There is a tendency to explain this inconsistency by differing climatic and environmental factors. The above results indicate the need for good crop nutrition and management when applying herbicides and could explain some of the breakdowns of good herbicide treatments when subjected to wider usage.

THE IMPORTANCE OF GENOTYPE X ENVIRONMENT INTERACTIONS

J.G. Paterson
Department of Agriculture, Western Australia

Experimental error associated with the interaction between environmental factors and particular genotypes is well recognized. This interaction can influence the results of field trials designed to evaluate herbicide effectiveness.

VARIABLE RESULTS

The technique of applying a range of herbicides at various rates to a weed species in a particular situation (crop, pasture, etc.) at a number of widely spaced sites has been used and accepted for years. In some cases variable results have been obtained, both between and within sites. These have been apparently unexplainable and have usually been attributed to chance. The problem has been compounded by the lack of site replication associated with factorial analyses. One important contributor is the variation between genotypes, inherent in any plant population. This is generally more localized in an outbreeding species and could account for the poor results associated with some herbicides; the range of genotypes present in a single trial site can be greater than the activity range of the herbicide under test. Widening the spectrum of a specific herbicide would necessarily reduce its crop tolerance.

LIFE CYCLE STUDIES

In order to evaluate the extent of within-species variation, life cycle studies are required. These should be conducted on material taken from a full range of environments. Outbreeding species require a more highly localized sampling intensity while selfed types should be extensively sampled. The accessions collected can be simply tested for response to

vernalization (low temperature) and photoperiod, two important environmental life cycle determinants. These attributes can be readily correlated with habitat and morphological characteristics.

IMPLICATIONS

The general morphology of an annual species changes at floral initiation. This can occur from a few days to a few months after emergence. Further, examination of a range of genotypes of the one species has shown that habit, leafiness, leaf surface characteristics, root-top ratios, chemical composition and hormonal balance are genetically controlled and vary from time to time. For this reason narrow-spectrum herbicides are unlikely to be totally effective on a paddock-scale infestation of even a single species. The position is complicated by the influence of the environment, which can affect the duration of the life cycle and of the internal plant processes involved in it.

Thus, apparently unexplainable poor results may, at least in theory, be attributable to the range of genotypes of the one species occurring either in a single paddock or over a relatively large area.

STATISTICAL TECHNIQUES

Although univariate factorial analysis cannot be used to evaluate inter-site variation, multivariate analysis can, and should, be used for this purpose. Suitable computer techniques are now widely available.

CONCLUSIONS

The occurrence of a range of genotypes within and between experimental sites, each affected by the environmental conditions at these sites, indicates the need for the simultaneous use of a range of herbicides. Specifically formulated mixtures could cover gaps in the activity range of each individual herbicide. The development of suitable mixtures would be assisted by evaluation of the genotypic range and of the influence of the environment on it.