FOCUS Vietnam

Farmer Options for Crops Under Saline conditions

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Quinoa and cowpea provide alternative crop options for the Vietnamese Mekong Delta

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Background

Dry-season soil salinisation is a prominent production and food security issue for farmers in the Vietnamese Mekong River Delta (MRD). **Rising sea levels** (Wassmann et al., 2004), **tidal fluctuations** and **decreased upstream river flow** (Dang et al., 2015) allow the intrusion of saline water inland up the MRD via the extensive network of canals and rivers. Dry-season soil salinisation is becoming a prominent issue as farmers apply saline irrigation water to rice crops to compensate for low rainfall and fluctuating climatic patterns (Lee et al., 2019). **Rice crop failure** due to salinity exposure occurring at critical reproductive phases is forcing the need to identify and implement **alternative dry season crops** to rice that can **withstand low rainfall and salinity** concentrations above 4 g L^{-1}. A glasshouse trial compared the growth of soybean (*Glycine max)*, cowpea (*Vigna unguiculata)* and quinoa (*Chenopodium quinoa)* in saline conditions using Chameleon soil moisture sensors to control irrigation frequency.

Key activities

- Two **saline treatments** (non-saline vs increasing salinity of irrigation water each week until 4 g NaCl L^{-1} was reached) and two **irrigation treatments** (constant irrigation=blue light or intermittent irrigation =red light) as determined by Chameleon soil moisture sensors
- **Plant** samples taken for biomass, yield, salt ($Na^{+,}$ K^+ and Cl^-) concentration in leaves,, stomatal conductance, proline and glycine betaine content.
- **Soil** samples taken for electrical conductivity (1:5), mineral N (NO_3^- & NH_4^+), gravimetric moisture content and cumulative Na^+
- **Chameleon soil moisture** data recorded through time and water use (volume applied daily) was recorded

Fig 1: Glasshouse set up with Chameleon soil moisture sensors installed

Chameleon soil moisture sensors

The Chameleon soil moisture sensor is a cost effective method that provides real-time, easily gathered information regarding a crop's soil moisture status. The sensors measure soil tension which negates the need to calibrate for soil type (Stirzaker et al., 2017). Three coloured lights indicate soil moisture status with blue as wet (0 to -22 kPa), green as moist (-22 to -50 kPa) and red indicating dry (> -50 kPa) soil.

Fig 2: A quinoa plant flowering, cowpea pods developing, and a saline affected soybean plant.

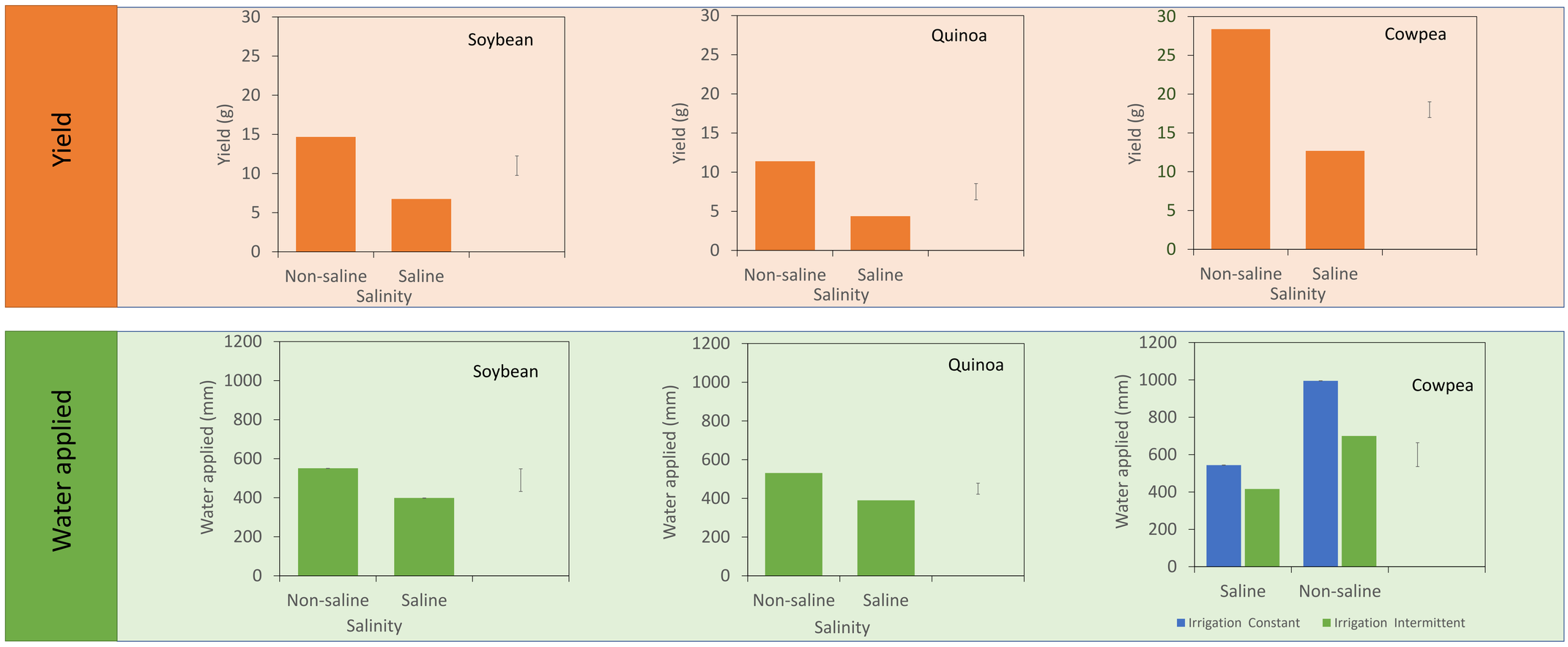
Fig 3: Chameleon soil moisture sensors

Results

All three plant species had significantly **lower yields when irrigated with saline water** however soybean was most affected by salinity with a termination of growth once irrigation concentrations reached 4 g NaCl L^{-1}. Consequently, **soybean is not suitable for growth** in the high saline conditions found in the Vietnamese Mekong River Delta.

Cowpea and quinoa tolerated the higher salinity concentrations through reproductive phases despite soil solute potentials below -1 MPa. **Cowpea used significantly more saline water** throughout the growth period than quinoa and recorded the **highest yields when constantly** and not intermittently watered with saline water. **No significant yield difference existed between quinoa plants** that were constantly or intermittently watered with saline water.

Cowpea is recommended as an alternative dry season crop to rice when an abundance of saline irrigation water is available, and quinoa is suitable when water irrigation sources are limited or saline. These alternative option crops could help contribute to **Vietnam's food security** and provide financial returns to farmers households.



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