Germination and seedling performance of cotton and sesame under projected climate conditions in Burkina Faso

Monique Altmann[1], Rico Möller[1], Dethardt Goetze[1], Christiana F. Olusegun[2], Stefan Porembski[1], Katharina Stein[1,3]

[1]University of Rostock, Inst. of Biological Sciences, Dept. of Botany and Botanical Garden, Germany; **katharina.stein@uni-rostock.de**
[2]Karlsruhe Institute of Technology, Institute of Meteorology and Climate Research, Atmospheric Environmental Research (KIT/IMK-IFU), Germany
[3]University of Wuerzburg, Theodor-Boveri-Institute of Bioscience, Dept. of Animal Ecology and Tropical Biology, Germany

Introduction

Cotton (*Gossypium hirsutum*) and sesame (*Sesamum indicum*) are the major export commodities of Burkina Faso. More than 80% of the population in Burkina Faso depend on rain-fed agriculture. The warming over Africa projected for the 21st century is higher than the global rate, but most likely to occur over West Africa between the late 2030s to early 2040s. Climate change is supposed to severely affect agricultural production. (Fig.1)

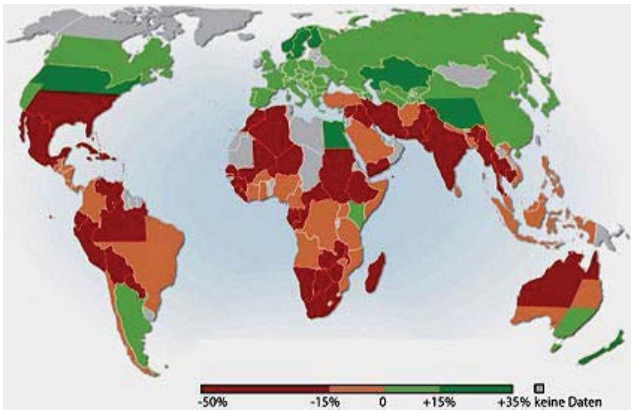

Figure 1: change in agricultural production in 2080 caused by climate change (grey color: no data)[1]

Methods

Using climate conditioning chambers (Fig.2) we analyzed germination rate, emergence time, survival time and seedling performance (root and shoot length, biomass) of 200 conventional cotton and 200 sesame seeds under recent and projected climate conditions. Seeds were obtained on site (south-west Burkina Faso, Bankandi, 11°08'56.566'' N, 003°03'36.446'' W). High resolution (12km) regional climate simulations were carried out at Karlsruhe Institute of Technology (KIT/IMK-IFU) as part of the West African Science Service Center on Climate Change and Adapted Land Use (WASCAL) Project. The projected climate conditions were modelled for the year 2040 in Bankandi for the months of June and July (higher temperature and lower relative air humidity above surface (rH in %) during the sowing and early recruitment phase). Recent climate data were collected on site hourly from 2013-2015. Climate chambers were set with a day/night rhythm (12h light/12h dark). Temperature and rH were set to 29,3°C (recent)/ 30,7°C (projected) and 71,4%/ 62,5% at day time. Night time was set to 26,8°C (recent)/ 29,5°C (projected) and 81,3%/ 72,4%, respectively.

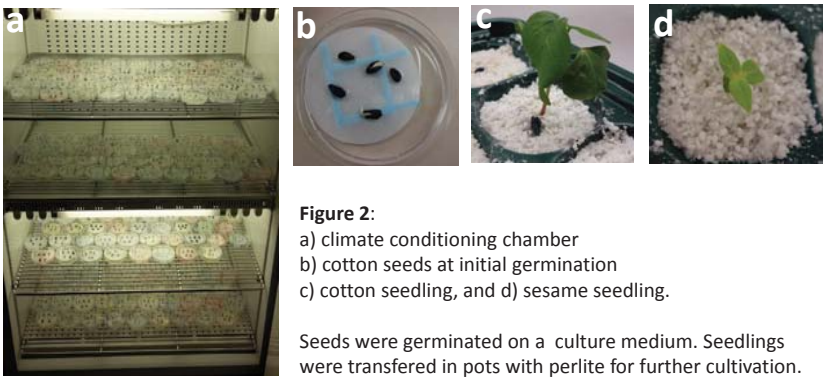

Figure 2:
a) climate conditioning chamber
b) cotton seeds at initial germination
c) cotton seedling, and d) sesame seedling.

Seeds were germinated on a culture medium. Seedlings were transfered in pots with perlite for further cultivation.

Results

Cotton: Germination rate under projected climate conditions was significantly higher than under recent conditions (Fig. 3). Emergence time, survival time and seedling performance of cotton did not differ significantly between recent and projected climate conditions.

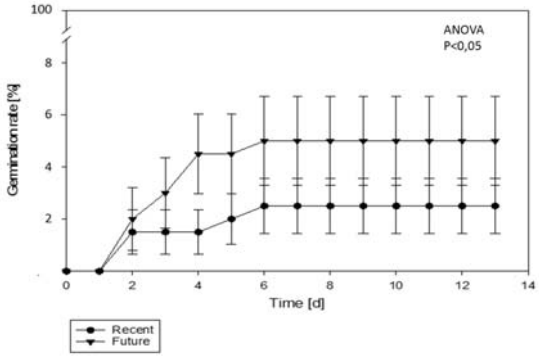

Figure 3: Germination rate of cotton under recent and projected climate conditions of West Africa (mean ± standard error)

Sesame: Survival rate and biomass of sesame seedlings (Fig. 4) were significantly higher under recent conditions. Germination rate and emergence time did not differ significantly between recent and projected climate conditions.

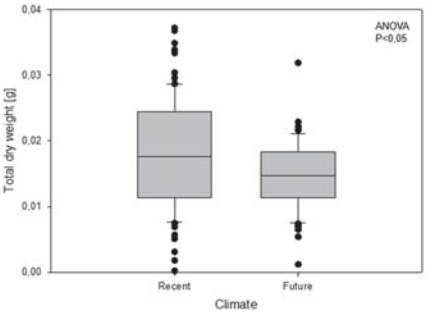

Figure 4: Total dry weight of sesame under recent and projected climate conditions of West Africa

Under projected conditions (higher temperatures and lower relative humidity) sesame roots were significantly more branched than under recent cooler and wetter conditions (Fig. 5).

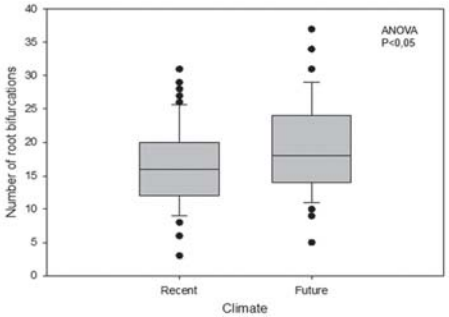

Figure 5: Number of root bifurcations of sesame under recent and projected climate conditions of West Africa

Conclusion

Sesame seems to suffer from heat stress and might be more sensitive to climate change than cotton. Newly bred varieties should be heat and drought resistant to secure future yields and income for the local smallholders.

Reference:
[1]http://wiki.bildungsserver.de/klimawandel/upload/thumb/Agrarproduktion2080.jpg/420px-Agrarproduktion2080.jpg