Chapter 1

PRODUCTION AND BIOLOGICAL NITROGEN FIXATION OF TROPICAL LEGUMES

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1. INTRODUCTION

More than 60% of grain-legume production is soybeans (Table 1). Therefore, this crop is covered by several chapters in this volume as a model for several other grain legumes in which our knowledge is much less developed due to the limited areas of production and, therefore, lower economic impact. However, for the people in many areas, especially in South America and Africa, other grain legumes are vital both for the diets of the population and for the production by small farmers. In terms of sustainable agriculture, both fodder legumes and legumes used as green

<table>
<thead>
<tr>
<th>Crop</th>
<th>Million tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybeans</td>
<td>176.6</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>35.1</td>
</tr>
<tr>
<td>Dry beans (Phaseolus and Vigna)</td>
<td>16.8</td>
</tr>
<tr>
<td>Dry peas</td>
<td>10.5</td>
</tr>
<tr>
<td>Chickpeas</td>
<td>6.1</td>
</tr>
<tr>
<td>Dry faba beans</td>
<td>3.7</td>
</tr>
<tr>
<td>Lentils</td>
<td>3.1</td>
</tr>
<tr>
<td>Green beans</td>
<td>4.7</td>
</tr>
<tr>
<td>Green peas</td>
<td>7.1</td>
</tr>
</tbody>
</table>
manure are equally important. As examples of recent progress in understanding production and biological nitrogen fixation (BNF) in these legumes, the following species will be discussed: beans (Phaseolus sp. and Vigna), chickpea (Cicer arietinum), pigeon pea (Cajanus cajan), peanuts (Arachis sp.), Mucuna and other tropical legumes.

The protein, lipid, and carbohydrate contents of grain legumes are summarized in Table 2. The protein content of most species is in the range of 20-30% in dry seeds. Only Psophocarpus tetragonolobus with 33%, Glycine max with ca. 34%, and Lupinus mutabilis with 48% are significantly beyond this range. The lipid content is very low with only 1-2% in Vigna, Phaseolus, Pisum, Cajanus, Lens, and Dolichos species. Three genera with a protein content greater than 25% have high lipid concentrations; these are 16% in Psophocarpus tetragonolobus, 18% in Glycine max, and up to 48% in Arachis hypogaea (peanuts).

Table 2. Protein, lipid and carbohydrate content (%) in dry seeds of grain legumes. Modified from Souci et al., 1994.

<table>
<thead>
<tr>
<th>Crop-species</th>
<th>Protein</th>
<th>Lipid</th>
<th>Carbohydrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arachis hypogaea</td>
<td>25.3</td>
<td>48.1</td>
<td>8.3</td>
</tr>
<tr>
<td>Cajanus cajan</td>
<td>20.2</td>
<td>1.4</td>
<td>47.0</td>
</tr>
<tr>
<td>Canavalia ensiformis</td>
<td>25.5</td>
<td>2.5</td>
<td>50.0</td>
</tr>
<tr>
<td>Cicer arietinum</td>
<td>19.8</td>
<td>3.4</td>
<td>41.2</td>
</tr>
<tr>
<td>Dolichos lablab</td>
<td>22.0</td>
<td>1.5</td>
<td>50.0</td>
</tr>
<tr>
<td>Glycine max</td>
<td>33.7</td>
<td>18.1</td>
<td>6.3</td>
</tr>
<tr>
<td>Lens culinaris</td>
<td>23.5</td>
<td>1.4</td>
<td>52.0</td>
</tr>
<tr>
<td>Phaseolus acutifolius</td>
<td>24.5</td>
<td>1.5</td>
<td>65.5</td>
</tr>
<tr>
<td>Phaseolus lunatus</td>
<td>20.6</td>
<td>1.4</td>
<td>45.0</td>
</tr>
<tr>
<td>Phaseolus vulgaris</td>
<td>21.3</td>
<td>1.6</td>
<td>40.1</td>
</tr>
<tr>
<td>Pisum sativum</td>
<td>22.9</td>
<td>1.4</td>
<td>41.2</td>
</tr>
<tr>
<td>Psophocarpus tetragonolobus</td>
<td>33.1</td>
<td>16.2</td>
<td>30.8</td>
</tr>
<tr>
<td>Vicia faba</td>
<td>23.0</td>
<td>2.0</td>
<td>55.0</td>
</tr>
<tr>
<td>Vigna aconitifolia</td>
<td>23.6</td>
<td>1.1</td>
<td>56.5</td>
</tr>
<tr>
<td>Vigna angularis</td>
<td>20.7</td>
<td>1.4</td>
<td>56.4</td>
</tr>
<tr>
<td>Vigna mungo</td>
<td>23.1</td>
<td>1.2</td>
<td>41.5</td>
</tr>
<tr>
<td>Vigna radiata</td>
<td>24.0</td>
<td>1.1</td>
<td>43.6</td>
</tr>
<tr>
<td>Vigna subterranea</td>
<td>19.0</td>
<td>7.0</td>
<td>54.0</td>
</tr>
<tr>
<td>Vigna umbellata</td>
<td>21.5</td>
<td>0.3</td>
<td>60.9</td>
</tr>
<tr>
<td>Vigna unguiculata</td>
<td>23.5</td>
<td>1.4</td>
<td>41.7</td>
</tr>
</tbody>
</table>

2. PHASEOLUS SP. AND VIGNA SP. (BEANS)

More than 200 species of the genus Phaseolus have been described (Smartt, 1988). The most important species economically are Phaseolus vulgaris var. nanus, Phaseolus coccineus, Phaseolus lunatus, Phaseolus acutifolius and Phaseolus...