VISIT REPORT

Institute of Plant Science and Resources (IPSR), Okayama University, Japan. Ms Gachie Sarah Wanjiru

Introduction

I got invited to visit IPSR under the Asia-Africa Scientific Platform Program (AASPP) from October 22nd to December 21st, 2015. The aim of my invitation was to conduct pilot study on hydroponically grown sorghum to determine whether the stay green trait in drought resistant sorghum is related to the root architecture of the sorghum. I left Kenya on21st of October and was privileged to travel with professor Sakamoto, professor Suzuki and professor Gallis all who work at IPSR-Okayama University. I arrived at Osaka Kansai airport - Japan on 22nd October, from here we took a train to Kurashiki. Fiona Wacera and Emily Macharia received me at the Kurashiki guest house which is situated inside the institute. It was a nice to space to live and work in.

Research work

During my visit I was attached to the group of Plant light acclimation research under Prof. Wataru Sakamoto. With the help of professor Sakamoto and other members of the laboratory, I grew sorghum hydroponically to enable easy observation of root growth and development.

Sorghum is grown principally in the semi-arid regions of tropics and subtropics of Africa and India, largely under stored soil moisture situations. It is an important staple food crop for millions of people and an excellent cattle feed across the world. Due to its adaptation to arid environments, diverse germplasm, close degree of relatedness to other economically important crops, and availability of whole genome sequence from recent past, sorghum has been considered as an excellent crop model of choice for studying the genetic and physiological mechanisms of drought tolerance (Andrew et al. 2009).

Drought tolerance is a complex trait affected by several interacting plant and environmental factors. Traits such as:

- Stay green
- water use efficiency
- Early maturity
- Long root and increased root density
- wax content on leaves and stems

These are the target traits considered for improvement of drought tolerance in sorghum (Ludlow and Muchow 1990; Hsiao et al. 1976).

Root system is a vital part of plants for absorbing soil moisture and nutrients and it influences the drought tolerance. Identification of the genomic regions harboring quantitative trait loci (QTLs) for root and yield traits, and the linked markers can facilitate sorghum improvement through marker-assisted selection (MAS) besides the deeper understanding of the plant response to drought stress.

Despite the critical role of roots in harnessing moisture and nutrients from the soil and its essential role in plant growth and adaptation, the root system in general has been studied far less intensively than the shoot due to difficulty of measuring root features in soil for larger number of plants under field conditions. Hence, most of the research endeavors to study root system are conducted in greenhouses, growth chambers and rarely in rhizotrons. Nonetheless, simulation of field situations in artificial structures can greatly aid in understanding the traits related to root system.

According to (Salih et al. 1999; Vadez et al. 2005), a drought tolerant sorghum line possessed roots at least 40 cm deeper than a drought sensitive one and deeper rooting of stay-green lines under drought conditions was reported. This is why it is essential to characterize sorghum root system features along with the yield related traits.

Materials and methods

Seed selection and sterilization

Seeds of NOG and BTx623 were selected from recently harvested field gown sorghum ,NOG (non stay green) which is a Japanese domestic line also known as Takakibi and BTx623 with stay green phenotype(genome reference). The process of sterilization was as follows : ten seeds were put in tubes, 600µl(70%EtOH) was poured in each tube, vortex the mixture for 1min,pour out EtOH and put 600µl(NaClO) ,vortex for 15mins,pour out NaClO and rinse out with 600µl(H_2O) three times.

Seed germination

Petri dishes were layered with wet absorbent paper and sterilized seeds were placed in the Petri dishes and transferred to the incubator where they were left to stay for two days. After two days the seedlings were ready for transplanting.

Hydroponics culture

The reservoirs were filled with growth media (water and MS), an air pump was fixed in two of the reservoirs and then the hydroponics system was transferred into a controlled growth chamber with (PFD: 100µmol/m^2/s, temp: 28^{o}c, day length; 16hours and no humidity control), where the experiment was carried out.

Data collection

Measurement of root length (cm) and taking pictures was done after every one day for 13 days. At the end of the experiment, plant shoot length and root length (cm) was measured to determine root to shoot ratio. Plants were then dried overnight at 100^{o}F and the dry weight was measured. Collected data was stored in excel sheets and analyzed in excel.

Results and discussion

There were visible differences in the roots of NOG and BTx623, BTx623 roots appeared longer and denser when they were grown in water and no source of nutrients. This could be because BTx623 is

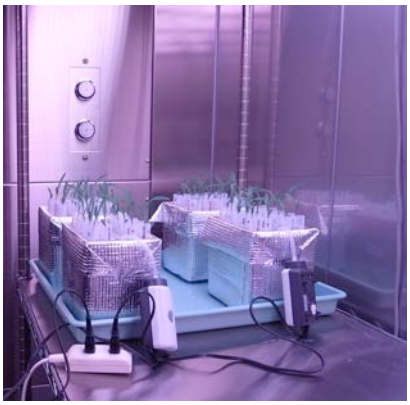
a drought resistant line and its roots grow deeper in search of water and nutrients. In the other culture that contained nutrient solution, there wasn't so much differences in both NOG and BTx623 roots but NOG shoots appeared longer than BTx623 shoots, this may be due to the dwarfing expressed by BTx623 or could mean that NOG absorbs and assimilates available nutrients to develop its shoot and not its roots. With depletion of nutrients in the MS media, NOG shoots turned yellow earlier that BTx623 shoots and this portrays the stay green trait in BTx623 sorghum line.

Conclusion

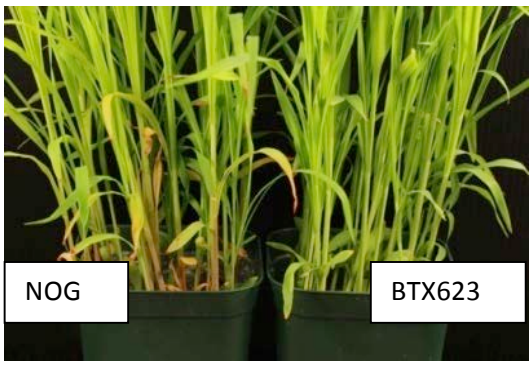
More research work needs to be done on the roots of sorghum as there are already some visible differences from this experiment. Inclusion of RILs and quantitative trait analysis in future experiments will also be key factors in this study.

Other research work

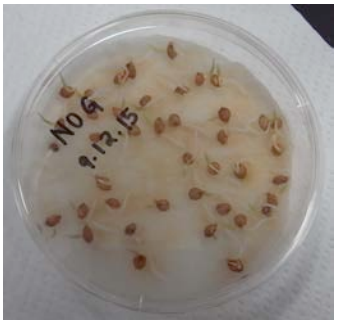
- DNA extraction in sorghum seedlings
- PCR
- Gel electrophoresis



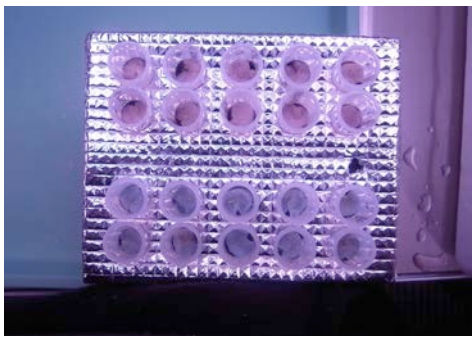
Controlled growth chamber



Parental lines used in the study

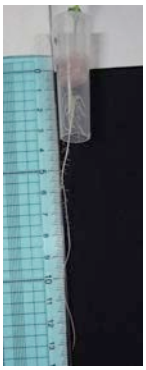


Seed germination



Hydroponics culture

Root observation



Measurement of root length

Harvesting sorghum seeds

Weekly Seminars

On every Friday, weekly seminars were held where Msc, PhD and PostDoc students presented their progress reports and other related scientific research work. These presentations were done to help improve the work of the students and also to get more information on the specific topics that were being researched in the laboratory.

Visit around Kurashiki

My visit around Okayama Prefecture was interesting and really eye catching. My idea about Japan before I visited was totally different from what I saw. The different landscapes, lots of trees, many rivers all around, I was amazed. I visited Kojima in Kurashiki city on one of the weekends and learnt that denim jeans in Japan originated from Kojima before the 50s, I later visited the great Seto Ohashi Bridge that is 13.1km and connecting Okayama and Kagawa prefectures it runs over five islands in

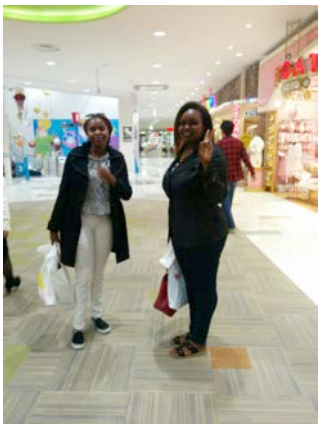
the Seto inland sea. I visited Okayama city a number of times and the light illumination and beauty was exemplary. I also had a chance to visit the Ikura limestone cave a 1200m long the cave was made through erosion of limestone by rain water. No doubt Kurashiki is a beautiful city with vast recourses and culture. The people are very kind welcoming.

Visit to the great Seto Ohashi bridge

Day out at Ikura limestone cave

Harvesting oranges at professor Kubo`s farm

At kojima




At Aeon mall, Kurashiki

At Okayama train station with other Kenyans

At Okayama

Visiting Okayama castle

Dinner with professor Sakamoto and lab members

Kenyans students seeing me off

Departure

I left Kurashiki city on Monday 21st Dec 2015 and took a bus to Osaka Kansai airport. I departed from Osaka airport and arrived in Kenya on 22nd Dec 2015.

Acknowledgment

I acknowledge JSPS-AASPP for providing funds that made my visit to IPSR a success. My sincere gratitude to IPSR-Okayama University for allowing me to use their facilities in the guest house and well facilitated laboratory, from this laboratory I was able to learn new scientific skills .My sincere gratitude to Prof. Wataru SAKAMOTO for believing in me, giving me this opportunity and ensuring that the travel arrangements, my stay in Japan and the objective of the visit were a success. Prof. Kubo of Okayama University, Prof Suzuki of IPSR for their kindness. I'm thankful to Dr. Hunja Murage of JKUAT horticulture department for his assistance and support before my visit to IPSR. I'm entirely grateful to all the members in Prof. Wataru Sakamoto`s laboratory for according me assistance in the laboratory whenever I needed it. Special thanks to Ms. Fiona Wacera for a warm welcome, giving me basic knowledge about living in Kurashiki and showing me around. Thank you all.

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