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EFFECT OF STORAGE PERIOD AND CHEMICAL TREATMENT ON SUNFLOWER SEED GERMINATION

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SUMMARY

Hybrid sunflower seed, regularly protected with chemicals, is used for sowing in the second or the third year if not used in the first year after production. In that case, it is stored in warehouses, and the length of storage period may significantly affect the quality of seeds.

An experiment was conducted in Laboratory for Seed Testing of Institute of Field and Vegetable Crops in Novi Sad, in order to examine the effect of storage period on germination of treated sunflower seeds of three commercial hybrids of the Novi Sad Institute. The seed was treated with fungicides - metalaxyl and fludioxonil, as well as with insecticides - thiamethoxam and imidacloprid, while untreated seeds served as control. The sowing was repeated throughout the year, at three-month intervals.

The obtained results indicated that, on average, the hybrid Sremac had the highest (94.61%), and the hybrid Šumadinac the lowest seed germination (90.29%). After one year of storage, seed germination declined significantly. All three hybrids treated with fungicides and the control had a significantly higher germination than hybrids treated with insecticides. This regularity was not evident right after the treatment - it became noticeable during the storage.

Key words: **storage period, genotype, chemical treatment, germination, sunflower seed**

INTRODUCTION

Sunflower is a major oil crop, grown at 150,000-220,000 hectars per year in Serbia, and at about 24 million hectars in the world (Miklič *et al.*, 2007). The area varies from year to year, depending on the yield and economic position of the crop as well (Miklič *et al.*, 2004).

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Economic aspects of seed storage period are of considerable significance. The term "longevity" is considered as both, a biological and an economic category. Economic longevity, which defines the period during which the seed preserves the technological and market values, is of primary importance for agricultural production (Dokić *et al.*, 2008). Viability, a period during which seed can be used for sowing and production, depends on its genetic constitution and genotype (Tomić *et al.*, 1998). Storage conditions and the period of storage have large influence on the quality of sunflower seed. The goal of storing is to provide optimum preservation of physiological and physical characteristics of seed, while poor storage conditions can lead to loss of seed viability (Đukanović and Sabovljević, 2001).

Indicators of seed vigor (germination energy, germination, and field emergence) determine directly the number of plants per unit area, which is one of the three basic components of yield in the world of plants. Besides, seed quality also affects the rate and uniformity of emergence, and on the dynamics of initial plant growth (Crnobarac, 1992).

The objective of this research was to determine the effects of storage period and different chemical treatments on seed germination of different sunflower genotypes.

MATERIAL AND METHOD

Three commercial hybrid sunflower seeds were tested for two years (2007-2008): NS-H-111, Sremac and Šumadinac. All three of them had been developed at Institute of Field and Vegetable Crops in Novi Sad. The seed was treated with fungicides - metalaxyl and fludioxonil, as well as with insecticides - thiamethoxam and imidakloprid, while untreated seeds were taken as control. The preparations that contained a.m. fludioxonil and metalaxyl were applied in the amount of 300 ml/100 kg of seeds, and those that contained a.m. thiamethoxam and imidakloprid in the amount of 1000 ml/100 kg of seeds. Beside these chemical preparations, the seed was also treated with color (300 ml/100 kg of seeds), pigment (150 g/100 kg of seeds) and water (500 ml/100 kg of seeds).

The referent examination of seed germination was performed on seeds recently treatedwith the following combinations: fludioxonil + metalaxyl (F+M), fludioxonil + metalaxyl + thiamethoxam (F+M+T) and fludioxonil + metalaxyl + imidakloprid (F+M+I). To test the effect of storage period on seed germination, treated seed was stored in paper bags in a warehouse. The sowing was repeated throughout the year, at three-month intervals.

The experiment was carried out in the Laboratory for Seed Testing of Institute of Field and Vegetable Crops in Novi Sad. Seed germination was tested by the standard laboratory method. Sets of 4 × 100 seeds represented each genotype. Wet sterile sand was used as a substrate. The seed was incubated in a germination chamber at 25°C and the relative air humidity of 95%. Seed germination rate was assessed 10 days after planting, by counting the number of typical seedlings. A typical seedling (ISTA Rules, 2007) should possess all structural parts and a well-developed primary root.

The obtained data were statistically processed by the variance analysis of factorial *split-split-plot* experiment (A factor - genotype, B factor - storage period, C factor - chemical treatment). Data were processed by a computer statistical package, and the significance of the obtained differences was determined by the least significance difference (LSD) test for the significance thresholds of 1 and 5% (Mead *et al.*, 1996).

RESULTS AND DISCUSSION

The variance analysis of the examined parameters indicated that the genotype, storage period and chemical treatment (p=<0.001) exhibited statistically highly significant effects on sunflower seed germination. Two-factor interactions were also highly statistically significant (p=<0.001). Mrđa (2009) reported that all of the examined factors showed highly significant effects on both germination and germination energy of sunflower seed. According to these results, the genotypes reacted differently to the examined factors. The examined parameters were highly significant in the hybrids as compared with the lines, and differences between hybrids were also highly significant.

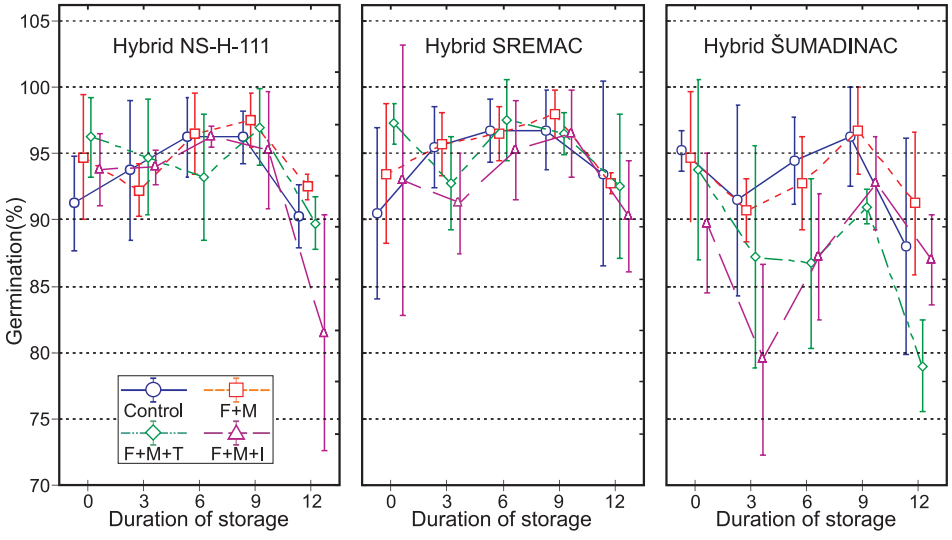

Figure 1: Seed germination rates of the examined sunflower genotypes

The results of the effects of the genotype, storage period and chemical treatment on sunflower seed germination rate are presented in Figure 1. On average for the tested genotypes, the hybrid Sremac had the highest (94.61%), and the hybrid Šumadinac the lowest seed germination rate (90.29%). The difference between with the values obtained for these two genotypes was statistically highly significant. The value of the tested parameter for the hybrid NS-H-111 (93.65%) was statistically significantly higher than that for the hybrid Šumadinac (by 3.36%). The difference

between the seed germination values of NS-H-111 and Sremac was not statistically significant.

Storage period had a negative influence on seed germination rate. After a year of storage, seed germination rates of all three genotypes declined significantly. After 12 months of storage, the average value of the tested parameter (89.03%) was statistically highly significantly lower that the other storage periods examined. Conversely, Ghasemnezhad and Honermeier (2009) observed no effect of storage period on seed germination. Figure 1 shows that the seed germination rate kept growing up to the ninth month when, on average, the statistically highest value was recorded (95.88%). Rajić *et al.* (2005) obtained similar results for sugar beet seed. The germination energy and germination increased significantly over the period of six months after harvest, while Tatić *et al.* (2008) concluded that, beside the storage period, the method of storage has a significant influence on seed quality.

On average, the highest seed germination rate was noted after the F+M treatment (94.42%). This value and the value of the control treatment (93.75%) were statistically highly significant compared with the treatments involving insecticide combinations. Vujaković (2001) concluded that fungicides did not have a negative effect on wheat seed germination rate - not even a double dose, which caused a decrease ingermination, but which was not statistically significant. Vujaković *et al.* (2008) concluded that fungicides such as mancozeb and benomyl did not affect the wheat seed germination, although the germination was lower in comparison with the control and variable in dependence of the genotype. However, Đorđević and Milijić (1994) claimed that the wheat seed treatment with different fungicide combinations significantly reduced the seed germination rate, which is diametrically opposite ion to the results of this research. Seed germination rate after the F+M+I treatment (90.88%) was highly significantly lower than the rates obtained with the other combinations. Based on the examination of germination energy and germination of sunflower and corn seed treated with insecticides, Stanković and Medić (1997) concluded that the treatment with insecticides led to a reduction of sunflower and corn seed germination, but this the reduction was not statistically significant in all cases. The same authors reported that the insecticides carbosulfan and imidakloprid exhibited lowest effects on seed quality. Studying the effect of fungicide and insecticide combinations on eight corn genotypes, Ivanović *et al.* (1994) concluded that the same chemical preparation influenced one genotype in a depressive way while it showed positive effects on another.

The obtained values of the genotype × storage period interaction indicated that the seed germination rate was highest after nine months of storage, and lowest after a year of storage for all three hybrids (Figure 2). In the case of the hybrid NS-H-111, the seed germination rate after 12 months of storage (88.50%) was highly significantly lower than in the other storage periods tested, while in the case of the hybrid Sremac, the seed germination rate after 12 months (92.25%) was highly significantly lower than the values obtained after six and nine months of storage. In the case of the hybrid Šumadinac, the seed germination rate after 12 months of storage (86.31%) was highly significantly lower with respect to the values obtained at the beginning of the test and after six and nine months of storage. Crnobarac and

Marinković (1994), who observed significant differences in germination rate during sunflower seed storage, stated that the genotype itself influences the storability too. Along this line, Đukanović (1999) concluded that the genotype is the most important factor that affects the storage characteristics and their changes in corn inbred lines and hybrids.

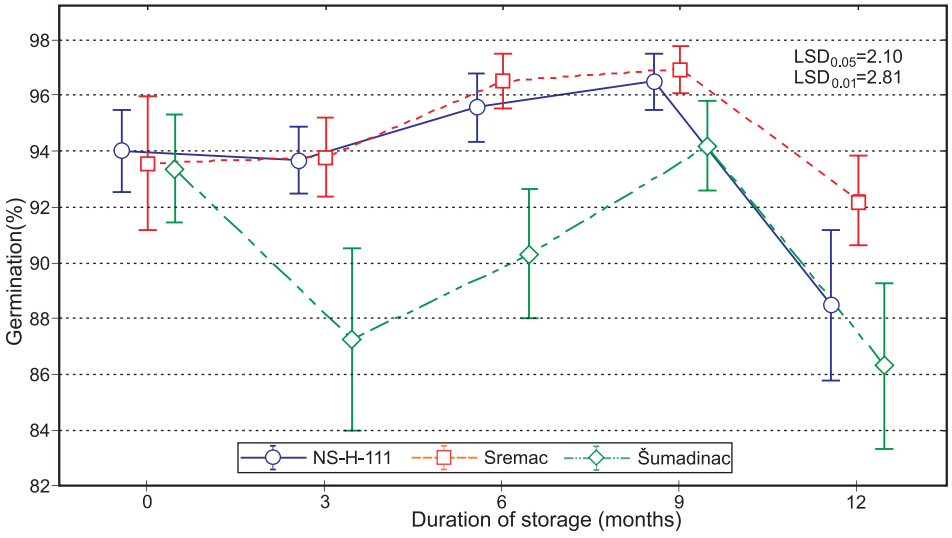

Figure 2: Sunflower seed germination for genotype x storage period interaction

Regarding the genotype × chemical treatment interaction, seed treatment with F+M+I resulted in lowest seed germination of all three hybrids (Figure 3).

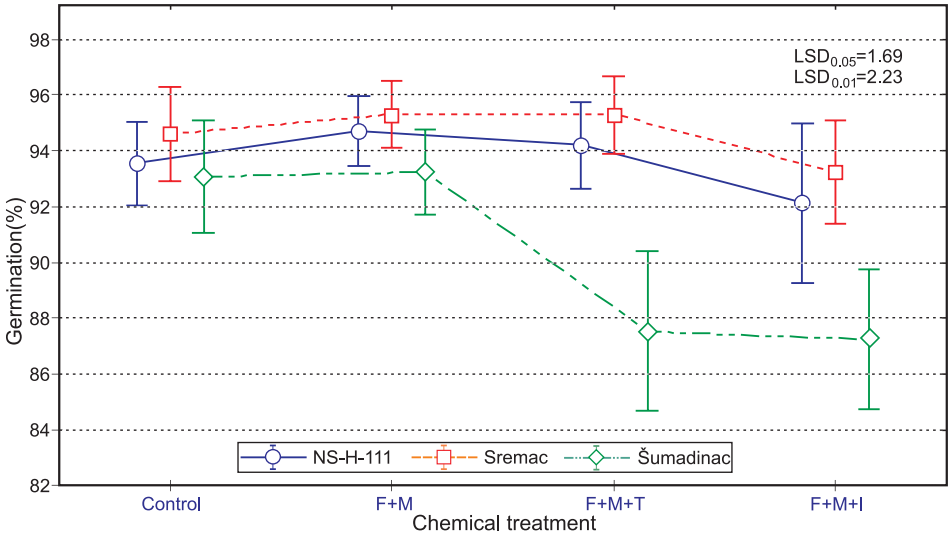

Figure 3: Sunflower seed germination for genotype × chemical treatment interaction

In the case of the hybrids NS-H-111 and Sremac, their seed germination was significantly lower when treated with F+M+I than with F+M or F+M+T, 92.15% and 93.25%, respectively. In the case of the hybrid Šumadinac, the treatment with the combination that included insecticides caused a highly significantly lower seed germination than the respective values obtained in the control and the treatment F+M. Marjanović-Jeromela *et al.* (2008) obtained similar results on negative influence of insecticides while examining the influence of insecticides on rapeseed seed quality. Kuhar *et al.* (2002) mentioned cases of germination loss in sweet corn seed due to imidakloprid treatment, and Kashypa *et al.* (1994) claimed that insecticide use prolongs the period of germination and lessens seed vigor.

The interaction storage period × chemical treatment showed that seed germination loss occurred in the tested sunflower genotypes after 12 months of storage regardless of chemical treatment used (Figure 4). Šimić *et al.* (2006) reported that the loss of sunflower seed vigor after four years of storage can exceed 50%, while still larger losses have been recorded at high temperatures. In our study, the significantly lowest seed germination rate was found in seed treated with combinations that included insecticides, except at the beginning of the test when significantly lowest values of the examined parameters were recorded in the control and F+M+I treatment. Conversely, Bača *et al.* (2008), in their four-year research on the effect of the insecticides imidakloprid and thiamethoxam on corn seed germination, did not confirm a negative influence of chemical treatment on field germination of corn seed.

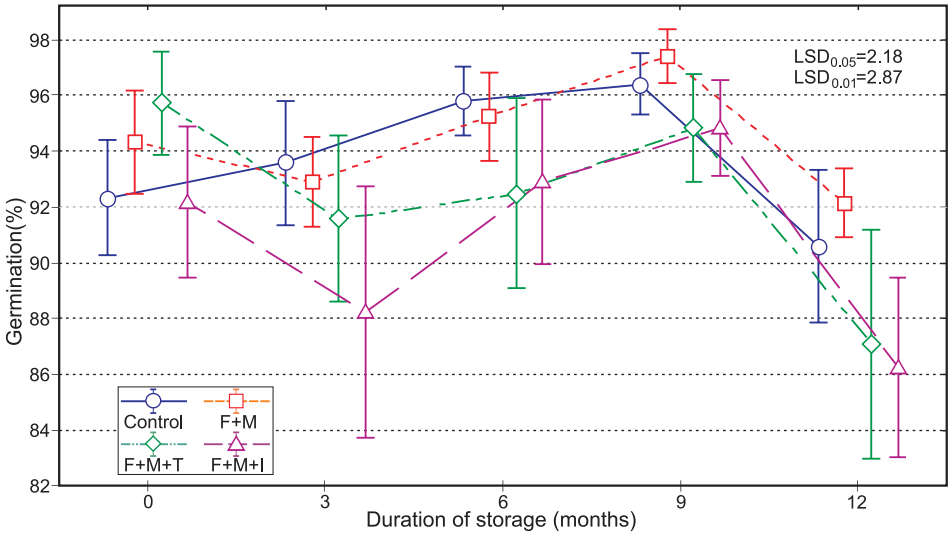

Figure 4: Sunflower seed germination for storage period × chemical treatment interaction

CONCLUSION

The effects of genotype, storage period and chemical treatment on sunflower seed germination were statistically highly significant. On average, the hybrids Sremac and Šumadinac had the highest and lowest seed germination rates, respectively. Storage period had a negative effect on seed germination. After a year of storage, seed germination of all three genotypes declined significantly. Highest seed germination values were recorded after F+M treatment and in the control, the lowest value was recorded after F+M+I treatment.

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