

Impact of Ultrasounds on the Share of Hard Seeds in *Lotus corniculatus* L.

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Abstract

Research has focused on 4 size groups of bird's-foot trefoil (*Lotus corniculatus* L.) (Ø 1.0-1.6 mm) and 10 variants of ultrasound treatments with different intensities and exposure times (0.11-2.72 W/cm² and 10-160 seconds). After treating the bird's-foot trefoil seed groups with ultrasounds, the bird's-foot trefoil seeds were put into Petri vases for germination and the following parameters were measured: germinating energy (after 10 days), germinating faculty (after 21 days) and share of hard bird's-foot trefoil seeds (after 31 days). Research results show a very significant decrease of the share of hard bird's-foot trefoil seeds in the groups of medium- and large-size bird's-foot trefoil seeds treated with ultrasounds, compared to the control variant (no group seeds) or to the small-size bird's-foot trefoil seed group treated with ultrasounds. Intensity and exposure time do not correlate with the share of hard bird's-foot trefoil seeds.

Keywords: hard seeds, *Lotus corniculatus* L., seed size, ultrasounds

1. Introduction

Natural conditions during seed maturation, harvesting methods, and genetic features of the cultivars can have a negative impact on the increase of the share of hard seeds, particularly in perennial legumes. Some researches point out an increase of the share of hard seeds up to 80%, which has a negative impact on seed quality [1-5]. This paper points out the effect of applying ultrasound treatments in bird's-foot trefoil seeds grouped into size groups on the share of hard seeds.

2. Materials and methods

Research was carried out in laboratory conditions, at a temperature of 22-25°C, at constant moisture, and in natural light. Bird's-foot trefoil seeds were grouped into 4 size groups: no group seeds (a₁), small-size seeds (Ø 1.0-1.4 mm) (a₂), medium-size seeds (Ø 1.4-1.5 mm) (a₃), and large-size seeds (Ø 1.5-1.6 mm) (a₄).

Before putting them in Petri vases to determine germination, the bird's-foot trefoil seeds were treated with ultrasounds in 10 different variants differentiated depending on the intensity of the ultrasound flow (between 0.11-2.72 W/cm²) and on the exposure time (10-160 seconds), as follows: b₁ = not treated, b₂ = (I = 0.11 W/cm², t = 60 s), b₃ = (I = 0.44 W/cm², t = 60 s), b₄ = (I = 0.98 W/cm², t = 60 s), b₅ = (I = 2.72 W/cm², t = 60 s), b₆ = (I = 2.72 W/cm², t = 10 s), b₇ = (I = 2.72 W/cm², t = 20 s), b₈ = (I = 2.72 W/cm², t = 40 s),

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$b_9 = (I = 2.72 \text{ W/cm}^2, t = 60 \text{ s}), b_{10} = (I = 2.72 \text{ W/cm}^2, t = 80 \text{ s}), b_{11} = (I = 2.72 \text{ W/cm}^2, t = 106 \text{ s})$. During bird's-foot trefoil seed germination, we made the following measurements: germinating energy (after 10 days), germinating faculty (after 21 days), and share of hard bird's-foot trefoil seeds (after 31 days).

3. Results and discussion

Processing the bird's-foot trefoil seeds after harvesting, through mechanical works of selection and conditioning, aims not only at separating vegetal debris and bird's-foot trefoil seeds from weeds, but also at grouping bird's-foot trefoil seeds depending on size or on weight. Larger-size bird's-foot trefoil seeds, with a better-developed embryo, are germination-safer and produce more vigorous bird's-foot trefoil seedlings.

In bird's-foot trefoil grouped depending on their size, the share of hard seeds correlated with seed size. Thus, compared to the control group (no group seeds) (a_1), the largest share of hard bird's-foot trefoil seeds (18.61%) was in the small-size seed group, i.e. 3.91% more. In the medium-size seed group, the share of hard bird's-foot trefoil seeds decreased to 9.88%, and in the large-size seed group, the share of hard bird's-foot trefoil seeds decreased the most, i.e. to 8.16% (Figure 1).

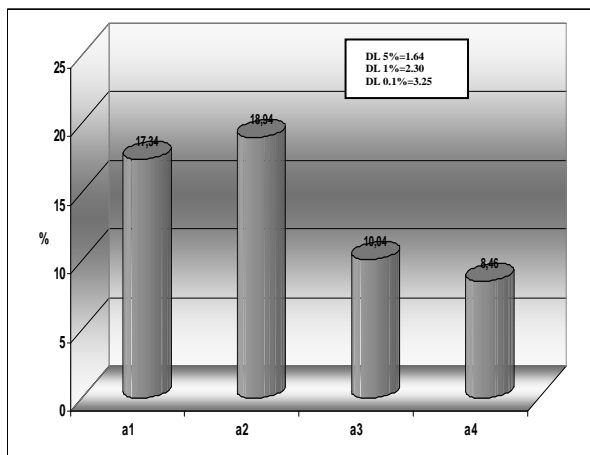


Figure 1. Share of hard bird's-foot trefoil seeds depending on seed size

Research results concerning the unilateral effect of ultrasound treatments show that, in all the variants treated, the share of hard bird's-foot trefoil seeds was much lower than the control variant (not

treated). In the variant treated with ultrasounds ($I = 2.72 \text{ W/cm}^2$ and $t = 60$ seconds), there was the lowest share of hard bird's-foot trefoil seeds (11.22%) compared to the control variant (17.98%). When the treatment had a lower intensity (1.74 W/cm^2), the lowest share of hard bird's-foot trefoil seeds (12.12%) was when exposure time increased to 160 seconds (Figure 2).

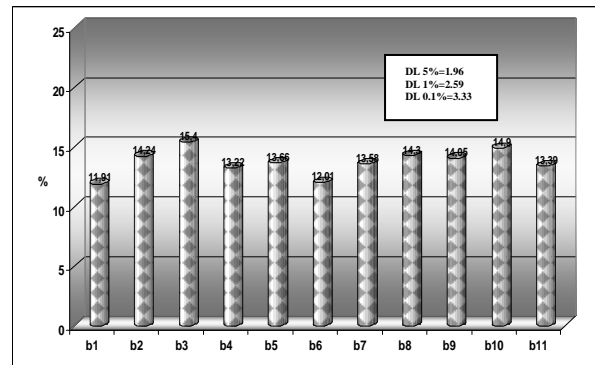


Figure 2. Unilateral impact of ultrasound treatments on the share of hard bird's-foot trefoil seeds

The study of the interactions between bird's-foot trefoil seed-size groups ($\varnothing 1.0-1.6 \text{ mm}$) and ultrasound treatments (with different intensities and exposure times) pointed out the following:

- when applying ultrasound treatments in bird's-foot trefoil seeds, the share of hard bird's-foot trefoil seeds in the control group (no size) varied between 10.85 and 18.77, compared to the control variant (not treated) (20.23%);
- when the small-size bird's-foot trefoil seed group was treated with ultrasounds, the share of hard bird's-foot trefoil seeds was 15.23-21.57%, with values below the values of the control group (no group);
- when the medium-size bird's-foot trefoil seed group was treated with ultrasounds, the share of hard bird's-foot trefoil seeds decreased dramatically to 6.30-12.20%;
- the lowest share of hard bird's-foot trefoil seeds was when the large-size bird's-foot trefoil seed group was treated with ultrasounds (4.13-11.50%) (Figure 3).

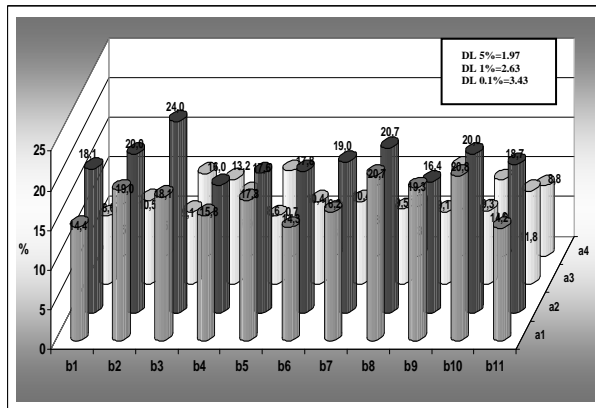


Figure 3. Impact of interactions between bird's-foot trefoil seed size and ultrasound treatment on the share of hard seeds

If we compare the 44 trial variants, we see that the lowest share of hard seeds in bird's-foot trefoil (4.80%) was in the large-size bird's-foot trefoil seed group treated with ultrasounds ($I = 2.72$ W/cm² and $t = 60$ seconds).

4. Conclusions

Grouping bird's-foot trefoil seeds depending on their size has a positive impact on the decrease of the share of hard bird's-foot trefoil seeds

compared to the control group (no size seeds) or to the small-size bird's-foot trefoil seed group (\emptyset below 1.4 mm).

The combinations between medium-size bird's-foot trefoil seed and large-size bird's-foot trefoil seed groups treated with ultrasounds resulted in a decrease of 40-60% of the share of hard bird's-foot trefoil seeds, depending on the intensity of the ultrasound waves and on exposure time.

References

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