THE INFLUENCE OF MOISTURE ON THE QUALITY INDICES OF *FESTUCA ARUNDINACEA* SEEDS

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Abstract: *Species Festuca arundinacea has been studied from many points of view. The research on this species has been performed by Romanian scientists, as well as many foreign ones. Nevertheless, the studies regarding seeds and their quality are rare.The paper aims to analyse the influence of moisture on the quality of Festuca arundinacea (Palma variety) seeds during storage. The parameters used were: moisture content (%); Pure seeds (%, weight); Inert matter (% weight); Other crop seeds(% weight); Total Germination Normal seedlings(% number); Abnormal seedlings(% number); Dead seeds (% number). The biological material we used was made up of Festuca arundinacea (Palma variety) seeds obtained in specific Banat conditions. The seed samples were taken from three granaries, found in three different towns: Jimbolia, Ciacova and Gherteniş (Caraş-Severin County). Two seed quality analyses were performed during storage: the first took place six weeks after harvest and the second was performed 30 days after the first determinations. Following the first determination (December 2009), the moisture of Festuca arundinacea (Palma variety) seeds was 13% in the granary at Ciacova germination ranged from 76% (granary at Jimbolia) and 77% (in the granary at Ciacova). In the storehouse at Gherheniş, the moisture of Festuca arundinacea (Palma variety) seeds was 14%, and germination was 76%. One month after the first determination, we made a second analysis (January 2012) of the seeds and we noticed that moisture had increased by one percent in the granaries at Ciacova and Jimbolia, which led to a decrease in seed germination, in the number of normal seedlings and an increase in the number of dead seeds in both granaries. In the Gherheniş granary, the second determination found the same moisture values for Festuca arundinacea seeds, i.e. 14%. However, seed germination went down. Low germination of Festuca arundinacea (Palma variety) seeds is caused primarily by unsuitable storage conditions that led to an increase in the moisture index. In its turn, moisture influences the variation of the parameters under study. The seed moisture content controls the variation of the parameters to a greater or a smaller extent. Lower Moisture Content is direct correlated with the percentage of Total Germination.*

Key words: *seed moisture, germination, purity, storage, cluster analysis, Diversity Profile Families , Festuca arundinacea.*

INTRODUCTION

Harvesting seeds before they are mature leads to a series of deficiencies (WAGNER MARIE HELENE et al., 2004; MIRDAD Z. et al., 2006; STANISAVLJEVIC R. et al. 2010). After the ovary is fertilized, the fundamental structures of the seed (with simple chemical composition - sugars, aminoacids) start to form and develop, and change through various biochemical processes into complex substances (starch, fats, protein substances). When the seeds are immature, they present either insufficient development of some parts of the embryo, or deficiencies of the substances necessary for germination (enzymes, gibberellin). GIRI GS and SCHILINGER WF., 2003). These can lead to abnormal seedlings, weak seeds or even non-germinative seeds (BASRA AS., 2006) the more mature a seed is at harvest, the more vigorous it is and the faster normal seedlings grow from it. (HONGFEI LU. et al. 2008).

Moreover, if harvest of seeds with high moisture content is followed by fast artificial drying, germination is weakened (FLORINA PALADA, 2009). Research conducted on several varieties of ***Lolium perenne***, (FLORINA PALADA, 2010.), found positive correlations between seed humidity and the other indicators of quality, both in controlled and non-controlled storage conditions. The closest correlations were discovered between humidity and germination percentage, between humidity percentage and the number of normal seedlings.

MATERIAL AND METHODS

Text the biological material used is represented by seeds of *Festuca arundinacea* (Palma variety) obtained in the conditions in Banat - România. Seeds samples were taken from three seed storage areas: one in Jimbolia, another in Ciacova and yet another in Gherteniş (Caraş-Severin County). Two analyses were performed on seed quality during storage, the first six months after harvest and the second 30 days after the first determination.

Several seed samples were taken from each storehouse, on two different dates (December 2009, January 2010). Elementary seed samples (from each storage) were combined and from their combination the laboratory sample was extracted for determining seed purity, germination and humidity. There were four determinations made for each sample under analysis, and then their mean was calculated.

Laboratory analyses were performed at ITCSMS (Inspectorate for the quality of seeds and planting material, Timiş County, where specialists made a very large number of determinations and observations using modern devices and laboratory equipment. Germination testing was performed in conformity with current ISTA rules and SR 1624/2003.

In order to determine the germination of *Festuca arundinacea* (Palma variety) seeds, the work method was TP-top of paper (International Seed Testing Association (ISTA)-2002, SR 1624, 2003). In accordance with this method, the seeds are placed on top of industrial filter paper in Petri dishes. The layer of paper is moistened at its maximum absorption capacity at the beginning, and the dishes are covered with a glass lid after each repetition in order to reduce evaporation.

The samples are introduced in the germinator at alternate temperatures, namely 20-30 °C. A higher temperature is followed by a lower one. The seeds placed in the germinator are kept at 20°C for 6 hours, and then at 30°C for 8 hours. The change in temperature is made in the course of three hours.

For each variant, the determination was made in 4 repetitions x 100 seeds.

The following categories were found on the germination layer: normal seedlings; abnormal seedlings; dead seeds. The assessment of normal seedlings was performed 11 days after the seeds were placed in the germinator.

Humidity was assessed in a drying chamber, in 8 cm diameter capsules. We employed two subsamples for analysis. The weighing, before and after drying, had a precision of 3 decimals, and the final result was reported in accordance with ISTA rules (International Seed Testing Association (ISTA)-2002). The drying temperature was 130 0 C, drying time - one hour and the cooling in the exsiccate 45 minutes.

The value of humidity was calculated with the following formula:

$$U (\%) = (M2-M3)*100/ (M2-M1)$$

where:

M1 = the weight of the capsule with the lid, in grams;

M2 = the weight of the capsule with the lid and the content before drying, in grams;

M3 = the weight of the capsule with the lid and the content after drying, in grams.

Statistical analysis

The statistical evaluation of the experimental data was made using PAST 2.14.

Cluster Analysis is a statistical method that groups data objects based on information found in the data that describes the objects and their relationship (http://www-users.cs.umn.edu/~kumar/dmbook/ch8.pdf).

The cluster analysis was performed using two-way clustering based on the average distance between all members in the two groups (HAMMER et all, 2001).

Diversity families.

For determining the diversity families the program plot together the diversity profiles using the exponential of the so-called Renyi index, which depends upon a parameter α. For α =0, the function gives the total species number. α =1 (in the limit) gives an index proportional to the Shannon index, while α =2 gives an index which behaves like the Simpson index (HAMMER et all, 2001)

The most commonly used diversity indices are simple transformations of the effective number of types where each diversity index can also be interpreted in its own right as a measure corresponding to some real phenomenon -a different one for each diversity index (TUOMISTO H., 2010).

RESULTS AND DISCUSSIONS

As the aim of the paper is to analyze the influence of humidity on the quality of *Festuca arundinacea* (Palma variety) seeds during storage, the parameters we focused on were: moisture content (%); Pure seeds (%, weight); Inert matter (% weight); Other crop seeds (% weight); Total Germination (% number); Normal seedlings (% number); Abnormal seedlings (% number); Dead seeds (% number).

The graphic representation of the parameters under study is presented in Figure 1.

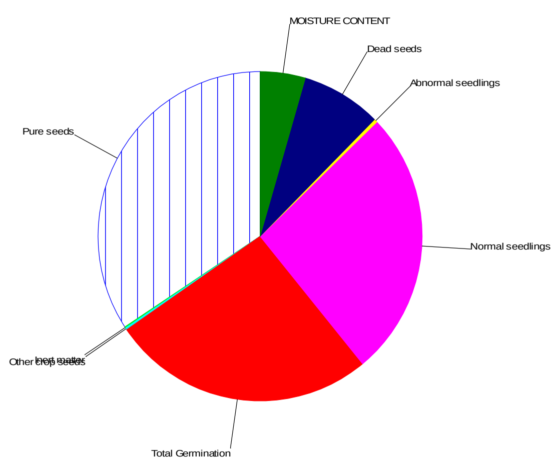

Figure 1. Graphical representation of the parameters under study

At our first determination (December 2009), *Festuca arundinacea* seed humidity was 13% in the storehouses at Ciacova and Jimbolia and germination was of 76% in the storehouse at Jimbolia) and 77% in the storehouse at Ciacova). In the storehouse at Gherheniş, seed humidity for *Festuca arundinacea* seeds was 14%, and seed germination was 76%.

Seed purity was over 98% in all three granaries, which proves that the crop technology was accurately followed.

One month after the first determination, we performed the second seed analysis (January 2010) and we found a one percent increase in humidity in the granaries from Ciacova and Jimbolia, which led to decreased germination, a decrease in the number of normal seedlings and an increase in the number of dead seeds, in both granaries.

In the storehouse at Gherheniş, the second determination revealed the same humidity values for the seeds of *Festuca arundinacea*, namely 14%. Nevertheless, seed germination was lower.

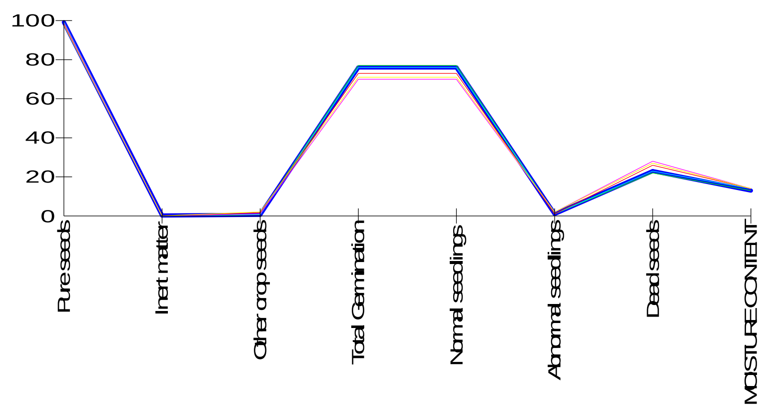

Figure 2. Graphical representation of seedling parameters distribution

The differences between the laboratory samples under analysis are influenced to a smaller extent by the number (%) of normal seedlings and humidity content (%). As seen in Figure 2, purity does not influence the distribution of the parameters we determined (similar line patterns) for the study of seed germination in the case of *Festuca arundinacea* seeds, Palma variety.

It is widely accepted that humidity plays a key part in maintaining the quality of a batch of seeds during storage. In controlled storage conditions, humidity decreases in forage plants as the storage period gets longer (FLORINA PALADA, 2010). Thus, low germination of *Festuca arundinacea* seeds is primarily due to the storage conditions which led to increased humidity. In its turn, humidity influences the value of the parameters under study.

Cluster analysis of the variables under study for the quality analysis of the seeds of *Festuca arundinacea* in the three granaries is presented in Figure 3.

Cluster analysis (figure 3) reveals that the studied parameters for *Festuca arundinacea* are separated into two large groups. After studying the groups (which were created on the basis of similitude) presented in figure 3, we can safely say that humidity has direct influence on dead seeds and abnormal seedlings. At the same time, it indirectly influences total germination and purity. Normal seedlings are the parameter that has the biggest impact on germination.

Seed humidity content controls, to a larger or smaller extent, all parameters we studied in *Festuca arundinacea* seeds, which can be seen in Figures 4, 5 and 6 in the study of diversity Profile Families.

If we study the humidity content as compared to the seven parameters under analysis: Pure seeds (%, weight); Inert matter (%, weight)**;** Other crop seeds (%, weight); Total Germination (%, number); Normal seedlings (%, number); Abnormal seedlings (%, number);

Dead seeds (%, number), we notice that humidity content has direct influence on the number of pure seeds, total germination number, number of normal seeds and number of dead seeds (Fig. 4) .

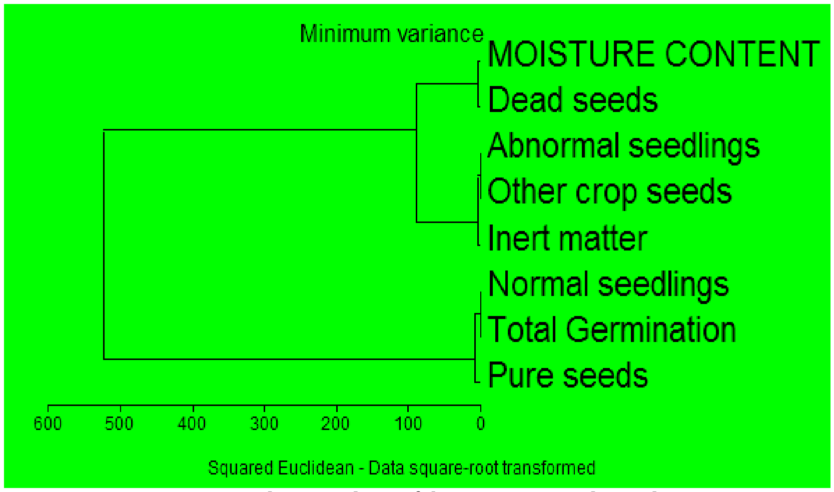

Figure 3. Cluster analysis of the parameters under study

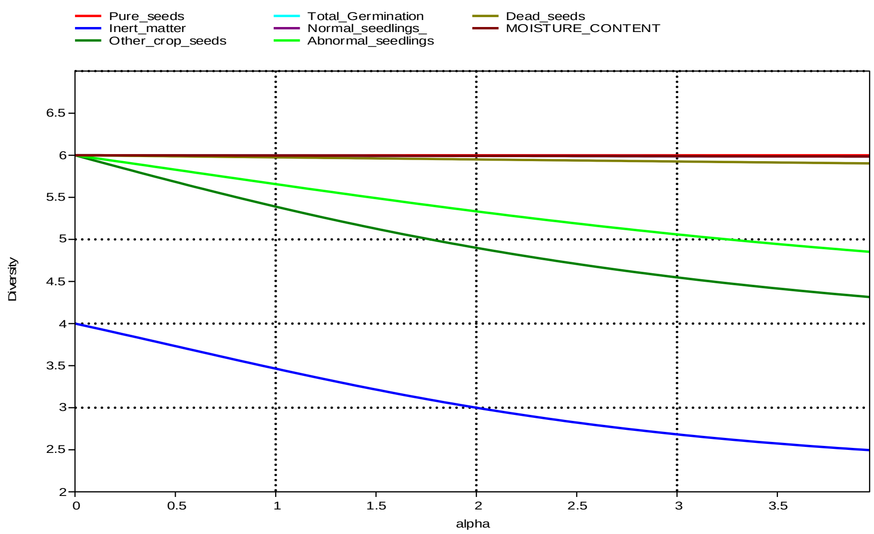

Figure 4. Diversity Profile Families

Looking at Figure 5, we can notice that humidity content influences directly the total germination number and the normal seeds.

Humidity content has direct influence on the number of pure seeds, which can be seen in Figure 6.

Studies and research made on other fodder plants revealed the same aspects emphasized in our studies (FLORINA PALADA, 2010).

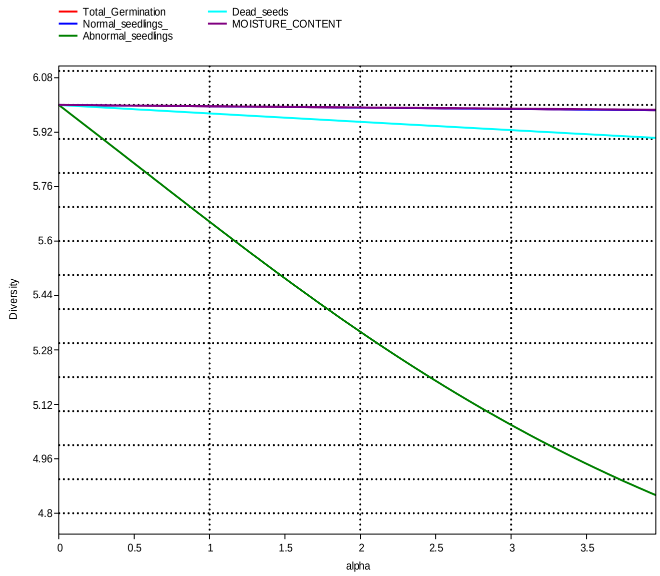

Figure 5. Diversity Profile Families

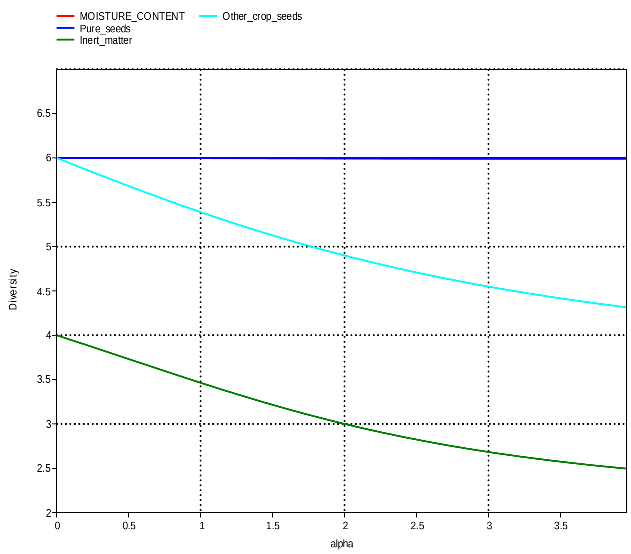

Figure 6. Diversity Profile Families

Cluster analysis, presented in Figure 7, reveals that lower humidity content is in direct correlation with the total germination percentage. The lower the humidity of *Festuca arundinacea* seeds is, the higher the seed germination process becomes.

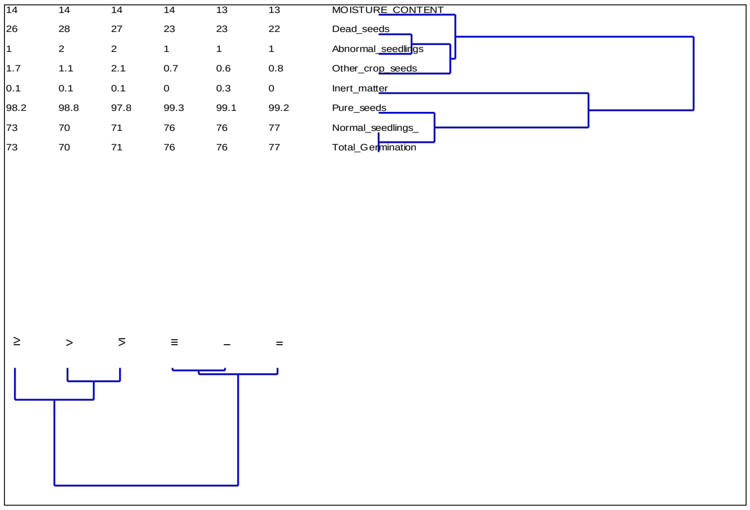

Figure 7. Cluster analysis
Using Paired Group, Two Way Correlation

CONCLUSIONS

At our first determination (December 2009), *Festuca arundinacea* seed humidity was 13% in the storehouses at Ciacova and Jimbolia and germination was of 76% in the storehouse at Jimbolia) and 77% in the storehouse at Ciacova). In the storehouse at Gherheniş, seed humidity for *Festuca arundinacea* seeds was 14%, and seed germination was 76%. Seed purity was over 98% in all three granaries, which proves that the crop technology was accurately followed. One month after the first determination, we performed the second seed analysis (January 2010) and we found a one percent increase in humidity in the granaries from Ciacova and Jimbolia, which led to decreased germination, a decrease in the number of normal seedlings and an increase in the number of dead seeds, in both granaries.

In the storehouse at Gherheniş, the second determination revealed the same humidity values for the seeds of *Festuca arundinacea*, namely 14%. Nevertheless, seed germination was lower.

Low germination of *Festuca arundinacea* seeds is primarily due to improper storage conditions which led to increased humidity. In its turn, humidity influences the value of the parameters under study. Seed humidity content controls, to a larger or smaller extent, all parameters we studied in *Festuca arundinacea* seeds.

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