SY-3

Summary:

Genetic improvement of resistance to diseases may become one of the basic approaches to disease control and enhanced general fitness in domestic animals. Therefore, methods should be developed which allow the estimation of an animal's breeding value with regard to resistance to diseases. This symposium discusses the problem under four main aspects.

1. Genetic variation of disease frequencies in dairy cattle.
2. Histocompatibility antigens as markers of disease resistance.
3. Genetic resistance against diseases not based on the immune response.
4. Genetic resistance against diseases based on the immune responses.

1. Genetic vatiation of disease frequencies in dairy cattle.

The most important disease in high yielding dairy cattle is mastitis. California mastitis test, cell counts and frequencies of clinical mastitis are used to record mastitis in dairy populations or progeny groups. The major limitation on the investigation of genetic differences in mastitis susceptibility is the difficulty to receive suitable data. Up to now, only the Scandinavian countries (Sweden, Norway) have established a disease recording system on a regional or national basis (Lindhé). The recording system includes in addition to mastitis further diseases such as parturient paresis, ketosis and the culling rate. The results show a great variation in breeding values between sires. The main problem in the models used to calculate breeding values is the adjustment for systematic environmental effects. The influences of systematic environmental effects are as to be expected enhanced under severe environmental conditions as the paper of AL-Dabakh et.al. shows. **Makarechian and Berg investigated genetic effects on the incidence of calf scours in beef cattle, but have not found any significant differences between breeding groups.**

The results in the papers and in literature prove that significant differences exist in susceptibility to diseases between breeds and between progeny groups. Heritability estimates vary widely and the difficulties in estimation of reliable breeding values for disease characters under practical conditions are not yet solved.

2. Histocompatibility antigens as markers of disease resistance.

Studies on experimental animals, mainly the mouse, have established that graft rejection is determined by genetically controlled antigenic differences. The relevant antigens are called histocompatibility antigens. In domestic animals, the genetic basis of the histocompatibility system has not been examined as widely as in mice and in humans. The genetic determination of histocompatibility antigens in horses, cattle, pigs, goats, dogs and chicken has only been partly established.

Associations between histocompatibility antigens and susceptibility against diseases were first found in humans, in mice and in chicken. It is to be expected that such associations exist in all domestic species. Four papers are dealing with disease resistance in connection with the distribution of histocompatibility antigens. Gavora et.al. report on the discovery of new haplotypes of the major histocompatibility complex in chicken and the association of those antigens to marek's disease. Lie et.al. and Solbu et.al. found genetic associations between the bovine major histocompatibility complex (BOLA) and mastitis in the Norwegian dairy population. If these results are confirmed in other populations the possibilities of selection for resistance to mastitis will be increased enormously. Bortollozi and Hines assume associations between histocompatibility antigens and the bovine leukosis virus in Jersey cattle in Brazil. For the following diseases associations to histocompatibility antigens are reported in literature: Tick born diseases in cattle (Australia), laminitis and heaves in horses, moist summer eczema in Island ponies.

It is to be expected, that the associations found between histocompatibility antigens and disease resistance will increase the possibilities for breeding on disease resistance considerably.

3. Genetic resistance against diseases not based on the immune response.

Two papers are dealing with genetic resistance to scours caused by Escherichia coli and one paper with susceptibility to bloat. In both cases, resistance or susceptibility is inherited as a simple Mendelian character.

In the first week of life, most scours in piglets are caused by Escherichia coli. But only a few of the great number of E coli strains cause problems. One important virulence factor of enteropathogenic E coli is the ability of the bacteria to adhere to the epethelial cells in the small intestine. The most important adherence factor is the receptor for the bacterial antigen K 88. This receptor is determined by a single locus with two alleles with adhesion being dominant over no adhesion. Walters and Sellwood prove that piglets which are unprotected against infection with K 88 E coli can be removed by the use of homozygous recessive boars for one generation of breeding. Edfors-Lilja et.al. found that the K 88 receptor is unfavourable during piglet period, but an advantage during the fattening period of slaughter pigs. This interesting result indicates a genetic antagonism between susceptibility of piglets to scours and the fattening performance of pigs.

Bloat is a metabolic disorder in ruminants caused by the retention of gas in the stomach. Salivary proteins may be involved in bloat susceptibility. McIntosh and Cockrem discuss the importance of these proteins in determining an animal's phenotype and support the hypothesis that bloat susceptibility may have a simple genetic basis. They found four proteins which have some relationship with bloat and the ratio between 3 proteins gave a good indication of an animal's bloat status.

The papers in this section are good examples for resistance factors which are inherited as simple Mendelian characters. The results are encouraging and might be applied in future selection programmes.

4. Genetic resistance against diseases based on the immune response.

Selection for general as well as for specific disease resistance has been studied intensively in experimental animals, mainly in mice. Selection experiments with domestic animals are expensive and therefore rare.
The selection experiments demonstrate that immunity is genetically regulated. Selection can modify antibody response without changing cell mediated immunity and reverse. The independent and polygenic regulation of the immune response can be considered as an optimal defence mechanism maintained during natural selection.

Lie et.al. and Buschmann discuss several immunological traits as indicators of resistance to infectious diseases in cattle and in pigs. Lie et.al. find that the genetic influence in the Norwegian cattle population is stronger and/or that the inheritance is more simple for natural or non-specific immune mechanisms (lysozyme and complement) than is the case with specific ones (immune responsiveness). Buschmann suggests on the basis of the results of selection experiments in pigs an immunocompetence profile for pigs which might become the basis for the construction of a selection index in the remote future.

Summarizing the existing knowledge about the genetics of the immune response, it has to be concluded that selection for better resistance against diseases by using immune response characteristics cannot be performed on a single item. A selection index in which macrophage activity and humoral and cell mediated immunity are taken into consideration might in the future lead to an increase of general resistance.