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**QUANTITATIVE INHERITANCE OF RESISTANCE
TO STRIPE RUST (*Puccinia striiformis* West.)
IN WHEAT (*Triticum aestivum* L.)**

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*In the name of Almighty God,
the most Compassionate, the most merciful,*

*Praise be to God, Lord, Master, Cherisher and Sustainer
of the universe*

ABSTRACT

Fifteen wheat (*Triticum aestivum* L.) cultivars, of widely varying resistance to stripe rust, were tested by measuring infection type, latent period, pustule size and pustule density in the glasshouses to study the inheritance of resistance to three pathotypes of stripe rust (*Puccinia striiformis* West.). Large differences were demonstrated between cultivars by using ANOVA and MANOVA. There were highly significant positive genotypic and phenotypic correlations amongst infection type, pustule size and pustule density whereas there were highly significant negative correlations amongst latent period with other components. Pathotype 232E137A- was more aggressive than the other pathotypes on these cultivars. Heritability was moderately high for infection type and latent period in comparison with pustule size and pustule density.

Genetic studies were made of seedling resistant to two pathotypes of stripe rust by means of a diallel cross among five seedling resistant cultivars and one susceptible. Parents and F_1 progenies were assessed for the four characters previously mentioned. Hayman's and Griffing's diallels demonstrated that the additive component of variation was the major component although dominance was important, in which case it was usually partial dominance. High heritability was observed for all characters showing the effectiveness of the breeding programme. By using W_r/V_r graphical analysis, it was observed that Tiritea which is susceptible to both pathotypes had reversal gene action. Reversal gene action was also observed amongst seedling resistant cultivars. In general, if a cultivar was susceptible to a pathotype it would show recessive gene action, and if it was resistant it would show dominance.

To study the interaction of seedling resistant gene(s) with adult plant resistant gene(s), four adult plant resistant with five seedling resistant cultivars were intercrossed in a factorial mating fashion. Parents and F_1 progenies were tested by two pathotypes of stripe rust in the glasshouse, measuring the four characters mentioned before. Estimates of genetic components of variance indicated that the major genetic effect controlling all characters was additive, and that the additive component resulting from seedling resistant cultivars was by far greater than that

which resulting from adult plant resistant cultivars. This suggests that even in crosses of seedling resistant cultivars transgressive segregation will be observed. In general, those genes in adult plant resistant cultivars were masked by those in seedling resistant cultivars.

Four adult plant resistant cultivars and one susceptible were intercrossed in a diallel fashion. Parents and F_1 progenies were tested with three pathotypes in the glasshouse, measuring the four previous characters. Griffing's and Hayman's analyses indicated that general combining ability explained a high proportion of the variability of most of the characters. This was substantiated by high narrow sense heritability estimates. Specific combining ability was small but significant, suggesting that dominance and nonallelic interaction played a minor role. In general, partial dominance was observed for most characters but in response to pathotype 232E137A-, full dominance and overdominance also were observed. The number of genes could be changed for any one character by changing the pathotype. The W/V_r graphic analysis of Hayman indicated that Tiritea which is susceptible to all pathotypes had reversal dominance. Reversal gene action were also observed in adult plant resistance cultivars but Briscard had constant recessiveness for most of characters against all pathotypes.

All possible crosses, except reciprocal, were made among four adult plant resistant cultivars and one susceptible to study in more detail the inheritance of infection type and latent period in the glasshouse by using generation mean analysis. This involves parents, F_1 , F_2 , and backcross populations. Testing was at the seedling stage, using the common pathotype (106E139A-) in New Zealand. All crosses showed transgressive segregation in both resistance and susceptibility. These results indicate that most of the genes conditioning resistance (low infection type or long latent period) in adult plant resistant cultivars are different from one another. This is collaborated by the number of genes conditioning both characters, which were also different. Over ten crosses, the broadsense and narrow sense heritabilities averaged 0.76 and 0.61, respectively for infection type. These were greater than the heritabilities for latent period. For both characters, simple additive-dominance model was not sufficient and epistatic gene action for resistance was significant for all crosses. This suggested the action of more than one gene. Additive and additive x

additive gene action were important for both characters.

Inheritance of stripe rust severity was studied in the field, by means of diallel and generation mean analysis of all possible crosses among four adult plant resistant cultivars and one susceptible. The diallel showed that the additive component of variation again was the major gene action. This was confirmed by a high narrow sense heritability. In the adult stage, resistant cultivars showed dominance which was partial for resistance. Results of generation means analysis confirmed the diallel results. Over all ten crosses, significant epistatic gene effects were present, suggesting polygenic inheritance. Transgressive segregation was observed, indicating different genes amongst the parents were controlling the resistance. The average broad sense and narrow sense heritabilities were 0.73 and 0.51, respectively. Genes conditioning rust severity in adult plant resistant cultivars showed more frequent (partial) dominance in the adult stage than in the seedling stage. Also the numbers of genes in the adult stage were greater than in the seedling stage.

Knowledge of the type of gene action involved in the expression of a character is helpful in deciding on the breeding procedures to be used for improvement of the character. The study showed that selection among F_2 plants of almost all crosses should be effective for higher levels of resistance than the parents and would be useful sources of resistance in breeding programme.

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