# GENOTYPE, PATHOGEN AND ENVIRONMENT INTERACTIONS INVOLVING STAGE OF PLANT DEVELOPMENT (MATURITY) AND TOLERANT REACTION TO COMMON BLIGHT BACTERIA IN GREAT NORTHERN DRY BEANS

D. P. Coyne and M. L. Schuster
University of Nebraska, Lincoln, Nebraska, U.S.A.

An important objective in the genetic improvement of beans at the University of Nebraska is the development of early-maturing Great Northern dry beans tolerant to Xanthomonas phaseoli bacteria which causes the common blight disease. Several cultivars and PI lines were observed in Phaseolus vulgaris and P. coccineus species to have high tolerance to this bacterium. However this trait was always associated with late maturity in these populations. Genetic studies showed that the reaction to the common blight bacterium was quantitatively inherited and heritability estimated by parent offspring regression under field conditions was low. Late flowering was due to a response of the plant to long days and high temperature and was under qualitative genetic control. Pedigree selection for tolerance and time of maturity was adopted in the breeding program. No early maturing and high common blight-tolerant lines were obtained. Two new G.N. varieties, 'Tara' and 'Jules', were developed which combined moderately late maturity and moderate common blight tolerance. The reason underlying this correlated response of later maturity and high blight tolerance was not known. It was thought that perhaps the genes controlling earliness have some physiological effect on the plant which is involved in the susceptible reaction, or that linkage was involved between genes controlling earliness and common blight susceptibility. The hypothesis was also proposed that a part of the high tolerance of the late maturing lines was due to the fact that the plants remain in the vegetative stage until later in the season so that the more susceptible stage of plant growth (pod development) develops under a lower temperature regime which is less favorable for bacterial multiplication. It was previously observed in the field that the vegetative stage of the growth of bean plants in general is more tolerant to this bacterium than the mature plant stage (pod development). In order to obtain an understanding of the situation, an early flowering near-isogenic line - - the late flowering common blight-tolerant G.N. Nebraska #1, Sel. 27 was used as a recurrent parent in six backcrosses. The genes controlling the early flowering response were transferred from the common blight-susceptible G.N. 1140. The late flowering G.N. Nebraska #1, Sel. 27, early flowering near-isogenic, G.N. 1140 and other lines were grown in the field at two locations in 1971 and inoculated with bacteria. The early flowering G.N. 1140 developed severe blight symptoms. The early flowering near-isogenic, G.N. Nebraska #1, Sel. 27 approached G.N. 1140 in time of flowering and maturity and had the same common blight tolerance as the late flowering G.N. Nebraska #1, Sel. 27 until close to pod maturity when it developed a disease rating of about 1.5 to 2. The tolerance of this early flowering near-isogenic line was similar to the blight tolerant, later maturing varieties, G.N. 'Tara' and G.N. 'Jules'. This line will be evaluated in variety trials again in 1972 and if equal in yield to the standard varieties will

be increased and considered for release. It is suggested that the reason for the increased tolerance of the early near-isogenic line is the recovery of nearly all of the genes for the tolerant reaction in the recurrent parent so that the plants can then withstand the increased selection pressure imposed by the bacteria when growing under more favorable, higher temperature conditions in the early part of August. However, since the tolerance of the near-isogenic early line was not equal to the late line at all times of examination (stages of growth different), it would appear that there is at least some degree of relationship between earliness and a lower degree of tolerance and this may be due to the occurrence of a less tolerant stage of plant development at a time of high temperature favorable for bacterial multiplication. These relationships will be studied further in growth chambers. The failure to originally extract early maturing, high tolerant lines from the large $F_2$ G.N. 1140 x G.N. Nebraska #1, Sel. 27 population was due to the low heritability of the reaction and the low frequency of genes for the tolerant reaction in selected segregates which did not give a high enough level of tolerance during a period of pod development (more susceptible stage) when the temperature was very favorable for the pathogen.

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## COMBINING HIGH TOLERANCE TO COMMON BLIGHT AND BACTERIAL WILT DISEASES AND EARLINESS IN GREAT NORTHERN DRY BEANS

D. P. Coyne and M. L. Schuster
University of Nebraska, Lincoln, Nebraska, U.S.A.

High tolerance to the bacteria causing wilt and common blight diseases was found in the very late maturing Phaseolus vulgaris Great Northern Nebraska #1, Sel. 27 and PI 165078 (Turkey), respectively. Both lines are not adapted to western Nebraska because of late maturity. It was found that the reaction to the common blight bacteria was under quantitative genetic control while the reaction to the wilt bacterium was mainly under qualitative genetic control. These two late maturing parents were crossed to explore the possibility of transgressive segregation for earliness and if detected to recombine tolerance to both bacterial species and earliness in a bean of G.N. type. Transgressive segregation for earliness was observed in the $F_2$ and some of these segregates showed high tolerance to the wilt bacteria. Previously, we had found that earliness (number of days to flowering under long days and high temperature) was under control of relatively few genes. The problem of recombining a high level of tolerance to blight and earliness was discussed in an earlier research note in the report. G.N. Nebraska #1, Sel. 27 was then used as a recurrent parent in the backcross program and early-maturing wilt-tolerant segregates were selected for crossing in each backcross generation. It was possible to transfer a high level of wilt tolerance and earliness through six backcross generations. Two wilt-tolerant early maturing lines derived from a sixth backcross