

SCREENING LEGUME GERMLASM AND FIELD TRIALS FOR PROTEIN CONTENT AND QUALITY

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As of the time of this meeting, over 5000 lines in the IITA World Cowpea Collection have been screened for protein content (total nitrogen) and over 3500 lines for protein quality (S/N ratio). The current daily analytical rate is over 80 total N assays and nearly 50 total S assays. All of the data are either in the Cowpea Germplasm Catalog Vol. 1 or ready for Vol. 2. It is expected that the chemical analysis of the cowpea germplasm in the World Collection will be completed in 1975.

Emphasis is now turning to other legumes under study at IITA (e.g. lima beans, soybeans, pigeon peas) and to cowpea lines grown under different environmental conditions in the advanced and uniform field trials. In this way information will be gained on the nutritional potential of other legume species and on the influence of environment on protein content and quality in cowpeas.

A four-step system of screening is utilized to evaluate the seed quality in the grain legumes, vis:

1. Parameters of protein quality (total nitrogen, total sulfur)
2. Protein quality (total protein, sulfur amino acids)
3. Nutritional value (amino acid composition, anti-nutritional factors, biological value and digestibility).
4. Consumer acceptable (cooking time and swelling; taste, texture and appearance of prepared foods).

These procedures have been described in the GLIP Annual Reports for 1973 and 1974 and need not be detailed here.

On the basis of the first 2900 cowpea lines screened for total N and total S, it has been possible to set up four selection classes for cowpea:

| <u>Class</u> | <u>Type</u> | <u>% S</u> | <u>% Protein</u> | <u>S/N, as %</u> |
|--------------|--------------------------------------|------------|------------------|------------------|
| I | Lines with high S and high N | > 0.17 | < 26 | <u>ca. 4</u> |
| II | Lines with high S and medium N | > 0.17 | < 25.5 | > 4 |
| III | Lines with low S and medium to low N | < 0.13 | < 25 | < 3 |
| IV | Lines with normal protein | 0.14-0.17 | 25-26 | 3-4 |

The frequency of lines in Class I is nearly 2%, while that of lines in Class II is less than 1%. Twenty-four Class I lines have now been reassayed and will be introduced into the IITA plant breeding program.

The 81 entries (some repeated) in the 1974-1975 uniform and advanced yield trials have been assayed for protein content (Table 1). The average protein content for each of the 5 trials was similar, as were values for the 4 selected lines. In some cases differences in protein for a given line are due to use to different seed lots in the trials.

The 74 entries in the 1974 second season soybean trials also showed consistency for average oil and protein content in the 4 trials, though there was considerable range in both oil and protein (from 15 to 20% and from 34 to 47%, respectively).

A relatively strong negative correlation ($r = -0.687$) was found between oil and protein, in agreement with others (e.g. Hymowitz *et al.* 1972). Oil content = $28.609 - 1.734$ (N content) for these trials. There was not a consistent trend of either oil or protein content with seed size.

The average and range of protein contents found in the grain legume species grown at IITA have been summarized in Table 3. Species with high protein include soybean, wing bean and, to a lesser extent, cowpea. Those having higher than average protein quality as estimated by the S/N ratio are yam bean, soybean, lima bean and cowpea. Large seed size was observed in lima bean, wing bean and yam bean. The wide ranges of protein contents found in wing and yam beans indicate considerable potential for protein improvement in these species.

REFERENCES

- Hymowitz, T., F.I. Collins, J. Pancgner, W.M. Walker 1972. Relationship between the content of oil, protein and sugar in soybean seed. *Agron. J.* 64, 613-616.

Table 1. Summary of seed protein contents in cowpea trials (1974-5)

| Trial | No. Entries | Aver. protein content, % (range) | TVu 201-1D | Protein content of selected lines: | | | High protein line |
|-------------------|-------------|--|---------------|---------------------------------------|-------------|-------------|----------------------|
| | | | | TVu 1977-0D | TVu 3629 | TVu 4557 | |
| Uniform No. 1 & 2 | 19 | 24.4 (20.4 - 27.2) | 26.1 | 22.2 | 24.9 | 22.8 | TVx 30-IG |
| Advanced No. 1 | 28 | 23.1 (20.7 - 25.1) | 22.4 | - | 23.1 | 23.8 | TVu 4552 |
| Advanced No. 2 | 23 | 25.7 (23.2 - 28.1) | 23.9 | 22.2 | 24.4 | 23.2 | TVu 853 |
| Advanced No. 3 | 29 | 24.8 (20.7 - 28.2) | 25.3 | 24.2 | 23.2 | 22.9 | TVu 7151 |
| Advanced No. 4 | 20 * | 24.3 (22.2 - 26.9) | 23.8 | 22.8 | 23.0 | 25.9 | TVx 11 - 2H |
| Averages | | 24.5 | 24.3 | 22.8 | 23.9 | 23.7 | |

* 1 entry excluded from calculations

Table 2. Seed size, Oil content and Protein content in Soybean Trials
(1974 Second Season)

| Trial | Aver. 100 seed weight, g. (range) | Aver. oil content, % (range) | Aver. protein content, % * (range) | High oil line | High protein line |
|---|---|------------------------------------|--|--------------------|----------------------|
| Uniform (no. 1 & 2) (18 entries) | 14.5 (9.6 - 17.4) | 17.5 (14.9 - 19.5) | 39.4* (36.1 - 44.5) | TGm 13-3-2644 | 236-6-1-b |
| Advanced (no. 3 & 4) (15 entries) | 14.3 (12.3 - 18.4) | 17.0 (15.6 - 18.6) | 42.1 (38.9 - 47.0) | Kent no. 3 | 297-2 |
| Preliminary (no. 5 & 6) (20 entries) | 13.4 (10.1 - 17.6) | 17.5 (16.1 - 19.3) | 39.8 (34.0 - 46.8) | 242-4-4230 | Davis |
| Preliminary (no. 7 & 8) | 15.0 (10.7 - 18.8) | 16.2 (15.6 - 20.0) | 39.3 (33.5 - 43.9) | TGm 249-5- 2444 | TGm 195-3-4215 |

* % protein = %N x 6.25

** Aver. S/N = 4.3%, with range 3.1 - 5.7%

Table 3. Seed Protein Content of Grain Legumes Grown at IITA

| Species | No. Entries | Aver. 100 seed weight, g. (range) | Aver. protein content, % (range) | Aver. S/N ratio, % (range) |
|------------|-------------|---|--|----------------------------------|
| Cowpea | 118 | 11.2 (6.8 - 19.6) | 24.4 (20.4 - 28.2) | 4.0 (2.5 - 5.0) |
| Lima bean | 31 | 39.0 (31.0 - 63.3) | 22.7 (20.4 - 27.4) | 4.4 (3.0 - 6.2) |
| Pigeon pea | 35 | 7.4 (6.2 - 8.6) | 21.6 (19.4 - 24.1) | - |
| Soybean | 74 | 14.3 (9.6 - 18.8) | 40.1 (33.5 - 46.9) | 4.6 ** (3.1 - 5.7) |
| Wing bean | 13 | 29.7 (20.5 - 35.3) | 35.2 (27.5 - 40.2) | 3.4 (2.1 - 4.2) |
| Yam bean | 36 | 24.2 (14.8 - 35.8) | 21.8 (17.7 - 27.2) | 6.0 * (5.5 - 7.5) |

* for 9 lines only

** for 18 lines only