

Estimation of fixed nitrogen in the field grown soybeans released from Korea and Japan

Jong-Tag Youn^{*1}, Yong-Hwan Ryu¹, Jong-Uk Park¹, Young-Ep Kwon¹,
Suk-Ha Lee², and Shinji Shimada³

¹National Institute of Crop Science, RDA, Suwon, 441-857, Republic of Korea

²College of Agriculture and Life Science, Seoul Nat'l Univ. 151-921, Republic of Korea

³NICS, NARO, 2-1-18, Kannondai, Tsukuba, University, Sendai 981-8555, Japan

Objectives

The supernodulating lines are in fact inferior in growth and seed yield, and do not seem to have any agronomic benefit. The objectives of this study are to analyze characteristics of symbiotically fixed nitrogen during growth period in field grown isogenic soybean lines with application of ¹⁵N-labelled ammonium sulfate.

Materials and Methods

Field experiments were conducted under upland soils in Suwon, Korea. The PVC pipes 30cm in diameter and 50cm in height were buried under the ground in the experiment plot to sow the seeds and to fertilize ¹⁵N enriched (NH₄)₂SO₄. Cultivars cv. Enrei and Shinpaldalkong 2 and its supernodulating mutant Sakukei 4 and SS2-2 and a non-nodulating control, T201 were planted on 22 May at PVC pipe.

Results and Discussion

The supernodulating soybean lines showed 68.4 ~ 78.9% of its N from fixation, 1.0 ~ 1.5% from fertilizer and 20.0 ~ 30.1 from soil at harvesting growth stage and wild type soybeans showed 46.2 ~ 50.7%, 2.5 ~ 2.6% and 46.8 ~ 51.2%, respectively. This trend of distribution of three N-sources during growth period was maintained similar to that of R8 stage. And these lines showed high fixed nitrogen and low nitrogen from soil. According to this results, we can consider that supernodulating soybeans save more nitrogen in the field and may be beneficial for nitrogen absorption of succeeding crops. In the comparison of nitrogen fixation rate between two different genotypes at several growth stage, the supernodulating lines showed higher nitrogen fixation rate than that of wild types throughout the growth period. Our results showed that supernodulating soybeans have higher nitrogen fixation efficiency than wild types and have possibility to exceed the total nitrogen accumulation per plant compare to normal nodulating soybeans..

^{*}Corresponding author : Tel: 031-290-6854 E-mail : jongtag@rda.go.kr

Table 1. The percentage of three nitrogen source of super and normal nodulating soybeans in total plant during growth period.

(unit : mg/plant)

Growth stage	Variety	Nitrogen source [†]		
		Ndfa	Ndff	Ndfs
V5	Sakukei 4	114.0±12.4 [78.4]	7.1±2.3 [5.0]	24.0±2.6 [16.6]
	SS2-2	118.3±11.9 [5.0]	5.5±1.9 [3.9]	18.4±1.6 [13.0]
	Enrei	60.0±17.2 [38.5]	20.9±3.8 [13.5]	73.3±7.0 [48.0]
	Sinpaldal 2	63.4±3.4 [48.5]	15.8±7.3 [11.6]	52.9±9.4 [39.9]
	Total	345.4±11.2 [42.6]	12.3±3.8 [8.5]	42.2±5.2 [29.4]
R1	Sakukei 4	201.9±31.6 [72.0]	14.7±4.8 [5.3]	63.2±9.5 [22.7]
	SS2-2	172.1±4.3 [71.3]	13.2±4.1 [5.4]	57.0±13.8 [23.3]
	Enrei	214.8±5.3 [58.2]	29.4±6.2 [7.9]	125.2±10.7 [33.8]
	Sinpaldal 2	150.0±1.2 [54.5]	23.6±3.8 [8.6]	101.8±6.4 [36.9]
	Total	184.7±10.6 [64.0]	20.2±4.7 [6.8]	86.8±10.1 [29.2]
R6	Sakukei 4	1087.7±45.3 [75.0]	15.3±6.3 [1.0]	348.8±61.5 [24.0]
	SS2-2	837.5±54.2 [66.0]	17.3±2.9 [1.4]	414.1±59.1 [32.6]
	Enrei	833.7±9.9 [47.0]	39.4±6.9 [2.2]	903.6±62.7 [50.8]
	Sinpaldal 2	542.6±78.9 [34.7]	42.3±7.4 [2.7]	975.0±131.4 [62.5]
	Total	825.4±47.1 [55.7]	28.6±5.9 [1.8]	660.4±78.7 [42.5]
R8	Sakukei 4	1088.0±45.2 [78.9]	14.3±4.3 [1.0]	277.3±34.8 [20.0]
	SS2-2	894.3±73.3 [68.4]	20.2±7.0 [1.5]	390.8±14.8 [30.0]
	Enrei	823.1±93.9 [50.7]	40.1±13.3 [2.5]	756.1±26.2 [46.8]
	Sinpaldal 2	668.2±8.5 [46.2]	37.7±12.4 [2.6]	746.8±106.8 [51.2]
	Total	868.4±55.2 [61.1]	28.1±9.3 [1.9]	542.8±45.7 [37.0]

[†] : Ndfa, Ndff, Ndfs denote nitrogen percent derived from atmosphere, fertilizer and soil, respectively.

Table 2. Comparison of nitrogen fixation rates in four soybeans during several growth stage.

(unit : mg/day/g)

Variety	Growth stage		
	VE-V5	V5-R1	R1-R6
Sakukei 4	1.30 ± 0.11	0.52 ± 0.12	0.42 ± 0.02
SS2-2	1.46 ± 0.13	0.65 ± 0.16	0.39 ± 0.03
mean	1.38 ± 0.12	0.58 ± 0.14	0.41 ± 0.02
Enrei	0.40 ± 0.11	0.56 ± 0.09	0.23 ± 0.01
Sinpaldakong 2	0.56 ± 0.02	0.64 ± 0.03	0.15 ± 0.01
mean	0.48 ± 0.07	0.60 ± 0.06	0.19 ± 0.01