ClimaViet Climate change and impacts on rice production in Vietnam: Pilot testing of climate-smart agricultural measures

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Impacts of drought and salinity on rice production in Vietnam: Challenges and opportunities

The main goal of the ClimaViet project is to identify and pilot test climate-smart rice farming systems that will contribute to improving rice production under changing climate, and at the same time help to mitigate greenhouse gas (GHG) emissions. In particular, the impacts of drought and salinity on rice production will be discussed in this technical brief.

Key points

- **Challenges:** Rice production in Vietnam is constrained by both drought and salinity.
- **Opportunities:** Genetic and management solutions are proposed to combat drought and salinity.
- **Other considerations:** Seed production and distribution, as well as water scheduling policy, will need to be addressed.

Introduction

Vietnam has been identified as one of the countries most affected by climate change and, as a consequence, rice production is particularly vulnerable (IPCC, 2014). Although the alluvial soil in the Red River Delta and Mekong Delta can contribute to high rice yields, the frequent occurrence of floods, salinity and drought continues to threaten rice production in these regions (MONRE, 2009). As a consequence, smallholder rice farmers in Vietnam face considerable risk, and require cropping systems that are more resilient to the negative impacts of drought and salinity.

Genotypes, management and the environment

Many different management systems are possible to combat drought and salinity (e.g. combinations of planting dates, fertilizers, irrigation, row spacing, population, cropping systems). Many different rice varieties are also possible. The challenge is to identify favourable combinations of rice varieties and management practices in a complex system. Understanding the interaction between genotypes, management and the environment is critical to improving grain yield under dry and saline conditions.

Challenges and opportunities for drought adaptation

Drought adaptation can be improved by both genetics (plant breeding) and management (agronomy). Let’s consider management solutions first. Traditionally, rice is grown under flooded conditions. However, studies during the past two decades have demonstrated that it is not necessary to flood rice to obtain high grain yield and quality.

The first year of experiments in the Soc Trang province of southern Vietnam in the current ClimaViet project (2013/14) found that alternative wetting and drying (AWD) used 37% less water than traditional flooding (Chu Van Hach et al., 2014). These studies support earlier work in Australia (Borrell et al., 1997), Indonesia (Mahrup et al., 2005) and India (Nagothu et al., 2014) showing that water-saving technologies in rice can use 32%, 44% and >50% less water compared with flooded systems. There is evidence, therefore, that alternative water-saving technologies can improve the efficiency of water use for rice production in Vietnam.

Drought adaptation can also be enhanced via genetics through 'escape' and/or 'resistance' strategies. Faster development is an example of an escape mechanism. Furthermore, drought resistance can be viewed as either dehydration 'avoidance' or 'tolerance'. Deeper rooting and greater distribution of roots are examples of dehydration avoidance strategies. Low lethal water status is an example of a dehydration tolerance strategy.

Challenges and opportunities for salt tolerance

Adaptation to salinity can also be improved by both genetics and management. Salinity is a serious problem affecting about one third of all irrigated land globally (Mass and Hoffman, 1977) and is one of the major obstacles to rice production worldwide. Rice is rated as an especially salt-sensitive crop (Shannon et al., 1998).

Rice productivity in salt-affected areas is very low, <1.5 t/ha, but can reasonably be raised by at least 2 t/ha (Ponnamperuma 1994). Salinity affects the percentage of filled spikelets, the 1000-grain weight, and can also prevent the uptake of K (Clermont-Dauphin et al., 2010).

In terms of genetic solutions, salt tolerance is a multigenic trait that allows plants to grow and maintain economic yield in the presence of high and relatively constant levels of salt, in particular NaCl (Hurkman, 1992).

Salt tolerance can also been improved by management. However, water table dynamics alone are not enough to leach the salt accumulated in the topsoil (Clermont-Dauphin et al., 2010). Strategies to prevent the upward movement of saline groundwater are also important.

General considerations

Improved seed production and distribution strategies will also need to be considered in Vietnam. Private-public partnerships may play an important role in this area. It is also unlikely that water-saving strategies such as AWD will be adopted without concurrent policy changes that address the timely release of water at the commune level.

References

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