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# HETEROGENEITY IN GREEN PANIC SEED

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SUMMARY

**The uneven distribution of pure seeds, other crop seeds, weed seeds and particles of inert matter in lines of green panic (*Panicum maximum* var. *trichoglume*) poses problems when drawing representative seed samples.**

**Purity analyses carried out on three lines of this seed grown by one seed producer showed a wide variation in pure seed from bag to bag, pure seed content varying from over 40% by weight to less than 1% by weight in two lines of seed each consisting of 10 bags. Pure seed contents in the remaining line of 3 bags were 67·7, 34·4, and 13·0% respectively.**

**Subsequent machine cleaning, while improving the percentage of pure seed, failed to produce a uniform seed mixture.**

## I. INTRODUCTION

Extremely variable analytical purity results and laboratory germination percentages have been known to occur in samples of seed of green panic (*Panicum maximum* var. *trichoglume* (K. Schum.) Eyles) taken from the same bulk. These variations in seed test results have been attributed to a number of factors, some of which cannot be controlled. The major variable is the uneven distribution of fully formed green panic seed in the bulk. This occurs because of uneven seed ripening in the panicle, time of harvesting, and the seed cleaning methods employed.

Variation in germination results of samples of this seed taken from the same bulk is known to occur mainly because of seed dormancy.

This variation in purity and germination test results suggests that existing methods, including sampling techniques, might not be entirely satisfactory for green panic seed.

The main objective of this investigation was to determine whether routine sampling and laboratory testing procedures provide a reliable estimate of seed

quality. This was undertaken by studying the degree of reproducibility achieved by using various sampling and testing methods, including routine sampling and testing, sampling and testing according to the heterogeneity test method recommended by the International Seed Testing Association, and the method of direct testing.

A subsidiary objective was to ascertain whether a uniform distribution of individual components in the seed bulk could be obtained by grading.

## II. MATERIALS AND METHODS

(i) *Seed.*—During May 1966, a Brisbane seed merchant drew representative samples from three separate lots of green panic seed and submitted them for testing to the Standards Branch, Department of Primary Industries, Brisbane, Queensland. Each lot had been harvested during mid February 1966 in the Wandoan district and was sun-dried immediately after harvest. Particulars of the lots are as follows:—

*Line A*: 13 bags representing 874 lb were harvested by the seed producer with a John Deere 30A header off 20 ac of brigalow/bauhinia/sandalwood country.

*Line B*: 29 bags representing 1,094 lb were harvested in a similar fashion to line A off 40 ac of brigalow/belah country.

*Line C*: 7 bags representing 253 lb were harvested from the same area as line B by a contractor using an Allis Chalmers 5 ft All-Crop header.

When seed test results obtained in May 1966 of each sample failed to comply with the standard for pure seed content, the merchant graded each line by means of a 2-screen Bodington machine and an Oliver gravity separator.

Seed test results obtained in August 1966 following grading again failed to comply with seed standards in respect of two lines of seed, one of which showed a lower pure seed content than that reported for the previous test.

Each line was subjected to further seed cleaning before samples were again submitted by the merchant for testing in November 1966. Cleaning operations resulted in total losses of 187 lb of seed from line A, 300 lb from line B and 111 lb from line C.

A summary of seed test results is as follows:

| Line | Tested May 1966 | | Tested August 1966 | | Tested November 1966 | |
|---|---|---|---|---|---|---|
| | Purity (%) | Germination (%) | Purity (%) | Germination (%) | Purity (%) | Germination (%) |
| A | 16·0 | 16·0 | 10·0 | 40·0 | 20·8 | No test |
| B | 22·4 | 23·0 | 29·3 | 36·0 | 36·7 | No test |
| C | 19·6 | 22·0 | 56·4 | 28·0 | 24·4 | No test |

(ii) *Checking.*—Before an investigation was made into the causes of variation in these seed test results, sampling methods, grading operations and seed testing procedures were checked for consistency. It was found that sampling and grading has been carried out by experienced seedsmen. Purity analyses had been completed by trained analysts who obtained representative working samples by means of an approved type of mechanical divider, and pure seed was separated by using a General ER seed blower calibrated with a number of carefully prepared laboratory samples. Germination tests of each sample had been carried out on 3 x 100 seeds at 20-35°C, alternating temperature.

(iii) *Sampling.*—Each line of seed was sampled by a Standards Branch Inspector in accordance with the sampling intensity prescribed in the International Rules for Seed Testing (Anon. 1966). A submitted sample representative of each line was drawn and additional samples were also taken in accordance with the sampling recommendation for the heterogeneity test contained in these Rules.

The trier used to sample the bagged seed was a hollow-tube Nobbe type trier with an overall length of 11¾ in. and an outside diameter of ¾ in.

Sampling for the heterogeneity test involved an equal quantity of seed being taken from each package by means of the seed trier, the sample consisting of seed taken across the diameter of the package from the top, middle and bottom portions of the package.

(iv) *Testing of the seed.*—The purity percentage of each sample was first determined according to the heterogeneity test by calculating the weight of 100 seeds taken at random, and then drawing a small working sample of a weight equivalent to 1,000 pure seeds of the particular sample. It was considered sufficient for the purposes of this investigation to use each purity percentage so obtained as a means of checking the accuracy of purity analyses carried out on larger working samples of 3 g used in routine seed tests of green panic seed.

Moisture tests using the air-oven (130°C for 1 hr) method were carried out on each sample to ascertain if seed moisture content had any appreciable effect on seed weight. Results of these determinations are shown in Table 1.

Purity analyses of 3 g working samples were then completed on each sample representing a package of seed and also on the submitted sample representing the line of seed. Germination tests were carried out on the pure seed, after which the pure live seed percentage was calculated. (Pure Live Seed per cent. = Purity per cent. x Germination per cent. ÷ 100).

As an additional check on the accuracy of seed testing, direct tests involving the determination of the numbers of normal seedlings germinating in 1 g samples were carried out. The direct test provides for the determination of the pure live seed percentage by an indirect method, provided the average number of pure seeds per gram of the bulk is first calculated. The usual method of a purity analysis is not required. Details of seed test results for lines A, B and C are shown in Tables 2, 3 and 4 respectively.

**TABLE 1**

HETEROGENEITY TEST METHOD

| — | Weight of Working Sample (1,000 seeds) (g) | Purity (%) | Moisture (%) |
|---|---|---|---|
| Line A—10 bags | | | |
| Sample No. | | | |
| 1 | 0·400 | 26·8 | 11·4 |
| 2 | 0·364 | 26·1 | 11·2 |
| 3 | 0·405 | 27·7 | 10·8 |
| 4 | 0·378 | 26·5 | 11·3 |
| 5 | 0·374 | nil | 11·8 |
| 6 | 0·352 | nil | 12·0 |
| 7 | 0·358 | 42·5 | 10·8 |
| 8 | 0·392 | 49·2 | 11·1 |
| 9 | 0·354 | 22·0 | 11·7 |
| 10 | 0·351 | 0·3 | 11·5 |
| Line B—10 bags | | | |
| Sample No. | | | |
| 1 | 0·336 | 50·6 | 9·8 |
| 2 | 0·335 | 24·2 | 10·6 |
| 3 | 0·337 | 43·9 | 9·7 |
| 4 | 0·332 | 23·8 | 10·6 |
| 5 | 0·348 | 33·9 | 10·4 |
| 6 | 0·263 | 4·6 | 11·0 |
| 7 | 0·267 | 0·1 | 10·7 |
| 8 | 0·325 | 22·5 | 10·9 |
| 9 | 0·274 | 7·7 | 10·8 |
| 10 | 0·306 | 31·4 | 10·8 |
| Line C—3 bags | | | |
| Sample No. | | | |
| 1 | 0·380 | 35·0 | 9·8 |
| 2 | 0·447 | 62·0 | 9·6 |
| 3 | 0·333 | 6·9 | 10·8 |

(v) *Grading.*—While seed tests were proceeding in 1966 the merchant returned the remaining packages of seed in each consignment to the seed producer. It was not until March 1967, when the seed producer returned four bags consisting of bags from which samples 1, 2, 3 and 4 had been drawn in line A, that endeavours could be made to grade this seed into a uniform mixture.

Grading was carried out under the supervision of a Standards Branch Inspector by means of an Oliver Hi-cap No. 80 gravity separator with a cloth deck. Machine settings were:

| | |
|---|---|
| Speed: | Full on |
| Air flow: | Two complete turns |
| Lateral tilt: | 2¼ in. |
| Longitudinal tilt: | 2¾ in. |

**TABLE 2**

SEED TEST RESULTS—LINE A (10 BAGS)

| Sample No. | Quantity in Line | Purity (% Pure Seed in 3 g) | Germination (3 x 100 seeds) (%) Time 21 days Temp. 20–35°C | Pure Live Seed (%) | Direct Test—Number of Normal Germinations in 1 g Samples | Direct Test—Calculated Pure Live Seed† (%) |
|---|---|---|---|---|---|---|
| 1 | 1 bag (50 lb.) | 22·8 | 33 | 7·5 | 77 | 5·9 |
| 2 | as above | 26·1 | 34 | 8·9 | 115 | 8·7 |
| 3 | as above | 29·1 | 31 | 9·0 | 116 | 8·8 |
| 4 | as above | 25·0 | 33 | 8·3 | 86 | 6·5 |
| 5 | as above | nil (14 pure seeds in 3 g) | insufficient pure seed | — | 2 | 0·2 |
| 6 | as above | nil (8 pure seeds in 3 g) | insufficient pure seed | — | 2 | 0·2 |
| 7 | as above | 40·2 | 26 | 10·5 | 147 | 11·2 |
| 8 | as above | 34·0 | 30 | 10·2 | 220 | 16·7 |
| 9 | 1 bag (40 lb) | 16·6 | 39 | 6·5 | 81 | 6·2 |
| 10 | as above | 0·2 (50 pure seeds in 3 g) | insufficient pure seed | — | 4 | 0·3 |
| Submitted sample* | 480 lb | 20·8 | 36 | 7·5 | 70 | 5·3 |

* 15 samples from 10 bags. † Based on an average of 1,315 pure seeds per gram of bulk

**TABLE 3**

SEED TEST RESULTS—LINE B (10 BAGS)

| Sample No. | Quantity in Line | Purity (% Pure Seed in 3 g) | Germination (3 x 100 seeds) (%) Time 21 days Temp. 20–35°C | Pure Live Seed (%) | Direct Test—Number of Normal Germinations in 1 g Samples | Direct Test—Calculated Pure Live Seed† (%) |
|---|---|---|---|---|---|---|
| 1 | 1 bag (50 lb) | 45·6 | 42 | 19·2 | 259 | 20·0 |
| 2 | as above | 24·1 | 40 | 9·6 | 99 | 7·6 |
| 3 | as above | 33·4 | 36 | 12·0 | 177 | 13·6 |
| 4 | as above | 30·3 | 30 | 9·1 | 129 | 9·9 |
| 5 | as above | 50·0 | 37 | 18·5 | 156 | 12·0 |
| 6 | as above | 4·2 (162 pure seeds in 3 g) | insufficient pure seed | — | 15 | 1·2 |
| 7 | as above | 0·1 (30 pure seeds in 3 g) | insufficient pure seed | — | — | — |
| 8 | as above | 20·4 | 41 | 8·4 | 47 | 3·6 |
| 9 | as above | 5·8 (200 pure seeds in 3 g) | insufficient pure seed | — | 17 | 1·3 |
| 10 | 1 bag (52 lb) | 29·1 | 48 | 14·0 | 121 | 9·3 |
| Submitted sample* | 502 lb | 22·1 | 32 | 7·1 | not done | not done |

* 15 samples from 10 bags. † Based on an average of 1,298 pure seeds per gram of bulk.

**TABLE 4**

SEED TEST RESULTS—LINE C (3 BAGS)

| Sample No. | Quantity in Line | Purity (% Pure Seed in 3 g) | Germination (3 x 100 seeds) (%) Time 21 days Temp. 20–35°C | Pure Live Seed (%) | Direct Test—Number of Normal Germinations in 1 g Samples | Direct Test—Calculated Pure Live Seed† (%) |
|---|---|---|---|---|---|---|
| 1 | 1 bag (50 lb) | 34·4 | 27 | 9·3 | 153 | 12·4 |
| 2 | 1 bag (50 lb) | 67·7 | 34 | 23·0 | 225 | 18·2 |
| 3 | 1 bag (42 lb) | 13·0 | insufficient pure seed | — | 25 | 2·0 |
| Submitted sample* | 142 lb | 45·4 | 22 | 10·0 | not done | not done |

* 3 samples from 3 bags. † Based on an average of 1,234 pure seeds per gram of bulk.

Since the purpose of grading was to produce a seed mixture containing a uniform distribution of component particles and consisting of at least 40% by weight of pure seed, the supervising Inspector arranged for three divisions by means of mechanical deflectors to be made in the mass of seed moving over the table. The first cut was set 12 in. from the highest side of the table and the remaining length of the table base was then divided into two equal outlets for the seed.

The bags of seed were fed on to the table in the following order.

| Line A Bag number | Purity % previously determined (shown in Table 2) | Quantity of seed (lb) |
|---|---|---|
| 4 | 25·0 | 50 |
| 3 | 29·1 | 50 |
| 1 | 22·8 | 50 |
| 2 | 26·1 | 50 |

This grading operation resulted in two bags of seed containing relatively heavier particles being recovered from the 12 in. outlet. These bags, which weighed 59 lb and 60 lb, were marked "P" and "Q" respectively. Recovery from the outlet representing the second cut was 48 lb of seed, which was placed in a bag marked "R". The 29 lb of seed recovered from the lower outlet representing the third cut was placed in a bag marked "S". Inert matter swept from the table after grading weighed 3 lb. The difference in total weight between the old and new bags used for repackaging the seed was 1 lb.

The inspector then sampled each of the four bags for a heterogeneity test and also obtained submitted samples, both methods being prescribed in International Rules for Seed Testing.

Seed tests were carried out in the same manner as previously outlined. Details of these operations and subsequent test results are shown in Tables 5 and 6.

**TABLE 5**

HETEROGENEITY TEST METHOD
RECOVERY OF FOUR BAGS OF SEED AFTER GRADING BAGS 1, 2, 3 AND 4 OF LINE A

| Samples from Bags Marked | Working sample, 1,000 seeds (g) | Purity (%) | Moisture (%) |
|---|---|---|---|
| P | 0·444 | 35·1 | 11·1 |
| Q | 0·479 | 45·5 | 11·1 |
| R | 0·337 | nil | 11·6 |
| S | 0·324 | nil | 11·5 |

**TABLE 6**

RECOVERY OF FOUR BAGS OF SEED AFTER GRADING BAGS 1, 2, 3 AND 4 OF LINE A

| Samples from Bags Marked | Quantity in Line (lb) | Purity (% Pure Seed in 3 g) | Germination (3 x 100 seeds) (%) Time 21 days Temp. 20–35°C | Pure Live Seed (%) | Direct Test—Number of Normal Germinations in 1 g Samples | Direct Test—Calculated Pure Live Seed† (%) |
|---|---|---|---|---|---|---|
| P | 59 | 37·5 | 45 | 16·9 | 204 | 15·5 |
| Q | 60 | 46·1 | 44 | 20·3 | 233 | 17·7 |
| R | 48 | nil | insufficient pure seed | — | 2 | 0·2 |
| S | 29 | 0·7 | insufficient pure seed | — | — | — |
| Submitted sample* | 119 | 45·0 | 39 | 17·6 | not done | not done |

* From samples taken from P and Q. † Based on an average of 1,315 pure seeds per gram of bulk.

## III. RESULTS

Table 1 shows that, by applying the heterogeneity test, definite proof was obtained that wide variation in pure seed content occurred between bags in each line. Separate seed moisture tests carried out on individual bags showed only a slight variation between bags.

Tables 2, 3 and 4 summarize test results obtained for the three separate lines of seed. While a wide variation in the percentage weight of pure seed is shown to occur between bags, the percentage weight of pure seed in the composite sample of each line is the approximate purity average of that line. The variation in the germination results between individual bags in each line cannot be accounted for, but it is considered that this is probably related to the degree of maturity of the green panic seed.

Direct tests on individual bags indicate the number of viable seeds present in a unit weight of sample.

Table 5, containing seed test results following grading, indicates that it is possible to separate pure seed from inert matter by efficient seed cleaning.

Table 6, which summarizes test results of this graded seed, supports results obtained in Table 5.

## IV. DISCUSSION

The internationally accepted method for sampling a large number of packages of seed in one line results in a determination of pure seed content which approximates to the average pure seed content of the line. This method fails to account for the wide variation of pure seed content between bags where there is a high level of heterogeneity in the bulk.

The gross differences observed between purity analysis results of each bag carried out by the routine testing method and by the heterogeneity test method are consistent. These differences are also indicated in the result obtained by the direct test method.

Tables 5 and 6 show results which might be attained if a machine operator were prepared to sustain a heavy loss of the seed bulk to achieve a minimum standard of 40% by weight of pure seed. In the final regrading operation of this investigation, 119 lb of seed which could legally be offered for sale was recovered from a total weight of 200 lb. Worthless material in this bulk amounted to 80 lb.

This investigation underlines the interdependence of the sampling method, testing procedure and subsequent regrading of seed in determining standardized arbitrary values of seed quality.

Bulks of seed of many agricultural species are relatively homogeneous mixtures and the prescribed sampling intensities for such seed are satisfactory in that purity analysis results obtained on different samples from the same bulk are reproducible. This cannot be said for green panic seed, where the bulk contains varying proportions of undeveloped seed. Further investigation is therefore warranted into practical supplementary methods of sampling such seed.

Investigations into the laboratory testing of green panic seed are being carried out by a number of workers. Broad aspects of this work relate to precise definitions of pure seed, which must take into account the separation of such seed from the bulk by mechanical means, and to the germination and storage behaviour of this seed during its period of maturation.

A study of machine cleaning methods of green panic seed is also indicated. In the laboratory, inert matter is removed from the heavier particles of pure seed by an adjustable current of air flowing through a vertical tube. This

method could perhaps be employed more widely in bulk cleaning methods provided consideration is also given to the separation of particles of admixture with weights equal to that of pure seed.

## V. ACKNOWLEDGEMENTS

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## REFERENCE

Anon. (1966).—International rules for seed testing. *Proc. Int. Seed Test. Ass.* 31 (1).

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