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PHYSICAL AND PHYSIOLOGICAL PROPERTIES OF SEEDS
ASSOCIATED WITH VIABILITY IN SMALL-SEEDED LEGUMES^{1/}

by

Charles E. Vaughan and James C. Delouche^{2/}

The buying and selling of seed is based primarily on results of germination and purity tests. However, seed buyers must initially base many of their decisions on the appearance of seed. Insect damage, mechanical damage, weathering, presence of weed seed and inert matter are easily evaluated visually. However, other characteristics associated with viability and vigor are not as easily determined. The objective of this study was to determine the extent to which seed size, specific gravity of the seed, seed color and rate of seed swelling were associated with viability in red clover, white clover and crimson clover.

Seed Size

Seeds of the three crops were separated into six to eight sizes, depending upon the crop, with the use of hand screens. Samples from these various size groups were then tested for germination. There appeared to be no consistent relationship between seed size and viability. Each of the three crops reacted differently and there was considerable variation among the lots studied. In white clover, germination percentage

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on the average increased as seed size increased (Figure 1) . In contrast, highest germination percentages were obtained from seed of intermediate size in red clover and crimson clover . The large seeds in crimson clover were lowest in viability, while the smallest seeds of red clover were lowest in viability.

Specific Gravity

A South Dakota seed blower was used to separate the seeds of the three crops into the various weight or specific gravity groups . Specific gravity appeared to be more consistently related to viability than was seed size (Figure 2) . In each crop an increase in specific gravity of the seed was also accompanied by an increase in germination . The difference in germination percentage between the lowest and highest specific gravity group was as follows for the different crops: red clover 15.9%, white clover 29.3% and crimson clover 30.0% .

Since white clover and crimson clover reacted differently in the seed size studies, yet reacted similarly in the specific gravity studies, the interaction of seed size and specific gravity was investigated in both crops . The seed were first sized and the largest and smallest sizes were separated into light, medium and heavy specific gravity groups . Differences in germination among these groups were much greater than when seed size and specific gravity were considered separately . In white clover the large - heavy seeds germinated highest while the small - light seeds germinated lowest with a mean difference in germination of 43% .

In crimson clover highest germination was obtained from the large - heavy seeds while lowest germination occurred among the large - light seeds. Mean germination difference between the two classes was 43.0%.

Hard seededness was also associated with seed size and specific gravity. The highest percentage of hard seeds was always found in the small - heavy group (Tables 1 and 2) .

Seed Color

Seeds of each of the three crops were separated visually into different color groups. It is generally known that seeds of the naturally light-colored, small-seeded legumes gradually turn dark with age. However, some seeds darken much more rapidly than others. In general, dark colored (brown) seeds of the three crops were found to be low in germination (Figure 3) .

Rate of Seed Swelling

Rate of seed swelling was closely associated with viability. It was also found to be the most easily evaluated characteristic. Seeds were placed between saturated blotters at 20^o C. and allowed to absorb water. After different time intervals, the seeds that had become swollen were transferred to other blotters and the germination process allowed to continue. Swollen seeds were identified by their larger size, lighter color, glossy appearance and softer, spongy texture as compared to firm seeds. Germination percentages of the seeds removed at the end of each time interval were determined.

Rate of seed swelling in red, white and crimson clover was closely associated with viability, particularly during the first four hours. Seeds which were swollen at the end of one hour were generally dead, and seeds swollen by two hours were also very low in viability (Figures 4, 5 and 6).

Table 1. Percentage hard seeds in various size - specific gravity classes of crimson clover.

Lot	Ungraded	Size-Specific Gravity Class					
		Large Light	Large Medium	Large Heavy	Small Light	Small Medium	Small Heavy
B	0.0	0.5	0.0	0.0	0.5	1.5	4.0
C	2.5	1.0	1.0	1.5	4.0	3.0	14.0
D	3.0	0.0	0.5	0.5	4.0	4.5	18.5
E	5.5	0.0	0.0	1.0	5.5	8.0	20.5
F	2.5	0.0	0.0	0.5	2.5	6.0	33.0
Avg.	2.7	0.3	0.3	0.7	3.3	4.6	18.0

Table 2. Percentage hard seeds in various size - specific gravity classes of white clover.

Lot	Ungraded	Size-Specific Gravity Class					
		Large Light	Large Medium	Large Heavy	Small Light	Small Medium	Small Heavy
A	11.0	9.0	7.5	7.0	26.0	21.0	28.0
B	4.5	3.5	6.0	3.0	2.5	19.0	59.5
C	1.0	1.0	1.5	1.0	6.5	6.5	10.5
D	6.5	3.5	2.0	2.0	7.5	9.0	11.0
E	8.0	4.5	8.0	4.5	24.0	22.0	47.0
F	13.5	9.5	6.0	15.5	30.0	34.0	63.5
Avg.	7.4	5.2	5.2	5.5	16.1	18.6	36.6