EFFECT OF CHEMICAL TREATMENT, LENGTH OF STORAGE AND THE SUBSTRATE ON GERMINATION ENERGY OF SUNFLOWER HYBRID NS-H-111

Jelena MRĐA[1], Jovan CRNOBARAC[2], Vladimir MIKLIČ[1]

[1]Institute of Field and Vegetable Crops, Novi Sad, Serbia
[2] Faculty of Agriculture, University of Novi Sad, Serbia
Corresponding author: Jelena MRĐA, e-mail: jelena.mrdja@ifvcns.ns.ac.rs

Abstract: *Germination energy is reliable index for evaluation of seed resistance to adverse environment conditions. Seed has better quality if there is no difference between germination energy and germination. With the germination energy increase, at the same level of germination, the yield is increased as well. Type of substratum is one of the factors that have influence on germination energy, because the percentage of germinated seed is increasing with increasing of absorption capacity of substratum. The research was conducted in Laboratory for seed testing and in greenhouse of Oil Crop Department, Institute of Field and Vegetable Crops Novi Sad. Seed of sunflower hybrid NS-H-111 was treated with fungicides: benomil, metalaxyl and fludioxonil and insecticides: tiametoxam and imidacloprid. Control variant was seed without chemical treatment. The next combinations were investigated: control (non-treated seed), fludioxonil + metalaxyl (F+M), fludioxonil + metalaxyl + tiametoxam (F+M+T) and fludioxonil + metalaxyl + imidacloprid (F+M+I). Seed was treated before sowing and first determination of germination energy was done after few days. For examination of influence of storage period length on seed quality, seed was kept in storage facility. Conditions in the storage were depending on environmental conditions. Sterilized sand and soil were used as substratum and germination energy was determined on the 4th day after sowing. The aim of this research was to examine influence of storage period length and type of substratum on germination energy. Based on results there are statistically high influence of chemical treatment, length of storage and type of substratum on seed germination energy. Double interaction chemical treatment x length of storage and length of storage x substratum type, were highly significant, while the interaction chemical treatment x substratum wasn't significant. Difference between germination energy of control and treatment F+M was highly significant compared with germination energy of seed treated with insecticides. The value of this parameter of B+M treatment was significantly higher compared with treatment F+M+T (for 1.70%), and highly significant different compared with F+M+I treatment (for 2.52%). Germination energy after six and nine month keeping was highly significantly different compared with other variants. The values of investigated parameters after twelve months was significantly lower than values measured at the beginning of research and after three months. Seed germination in soil was significantly higher then in the sand for 2.62%.*

***Key words*:** *sunflower seed, germination energy, chemical treatment, length of storage, substrate*

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is one of the most important oil crops (*DE RODRIGUEZ et al., 2002, ŠIMIC et al., 2008*) and it has been grown on more than 23 million hectares in more than 70 countries (http://faostat.fao.org). In Serbia it is cultivated in the last 20 years on 146.000 - 201.000 ha (http://webrzs.stat.gov.rs/axd/poljoprivreda), and interest of growers was dependent on yield and profitability *(Miklič et al., 2004).*

Seed of sunflower hybrid, which is usually treated with the pesticides, is kept in storage facilities if not used for sowing in current year. Viability of seeds during storage is gradually reduced, with an adverse effect on the germination, and later on the growth and development of plant. The period of storage is very important from an economic point of view.

Viability of seed can be defined as biological and economic category. The later one is defined as period in which seed maintained technological and market value *(DOKIĆ et al., 2008)*. Length of this period is closely related to genotype *(TOMIĆ et al., 1998)*. Parameters of seed viability (germination energy, germination and seed emergence under field conditions) directly determine the number of plants per hectare, which is one of three basic components of yield. In addition to this, uniformity of seedlings emergence and their growth is affected by seed quality *(CRNOBARAC, 1992)*. According to *AHMAD (2001)* using high quality, healthy, large seed is very important to achieve the optimal plant density and parameter that is most frequently used to determining seed quality is germination. Growth and development of sprout in this process is important for development of strong plant *(MILOŠEVIĆ and ZLOKOLICA, 1996*).

For the examination of sunflower seed quality several types of substratum have been used: sand, soil, compost and filter paper, and the most widely used is sand. Sand provides good contact of seeds and substratum, and reduces the occurrence of seedling diseases. Unlike sand, which can be used more than once after, almost all others can be safely use only one time. Therefore, the soil, compost and filter paper as a seedling substratum are used less frequently. Their most common use is for comparative testing or research purposes.

The aim of this research was to examine influence of storage period length and type of substratum on germination energy.

MATERIAL AND METHODS

Research was conducted during 2007. and 2008. using seed of commercial sunflower hybrid NS-H-111 created at the Institute of Field and Vegetable Crops in Novi Sad. Seeds were treated with fungicides: benomil, metalaxyl and fludioxonil and insecticides: tiametoxam and imidacloprid, and for the research following combinations were selected: control (untreated seed), benomil + metalaxyl (B + M), fludioxonil + metalaxyl (F + M), fludioxonil + metalaxyl + tiametoxam (F + M + T) and fludioxonil + metalaxyl + imidacloprid (F + M + I).

Commercial product was applied by manufacture recommendation, and the entire quantity of seed was treated just before planting. First measurement of germination energy was performed few days after treatment. Seed was kept in a warehouse were storage conditions were dependent on weather conditions. Seeds were kept in paper bags. Sowing of seed was repeated every three months.

The experiment was set up in the Seed Testing Laboratory of the Institute of Field and Vegetable Crops in Novi Sad and seed germination test was performed using standard laboratory methods, sowing 100 seeds in four replications. As substratum was used previously watered, sterilized sand. Seed was incubated at the temperature of 25ºC and relative humidity of 95%. The energy of germination was determined 4th days, the evaluation of typical seedlings *(ISTA Rules, 2007)*.

The results were calculated using factorial analyses of variance, with three factors (A factor – chemical treatment, B factor – length of storage, C factor – substratum for germination), as part of software STATISTIKA 8.0. Differences between treatments were tested using Fishers post-hoc test at 1 and 5 % level of significance *(MEAD et al., 1996)*.

RESULTS AND DISCUSSIONS

Analysis of variance of investigated parameters indicated a statistically highly significant influence of chemical treatment (p=0.001), length of storage and the substratum (p=<.001) on the germination energy hybrid NS-H-111. Interactions chemical treatment x length of storage and length of storage x substratum, were highly significant (p=<.001), and interaction chemical treatment x substratum was not significant (p=0.406).

On average, the highest germination energy had control (94.50%) and treatment F + M (94.73%) and it was significantly higher than treatments with insecticides. The value of the germination energy in treatment B + M (93.75%) was significantly different on level of 5 % than in treatment F + M + T (for 1.70%) and significantly different on level of 1 % than in treatment F + M + I (for 2.52%).

Germination energy after six (95.35%) and nine months (95.58%) of storage was significantly higher than in other treatments. The value of the studied parameters after twelve months of storage (89.35%) was significantly lower than the value at the initial examination (92.40%) and testing after three months of storage (93.58%).

The germination energy of seed in the soil (94.56%) was significantly higher than in the sand (for 2.62%). Positive correlation between absorption capacity of substratum and germination was confirmed by *NIJËNSTEIN and ESTER (1998).* Similar results were published by other authors *(FUCHS and WEIGAND, 1985, STEINER and FUCHS, 1987; TONKIN, 1987).* However, *PEREZ et al. (1999)* did not found any influence of different substrates on germination of seed.

In the interaction of chemical treatment x length of storage germination energy after six and nine months of storage was significantly higher comparing to initial testing done after twelve months in all treatments that includes treatment with pesticides (Fig.1). The values of the studied parameters after twelve months of storage for the treatment F + M + T (87.75%) and F + M + I (82.25%) were significantly lower in comparison with the values of other variables. These results are in agreement with the results of *STANKOVIĆ and MEDIĆ (1997).* They were examining impact of insecticide treatment on germination energy and seed germination of sunflower and corn and came to the conclusion that in all treatments with insecticides germination was lower. The same authors state that the insecticides carbosulfan and imidacloprid had the least negative impact on seed quality, but each insecticide had negative influence on germination after storage period of one year. Contrary to these results in four-year study of *BAČA et al. (2008)* impact of insecticides imidacloprid and tiametoxam proved not to be negative on seed germination. According to *Miklič et al. (2008)* previous experience in most cases did not show the negative impact of fungicides on seed quality, particularly on germination energy and germination of sunflower seeds.

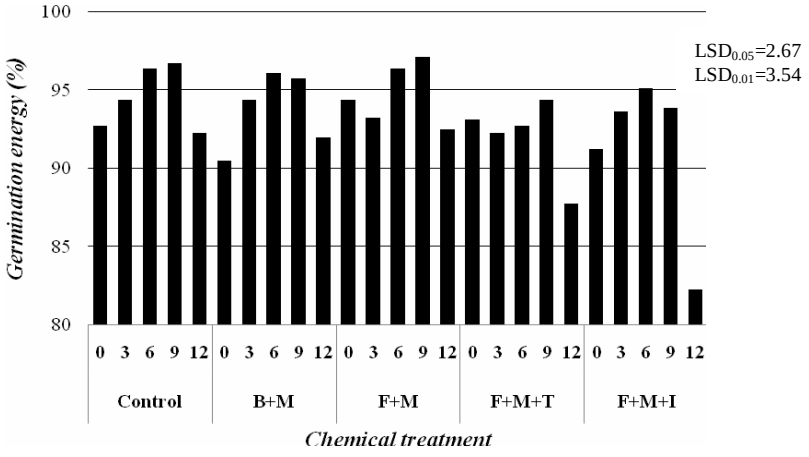

Figure 1: The germination energy of hybrid NS-H-111 for interaction chemical treatment x length of storage

From the interaction chemical treatment x substratum one can see that the energy of germination in the soil was higher than in the sand for all treatments (Fig.2). The differences in results that were demonstrated between the sand and soil can be explained by fact that the germination energy and germination of seeds were affected by the nature of the substrate that was used for testing as *Nijënstein and Ester (1998)* showed that when using the substrate of greater absorption of power, which is in this study was a soil, the percentage of germinated seeds rise.

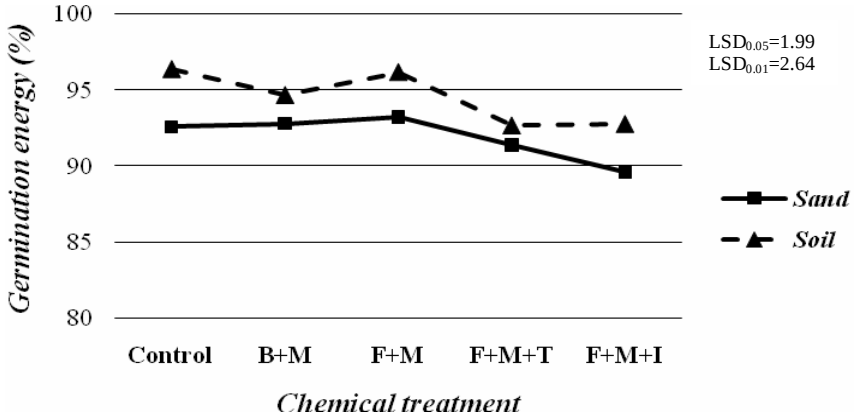

Figure 2: The germination energy of hybrid NS-H-111 for interaction chemical treatment x substratum

To similar results in their research came *Mrđa et al. (2009)*, where the seeds sown in compost had a higher germination energy and germination of than seeds sown in sand. In the results of this research showed significant differences between control (3.80%) and treatments F + M (2.95%) and F + M + I (3.15%). Negative impact of imidacloprid on the quality of sunflower seeds was proved by *Mrđa et al. (2008).*

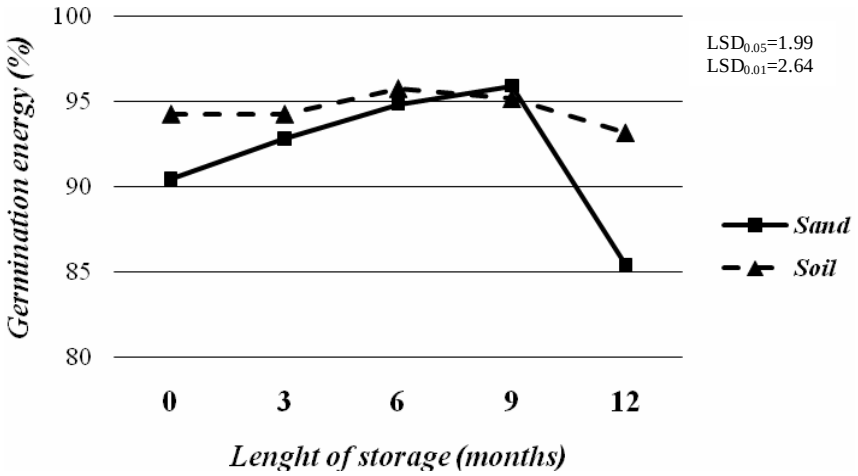

Figure 3: The germination energy of hybrid NS-H-111 for interaction length of storage x substratum

In the interaction length of storage x substratum one can see that the germination energy of seed sown in soil was higher than in the sand in all tested storage lengths, except for test done after nine months of storage where the germination energy in the sand was higher for 0.75%, but this difference was not statistically significant. Statistically significant difference between used substratum existed between germination energy in initial test (for 3.80%) and test performed after twelve months of storage (for 7.70%), where the germination energy in soil was higher than in the sand. (Fig.3). Also, germination energy using the soil, rose during the period of six months after treatment with pesticides. Same trend was observed with usage of sand, but up to nine months after treatment. Increasing of seed quality with increasing of length of storage up to certain point was observed by *Rajić et al. (2005)* according to who germination energy and germination of sugar beet seed increased during a period of six months after harvest. Based on the results shown in Fig.3 one can see that there has been a decrease in germination after twelve months storage on both substratum used for the examination. Drop in sunflower seed vigour after four years of saving can reach to over 50%, with losses positively correlated with high temperature *(Šimić et al., 2006)*. *Tatić et al. (2008)* found significant differences in the quality of seeds based the method of keeping and the length of storage period of soybean seeds. However, *Ghasemnezhad und Honermeier (2009)* did not prove the effect of temperature and length of storage on germination of sunflower seeds.

CONCLUSIONS

Examining the impact of chemical treatment, length of storage and type of substratum on germination energy of sunflower hybrid NS-H-111 led to following conclusions:

- Effect of chemical treatment, length of storage and substratum was highly statistically significant. Interactions chemical treatment x length of storage and length of storage x substratum, were highly significant, while the interaction chemical treatment x substratum was not significant.
- On average, the highest germination energy of chemical treatment was found in control and in treatment F + M and was significantly higher than for treatment with insecticides.
- The energy of germination after six and nine months of storage was significantly higher than in other treatments, but after twelve months dropped significantly.
- The energy of germination in the soil was significantly higher than in the sand.
- At the interaction chemical treatment x length of storage, germination energy after six and nine months of storage was highly significantly higher than in the initial testing, and after twelve months in all investigated treatments with pesticides.
- From the interaction chemical treatment x substratum one can see that the energy of germination in the soil was higher than in the sand for all treatments. Statistically significant differences were found between the control and the treatment F + M and F + M + I.
- In interaction length of storage x substratum significant differences were found in germination energy during initial test and after twelve months of storage where the germination energy of seed sown in soil was higher than seed sown in sand.

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