Evidence for the non-involvement of a signaling pathway via the shoot in the resistance of cowpea to *S. gesnerioides*

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地上部のシグナル伝達経路が関与しないササの*S. gesnerioides*抵抗性機構

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**[Background]**

Parasitic weed *Striga gesnerioides* is major biotic constraints limiting cowpea production in Africa (Emechebe *et al.*, 1991). Though several dominant genes have been identified to confer the resistance to specific races of *S. gesnerioides*, the mechanisms involved in race-specific resistance are not yet clear (Li *et al.*, 2009). Lohar (2005) suggested that an unidentified shoot-derived factor is responsible for regulating legume-rhizobia host specification. Based on observation of several mutants of *Lotus japonicus*, a model legume plant, it has been suggested that the resistance to its parasitic plant *Orobanche aegyptiaca* may be controlled by similar mechanisms which modulate nodulation and mycorrhizal colonization (Kubo *et al.*, 2008). To understand the involvement of shoot factors in the mechanisms of resistance to *S. gesnerioides* in cowpea, the reactions of grafted plants to the race of *S. gesnerioides* dominant in Nigeria were investigated.

**[Materials and Methods]**

Three cowpea genotypes, IT98K-205-8, (*S. gesnerioides* resistant), and IT98D-1399 and Dan Ila (*S. gesnerioides* susceptible) were used for the experiments. In the first experiment, a total of six graft combinations of shoot and root (shoot/root) of three cowpea genotypes were made using a reciprocal grafting technique (Figure 1A). In the second experiment, two combinations of main plant and root of IT98K-205-8 and IT98D-1399 were made using the side-grafting technique (Figure 1B). For both experiments, all grafted plants were transferred to pot containing 3.5kg dry sand and 0.05g of *S. gesnerioides* seed (approx. 5000 germinable seeds) at 8 days after grafting, and the pots were arranged using a completely randomized design with three replications. Plants were watered daily, and cowpea shoot length, SPAD value of the highest fully expanded leaf using a leaf chlorophyll meter (SPAD 502, Minolta) and the number of emerged *S. gesnerioides* plants were collected weekly. At 7-9 weeks after transplanting (WAT) for first experiment, and 6 WAT for second experiment, shoots and roots of cowpea, and attached *S. gesnerioides* were harvested for the measurement of dry weight after observation of *S. gesnerioides* attachment to roots.

**[Results and Discussion]**

In the experiment with reciprocal grafting, no attachment of *S. gesnerioides* was observed on all grafting combinations with the root derived from a resistant genotype IT98K-205-8, although other combinations with the roots derived from two susceptible genotypes supported a number of *S. gesnerioides* plants. With side-grafting, the plants showed the attachment of *S. gesnerioides* only on the root derived from the susceptible genotype, no matter whether the shoot was derived from resistant or susceptible genotypes. Moreover, the inhibition of direct root growth caused by *S. gesnerioides* parasitism without altering host photosynthesis was suggested.
The obtained results indicate that the resistance mechanism of IT98K-205-8 to *S. gesnerioides* race SG3 dominant in Nigeria is dependent on the root factors of the host plant without the involvement of a signaling pathway via the shoot.

Figure 1. Diagrammatic representation of grafting system used in two experiments.

Figure 2. Cowpea plant and attached *S. gesnerioides* at 6 weeks after transplanting (Main plant: IT98D-1399 Grafted root: IT98K-205-8)

Table 1. Flowering and harvesting dates, and numbers of emerged and non-emerged *S. gesnerioides* plants on 6 reciprocal graft combinations

<table>
<thead>
<tr>
<th>Graft combination</th>
<th>Flowering date (DAS)</th>
<th>Harvesting date (DAS)</th>
<th>Number of emerged <em>S. gesnerioides</em> (Striga plants/pot)</th>
<th>Number of non-emerged <em>S. gesnerioides</em> (Striga plants/pot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoot Root</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dan lla / IT98D-1399</td>
<td>-</td>
<td>76*</td>
<td>4.0 ± 0.6</td>
<td>6.7 ± 1.2</td>
</tr>
<tr>
<td>Dan lla / IT98K-205-8</td>
<td>-</td>
<td>76*</td>
<td>0.0 ± 0.0</td>
<td>0.0 ± 0.0</td>
</tr>
<tr>
<td>IT98K-205-8 / Dan lla</td>
<td>35 ± 3</td>
<td>62**</td>
<td>2.3 ± 11.2</td>
<td>0.7 ± 0.3</td>
</tr>
<tr>
<td>IT98K-205-8 / IT98D-1399</td>
<td>39 ± 3</td>
<td>62**</td>
<td>1.7 ± 0.3</td>
<td>1.0 ± 0.0</td>
</tr>
<tr>
<td>IT98D-1399 / Dan lla</td>
<td>37 ± 1</td>
<td>62**</td>
<td>1.3 ± 0.9</td>
<td>1.3 ± 0.3</td>
</tr>
<tr>
<td>IT98D-1399 / IT98K-205-8</td>
<td>40 ± 3</td>
<td>62**</td>
<td>0.0 ± 0.0</td>
<td>0.0 ± 0.0</td>
</tr>
</tbody>
</table>

*Harvesting was conducted at 9 weeks after transplanting before maturing of cowpea plant

**Harvesting was conducted at 7 weeks after transplanting when all plants showed physiological maturity


