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ASSESSMENT OF SUSCEPTIBILITY OF RAPE STEMS TO SHEARING

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A b s t r a c t. In the present study, the authors used a dynamic shearing and densitometric method for the assessment of susceptibility of stems of winter rape, vars Mar, Bolko, Leo, Ceres and Libravo to shearing. They determined dynamic shearing energy per a unit of the stem cross section area, in the natural state as well as after the removed of parenchyma, density and ΔOD parameter, indicating the amount of X-ray energy absorbed by the stems. It was found that susceptibility of rape stems to shearing depends on their structure. A strict correlation was shown to exist between the dynamic shearing energy and the amount of X-ray radiation energy absorbed by the stem. Moreover, in study showed that the application of the X-ray method greatly enhanced the possibility to determine of the susceptibility of rape stems to shearing.

K e y w o r d s: winter rape stem, dynamic shearing energy, parameter ΔOD

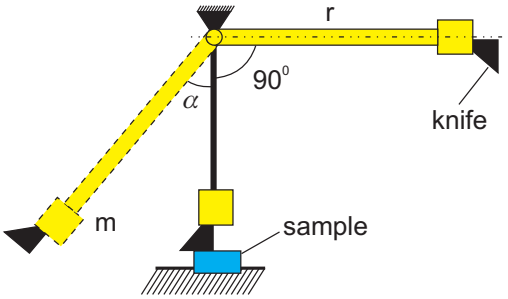
INTRODUCTION

Winter rape is a basic industrial plant of our climatic zone. Recently its importance has further increased since it is possible to use as raw material for the production of fuel for internal combustion automative engines. Therefore, it seems justified to expand studies on the hereditary mechanical properties of rape stems and provide basis for the assessment of rape varieties in terms of their strength properties[1].

In the present study, the authors performed an assessment of the susceptibility of rape stems to shearing, by determining dynamic shearing energy and the work required to shear a surface unit of the stem cross section ripe plants in the case of five winter rape varieties. Stem resistance (when filled with parenchyma and with parenchyma removed) to shearing was assessed in relation to stem structure as expressed by the cross section surface area, density, and the ΔOD parameter which represents stem absorption of X-ray radiation.

METHODS

The study was conducted on the stems of winter rape vars Mar, Bolko, Leo, Ceres and Libravo varieties, at their full ripeness. The rape varieties were grown on the experimental plots at Zadąbrowie. The batch for testing comprised 35 plants at a time. Measurements were made at the heigth of cutting elements operation during harvest, i.e., at 25 cm.The dynamic shearing energy (*Ed*) and the work required to shear a unit of cross section area of natural (*wd*) and prepared (*wd* ') stems (the prepared stems are stems with the parenchyma removed) were determined by means of a Dynstat apparatus, an apparatus operating on the principle of a pendulum hammer travelling at a speed of 2.1 cm/s (Fig. 1). The cross section areas, natural (*S*) and artificial (*S*'), were determined by means of a lens recording the degree of darkening of stem cross section image, using a British-made instrument. Moreover, the authors determined the density of stems with natural cross section (ρ) as well as after the removal of the parenchyma (ρ'), using a geometric method. For a more



m = 129 g; 354.7 g
r = 25 cm
E_d = m g r cos α
$w_d = E_d/S$
$w_d' = E_d/S'$

Fig. 1. Schematic illustration o f the dynamic test used to study mechanical properties of rape stems.

accurate determination of the structure of rape stems the authors employed an X-ray method, by means of which they determined the values of the parameter ΔOD, indicating the amount of X-ray energy absorbed by the stems. It should be noted that a detailed description of the method (densitometric) for the determination of parameter ΔOD in X-ray tests can be found in the paper by Skubisz and Vielikanov [2].

RESULTS

The study showed that susceptibility of rape stems to shearing depends on their structure. A directly proportional correlation was found between the shearing energy and the parameters defining the stem structure. The values of the correlation coefficients fell within the following ranges: r for E_d
E_d x S from 0.53 to 0.71;
for E_d x S' from 0.61 to 0.82;
for E_d x ρ from 0.34 to 0.71;
for E_d x ρ' from 0.32 to 0.67; and
for E_d x ΔOD from 0.53 to 0.77.

A close correlation was shown between the dynamic shearing energy corresponding to a unit of stem cross section area, and the amount of X-ray energy absorbed by the stem. The correlation coefficients between w_d and w_d' and the parameter ΔOD for the particular varieties were as follows:

Mar w_d x ΔOD = 0.57, w_d' x ΔOD= 0.47;
Bolko w_d x ΔOD = 0.71, w_d' x ΔOD = 0.55;
Leo w_d x ΔOD = 0.40, w_d' x ΔOD = 0.49;
Ceres w_d x ΔOD = 0.34, w_d x ΔOD = 0.38; and
Libravo w_d x ΔOD = 0.69, w_d'x ΔOD = 0.59.

As a resultat of variance analysis performed, the authors obtained the intervarietal differences, both on the basis of the mechanical parameters (E_d) and (w_d) and on the basis of the value representing the amount of X-ray energy absorbed by the stems (ΔOD) (Figs 2-4).

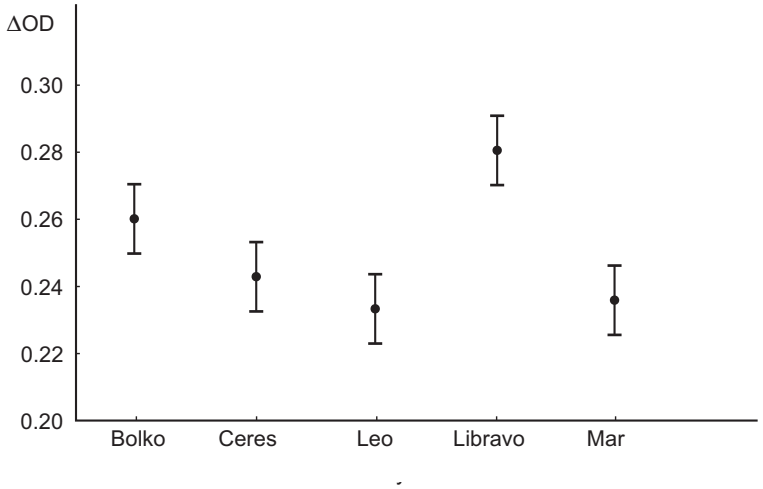


Fig. 2. Mean values and the 95% Tukey HSD intervals of ΔOD stems for the winter rape varieties.

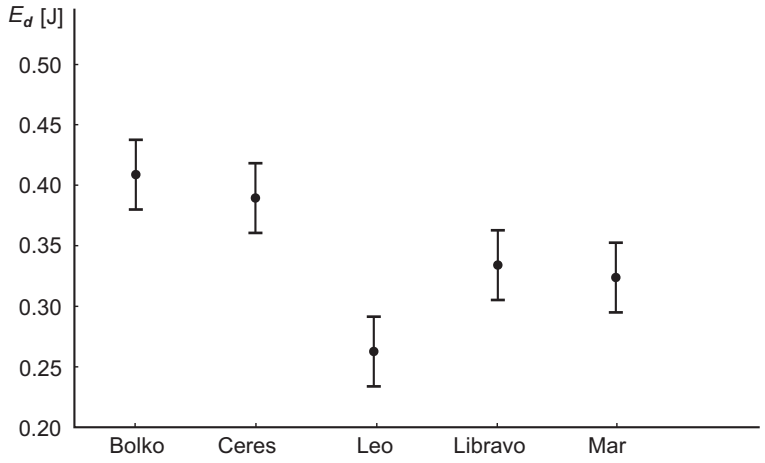


Fig. 3. Mean values and the 95%Tukey HSD intervals of E_d stems for the winter rape varieties.

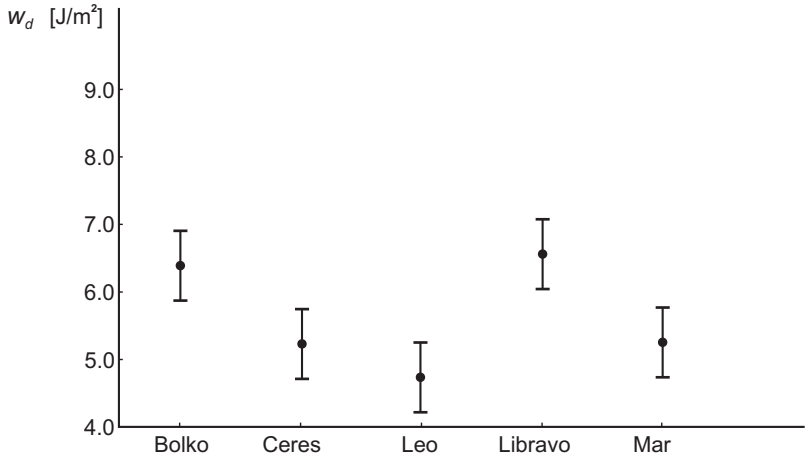


Fig. 4. Mean values and the 95% Tukey HSD intervals of wd stems for the winter rape varieties.

The study showed without question that the application of the X-ray method greaty enhanced the possibility of determination of the susceptibility of rape stems to shearing.

CONCLUSIONS

- It was found out that susceptibility of rape stems to shearing depends on their structure.

- Basing on the X-ray tests, a directly proportional correlation was found between the shearing energy and the parameters characterizing the stem structure. A strict correlation was shown to exist between the dynamic shearing energy corresponding to a unit of stem cross section area and the amount of X-ray radiation energy absorbed by the stem.

- It was found that the application of the X-ray method greatly enhanced possibility of determination of the susceptibility of rape stems to shearing and allowed for a more detailed and accurate assessment of the effect of stem structure on the strength properties of rape stems.

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