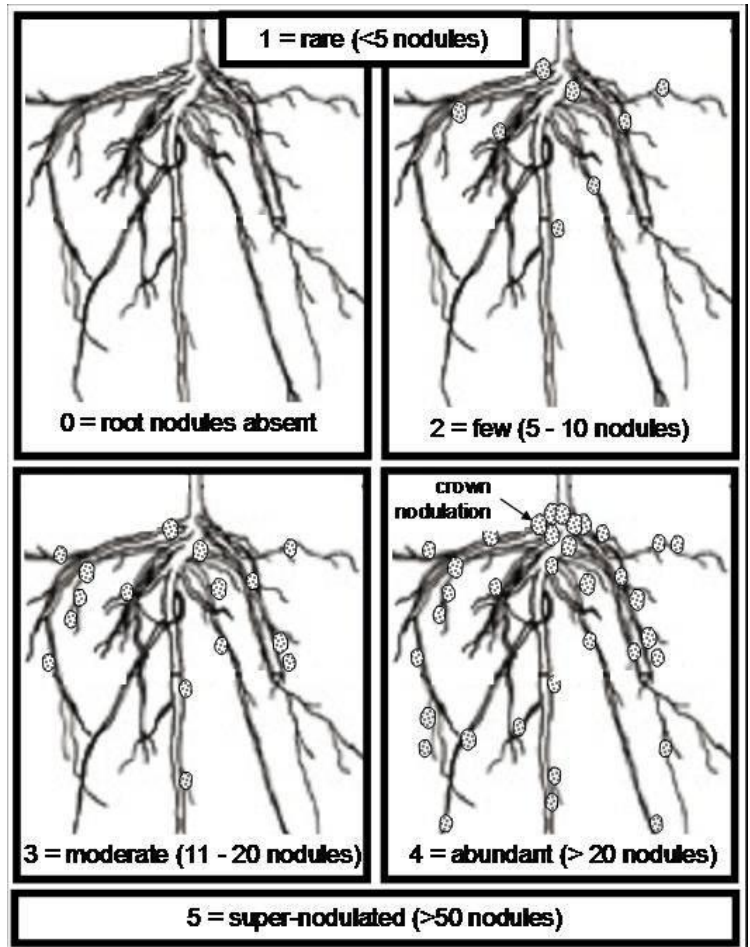# Assessing Root Nodulation of Grain Legumes: An Agro-dealer Training Practical

The best way to determine if inoculation is needed is to compare the growth and root nodulation of plants that were, and were not, inoculated. This simple practical compares the root nodulation of soybeans and climbing beans by scoring the number of nodules, and the frequency of crown (upper root) nodulation and the nodule interior color.

Nodule Scoring

These observations require that five plants be uprooted, the root systems washed and the root nodules compared to a simple key containing six different nodulation categories. These categories appear in this protocol (right) and on the accompanying data report forms. The categories are both numerical and descriptive: 0) no nodules, 1) nodules rare (<5), 2) few nodules (5–10 nodules), 3) moderate nodulation (11-20 nodules), 4) abundant nodulation (> 20 nodules) and 5) super-nodulated (>50 nodules). It is not necessary to collect nodules and count them, rather the nodulation pattern on the intact root is sufficient to assign a nodule score. *Nodulation assessment should be conducted at the crop's mid-bloom growth stage.* This system is intended for soybean, bean and cowpea but not groundnut. The field procedure follows:

1. *For soybean or bush bean:* identify a sample area consisting of a 0.5 meter length of row comparing soybean not inoculated and soybean inoculated with BIOFIX. This sample row length should contain 8 to 10 plants and be selected from a field not expressing pest, disease or nutrient deficieny symptoms. In some cases, it may be necessary to sample soybean intercropped with maize.
2. Carefully uproot the soybean plants with a shovel or machete, lifting them from the bottom so that nodules remain on the roots.
3. Place the uprooted plants in a bucket of clean water and gently remove adhering soil. If the soil is sandy or silty, it is not necessary to wash the roots, rather remove the soil by gently shaking the roots.
4. Score each of the nodulation patterns from each individual plant on a scale of 0 to 5 as described in this protocol. If the root system is crown nodulated, circle the "C" next to the score. Cut two nodules open from each plant and inspect the color of the nodule interior. If the nodule interior is red or pink circle the "R" and if green or grey circle the "G".
5. Enter the rank into the accompanying data report form (Appendix 1) and return it to the Node Leader. Enter any additional comments of the soybean technologies in the space provided (e.g. poor crop stand, presence of pest and disease, hail damage, etc.)
6. *For climbing bean*, sample fewer plants (e.g. 5 inoculated and not inoculated), wash the roots, score and enter data as described above for soybean.

Note that properly inoculated soybeans should score 4 with heavy crown nodulation and dark red interiors and climbing beans should score 5 with red interiors.

Nodulation score of soybean and climbing bean to assess inoculation effect: Record Sheet

Cooperator _____   Prepared by _____

Field Demonstration _____

District _____

Date _____

Soybean Nodule Scores

Not inoculated

Plant 1 _____ C R G   Plant 2 _____ C R G

Plant 3 _____ C R G   Plant 4 _____ C R G

Plant 5 _____ C R G   Plant 6 _____ C R G

Plant 7 _____ C R G   Plant 8 _____ C R G

Plant 9 _____ C R G   Plant 10 _____ C R G

Plot 2: Inoculated with BIOFIX

Plant 1 _____ C R G   Plant 2 _____ C R G

Plant 3 _____ C R G   Plant 4 _____ C R G

Plant 5 _____ C R G   Plant 6 _____ C R G

Plant 7 _____ C R G   Plant 8 _____ C R G

Plant 9 _____ C R G   Plant 10 _____ C R G

Calculate average score for each group, are inoculated soybeans better nodulated?

Climbing Bean Nodule Scores

Inoculated with BIOFIX

Plant 1 _____ C R G   Plant 2 _____ C R G

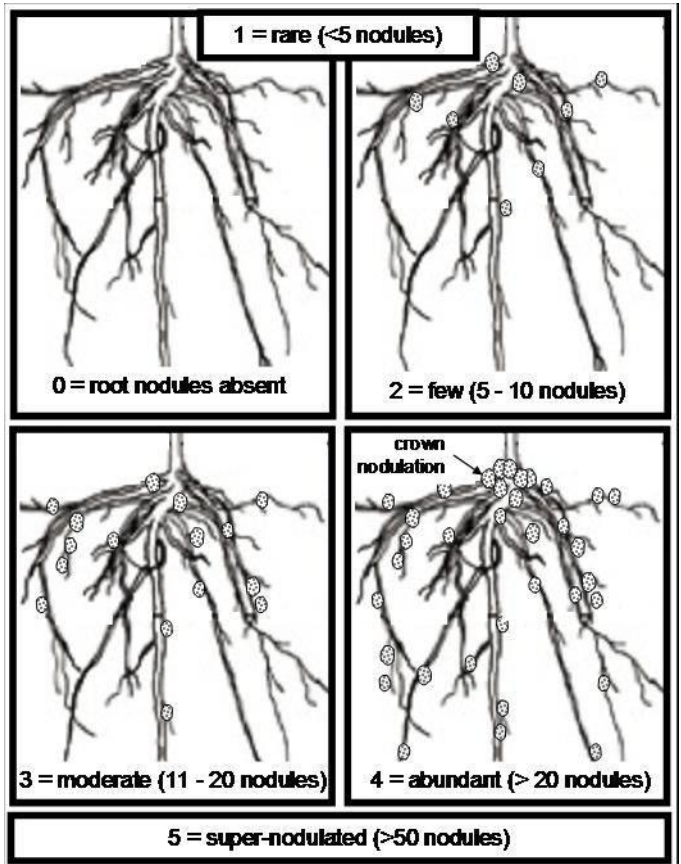Plant 3 _____ C R G   Plant 4 _____ C R G

Plant 5 _____ C R G

Not inoculated

Plant 1 _____ C R G   Plant 2 _____ C R G

Plant 3 _____ C R G   Plant 4 _____ C R G

Plant 5 _____ C R G

1 = rare (<5 nodules)	
0 = root nodules absent	2 = few (5 - 10 nodules)
3 = moderate (11 - 20 nodules)	crown nodulation → 4 = abundant (> 20 nodules)
5 = super-nodulated (>50 nodules)	

Any additional comments on the field demonstration technologies

Soybean _____

_____

_____

_____

_____

_____

Climbing bean _____

_____

_____

_____

_____

_____

_____

Calculate average score for each group, are inoculated climbing beans better nodulated?