QUANTITATIVE INHERITANCE STUDIES OF GRAIN MATURATION AND GERMINATION IN THREE WHEAT CROSSES.

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ABSTRACT

The pattern of grain maturation and germinability was studied in three wheat crosses ripening in warm and cool environments. Two white grained and two red grained wheat cultivars with varying resistance to preharvest sprouting were used as parents in three crosses. The white grained wheats were Tordo, "resistant" to sprouting through gibberellin insensitivity,and Gabo, a standard cultivar susceptible to sprouting. The two red grained wheats were Karamu and Sonora 64A, the former being sprouting resistant while the latter was susceptible. Tordo was the common parent in all three crosses. Six generations, P_1, P_2, F_2, F_3, $BC_1(P_1)S_1$ and $BC_1(P_2)S1$ from each cross were grown in a glasshouse and were transferred into controlled climate rooms at booting stage, being arranged in a randomized complete block experiment with three replications. The patterns of grain development were measured from serial samples of the grains from ears which had been tagged at anthesis. The changes in grain dry weight, moisture content, germination and α-amylase activities were measured at intervals from just after anthesis until maturity; and the patterns were described using regression analysis against age of grain (in days after anthesis). The functions of best fitted were used to estimate nine key stages of grain development, which were : harvest ripeness, amylase maturity, GA amylase maturity, median germination, germination maturity, median embryo maturity, embryo maturity, grain colour maturity and grain weight maturity.

Gene effects were estimated for these variables, and also for maximum grain coat colour, grain weight at harvest ripeness, maximum dry weight, α-amylase activities at harvest ripeness and at embryo maturity, standard germination and potential germination at harvest ripeness. The gene effects were fitted using Hayman's Generation Means Analysis. The full twelve parameter model (digenic epistasis, environment and their interactions included) were used to explain the phenotypic variations among the six genetic populations ripening in the two environments. The gene effects estimated were used to assist in making recommendation for breeding for preharvest sprouting resistance.

The experimental results showed that cool environment prolonged the time to reach most developmental stages compared to the warm environment. Harvest ripeness (12.5 % grain moisture) occurred after grain weight maturity (time to 90 % maximum grain weight) but before the time when the grains reached their maximum dry weight. Embryo maturity, as a measure of ability of the grains to germinate when the dormancy had been bypassed, was considered the important component for germinability. Germinative α-amylase at harvest ripeness was the variable most consistently correlated with germination at harvest ripeness.

The gene actions for the derived variables appeared to be complicated, with epistasis and epistasis x environment effects being significant more often than the additive or dominance effects. The gene actions for the maximum grain colour and percent sterility were also studied. For the maximum colour score the result indicated that there was interallelic interaction between the "classical" gene for grain redness and unknown genes. The breeding strategies for preharvest sprouting resistance were discussed based on the actions of the genes for the characters. Briefly it appeared that producing hybrids would enhance the earliness in many maturity characters which would indirectly resulted in more susceptible genotypes. To improve resistance to preharvest sprouting, selection for characters like low α-amylase activities at harvest ripeness, low standard germination and potential germination at harvest ripeness, or late embryo maturity was recommended. These characters were controlled by many genes which interacted and showed epistasis effect and also the gene effects were dependent on environmental condition. Effectiveness in selection would be specific to a particular environment. The selection for cultivar resistant to preharvest sprouting based on these characters should be deferred until later generations when the plants had reached

high level of homozygosity. The selection for low α-amylase and low germination at harvest ripeness would give more reliable protection against preharvest sprouting damage.

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