CEREALS SEMINAR: 8 NOV 1988

A PERSPECTIVE ON DROUGHT RESEARCH FOR ENHANCING FIELD-CROP PRODUCTIVITY with special reference to BREEDING FOR DROUGHT RESISTANCE*

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Note: This seminar is based on a paper written for 'Agric. Systems' (currently under review). It is essentially on drought research themes, and time will permit to present only some of them, very briefly, by only one speaker.

We will be pleased to have your comments on the draft paper, a copy of which would be made available to interested individuals.

The visuals for the seminar are prepared using the picture making sub-program. 'Story telling' is deployed for projection, with the time preset for the duration of display of each slide, with only a few exceptions, meant for using overheads.

SUMMARY AND CONCLUSIONS

1. The recent surge in literature on drought resistance in crop plants has accentuated the challenge and excitement of drought research. It is essential to note, unlike the case with most biotic stress factors, there is no "miracle cure" for drought, neither in plants themselves nor in field management techniques, nor in overall improvement of the agroclimate of the region (soil and water conservation measures, aforestation, etc.). However sufficient scope exists to combine all these methods to increase significantly, and stabilize crop production in many semi-arid regions.

2. Research to stabilize yields in drought environments should begin with assessment and prospects for utilization of climatic, soil, and genetic resources. Although currently available climatic and soil data base are not sufficiently adequate for precise analysis, sufficient scope exists to further analyze and interpret existing data for agricultural purposes. In future greater emphasis is needed to interpret climatic and soil data in agronomically relevant terms,

making the best use of available information on climatic requirements of recent and emerging crop genotypes, cropping systems, and their interaction with other biotic stress factors (such as insects, diseases, and weeds), and agricultural operational requirements (timely sowing and harvesting, spraying chemicals, etc.).

3. Crop responses to water stress are both diverse and complex, so are the peculiarities of the site of study which certainly includes the aspects of agriculture even outside the realm of drought resistance (e.g., grain quality or alternate/whole plant utilization, etc.). Hence research projects must cautiously take into account short vs long term goals, and economics of various alternatives, including cropping systems. Studies must be as comprehensive as possible and as much needed data as possible should be collected for evaluation of the project right from the beginning.

4. Although there are several traits that have been identified for drought resistance, normally one can decide upon the most important ones for a given environment. Greater attention should be paid to incorporate the right balance of drought resistance traits in optimal doses, and to specify the scope and limits of the new material incorporating selected traits in actual crop production, than at present. Satisfactory criteria for evaluating success in breeding for drought resistance are needed. Newer biotechnological approaches may be useful in incorporating novel traits from alien sources, but basic knowledge of the traits themselves are inadequate, and hence need further study.

5. Sullivan's (1972) statement that most of the progress in breeding for drought resistance in crops has been achieved by empirical method, holds good even today after 15 years! The demonstration of the success of physiological approach is yet largely awaited. Physiologists must make adequate distinction between tests for presence of a trait or response associated with drought, and field tests that finally prove the stress resistance of the cultivar. However, progress based on empirical field testing of cultivars under drought in carefully chosen target sites, and by total integration of a selected cultivar with other aspects of crop production is already seen at farm levels in many developing agricultural systems. In the future physiological selection criteria should be employed as an adjunct to the ongoing empirical approach, for increasing the rate of progress.

6. Breeding and management efforts should be at levels that will optimize investment and yield for maximum economic return. Ensuring the high probability of matching the crop growth pattern to the seasonal soil water profile, and avoiding any growth reduction or at least catastrophic

events, is a big challenge to the plant physiologist and climatologists. In extreme environments crop breeding strategies, especially of food crops, are unlikely to be economically viable.

Greater attention should be paid to those types of drought where the chance of impact is highest within a reasonable period of time. In areas with high and erratic rainfall, the drainage and supplementary irrigation practices need more attention, in addition to research on drought management.

7. Pilot projects should be established where technical and institutional innovation are tested before any attempt is made to transfer the technology to the farmers. Sufficient emphasis should be placed on developing sustainable agricultural systems compatible with the socioeconomic conditions of the region. Thus only those with broad understanding of the dynamics of agricultural production systems, rather than mere specialists in any one field can be expected to find practical solutions; the specialist's work can bring greater understanding of components of such a technical package.

ACKNOWLEDGEMENTS

We are grateful to Drs. Belum V.S. Reddy, Jagdish Kumar, C. Johansen, F.M. Khalifa, D.L. Oswalt, J.M. Peacock, Laxman Singh and P. Soman and others for their suggestions to improve this manuscript.

Thanks are also due to training officers, and Messers. Chenchayya, I.N. Rao, T.H. Rao, and K. Prabhakar for helping to make the visuals.