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OIL CROPS:
PROCEEDINGS OF THE THREE MEETINGS HELD AT
PANTNAGAR AND HYDERABAD, INDIA, 4-17 JANUARY 1989

1. The Brassica Subnetwork-II
2. The Other Oil Crops Subnetwork-I
3. The Oil Crops Network Steering Committee-I

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International Development Research Centre, Ethiopia/Canada

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Niger or noug (Guizotia abyssinica Cass) is one of the major oilseed crops in Ethiopia. It is grown in mid and high-altitudes on heavy, poorly drained soils (5). It provides about 50-60% of the country's edible oil. However, the seed yield and oil content are very low.

In sunflower, the increase in oil content was achieved through decreasing the thickness of seed coat or increasing the embryo size (3). In safflower, oil content was found to be inversely related with hull percent (4). Niger, safflower and sunflower have similarities in that they all belong to the family Compositae.

Investigations on some of the seed morphology and quality parameters and understanding their relationship would help in indirect selection for oil and improved meal quality. Thus, this experiment was designed:

1) to develop a technique to separate the seed coat (hull) and embryo from niger seeds,

2) to determine the oil, protein and crude fibre contents as well as weight of seed parts of the selected niger genotypes and investigate the inter-relationship among these parameters, and

3) to identify factors which would be useful for screening breeding materials for high oil and protein contents.

Materials and Methods

In 1987, 25 niger accessions selected from 1986 micro, pre-national and national variety trials grown at Holetta were included. In 1987, the study was made on two sets of genotypes which were either high or low in oil content. The two types were identified from the medium-and early-maturing landraces tested in 1987 at Holetta and Debre Zeit, respectively. Holetta and Debre Zeit, are at altitudes of 2380 and 1900 meters, respectively. The inclusion of high and low oil materials was to see the association of this trait with hull characteristics within medium and early maturing ecotypes grown at high and low altitude sites, respectively.

For dehulling, seeds were soaked with water in petridish containing filter papers and were kept in an incubator at temperature of 25 to 30°C for 24 hours. Following this the seeds were oven dried at 75 to 80°C for 24 hours to obtain expanded fibrous hull and shrivelled embryo without any weight loss. For each genotype 20 randomly selected seeds from oven dried samples were carefully separated into seed coat and embryo using sharp needle.
Each fraction was weighed, and hull percent (HP) and embryo percent (EP) were calculated as the ratio of hull and embryo weight expressed as percent of the total seed weight (TSW) respectively. Oil content was determined using wide line magnetic resonance spectrometre (2). Crude fibre and protein contents were determined using acid base digest and the method of Micro Kjeldhal respectively (1). ANOVA was computed for TSW, EP and HP considering the 20 single seeds as replications. Protein, oil and crude fibre determinations were made on three samples from each accessions. A conversion factor of 6.25 was used for protein content.

Results and Discussion

There are significant differences in all characteristics between the genotypes studied in 1987. As shown in Table 1, these genotypes exhibited wide variability in almost all parameters.

Table 1. Mean total seed weight (TSW) hull percent, embryo percent, oil, protein and crude fibre contents of 25 niger populations grown at Holetta in 1986.

<table>
<thead>
<tr>
<th>Genotype</th>
<th>TSW (mg)</th>
<th>Hull (%)</th>
<th>Embryo (%)</th>
<th>Oil (%)</th>
<th>Protein (%)</th>
<th>Crude Fibre (%)</th>
</tr>
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<td>13.5</td>
<td>86.5</td>
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<td>18.4</td>
<td>81.5</td>
<td>38.6</td>
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<td>21.2</td>
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<td>015505</td>
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<td>18.8</td>
<td>81.2</td>
<td>38.5</td>
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<td>22.6</td>
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<td>80.0</td>
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<td>20.9</td>
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<td>26.9</td>
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<td>39.9</td>
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<td>65.2</td>
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<td>63.3</td>
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</tr>
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<td>Mean</td>
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<td>25.6</td>
<td>74.4</td>
<td>39.2</td>
<td>24.9</td>
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</tr>
<tr>
<td>LSD 5%</td>
<td>0.4</td>
<td>3.6</td>
<td>3.0</td>
<td>0.2</td>
<td>1.2</td>
<td>0.4</td>
</tr>
<tr>
<td>CV%</td>
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<td>19.0</td>
<td>7.7</td>
<td>0.8</td>
<td>7.6</td>
<td>8.8</td>
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* NMR reading of oven-dried seed.
** Analysis based on oven-dried meal.

Increase in EP was accompanied by an increase in protein and a decrease in hull percent. The relationship between oil content and total seed weight, embryo percent and hull percent was not
clear because of the narrow range of oil content. This could be because of the materials were under high selection pressure for a higher oil.

There appeared to be genotype-parameter interaction in this study. The genotypes PGRC/E 015506, 015585, 200426 and Sendafa which had high embryo and low hull proportions but relatively low oil and quite high protein. Accessions 207399, 203187, and 015504 had low hull, high embryo proportions and high oil content. These relationships indicate that thin hull results in higher embryo proportion which in turn results either in higher oil or protein content as well as low crude fibre.

In 1988, early and medium maturing types were included (Table 2). Increase in oil content was associated with a decrease in hull thickness and an increase in embryo proportion, confirming that larger embryo results in more oil.

The correlation coefficients among total seed weight, oil and protein contents, hull and embryo percents are shown in Table 3. Total seed weight was negatively related with hull thickness and positively, with embryo proportion. Oil content was negatively related with hull thickness and protein content. Embryo percent was negatively associated with hull percent and positively, with oil content indicating that thin-hull seeds have larger embryo size. The positive relationship of embryo proportion and oil content shows that most of the oil is deposited in the embryo. Hull percent was positively associated with crude fibre and negatively with embryo percent showing that thick hulled seeds have more crude fibre than thin hulled seeds.

As it has been observed in sunflower and safflower (3,4), thinner seed coat or hull in niger seed results in larger embryo proportion that can produce more oil and quality meal as a by-product.

**Table 2. Mean total seed weight, hull percent, embryo percent, oil and protein content of three lowland and six highland types of niger grown at Debre Zeit and Holetta respectively, in 1988.**

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Total seed weight (mg)</th>
<th>Hull (%)</th>
<th>Embryo (%)</th>
<th>Oil 1 (%)</th>
<th>Protein 2 (%)</th>
<th>Crude fibre (%)</th>
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<tbody>
<tr>
<td>Acc. No.</td>
<td></td>
<td></td>
<td></td>
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<td>Lowland (Bunigde)</td>
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<td>69.8</td>
<td>31.2</td>
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<tr>
<td>Highland (Abat)</td>
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<td>1.4</td>
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<td>12.2</td>
<td>4.7</td>
<td>3.2</td>
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1 - NMR reading of oven dried seed.
2 - Based on defatted dry meal.
Table 3. Correlation coefficients among some physico-chemical characteristics of 9 niger accessions grown at Holetta and Debre Zeit, Ethiopia in 1988.

<table>
<thead>
<tr>
<th>Character</th>
<th>Hull percent</th>
<th>Embryo percent</th>
<th>Oil content</th>
<th>Protein content</th>
<th>Crude fibre</th>
</tr>
</thead>
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<tr>
<td>Total seed weight</td>
<td>-0.28</td>
<td>0.29</td>
<td>-0.01</td>
<td>0.59</td>
<td>0.08</td>
</tr>
<tr>
<td>Hull percent</td>
<td>-0.99**</td>
<td>-0.76*</td>
<td>-0.22</td>
<td>0.62*</td>
<td></td>
</tr>
<tr>
<td>Embryo percent</td>
<td>0.75*</td>
<td></td>
<td>0.23</td>
<td>-0.61*</td>
<td></td>
</tr>
<tr>
<td>Oil content</td>
<td></td>
<td>-0.15</td>
<td></td>
<td>-0.50</td>
<td></td>
</tr>
<tr>
<td>Protein content</td>
<td></td>
<td></td>
<td></td>
<td>-0.31</td>
<td></td>
</tr>
</tbody>
</table>

* Significant at 5% probability level.
** Significant at 1% probability level.

Acknowledgement

Ato Tadesse Deme assisted in the various phases of the study.

References