Int. Agrophysics, 1994, 8, 235-237

TESTING OF LEGUMINOUS SEED COAT MICROHARDNESS

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A b s t r a c t. A method of measurement of seed hardness (particularly leguminous plants) with a microhardness testing machine (PMT-3), and an IRHD hardness testing machine is presented in this paper.

K e y w o r d s: leguminous seeds, coat microhardness, horse bean

INTRODUCTION

Among the numerous properties which characterize seeds, hardness is of paramount importance. Studies of micro- and macrohardness of seeds have been carried out by many scientists, but those studies have concentrated on corn.

The studies were carried out by different scientists using different methods. Frontczak [3] evaluated the microhardness of involucre of maize seeds, with a static method using a microhardness testing machine PMT-3. Jindal [4] determined the hardness of seeds using with dynamic methods, measuring collision of a seed with the steel nodule of a special pendulum. Chung [1,2] described the method of determining hardness of wheat seeds by measuring the torque force when grinding seeds and presented wheat hardness in terms of its susceptibility to comminution.

The studies concerned with the measurement of micro- and macrohardness have not been systemized and, until now, there have been no universal measuring techniques.

The objective of this paper is to work out a method of measurement of seeds hardness (particularly leguminous plants) with a microhardness testing machine (PMT-3), and an IRHD hardness testing machine.

MATERIALS AND METHODOLOGY

The research was concerned with three varieties of horse bean (Nadwiślański, Jasny II and Dębek) delivered from plant breeding stations. The initial moisture content of the seeds was about 9 %. A sample of seed of approximately the same size were selected and rewetted to provide 10 moisture levels for each variety, ranging from 9 % to 27 %.

The experiment was performed using Vickers' method with a microhardness testing machine (PMT-3) where a pyramidal shaped indenter and a hardness testing machine (IRHD), where a sphere was used as the loading element. In the measurement using microhardness testing machine PMT-3, the loading force of the a penetrator was 0.409 N. To eliminate displacing the seeds during measurement, they were glued into a specially made metal disk.

RESULTS AND DISCUSSION

This research led to the determination, microhardness of horse-bean seed covers and its dependence on seed moisture content. Figure 1 shows the values of seed cover microhardness of three varieties of horse-bean. It has been found that seed cover microhardness decreased as the moisture content of the beans increased. This was more apparent when the PMT-3 apparatus was applied. The dependence of seed covers microhardness on moisture content is described by the power function $H_v=a \cdot w^b$, where H_v-microhardness, w-moisture content, a,b-coefficients ($a>0$, $b<0$) for the PMT-3, and by the linear function H_I- $a+bw$, where H_I-hardness, w-moisture content, a,b-coefficients ($a>0, b<0$) for the IRHD.

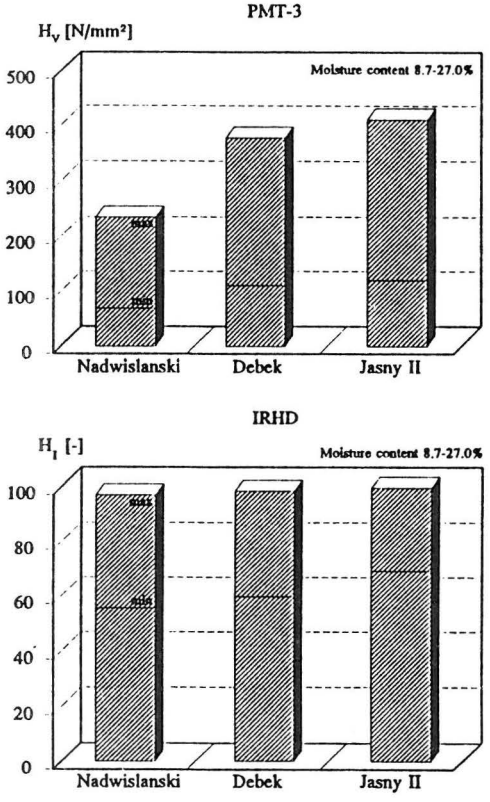

Fig. 1. Setting up the values of microhardness for horse-bean seeds.

For the resulted regression equations, the correlation coefficients were higher than r=0.95. Figures 2 and 3 show the relationships between the microhardness of a seed cover and bean moisture content for the varieties of horse-beans for measurements taken with testing machines PMT-3 and IRHD, respectively.

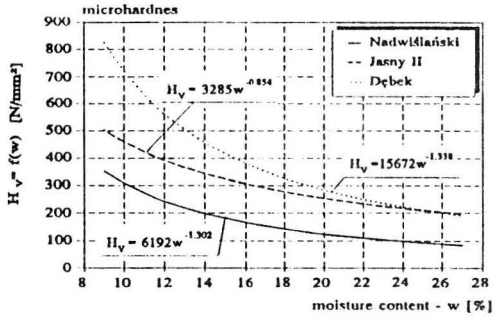

Fig. 2. The dependence of microharndess of a seed cover on the moisture content for horse-bean seeds (using testing machone PMT-3).

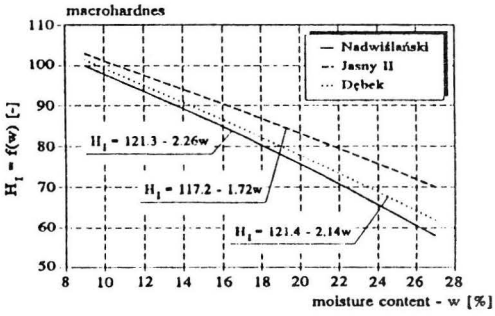

Fig. 3. The dependence of macrohardness of a seed cover on the moisture content for horse-bean seeds (using IRHD method).

CONCLUSIONS

From the experiments conducted the following conclusions may be drawn:

1. The usability for measurements of seeds microhardness of both methods have been proved.

2. Microhardness of a seed cover is dependent on the variety as well as moisture content.

3. As the moisture content increases there is a decrease in the seed cover microhardness in the examined range of moisture contents.

4. The dependence of a seed cover microhardness on moisture content is described best by a power function for the PMT-3 method and by a linear function for the IRHD-method.

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