SEED SIZE FRACTIONS AMONG VARIOUS *BETA VULGARIS* GENOTYPES WERE EVALUATED FOR EMBRYO SIZE, GERMINATION, AND REACTION TO ENVIRONMENTAL STRESS.

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ABSTRACT

The sugarbeet industry in the USA utilizes a range of seed sizes to plant the sugarbeet crop ranging from Small to X-Large. Diverse genetics exist that carries disease tolerance, sugar content, sugar yield etc. The diversity of agronomic traits found in the seed is also expressed in the size of the seed that is produced and processed for sale. Some varieties produce predominantly small to medium sized seed and some varieties typically produce Large and Extra Large seed based on seed diameter and thickness. The purpose of this study is to evaluate seed size differences of three diverse commercial varieties representing genetics sold in the Red River Valley by Syngenta, Beta Seed and Vanderhave. Parameters measured are embryo weight, hull weight, germination, germination rate, emergence under various stress tests, and greenhouse depth of planting evaluation. Significant differences were found in germination and emergence among seed sizes but interactions existed among varieties. Small seeded varieties tended to have better quality indicators in the small fraction rather than the large. Conversely, a larger seeded variety had better quality in the large compared to its corresponding small fraction.

INTRODUCTION

The sugarbeet industry in the USA utilizes a range of seed sizes ranging from Small to X-Large to plant the sugarbeet crop. Diverse genetics exist that vary in sugar content and root yield as well as tolerance to diseases and insects. The diversity of agronomic traits found in the seed is also expressed in the size of the seed that is produced and processed for sale. Some varieties produce predominantly small to medium sized seed and some varieties typically produce Large and Extra Large seed based on seed diameter and thickness.

The purpose of this study was to evaluate the quality of various seed size fractions of three diverse commercial varieties representing genetics sold in the Red River Valley. Parameters measured were embryo weight, hull (pericarp) weight, germination, germination rate, emergence under various stress tests, and greenhouse depth of planting evaluation.

MATERIALS AND METHODS

Three seed size fractions were obtained from a large seeded genotype (Beta 3800), a medium sized genotype (Hilleshog Resist) and a small seeded genotype (Vanderhave 66240). The sizes commercially available in these varieties that were used in this trial were:

(a) Small with a diameter of 7-8/64 inch or 2.8 - 3.2 mm,

(b) Medium with a diameter of 8-9/64 inch or 3.2 to 3.6 mm, and

(c) Large with a diameter of 9-10/64 inch or 3.6 to 4.0 mm.

Each sample (genotype/size) was evaluated for total seed weight, embryo weight, germination, germination under compacted conditions (Pack Sand test) and seed depth trial. Five 20 seed replicates were weighed. The embryos were then extracted from the pericarp to determine the embryo weight. An analysis was made to determine whether significant differences existed among genotypes and sizes.

Germinations were conducted according to "Rules for Testing Seeds" as set forth by the Association of Official Seed Analysts. Four replicates of 100 seeds were germinated on blotter paper conducted at 20° C with counts taken at day 3, 7 and 10.

The Pack sand test was conducted by the American Crystal Sugar Company to determine the seeds ability to sprout and emerge under compacted situations. Four replicates of 100 seeds were placed under 2.6 cm of moist sand which was packed before placing in a germination chamber at 10°C. Counts were taken at 14, 21 and 28 days.

Seed depth study was conducted by planting 10 seeds with 6 replications at a depth of 1.9 cm, 3.2 cm and 5.1 cm in plastic cones and kept moist in greenhouse temperatures of 25°C. Counts were taken daily and final counts recorded at 14 days.

RESULTS

Significant differences were found among seed sizes and varieties in seed weight and embryo weight. The largest differences were due to seed weight. Averaging all genotypes together the seed weight increases 77% when small was compared to large. Only 10% of that increase in seed weight is due to seed embryo weight (Table 1). Figure 1 graphically shows the distribution of seed size and the relative difference in pericarp and embryo weights of the three genotypes and three seed sizes evaluated.

The small seeded genotype, Vanderhave 66240, had a significantly larger embryo weight in the small seed size compared to its large counterpart. Germinations of the small fraction were also significantly faster in germination speed and final analysis compared to large (Table 1). Regardless of the planting depth, Vanderhave 66240 small was significantly better than large of the same variety. Small also emerged faster and had higher final counts than large in the "Pack Sand" test.

The medium sized genotype, Hilleshog Resist, had the fastest and highest germination and best emergence under the 1.9 to 3.2 cm seeding depths from the medium size fraction of seed.

The large seeded genotype, Beta 3800, showed a trend where the large fraction was better than the smaller seed fraction. Compared to small, the large seed had significantly larger embryo sizes, faster and higher in germination and resulted in better stands when planted at 5.1 cm deep in the depth of planting study. The pack sand test showed smaller seed was better which may be due to smaller cotyledons being pulled up under the compaction stress or the fact the small seed has a larger embryo to pericarp ratio than the larger seed sizes.

Interactions existed in the quality tests conducted. The Standard Germination tests showed a significant genotype by size interaction. Small seed germinated the highest with the small seeded type (VDH 66240) and large seed germinated the highest with the large seeded genotype (Beta 3800). The largest significant differences however, were more from genotype rather than seed size.

Significant interactions also existed among results of the seeding depth trial with larger differences noted in the sizes used. Large and Medium of the large variety Beta 3800 had significantly higher stands than their small counterpart. However, small seed from the smaller seeded variety VDH 66240 was significantly better in stand establishment at any depth compared to its medium and large counterpart.

CONCLUSION

Seed weight differences, when comparing small with large seed, were mainly due to the increase in the pericarp weight. 90% of the seed weight increase was due to the pericarp and 10% of the seed weight increase was due to the embryo.

Small seeded genotypes generally have the best quality in the small sized fraction, medium in the medium sized fraction and large seeded genotypes in the large fraction.

Comparisons among genotypes can best be made with medium sized seed as that fraction generally led to the least amount of quality variability among the genotypes evaluated.

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