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TO THE ISSUE OF METHODOLOGY FOR PRIMARY SUGAR BEET BREEDING MATERIAL ESTIMATION AND SELECTION ACCORDING TO THE SIGN OF REPRODUCTIVE SYSTEM AND SEED VIABILITY

Developed is a methodology for primary sugar beet breeding material estimation and selection based on the research results according to the sign of reproductive system and seed viability. Highlighted are variability issues of viability and field seed germination signs depending on the germination conditions.
***Keywords**: seed viability; variability; reproductive system; breeding numbers*

Introduction. The long-term domestic and foreign experience shows that the main condition for obtaining sugar beet seed with high vitality is to use hybrid or variety genetic potential and its propagation in favourable areas. Seed is not only a body part that completes its life cycle, but also a new independent body, which includes the basis for new plant development. Therefore, viability and vitality is inherent to seed [3].

From a biological point of view, seed field germination determined after its primary cleaning is viability quantitative representation, but it does not fully reflect viability, the seed quality level.

The modern representation of field germination as polygenic quantitative sign and breeding methodology based on it do not allow increasing field germination(viability) and, especially, its vitality. Under the existing breeding process when the best certain seed cluster selection according to seed field germination sign with cross pollination is used, there is selection under female line with a large variety of male forms. At a meeting of two identical gametes we observe a certain number of non-viable zygotes producing. Therefore, genotype seed viability level is so higher, the more heterozygous pairs of alleles are in the genotype.

The investigation results show that to obtain highly viable seeds of sugar beet manufactured generation hybrids we must proceed from single seed viability as an alternative quality sign,which is controlled by a small number of genes and heterozygous state [8].

The research goal was to develop breeding methodology for initial material evaluation and selection to obtain highly viable seeds (95-100%) of sugar beet hybrids by analyzing the reproductive system and seed samples in dynamics of field germination under different temperature conditions and other factors.

Materials and methods. The research was carried out in Uladiv-Liulynets and Bila Tserkva EBS Institute of Bioenergy Crops and Sugar Beet NAAS of Ukraine during 2010-2013. We selected seed clusters of different breeding origin (30 numbers each): male-sterile component (MSC), pollinator (PL) and simple sterile hybrid (SH).

Breeding number classification under the sign of seed reproductive system, its vitality and viability was performed using conventional methodology [1-3,5]. Seed for determination of field germination was selected from the harvest of2011 and 2012.

Statistical analysis of the research results was carried out by variation, dispersion and correlation methodology using Statistics 6 software [4].

Results. The research target was to develop a methodology for evaluation and selection of primary breeding material under the following signs: 1) reproductive system variability; 2) seed viability variability; 3) variability on the basis of viability and seed field germination depending on the germination conditions.

1. *Reproductive system variability determination*

1.1. An important feature of sugar beet seed breeding process is seed cluster selection under reproductive system in breeding numbers of different origin: male-sterile component (MSC), pollinator (PL) and simple hybrid (SH).

1.2. Before collecting of seed clusters, we analyzed their state according to the following components: architectonics (number of single-stem and multiple-stem seed bearers, stems of the 1st, 2nd and 3rd order); seed set level; seeding density; seed productivity.

1.3. Seed cluster architectonics record technology is following: at fixed line intervals (30 m) in three repetitions according to the components there were recorded the number of single-stem and multiple-stem seed bearers, stems of the 1st, 2nd and 3rd order.

1.4. Seed set level was determined when the majority of seeds have already formed, namely the start seed browning begins. Technology of determination was as follows. Three segments of 10 cm on single-stem seed bearers were marked in the following locations: one on the stem (4-5 cm) above the shoot attachment of the first order and two on the shoots of the first order; 10 cm segment on multiple-stem seed bearers was marked in the shoots of the first order and the other two on the shoots of the second order.

The number of seed sets and number of un fertiles were calculated in each 10 centimeter segment. On this basis, it was determined the degree of non-set seed (NSS) as a percentage, which is calculated according to the formula:

$$NSS = NSS / SSN \times 100, \text{ where}$$

NSS – non-seed set number, pieces;

SSN – seed set number, pieces.

Seed set level is the difference between the total number of seed sets in percent and non-seed sets.

1.5. Seeding density per 10 centimeter interval was determined for every stem and shoot in its middle part.

1.6. Seed production was determined individually for each seed cluster by means of pre-cut, thrashing, followed by cleaning and weighing the total seed volume by technical weight.

2. *Variability determining under the seed viability sign*

2.1. After complete seed cleaning the average sample was selected for viability determining according to DSTU (Ukrainian State Standards) 2292-93 [2, 5].

2.2. For 30 seed clusters of each breeding number there were determined the weight of 1000 seeds, germination energy and field germination in 4 samples with 100 seeds each.

3. *Seed viability variability determination depending on germination conditions*

3.1. Determination of germination energy and field germination depending on germination conditions is carried out in 4 samples of each breeding number individually in 30 clusters.

3.2. Records for seed germination were performed on the 2nd, 3rd, 4th, 5th, 8th and 10th day.

3.3. Determination of seed germination in temperature dynamics according to DSTU 2292-93 (control).

3.4. Determination of seed germination in dynamics of the temperature +8°C.

3.5. Determination of seed germination in dynamics depending on the weight proportion.

For the analysis it was used seed that has been soaked in water for 24 hours.

3.6. Determination of seed germination dynamics after freezing.

For the analysis it was used seed frozen under the temperature of -3- (-5)°C during 24 hours.

3.7. Average germination time of one seed was determined according to the formula:

$$e = (\partial_1 K_1 + \partial_2 K_2 + \partial_K K_K) / \partial_1 + \partial_2 + \partial_3 + \partial_K), \text{ where}$$

e – germination energy;

∂ – counting days;

K – number of seeds germinated at a given day.

3.8. Correlation coefficient was determined between the number of seed germinated on the 2nd, 3rd, 4th, 5th and 8th, on hand, and germination (10^{th}day), from the other hand.

3.9. The field germination in seed breeding process was determined by hand seeding in reproduction areas.

3.10. There were sown at least 400 seeds (4 repetitions of 100 seeds). Sowing depth was 3.0 ± 0.5 cm with intervals between seeds at least 1 cm and width row of 15 cm.

3.11. The field germination (*Fg*) was calculated according to the formula:

$$Fg = Ngf / Ngl \times 100,$$ where

Ngf – number of germinated seeds in the field;

Ngl – number of germinated seeds in the laboratory.

3.12. To establish a correlation between laboratory and field germination there were used four attempts of each breeding number individually in 10 selected clusters determined germination energy and field germination depending on germination conditions.

3.13. Selected in the laboratory samples (according to clause 3.12) were sown in the field to determine field germination (according to clauses 3.9-3.10).

3.14. It was determined correlation dependence between laboratory and field germination.

3.15. For seed field germination prediction it was taken into account viability (field germination) and germination energy (vitality) depending on germination conditions[6, 7].

3.16. As optimal day for germination energy counting was taken the day that is not very close to final count, giving the highest correlation coefficient (0.95) between field germination in of previous (generation energy) and final counting.

After field germination completion it was determined germination energy and field germination mean that was used as the basis for estimated field germination (FG), calculated according to the formula:

$$FG = Eg \times Lg / 100,$$ where

Eg – generation energy, %;

Lg – laboratory germination, %.

Conclusions. For sugar beet seed high viability it was proposed to use in breeding process plant selection under reproductive signs (stem number of the 1st, 2nd and 3rd order, seed set level, seeding density and seed productivity) according to germination energy and field germination as well as viability and field germination depending on germination conditions. It will provide a comprehensive evaluation and the best breeding sample selection.

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Анотація

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До питання методики оцінки та добору вихідних селекційних матеріалів цукрових буряків за ознакою репродуктивної системи та життєздатності насіння

На підставі результатів досліджень розроблено методику оцінки та добору вихідних селекційних матеріалів цукрових буряків за ознакою репродуктивної системи та життєздатності насіння. Висвітлені питання мінливості ознак життєздатності і польової схожості насіння залежно від умов його пророщування.

Ключові слова: *життєздатність насіння, мінливість, репродуктивна система, селекційні номери*

Аннотация

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К вопросу методики оценки и отбора исходных селекционных материалов сахарной свеклы по признаку репродуктивной системы и жизнеспособности семян

На основании результатов исследований разработана методика оценки и отбора исходных селекционных материалов сахарной свеклы по признакам репродуктивной системы и жизнеспособности семян. Освещены вопросы изменчивости показателей жизнеспособности и полевой всхожести семян в зависимости от условий их проращивания.

Ключевые слова: *жизнеспособность семян, изменчивость, репродуктивна система, селекционные номера*