

Thesis Title Measurement of N_2 Fixation of Red Kidney Bean Plant by Ureide Analysis of Dry Stem Sample

Author Miss. Jeraporn Intasan

M.S. (Agriculture) Soil Science

Examining Committee :

Assist. Prof. Dr. Ampan Bhromsiri Chairman

Assist. Prof. Dr. Soonthorn Buranawiriyakul member

Lecturer Phrek Gypmantasiri member

Lecturer Dr. Somporn Chconluchanon member

Abstract

Pot experiments were conducted to estimate N_2 - fixation of red kidney bean by analysis of ureide-N of dry tissue of stem. Mokcham variety of red kidney bean plants were grown in sand. Nutrient solution of Broughton and Dillworth with different concentrations of KNO_3 and $(NH_4)_2SO_4$ ranging from 0-10 mM N were applied to rhizobium inoculated bean plants. Mixed strains of *Rhizobium leguminosarum* biovar *phaseoli* (CIAT 899, UMR 1899 and isolate KN 6) at the ratio of 1:1:1 were inoculated at the rate of 10^6 cell/seed. Increasing level of N from each N source caused significant reduction of nodule dry weight while dry weight and N uptake of shoot at each stage of growth increased significantly. N_2 -fixation activities of the control plants (0 mM N) as evaluated by relative ureide index (% RUI) or percentage of ureide-N as compared to the total N content of the xylem sap or dry tissue of stem were at maximum about 86-90% for sap and 75-79 % for tissue at V_4 - R_2 stage. The RUI of both xylem sap and tissue decreased with stage of growth but the high value of RUI about 76-79 % for sap and 71-78 % for tissue were still maintained throughout the growing season up to R_6 -stage. Increasing rate of N application from both N sources, reduced significantly RUI of xylem sap and tissue at all stages of growth. The application of NH_4^+ -N resulted in higher RUI value of the dry tissue than NO_3^- -N at all rate of N applied and at all stages of growth. The same phenomenon was also observed for the xylem sap at the higher N rates (6-10 mM N) and at R_2 - R_6 stage. While the percentage of NO_3^- -N in the xylem sap of the bean receiving NO_3^- -N fertilizer increased significantly with the increasing N rates and the maximum NO_3^- -N content

of the xylem sap were ranged from 58-81 % of the total N, whereas the bean plants receiving NH_4^+ -N contained maximum percentage of NO_3^- -N in the xylem sap of only 20-40 %. For amino-N, there were higher percentage of amino-N in the xylem sap of NH_4^+ -N applied beans than those receiving NO_3^- -N. Significant correlation between RUI from xylem sap and dry stem for each stage of growth was observed. The estimated RUI of the xylem sap was calculated from RUI of the dry tissue by using regression equation in order to estimate the proportion of N_2 fixed with the assumption that NO_3^- -N was the main source of N taken up from soil by the bean plants. The calibrated equations for estimation of proportion of N_2 fixed from RUI of the dry tissue of stem were proposed. Validation of these equations were tested in the field experiments at 2 sites with different environments. At each site, the RUI, amount and % of N_2 fixed of the bean plants from 5 different treatments, control, 8 kgN/rai and three rhizobial inoculated treatments were compared. The inoculated strains were CIAT 899, UMR 1899 and isolate KN 6. There were significant correlation between the observed and estimated values of RUI of xylem sap at both sites. The significant correlation between N_2 fixation measurement by ureide analysis of xylem sap and dry tissue of stem were also observed for the beans grown in pot experiment and in the fields. These two methods provides similar prediction of the amount and % of N_2 fixed. In the pot experiment with N free nutrient solution, the percentage of N_2 fixed of the inoculated bean estimated by ureide analysis of dry tissue of stem was about 86 % of total N uptake from sowing to R_6 stage of growth. In the fertile soil with irrigation, the best fixation was obtained from UMR 1899 inoculated bean with 11 kgN/rai of N_2 fixed or 63 % of total N accumulated in the shoot from sowing upto R_6 stage. For unfertile soil in the rainfed area the amounts of N_2 fixed between CIAT 899 and UMR 1899 were not different. The amount of N_2 fixed by these two inoculated treatments were 2.6 and 2.3 kgN/rai or 46 and 38 % of the total N uptake from sowing to R_4 stage respectively, while the fixed N of the uninoculated control bean was 2.4 kgN/rai or 41 % of the total N uptake.