High-Throughput Phenotyping of the Leaf Transpiration at the Primary Leaf in Soybean [*Glycine max.* (L.) Merr.]

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High-throughput phenotyping of the leaf photosynthetic capacity will be a key to realize the enhanced photosynthesis in crop plants. We focused on the soybean primary leaf and found that there was a clear genotypic difference in the leaf transpiration rate by measuring the leaf temperature at this leaf position(T_{PL}). The diversity in T_{PL} correlated with the stomatal conductance and photosynthetic capacity measured in the field condition. Our study opens the possibility of the high-throughput phenotyping of the leaf transpiration and photosynthetic capacity at very early stage of the growth in soybean.

Materials and Methods

5 soybean cultivars (3 from the US and 2 from Japan), and 8 recombinant inbred lines derived from a cross between Stressland and Tachinagaha were used in this study (Table 1).

Leaf temperature measurements:

Soybean were seeded in the plant density of 5x5cm in a planter sized for 65(L)x25(W)x20(H) cm filled with the vermiculite. Four soybean plants per genotype were grown under LED light (VEFA280WZ, ALTRADER, Japan) without sunlight. The day-length was set to 12 hr and the temperature were controlled between 25 and 28 ℃. At 14 days after sowing, leaf temperature at the primary leaf (T_{PL}) were recorded using Thermo Gear G100 (Nippon Avionics, Japan).

Leaf photosynthetic measurements:

Soybean were seeded at the experimental field of Graduate School of Agriculture, Kyoto University on June 25th, 2013. The leaf photosynthetic rate (P_n) and stomatal conductance (g_s) was measured by LI-6400 (Li-COR, USA). The measurement was conducted on August 13th, 2013 with the condition of PPFD = 2000μmol m^{-2} s^{-1} and [CO_2] = 380 ppm.

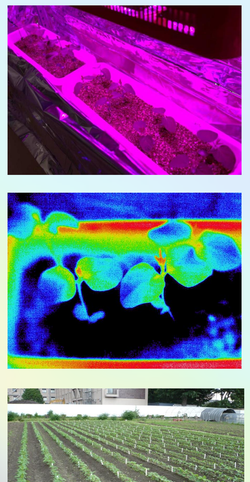
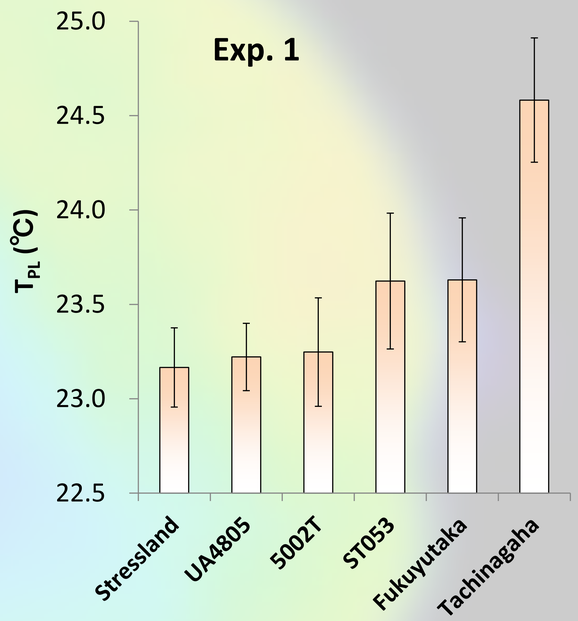


Table 1. Genotypes used in the study

	Exp.1	Exp.2
UA4805	○	
5002T	○	
Fukuyutaka	○	
Stressland	○	○
Tachinagaha	○	○
ST048		○
ST053	○	○
ST068		○
ST100		○
ST128		○
ST178		○
ST203		○
ST283		○



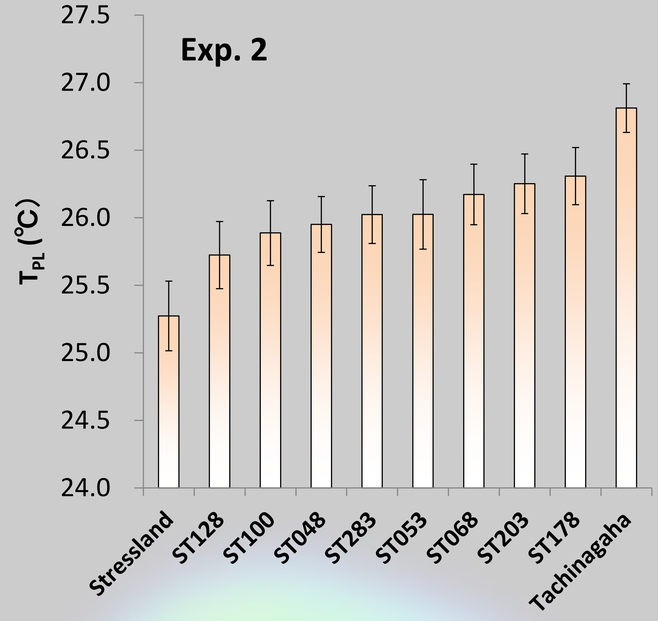


Fig. 1 Variation of the temperature at the primary leaf (T_{PL}). Bars indicate SE (n = 4).

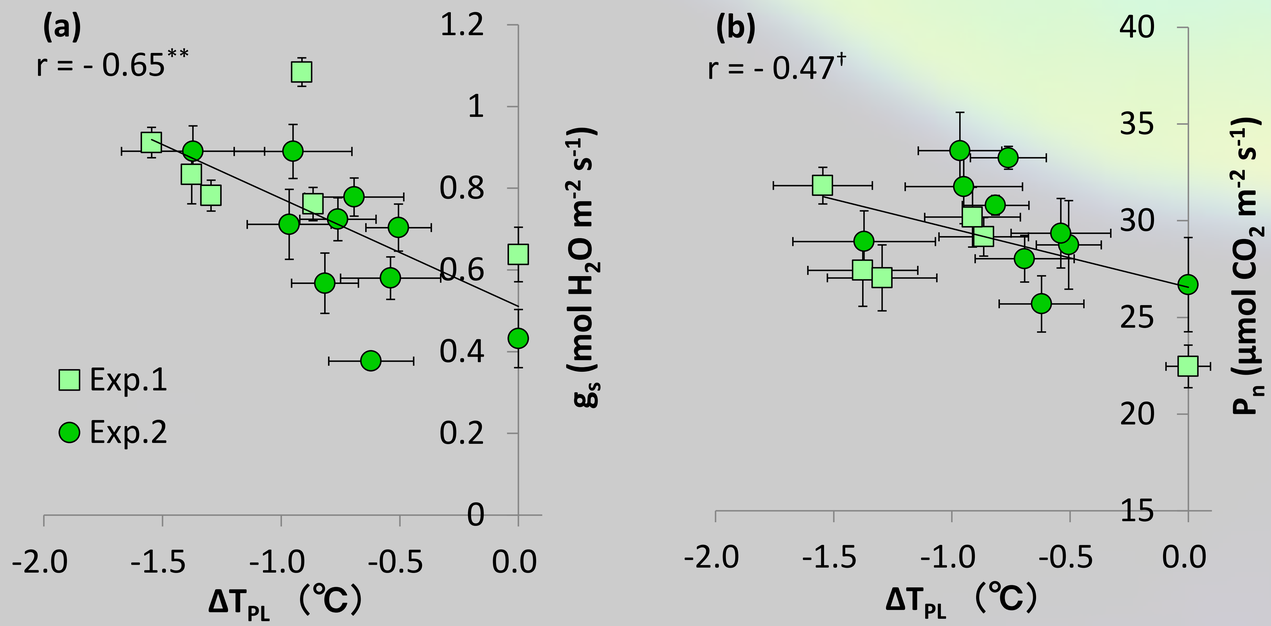
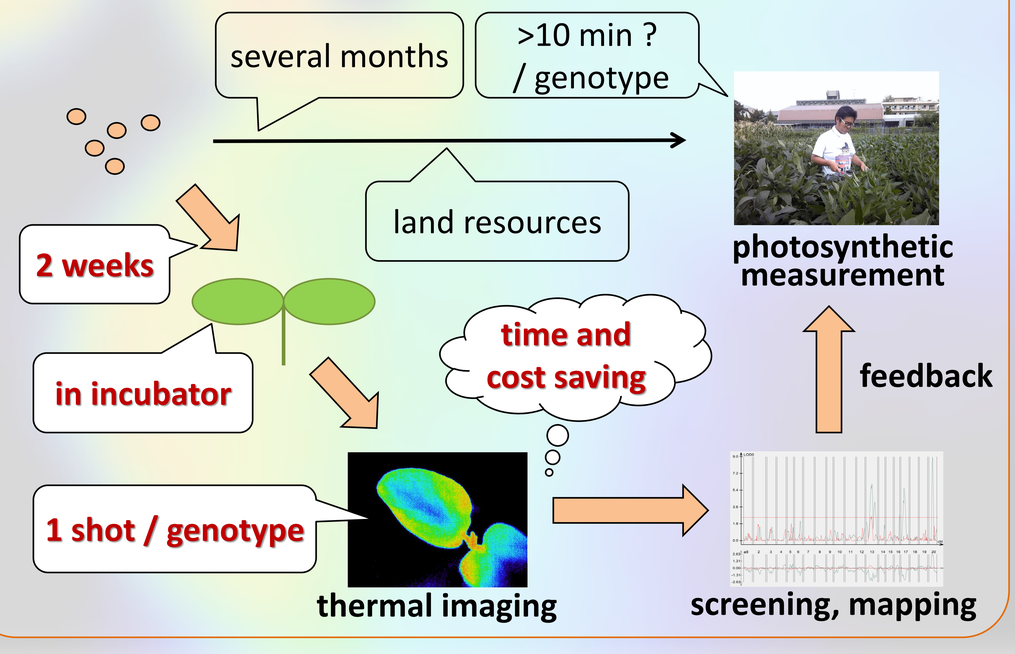


Fig. 2 The relationship between normalized T_{PL} by the subtraction against the value of Tachinagaha (ΔT_{PL}) and stomatal conductance (g_s; a) and photosynthetic rate (P_n; b). Both g_s and P_n were measured at the full pod stage in the field condition.
, †: significant at 1 % and 10 %, respectively. Bars indicate SE (n = 4).

Conclusion

High throughput phenotyping of the transpiration characteristics is expected by measuring the leaf temperature at the primary leaf.



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