Measurement of stem internode length as non-destructive and easy method for determination of drought stress in Miscanthus

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Introduction

For Miscanthus, stem development can easily and accurately be determined by the length of the internodes at the end of vegetation when leaf fall takes place and nodes become visible. The length of the internodes is to a large degree influenced by temperature and precipitation and gives information about periods of drought stress.

Methods

Accumulated internode length of Miscanthus under average weather conditions

The length between neighbouring nodes (internode) under conditions without water stress is related to the temperature during vegetation:

Cool temperatures at the beginning and the end of vegetation result in comparatively short internodes at stem basis and stem top, whereas warmer temperatures in summer are related to longer internodes at stem middle.

Under „normal“ weather conditions the accumulated internode length is described by a S-curve representing a growth curve.

Results and discussion

Accumulated internode length of Miscanthus depending on low and high water supply

The red curve represents the potential of the site: a sandy soil with a low water capacity. The blue curve shows the potential of the plant under irrigated conditions at the same site.

Differences in length between water regimes related to stem position of internodes can provide information on drought stress with regard to:

- severity and
- time of occurrence

Elongation of stem internodes of Miscanthus Giganteus under conditions with and without water stress

At the beginning of the vegetation with a high soil water status when basal internodes begin to elongate little or no differences between water regimes occur. Length differences at this stage are more affected by primary and secondary tillering.

Increasing water shortage under unirrigated compared to irrigated conditions in summer results in shorter and a lower number of visible internodes of the middle and upper part of the stem.

Conclusion

Stems of Miscanthus cut into internodes, irrigated (7) and unirrigated (5)

Symptoms of drought stress in Miscanthus can be determined by e.g. scoring leaf roll, leaf discoloration and necrosis. Some of these symptoms are reversible under favorite weather conditions and have, therefore, to be recorded directly under drought conditions. In contrast, the "accumulated internode length" is measured only once after the end of vegetation and might be a useful indicator for water stress which is closely correlated to yield. It 'stores' the information on plant water deficits throughout the whole growing season. However, further work is needed on continuous measurements of the internode length in the growing season in order to strengthen the relationship between growth pattern and climate data.