Crop production is being affected by the climate change. The authors have been trying quantitative evaluation of potential impact of increasing temperature on soybean yield in Japan.

Experiments with TGC (temperature gradient chamber) have been repeated at Iwate (39.7 lat.) and Kyoto (35 lat.) using major commercial cultivars. Temperature rise up to 3 or 4 °C with gradient was set on the respective natural environments, where mean normal temperatures of conventional cropping season were 19.7 and 24.8 °C at Iwate and Kyoto, respectively. The primary finding was that the temperature rise affects HI of soybean positively at Iwate but negatively at Kyoto for cv. Enrei that adapts both regions. The optimal temperature seemed around 25 °C and it was consistent for earlier-maturing cvs. at Iwate and later-maturing cvs. at Kyoto.

The yield increase at Iwate was attributed to be extension of the flowering and pod setting period through earlier flowering by high temperature associated with less-changed onset of seed filling. This enabled plants to produce greater number of pods. The effect of genotype of the specific loci on plant development is being studied regarding this response.

At Kyoto, the decline of HI (also yield) was associated always with decrease of single seed weight and conditionally with other yield components. In the Kyoto study, biomass production and transpiration activity were also examined for the mini-crop canopy and it was suggested that increased vapor pressure deficit (VPD) by temperature rise cause decline of canopy/leaf conductance to gas exchange and hence decrease of biomass at maturity.

In order to quantify the impact of temperature increase on soybean yield in Japan, the crop model analysis is being attempted. A soybean crop model (Soltani and Sinclair 2012) was modified to apply it to soybean cultivation in Japan accounting for low plant density there and the HI response to temperature. Test simulations were done with current temperature and with a temperature rise by 3 °C for north to south soybean producing areas. It was estimated that the temperature rise will affect production positively in Tohoku region but more-or-less negatively in Hokuriku and Kyushu regions.

Under changing climate, adaptive technologies for soybean production would include phenological adjustment, controlling water environment, controlling biotic stresses and resistance traits to biotic stresses. In particular, the above TGC studies emphasize the importance of phenological adaptation for both north and south regions. Soybean production in Japan is largely affected/disturbed by excess/deficit water in the drained paddy fields and on-going climate change is associated with increased fluctuation of water environment. Thus the crop management technologies such as facilitation of drainage and raised bed culture or ridge seeding would contribute to stable production further than at present. Enhancing resistances to biotic and abiotic stresses is still challenging and requires introduction of genetic resources from outside of Japan.

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