Influence of maturation regulators on mechanical properties of stems in rapeseed

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Abstract

The aim of the research was to determine the influence of Caramba maturation regulator (applied in various doses both in the autumn and spring) on mechanical properties of stems in rapeseed. During examination process, biometrical features of plants such as height, thickness of root collar, thickness of stem at base and at height of 30 cm were determined. The maximum force necessary to break the stem at those points was also determined along with the coefficient of stem's rigidity at the root collar and at the height of 30 cm. Three plants of winter rapeseed varieties (Lisek, Kaszub, Californium) were examined throughout the study. The research was conducted over a period of 3 years and its results allow us to evaluate the effect of the Caramba maturation regulator on those features of stems which determine their strength parameters. This will allow growers to choose optimum dose and period of applying the regulator as well as to determine its effect on lodging and freezing of plants in the winter.

Key words: rapeseed, varieties, mechanical properties of stems

Introduction

The structure of a fief is a very important factor to minimize volumetric and quality loss of seeds during harvest. The harvest of vertically positioned or slightly tilted fiefs provides for maximum efficiency of harvesting at minimal loss in the seeds (136). The resistance to threshability is, in the opinion of some experts, correlated with other properties of rapeseed plants. Loofa (1961) indicates, that there is additional correlation between the rigidity of stem and the seed pods' resistance to cracking. Other works of the author (Loofa et ol., 1970) provide that too high rigidity of stem may lead to high losses in the seeds as a result of plants' swaying in the wind, which causes the pods to hit one another, by which they crack and thresh as a result. It has been proven, that laying down plants involves establishment of microclimate that supports development of fungi. Determining a method to evaluate mechanical properties of rapeseed stems to prevent lay-down of plants and finding effect of application of plant growth regulators on the plants has become the key point of this study.

Resource and methodology of research

The aim of this study was to determine the impact of the Caramba growth regulator that is used at various rates (autumn and spring) on mechanical properties of rapeseed stems. As resource, there were plants of three rapeseed winter varieties selected for examination (the Lisek, Kaszub, Californium). Each variety was present in four combinations:

1.ontrol
2.aramba applied only in autumn
3.aramba applied in late autumn and twice at spring at 0,7 l/ha
4.aramba applied in late autumn and twice at spring at 1,0 l/ha

The research was carried over three years. Mechanical properties and rigidity of stems was analysed on mature plants. The stem rigidity reference point was made at 10 and 30 cm from the root collar.

Evaluation of the stem resistance was made according to methodology which was based on establishment of the stem rigidity rate (**k**). To determine the rate, a theory of bending an empty and supple bar of circular shape, that was supported at two sides – Fig. 1 (Skubisz, Tys). An INSTRON durability device was used for the examination. The measurement was made by applying force to respective stem segments till the moment of breaking (Fot. 2). Deformation of the stem during forceful interaction was shown on diagram produced by the INSTRON device (Fig. 2).

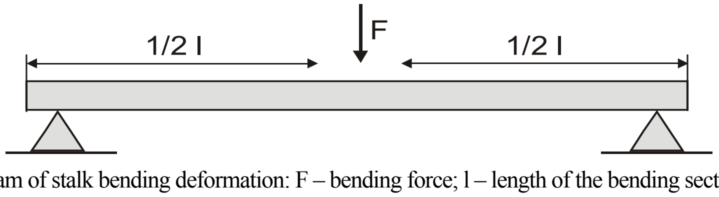

Fig. 1. Diagram of stalk bending deformation: F – bending force; l – length of the bending section (60 mm).

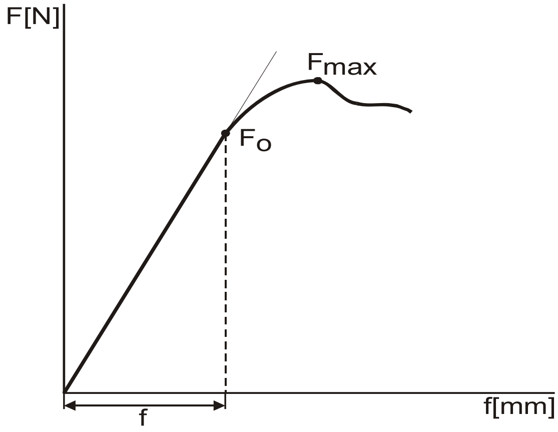

Fig. 2. Rapeseed stalk bending force: F max – maximum bending force (N); F_o -deflection force (N); f -maximum deflection in the range of elastic deformations (m).

Fot. 1. Stem bending in the INSTRON device.

The resistance of rapeseed stem was defined by determining the stems' rigidity rate (**k**). To determine the rate, a theory of bending an empty and supple bar of circular shape, that was supported at two sides [72,73]. The stem rigidity was determined by following formula:

$$k = E \cdot J = \frac{F \cdot l^3}{48 \cdot f}$$

where stem's rigidity: $k = 10^{-4}$ Nm^2

Results of examination and discussion

Examination of mechanical properties of rapeseed stem were conducted on laboratory plants (1) and on three combinations using the Caramba (2, 3 and 4). Delivered results in the study (Fig. 3 - 5) illustrate that application of the Caramba regulator, as applied in combination 3 and 4 reduces rigidity rate of rapeseed stem. This allows the plants to exhibit greater resilience, to prevent breaking of stems at wind or under bending of plant at maturity. In this respect, the effect delivered by the regulator is very positive. Conducted research, has proven that application of minimal rates of 0,7 l/ha of the regulator only in the late autumn may not be sufficient (lack of significant difference between the reference control (combination 1) and combination 2 – Fig. 3). On the other hand, application of the regulator at autumn and spring delivers much better effect. The stem rigidity rate for the control combination was : for topmost part 1680 Nm^2, while for B section - k = 1530 Nm^2). The plants treated with the Caramba regulator at late autumn, had the stem's rigidity rates respectively 1990 Nm^2 for A, and 1820 Nm^2 for B. There was no significant statistical difference reported between combinations 3 and 4, which means that application of higher rates (1 l/ha) may prove unessential.

Characteristic of the examined varieties evaluated in respect of the stem's rigidity rate has not demonstrated any significant differences (Fig. 4).

Comparing the *k* rate in respective years, it was discovered that the plants harvested in years 2004 and 2005 were not much different from one another (Fig. 5). On the other hand, the plants harvested in 2006 were demonstrating much greater rigidity of stem, while the stem rigidity rate was almost three times as high (k for the A sector was 2860 Nm^2, while for B - 2500 Nm^2). This points for significance of climate conditions on examined property.

Comparing the obtained values of the *k* rigidity rate for other examined varieties, it should be stated that they were confined within the range from 829 to 1873 Nm^2 (Tys 1997).

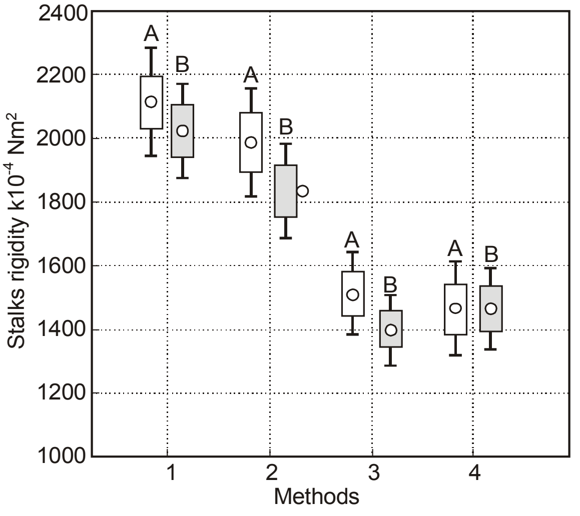

Fig. 3. Stalks rigidity for methods

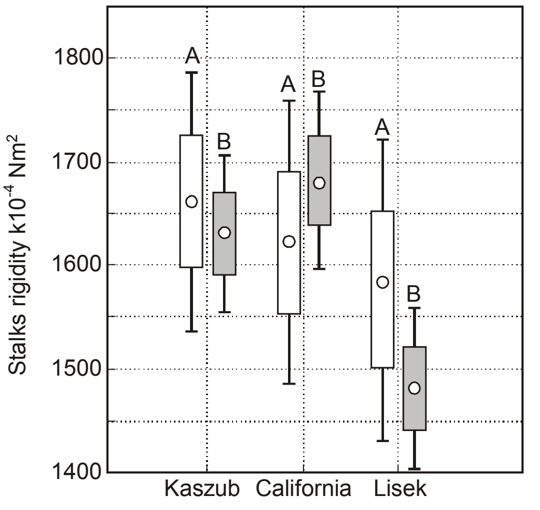

Fig. 4. Stalks rigidity for varieties

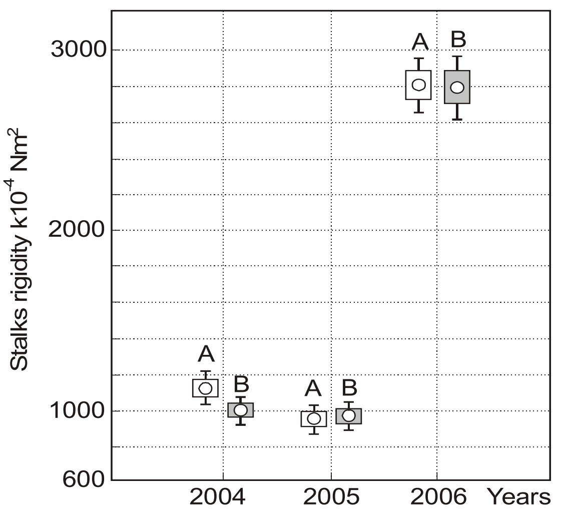

Fig. 5. Stalks rigidity for years

Conclusions

1. The applied method for evaluation of mechanical resistance of rapeseed stem not only allows to determine the resistance of respective varieties of families of seeds to laying down in the field, which can be used in seed breeding, but it also allows to determine possible effects of applying certain growth regulators.

2. The impact of Caramba growth regulator on mechanical properties of rapeseed stem is only positive when applied in the autumn and spring time.

3. Climate conditions have significant impact on mechanical resistance of rapeseed stem.

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