Summary of Doctoral Thesis

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Title	Effect of elevated soil temperature on productivity of tuber and legume crops under cool climate

Introduction and purpose

Increasing global temperature has been threatening crop production in the world. However, there is a huge bias of information on the effects of global warming on crop production among regions as limited information is available for developing countries especially in Africa with poor infrastructure and experimental equipment, even though developing countries are more seriously and directly affected by global warming. Crops grown in the field can experience increase in aboveground and root-zone temperatures independently, but scarce information is available on the effects of root-zone temperature for crop species with different sink positions.

Therefore, the main objective of the study was to evaluate the effect of soil temperature on growth and yield of tuber and legume crops using sweet potato and soybean as model species.

Materials and methods

Field experiment was conducted with four soil temperature treatments – High (HT), medium (MT), low (LT) and control (CT) which were controlled using green, black, white color polyethylene film and no mulch, respectively. soil temperature treatments were interacted with three genotypes of two determinate types (dt1Dt2, dt1dt2) and one indeterminate of wild type of Harsoy (Dt1dt2) with two sowing time (early and late sowing, May, or June, respectively). Additionally, HT and LT were interacted with nodulated (T202) and non-nodulated (T201) soybean with two sowing times. Soil temperature was measured at 30 minutes interval from 5 cm depth. Plant vegetative, physiological, and reproductive development were recorded from emergence to maturity.

Results

For sweet potato, elevated soil temperature promoted vegetative growth of number of leaves, leaf area development, and chlorophyll content. Despite the faster growth of vegetative organs at increasing soil temperatures, there was no significant difference on tuber fresh yield at maturity. Number of tubers was smaller for high soil temperatures and individual tuber weight was greater than low soil temperature. This result was consistently observed over 2 years, indicating the less responsiveness of tuber crops to global warming.

For the determinate and indeterminate soybean, elevated soil temperature promoted vegetative growth of number of branches and nodes, leaf area and phenology. However, the magnitude was differed by cultivar types, and greater responsiveness was observed for indeterminate with greater sink size than determinate types. In contrast to sweet potato, the effect of soil temperature on vegetative growth was carried over to influence final yield in soybean, with significant increase in

yield due to the higher total number of flowers and pods under elevated soil temperature. There was significant interaction of soil temperature × cultivar on final yield. For nodulated and non-nodulated soybean, similar response was observed in final yield. The magnitude of increase was greater for nodulated than non-nodulated type. The results indicated that higher sink capacities with supporting N requirement is the key phenotype to promote positive impact on soybean under elevated soil temperatures.

Conclusion and consideration

In conclusion, the 3-years field experiment using tuber and legume crops confirmed that, mulching systems are useful to evaluate different crop-temperature response with low cost. Positive impacts of increasing soil temperatures were observed only for soybean through sink formation processes with stimulated N supply from nodules, but not for sweet potato within the tested soil temperature range of 24~30°C under cool climate of Iwate, Japan.

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