Tropentag, September 17-19, 2014, Prague, Czech Republic

“Bridging the gap between increasing knowledge and decreasing resources”

Polyamine Action in Sweetpotato Plants in Response to Environmental Stresses

Mervat Ahmed El-Far1,2,3, Hans-Werner Koyro2, Thomas Berberich3

1, Agricultural Genetic Engineering Research Institute (AGERI), Agricultural Research Centre (ARC), Egypt.
2, Justus-Liebig-University Giessen. Institute for Plant Ecology, Germany.
3, Biodiversity and Climate Research Center, Laboratory Centre (BIK-F), Germany

Abstract
Adjustment to certain environmental stresses is one of the most required abilities of crop plants in times of global changes climatic especially in arid and semi-arid regions. Ipomoea batatas (sweetpotato) shows a high future viability because it is a species with a conspicuous adaptability and a wide range of genotypes. It is therefore cultivated in more than 100 countries with tropical, subtropical and moderate climate. It is expected that the importance of Ipomoea batatas also called sweetpotato, the ranked number seven among the most important food crops, will increase in times of drought, desertification, flooding and rising temperatures. It already serves as a candidate for reducing the increasing food insecurity and poverty alleviation in developing countries, buffering the over malnutrition and has the potential to play an important role in the industrial sector. However studies are rare about the mechanisms behind the stress resistance of sweetpotato. Certain metabolites play important roles in the resistance of plants to a broad range of stresses. Polyamines, small organic polycations found in all eukaryotic cells, have been identified as such metabolites. The major plant polyamines, putrescine (Put), spermidine (Spd), and spermine (Spm) frequently accumulate in response to abiotic and biotic stresses. Our aim is to identify the correlation between abiotic stresses and polyamine production in sweetpotato. A bees sweetpotato Egyptian orange-flesh genotype was used in all stresses of this study, four weeks old plants were exposed to heat, cold, drought and salinity stresses separately, polyamines, putrescine (Put), spermidine (Spd), and spermine (Spm) were analysed using the high-performance liquid chromatography (HPLC). The results obtained showed a correlation among the identified polyamines putrescine, spermidine, spermine and the different abiotic stresses in our study. Moreover, unique poly-amine products were also found as a specific response to each stress type. These polyamine products undergo identification process by massspectroscopy. Our results indicate that the expression of polyamines can serve as specific stress indicators.

Keywords:
Environmental stresses, polyamines, sweetpotato

Contact Address:
Mervat Ahmed El-Far, Justus-Liebig University, Giessen, Institute For Plant Ecology, Giessen,

Introduction
Certain metabolites play roles in plant tolerance to abiotic stresses. Polyamines, small organic polycations found in all eukaryotic cells, have been identified as such metabolites [1]. The major plant polyamines, putrescine (Put), spermidine (Spd), and spermine (Spm) frequently accumulate in response to abiotic and biotic stresses [2,3,4]. However specific information on the effects of abiotic stresses on
the endogenous free levels of polyamines in sweetpotato is very rare. Owing to climatic change it is expected that sweetpotato (*Ipomoea batatas*) would serve as a candidate for reducing the increasing food insecurity and poverty alleviation in developing countries, buffering the over malnutrition in developed countries and play an important role in the industrial sector. It is a species with a conspicuous adaptability and a wide range of genotypes. Ranked number seven among the most important food crops it is cultivated in more than 100 countries with tropical, subtropical and moderate climate. This study aims to answer the question: Are the polyamine contents and/or patterns related to drought, cold, heat and salt resistance? The analysis of polyamines could serve as a reliable method to identify most abiotic stress resistance of sweetpotato varieties.

**Materials and methods**

The Egyptian orange-flesh sweetpotato genotype Abees was used in all stresses of this study. Pots with 16 cm dimensions were filled with 1 kg experimental soil, planted with rotted node cutting. Plants were grown under 30% volumetric water content and air humidity of 60%, at 16/8 hrs light/dark (400 µmol quanta m$^{-2}$ s$^{-1}$) and temperatures of 28°C/ 26°C for four weeks until development of the ninth leaf.

1- Heat treatment

Plants placed in the growth chamber with the above growing conditions and temperature increased linearly over 5 hours from 28°C up to 50°C followed by 2 hrs at 50 °C prior to sample collection.

2- Cold treatment

Plants placed in the growth chamber with the above growing conditions and temperature decreased linearly over 5 hours from 28°C to 4°C followed by 4 hours at 4°C then samples collected.

3- Drought treatment

Pots were left to dry slowly to 5% volumetric water content prior to sample collection and identified as moderate drought. At 0% volumetric water content samples were collected and identified as severe drought. Recovery samples achieved after 1 hr of watering the exposed plants to moderate and severe drought.

4- Salinity treatment

At the age of 4 weeks, plants were watered twice a week with 50, 100, 150 and 200 mM NaCl. After the eights watering samples were collected.

**Sample collection**

The third leaf from top of each plant from each pot was collected as one biological replica. In the case of cold and heat stress also the fifth leaves were collected and identified as old leaf. Three biological replicas/ treatment were collected for the polyamines analysis. Controls were collected at the same time of stress treatments. Samples were collected under liquid nitrogen and lyophilized.

**Polyamines extraction and analysis**

Polyamines were extracted and analysed according to [5], using high-performance liquid chromatography (HPLC) (Agilent Technology 1260 Infinity Quaternary LC System, Diode Array Detector (DAD), Tosoh 4.6 x 250 mm, TSK-GEL ODS-80Ts column). Methanol was used as the mobile phase. Extracted polyamines were compared to the polyamines standard profile.

**Results**

According to the obtained results (fig.1 and 2) we could find a correlation among the identified polyamines putrescine, spermidine, spermine and the different abiotic stresses in our study. Moreover unique polyamine products were also found (fig.3) as a unique response to each stress type. Thess polyamine products undergo identification process by mass spectroscopy.

**Conclusion**

Polyamines can be used as a biomarker to study the abiotic stress response in sweetpotato.
References

Sweetpotato abeес genotype after exposing to different abiotic stresses.

Fig.1. The polyamine profile under different levels of drought and salinity stresses in sweetpotato abeес genotype determined by HPLC analysis. The levels of polyamines are relatively displayed in comparison to control that was set to 1.
Fig. (2). The polyamine profile under cold and heat stresses in sweetpotato abies genotype. The level of polyamines production presented as a relative activity using the value of peak area. Values ±SD of three independent replicates are shown.

Fig. (3). A new polyamine product appears in the 27.7 min retention time in the case of drought stress, while under the salinity stress the plant produced another polyamine product in the 29.7 min retention time.