

## CONFERENCE ON PLANT BREEDING

THE eighth Plant Breeders' Conference was held at the Welsh Plant Breeding Station, Aberystwyth, on July 2 and 3. Participants included representatives of nine research stations in the United Kingdom together with representatives of universities and other institutions at home and abroad.

Members of the Welsh Plant Breeding Station and also Mr. J. L. Fyfe of the Plant Breeding Institute, Cambridge, opened discussions on problems relating to the breeding and assessment of grasses, clovers, cereals and field beans.

Mr. Elfed J. Lewis described an experiment designed to assess, by means of a diallel cross, the potential breeding value of plants selected from an outbreeding species (perennial rye-grass). The data were analysed to determine the usefulness of the diallel technique as a rapid means of obtaining the information required.

It was found that increase in hay and aftermath production showed high average dominance, uncomplicated by non-allelic interaction, indicating that there was no specific combining ability among the plants involved. This implies that improvement could be achieved by the accumulation of favourable dominant alleles, and this is borne out by the fact that the plants from the improved strains show a relatively higher degree of homozygosity for the dominant genes giving favourable expression.

During the discussion it was emphasized that the high degree of homozygosity shown in plants from certain of the bred strains did not necessarily mean that these plants were homozygous for all genes, but rather for those genes by which the plants involved differed, and that the information derived was heavily weighted with regard to the degree of dominance exhibited.

The genetics of production characters in rye-grass were dealt with by Dr. J. P. Cooper, who stressed the importance of three parameters: the amount of genetic variation available, its accuracy of measurement and its heritability. Estimates of these parameters had been obtained for several agronomic characters in local and bred strains of rye-grass.

Heading behaviour had been subjected to the most detailed study; the data for replicated clones showed little variation between blocks within one year, and high repeatability between years. Heritability was also high and most of the genetic variation is additive, but all plants were heterozygous for genes controlling date of heading, and a small group of plants of similar phenotype could carry much potential genetic variation.

Pilot studies indicate that length of leaf and rate of leaf appearance were highly heritable, but this was less marked for the rate of tillering. Italian rye-grass and both Irish and S23 perennial rye-grass contain appreciable additive genetic variation for these components, and response to selection should thus be possible. Most plants are highly heterozygous for genes controlling these vegetative characters.

Dr. Keith Jones dealt with the cytological basis for interspecific hybridization in cocksfoot breeding. A classification has been made of a wide range of

material into diploids ( $2n = 14$ ) and tetraploids ( $2n = 28$ ) and the extent of aneuploidy was determined. No appreciable chromosomal differentiation was found between diploids and tetraploids or between different tetraploids. It now seems quite possible to combine genes from diploids and tetraploids, for when triploids were crossed with either diploids or tetraploids the most common progeny types had the same chromosome number as the male parent, and chromosome pairing in them was complete and stable.

Dr. M. Borrill showed that the diploid subspecies had a restricted geographical distribution and that they intercrossed freely and produced fertile hybrids. Similarly the geographical races of tetraploids had produced fertile hybrids. As the extensive genic differentiation had not reduced hybrid fertility, any potentially useful genetic type could be utilized by the breeder; for example, a diploid from Portugal and some Mediterranean races which have winter green growth and desirable foliar characteristics.

Mr. W. Ellis Davies read a paper on the number of plants required as the basis of a strain of red clover. Sixteen experimental strains had been produced from a population of Montgomery red clover; they were based on 3, 6 or 12 plants taken at random, with a control based on 200 plants. The control strain gave a similar yield from the second to the fifth generation; the other strains showed an average decrease in yield of green matter, but this was due largely to the strains based on three plants. One of the latter strains yielded 50 per cent above control in the second generation but it showed a rapid decrease thereafter. When the number of plants in the base of the strain is increased the mean yield approximates the control. On the other hand, evidence was produced showing that improvement could be effected by restricting the base to a limited number of superior plants.

Mr. J. L. Fyfe spoke on the evaluation of inbred lines of lucerne; his data on single crosses between second inbreds showed that reciprocal differences were negligible and that contributions made by specific combining ability are usually not statistically significant; inferior lines could be eliminated by tests of general combining ability. A linear relation appears to exist between yield and inbreeding coefficient, which should be considered in comparing single-cross or test-cross with double-cross performance.

The use of polyploidy and species hybridization in the breeding of forage legumes was discussed by Dr. Alice M. Evans. Her results showed that induced polyploidy in *Trifolium pratense*, *T. repens* and *Medicago sativa* could produce higher yields and that reduced fertility could largely be restored by continued selection. By using some of the newer techniques, a few species of *Trifolium* were found capable of inter-hybridization and thus the introduction of new genes into these species had become possible.

Mr. Ll. Iorwerth Jones presented data to show that the height of cutting when sampling herbage plants with different habits of growth affected the assess-

ment of their yield and that the management practised affected the subsequent production of the swards based on different strains of a species. It was impossible to obtain one assessment figure to express the value of a strain relative to another when tested under different conditions; trials involving grazing had given different results from those based on cutting.

An outline of the problems of introducing new variability into cultivated oats through  $6 \times$  amphidiploids and the induction of mutations was given by Dr. D. J. Griffiths. With the view of introducing genetic factors such as disease resistance into cultivated hexaploid varieties, experimental  $6 \times$  amphidiploids had been produced through crossing tetraploid with diploid species followed by colchicine treatment. Representative plants from  $A_2$  and  $A_3$  generations of  $6 \times$  amphidiploids developed from *A. barbata*  $\times$  *A. strigosa* subsp. *hirtula* had been crossed with natural hexaploid species as well as with other amphidiploids. The data produced on disease reactions, fertility and morphological characteristics of the  $F_1$  generations were discussed in relation to practical breeding.

In his paper on problems of selecting for yield in oats Mr. J. D. Hayes indicated that improvements had been achieved by concentrating on major factors limiting yields such as straw length and disease reaction. Further improvement must, however, be based on increase in yield of grain, and tests capable of detecting differences of 10 per cent or less are required. A large number of replications were required at present to achieve this precision, but the error variance could be reduced in various ways. Some problems associated with early generation testing were raised; it was suggested that the area of land used for this test should be greatly increased.

Dr. D. G. Rowlands had found that *Vicia faba* showed cytological irregularities of a type normally associated with the inbreeding of a naturally outbreeding species; this was confirmed by controlled pollination experiments. The existence of both cross- and self-sterility has been found; inbreeding resulted in reduced pod and seed formation as well as in many sterile plants, but occasional plants produced pods and seeds satisfactorily. Although hybrid populations had shown consistent superiority over inbreds, long-term improvement of field beans must be sought through the development of self-

fertile lines; in the meantime improvement in yield may be possible by producing synthetic varieties.

Informal discussions were continued during the afternoons at demonstrations of the work of the Station in the breeding grounds, greenhouses and laboratories of the new headquarters, Gogerddan, near Aberystwyth.

*Lolium multiflorum*  $\times$  *Festuca arundinacea* derivatives in which fertility had been restored by doubling the chromosome number were demonstrated. Several potential strains of grasses bred for the colder months when grass is normally scarce were shown as well as the wide range of diploid and tetraploid ecotypes of *Dactylis*. The work in cytology included investigations of inter- and intra-specific relationships of grasses and cytological surveys of field populations. The laboratory techniques for uncovering genetic variation in *Lolium* and *Phleum* under controlled photoperiod and temperature were illustrated and also the application of this rapid technique for strain identification. The herbage legume breeding programme included the production of higher-yielding, late-flowering red clover, larger-leaved and more persistent types of white clover and lucerne for high rainfall areas. Studies on the inheritance of flower colour in lucerne and lucerne selections for tolerance to manganese deficiency were demonstrated.

In the work on oats, emphasis was laid on improvement of yields for different levels of fertility, resistance to stem eelworm and mildew and the use of irradiation for improvement of winter varieties. The value of diallel crossing for barley and wheat breeding was under investigation. Improvement in yields and early ripening was sought in field beans. In the rape crop the chief aims were improvement in frost resistance and leafiness; the effect of hybridization on plant vigour was shown.

Studies of agronomic techniques for the assessment of herbage strains were seen and also agronomic studies of potential strains of grasses. The effects of management of grasses grown in wide drills and as clones on the subsequent seed crops were under investigation and also the effect of density on grass seed yields. Gibberellic acid was used in seed-production studies of late-flowering red clover. Routine laboratory determinations of fibre and nitrogen contents are made for the breeders and agronomists and investigations of soil nutrients are in progress.

GWILYM EVANS

## THE MACAULAY INSTITUTE FOR SOIL RESEARCH

THE main body of the annual report (1956-57) of the Macaulay Institute for Soil Research, Aberdeen (pp. 66; from the Institute at Craigiebuckler, Aberdeen; 1958), is devoted to the work of the Pedology Department. The soil survey of the country around Banff, Huntly and Turriff, Jedburgh and Morebattle, and Kilmarnock has been completed. The typical horizons of the seven major soil groups so far encountered are listed. (Full details will be found in the three appropriate memoirs published by the Soil Survey of Scotland.) Other sections of the Pedology Department contribute to the ecology of peat pollen analysis and Quaternary research, bog cultivation and reclamation, studies on Scottish soils, problems of phosphate fixation, rock weathering, the

application of differential thermal analysis to clay mineralogy, etc.

The Department of Spectrochemistry has done collaborative work on trace elements in addition to the investigation of spectrochemical methods of analysis concerning flame, arc, spark and pulsed arc emission. Differences in the infra-red absorption spectra of di- and tri-octahedral clay minerals as well as smaller differences between individual minerals in each group have been observed. Infra-red spectroscopy has also been applied to the identification of organic compounds in microbial metabolism. Modification of absorption spectra are described due to the presence of bases in alcohols and sodium ions in potassium bromide in ultra-violet and infra-red spectrometry.