

Summaries

EXECUTIVE SUMMARY

Drought continues to be a major limiting factor to wheat crop production worldwide, with often devastating consequences especially in developing countries. This project proposes to facilitate plant breeding for drought adaptation by developing a package of high-throughput non-invasive techniques to detect genetic variation for single and combined or complex (water use) drought adaptive traits under field conditions. We will also assess the value of different plant characteristics (transpiration efficiency, early vigour, storage of sugars in the stem, flowering date, tillering and stay green) on performance under different types of drought. Finally, we will investigate the traits or trait combinations behind ICARDA's elite drought adapted material. We believe this new knowledge will help focus breeding programs in the partner regions, particularly Central and West Asia and North Africa (CWANA). All project lines will be genotyped using markers from the GCP genetic diversity kit and markers related to agronomic and drought adaptive characteristics. The project will be executed by a multidisciplinary team operating from cornerstone centres for wheat breeding located in contrasting drought environments (from summer to winter rainfall), working in contrasting wheat gene pools, and with a wide range of relevant expertise (from genetics to remote sensing). A workshop targeted at mainly breeding programs in the CWANA region as well as Generation Challenge Program (GCP) members will be held to demonstrate the breeder-friendly tools, the value of several drought adaptive traits per region and the physiological and genetic knowledge on ICARDA's elite lines.

SCIENTIFIC SUMMARY

The Generation Challenge Program (GCP) and other research programs are increasing the understanding of the wheat genome and its genetic variability with the aim to improve adaptation to drought. At the field level, advances in plant breeding are limited by the lack of methods for reliable high-throughput phenotyping that allow season-long monitoring of complex traits (e.g. crop water status or water use). Non-invasive technologies (e.g. spectral reflectance) will be used to develop breeder-friendly screens for specific drought adaptive traits. This information will be linked to other soil, weather, and/or crop characteristics to produce a field-based, high throughput, season-long phenotypic signature to estimate differences in the pattern of crop water use between lines. In addition, we will investigate which traits and trait combinations are most relevant to different drought mega-environments by comparing related lines contrasting in trait values. Target traits will be transpiration efficiency, tillering, stem water soluble carbohydrates (WSC), early vigour, stay green and flowering. Finally, we will study which are the traits or trait combinations behind ICARDA's elite drought adapted material. All project lines will be genotyped using SSR markers from the GCP genetic diversity kit and publicly available markers related to agronomic and drought adaptive traits. The project will be executed by a multidisciplinary team operating from cornerstone centres for wheat breeding located in contrasting drought environments (from summer to winter rainfall) over a latitudinal spread. The partners work in contrasting wheat gene pools, apply different breeding philosophies and have a wide range of relevant expertise (from genetics to remote sensing). New knowledge on breeder friendly phenotyping methods, trait value per region and the basis for drought adaptation of ICARDA lines will be communicated in a workshop open to breeding programs in the CWANA region as well as GCP members. This will hasten the development of more resilient wheat cultivars to mitigate the impact of drought, particularly in Central and West Asia and North Africa (CWANA).