This is consistent with other papers whose investigation revealed that germination energy increased in the first nine months of storage and after that there was a sharp drop of germination energy (Mrda et al., 2011). Sunflower seeds lose their vigor during storage at high temperature and high relative humidity (Kausar et al., 2009). Seed germination of dill was influenced by temperature, and 25°C was found to be the optimal temperature for germination (Unver et al., 2012). A clear understanding of the germination and seedling growth is useful in screening for tolerance of crops and cultivars either to low or to high temperatures (Vassilevska-Ivanova and Tcekova 2002). Seed treated with insecticide can only be kept in controlled conditions for six months. Basra et al. (2005) reported that treated achens in rice emerged 12 h earlier compared to nonprimed achens. The lowest decrease of germination energy and seed germination was in treatment T-1. In this treatment germination energy was higher compared to control and T-2 up to 10%, and compared to T-3 up to 8%. By observing genotype and storage conditions, sunflower hybrid 'Apolon' in all storage conditions compared to hybrid 'Luka' had lower germination energy up to 4% and seed germination up to 3%. This variation of seed quality can be related to higher oil content of hybrid 'Apolon' (52-55% oil/AST).

The poorer germination of 'Apolon' also might be due to the presence of hard seed coat and compact kernel, obstructing water entry.

Obtained results of this research confirm hypothesis about importance of optimization of storage conditions, application of preparations, importance of genotype (hybrid) and changes in storage manners of natural seed. The obtained results confirm that during storage seed treated with fungicide has reduced development of mycoflora and preserved germination energy and seed germination (Singh et al., 2003; Solanke et al., 1998). Seed treatment with insecticides significantly reduces germination energy and seed germination. Grisi et al. (2009) obtained results where they concluded that there was no effect of treatment with fungicides, insecticides and their associations in sunflower seed of the tests. The exception is the test of humidity which rose when treated with fungicides Carboxin + Thiram and Carbendazim + Thiram and had higher incidence the seeds of fungi without chemical treatment. Mihalte et al. (2011) concluded that seed germination using different chemical treatments can be extremely useful for seed production industry. Therefore, insecticide treatment should be planned in advance only for seed amounts which can be placed for sale, since after a certain period they will not comply with legal regulations of seed quality for seed trafficking.

Table 1. F-test and LSD test for germination energy and seed germination rate of two sunflower hybrids after four different seed treatments and two storages conditions

Tablica 1. F-test i LSD test za energiju klijanja i klijavost sjemena u četiri tretmana i dva uvjeta skladištenja

Source of variation *Izvor variranja*	Germination energy *Energija klijanja*			Seed germination rate *Klijavost sjemena*		
	F-test	LSD-test		F-test	LSD-test	
		0.05	0.01		0.05	0.01
Hybrid (A)	18.751**	4.01	5.24	11.156*	8.78	9.17
Treatment (B)	477.421**	5.14	7.37	358.257**	9.64	10.63
Storage (C)	315.562**	8.26	9.34	286.156**	7.78	8.56
Interaction (ABC)	258.587**	7.07	7.96	176.752*	6.57	7.12

***,**,*=significant at P<0.001, 0.01 and 0.05, respectively

Table 2. Influence of treatment and storage conditions on germination energy and seed germination rate of sunflower hybrids (%)

Tablica 2. Utjecaj tretmana i uvjeta skladištenja na energiju klijanja i klijavost sjemena hibrida suncokreta

Seed treatment *Izvor variranja*	Apolon				Luka			
	Germination energy *Energija klijanja*		Total Germination *Ukupna klijavost*		Germination Energy *Energija klijanja*		Total Germination *Ukupna klijavost*	
	*S-1	S-2	S-1	S-2	S-1	S-2	S-1	S-2
Beginning of storage, C-1								
Control	80	80	89	89	82	82	88	88
**T-1	82	82	89	89	84	84	90	90
T-2	77	77	85	85	78	78	85	85
T-3	81	81	86	86	81	81	86	86
After 6 months of storage, C-2								
Control	80	80	84	86	82	82	85	85
T-1	80	81	84	86	82	84	87	87
T-2	73	75	80	82	76	78	83	85
T-3	78	80	82	84	80	81	84	86
After 12 months of storage, C-3								
Control	78	80	83	85	75	78	82	84
T-1	80	81	83	85	80	81	85	87
T-2	71	72	78	82	74	76	80	82
T-3	76	78	80	82	78	80	83	85
After 18 months of storage, C-4								
Control	70	74	75	83	70	72	78	82
T-1	76	78	81	85	80	82	85	86
T-2	70	71	73	76	70	73	75	78
T-3	68	70	75	78	68	74	78	80

*S-1: air temperature 15-18°C and relative air humidity 65-70%, S-2: air temperature 10-12°C and relative air humidity 60-65%

**T-1: treated with A.I. metalaxyl-M; T-2: treated with A.I. metalaxyl-M + A.I. imidacloprid and T-3: treated with A.I. metalaxyl-M + A.I. clothianidin

CONCLUSION

The results indicate that preconditioning seeds could increase germination traits, accelerate germination and improve seedling establishment. The difference in germination of sunflower hybrids might be due to their genetic potential. In our research treatment of seeds of both sunflower hybrids with A.I. imidacloprid had the most significant influence on decrease of germination energy and seed germination through all periods and storage conditions. Also, different storage conditions (air temperature, relative air humidity) in generally have significant influence on seed quality (germination energy and seed germination).

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ZNAČAJ UVJETA SKLADIŠTENJA I TRETIRANJA SJEMENA NA ENERGIJU KLIJANJA I KLIJAVOST SJEMENA HIBRIDA SUNCOKRETA

SAŽETAK

Istraživanjem je utvrđena energija klijanja i klijavost sjemena hibrida suncokreta Luka i Apolon nakon skladištenja od 18 mjeseci (2011.-2012.) u podno-betonskome skladištu (S-1; temperatura zraka 15-18°C i relativna vlaga zraka 65-70%) i klima komori (S-2; temperatura zraka 10-12°C i relativna vlaga zraka 60-65%), skladišteno u četiri tretmana (Kontrola; dorađeno-netretirano sjeme, T-1; tretirano s a.t. metalaksil-M, T-2; tretirano s a.t. metalaksil-M + a.t. imidakloprid i T-3; tretirano s a.t. metalaksil-M + a.t. klotianidin). Na osnovi dobivenih rezultata istraživanja, utvrđeno je da hibrid suncokreta Luka u odnosu na hibrid Apolon u danim uvjetima skladištenja i pri istome tretmanu sjemena ima 5-8% veću energiju klijanja i klijavost sjemena te da je u klima komori kod oba hibrida kvaliteta sjemena veća za 5-7%. Tretiranje sjemena oba hibrida suncokreta s a.t. imidakloprid najviše smanjuje početnu energiju klijanja i klijavost sjemena kao i u svim dužinama i uvjetima skladištenja sjemena. U prosjeku, nakon skladištenja od 18 mjeseci naturalno sjeme i sjeme tretirano s a.t. metalaksil-M nisu se razlikovali u kvaliteti, dok su ostali tretmani značajno više utjecali na smanjenje energije i klijavosti sjemena 6-15%. U prosjeku, tretirano je sjeme s a.t. metalaksil-M poslije skladištenja od 18 mjeseci pri oba uvjeta imalo veću energiju klijanja za 4-15%, a klijavost sjemena za 2-12% u odnosu na druge varijante.

Ključne riječi: suncokret, energija klijanja, klijavost, skladištenje, tretman sjemena

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