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ONLINE ISSN : 1349-1008

PRINT ISSN : 1343-943X

**Plant Production Science**

Vol. 9 (2006) , No. 3 219-227

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## Alteration in Intra-plant Distribution of $\delta^{15}\text{N}$ in Response to Shading in Legumes

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(Received: December 27, 2005)

**Abstract:** The intra-plant distribution of  $^{15}\text{N}$  in common bean, cowpea and soybean having different levels of responses to shading and  $\text{N}_2$ -fixing ability were analyzed under shaded and non-shaded conditions. Maize was used as a reference (non  $\text{N}_2$ -fixing) plant. Seedlings were grown in pot soils for 3 weeks then transferred to shaded (55% of control) and non-shaded (control) conditions in a greenhouse, and sampled at 13 days and 24 days after shading. The proportion of plant N derived from  $\text{N}_2$ -fixation (%Ndfa) estimated by the natural  $^{15}\text{N}$  abundance method was higher in cowpea and soybean (74–91%) than in common bean (37–38%). Shade treatment reduced %Ndfa significantly in cowpea and soybean. The difference in  $\delta^{15}\text{N}$  between shoot and root ( $\Delta\delta^{15}\text{N}_{\text{s-r}}$ ) was the highest in maize followed by common bean, cowpea and soybean. Shading increased  $\Delta\delta^{15}\text{N}_{\text{s-r}}$  in each legume species, particularly in cowpea and soybean. A significant negative correlation was found between  $\Delta\delta^{15}\text{N}_{\text{s-r}}$  and %Ndfa in all legumes at both sampling dates ( $R^2 = 0.67\text{--}0.96$ ,  $P < 0.1$ ). The slope and Y-intercept of the regression line was similar at the sampling dates, but varied with the species. The slope was  $-0.05$  in cowpea,  $-0.06$  in common bean, and  $-0.11$  in soybean. The  $\Delta\delta^{15}\text{N}_{\text{s-r}}$  value estimated by extrapolation of the regression line was 2.9, 2.5 and 8.6‰ at 0 %Ndfa, and  $-3.2$ ,  $-2.8$  and  $-2.6$ ‰ at 100 % Ndfa, in common bean, cowpea and soybean, respectively. The consistent relationships between  $\Delta\delta^{15}\text{N}_{\text{s-r}}$  and %Ndfa found among legume species suggest that  $\Delta\delta^{15}\text{N}_{\text{s-r}}$  could be used as a parameter for estimating %Ndfa without using a reference plant, although the

component of regression line was characteristically different among legume species.

**Keywords:** [Common bean](#), [Cowpea](#), [δ<sup>15</sup>N](#), [Natural <sup>15</sup>N abundance method](#), [Nitrogen fixation](#), [%Ndfa](#), [Soybean](#)

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Janardan Khadka and Jiro Tatsumi: "Alteration in Intra-plant Distribution of δ<sup>15</sup>N in Response to Shading in Legumes". *Plant Production Science*, Vol. **9**, pp.219-227 (2006) .

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doi:10.1626/pps.9.219

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