Group discussion of multi-location trials at a farm near Tirupati, Andhra Pradesh, India.

Participants at the final review meeting for ACIAR project CS97/114 held at ICRISAT Centre, Andhra Pradesh, India.

Where To from Here?

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WATER IS GROWING in importance as a limiting factor in agriculture due to the unpredictable nature of rainfall and increasing competition for it from human and industrial uses. To sustain agricultural productivity, water-use-efficient systems are required. Transpiration-efficient cultivars are an important component of such systems.

Yield is a complex character and is an integrated expression of several physiological processes and their interactions within plant and whole-crop systems. Passioura (1977) gave a simplified expression of this complex phenomenon in the model Y = T*TE*HI as described by Bindu Madhava *et al*. (2003). This simple model generated a lot of interest among plant scientists wishing to address the issue of yield through its physiological components. Further studies leading to the identification of simple surrogate measures of physiological traits difficult to measure in the field, have encouraged interest in pursuing the trait-based approach for improving crop yield.

The present study, however, failed to establish a clear superiority of the trait-based selection approach over the empirical selection approach for yield improvement in peanut. There could be several reasons for these inconclusive results: failure of the simple yield model to capture all physiological 'happenings' in the plant system; an imperfect selection index; negative associations among various yield-related physiological traits; and failure of surrogate traits to fully explain the association between yield and its physiological components. Whatever the reason, a logical expectation of the superiority of trait-based approach over empirical approach was not realised from the present study.

So, where do we go from here? To pursue the issue of trait-based versus empirical approach further, we may need to look closer at the model traits, for example at the molecular level. Precise characterisation of parental and breeding materials for yield-related physiological traits, identification of appropriate markers and QTLs, and marker-assisted selection should help to resolve this issue. The QDPI sorghum research into 'stay-green' provides a good model for

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such an approach. Integrated breeding and physiological research has laid a platform of knowledge and germplasm for current research into the molecular biology determining the 'stay-green' trait. Similarly, this project has provided knowledge and germplasm which will facilitate research into the molecular biology of expression of drought-resistance traits in peanut.

The association of SPAD chlorophyll meter readings with specific leaf area and carbon isotope discrimination — and therefore, with transpiration efficiency — is of interest to peanut breeders. The SPAD meter provides an easy-to-use practical tool for use in breeding programs. The SPAD measurements should be integrated with other parameters in the selection scheme. Results from the Australian studies clearly demonstrated that trait-based selection for high TE (via SPAD) was more efficient than empirical yield selection for improvement in TE. The challenge remains to be able to concurrently select for high levels of the three yield component traits (T, TE, HI) to generate genotypes with superior yield under drought conditions.

The present study has generated and identified much promising breeding material through multi-location testing in diverse environments. These promising lines are now entering the national testing system for their ultimate release to farmers. In some cases, particularly the Australian program, material identified in this project is broadening the genetic base of the core breeding program.

End-of-season drought is a major cause of aflatoxin contamination of peanut kernel. There is evidence that peanut genotypes with lower aflatoxin risk maintain kernels at higher water activity. Water-use-efficient lines are likely to have better inherent ability to drive seed and plant physiological processes that would discourage *Aspergillus* spp. infection and aflatoxin production. This hypothesis needs to be further tested under field conditions.

References

Bindu Madhava, H., Sheshshayee, M.S., Shankar, A.G., Prasad, T.G. and Udayakumar, M. 2003. Use of SPAD chlorophyll meter to assess transpiration efficiency of peanut. These Proceedings.

Passioura, J.B. 1977. Grain yield, harvest index and water use of wheat. Journal of Australian Institute of Agricultural Science 43: 117–120.