THE INFLUENCE OF KERNEL-TYPE AND FERTILIZER ON THE PERFORMANCE OF TRITICALE (X Triticosecale Wittmack)

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ABSTRACT

Three advanced and genetically diverse lines of triticale were used to test the influence of parental seed size and fertilizer response on yield components, yield and quality of kernel. Seed of each line was sub-divided into three size classes, large, small and unsorted, based on test weight and density. The experiment was grown at two locations in the North Central Region of Chile in 1975-76.

Parental seed size did not affect germination rate although plants derived from small seed were generally weaker throughout their developmental cycle. Yield and yield components were positively influenced by parental kernel type in that progeny of the large kernel class possessed a large spike number and kernel number per plant and a higher kernel weight (density) relative to progeny produced from small seeds. Grain yields of plants grown from the small seed class were significantly below those obtained from progeny of the large-seed class. In general, the grain from plants grown from small seeds had a higher protein content than grain grown from subclasses comprised of larger seeds. Small parental seeds also gave rise to plants with relatively poorer post harvest seed development. Plant vigor was positively and significantly associated with

fertilizer application at the stages of tillering and anthesis. However, seedling vigor as well as kernel weights, test weights and post-harvest seed development were maximum at the intermediate rates of fertilizer application. In contrast, yield and yield components, and grain protein content were significantly improved with increasing fertilizer levels.

INTRODUCTION

Triticale (X Triticosecale Wittmack) has the potential to produce high grain yields associated with comparatively high levels of protein content. Thus, it may become an important commercial crop in many countries of the world, especially the less privileged areas where it will provide a source of increased income for the farmers and an improved level of nutrition for the population.

Information on triticale collected in Chile over the past few years corroborates the above statements. Several triticale lines are presently being tested throughout the country, and are favorably competing with wheat in yield, protein content, adaptation, and disease resistance. The main agronomic drawback of the species as a crop for Chile, rests with its tendency to produce shrivelled kernels resulting in low test weight. This limitation is a major reason for rejection of triticale by farmers, and also by the milling and baking industries. For industrial use, well developed plump kernels are required with a test-weight of 72 k/hl or above. The basic cause for seed shrivelling resulting from incomplete endosperm development is still not fully known.

Among the objectives of triticale breeding programs, the improvement of kernel type and test weight has taken a

high priority. To this end, considerable progress has been made within the last few years. If these problems are solved without adversely affecting either agronomic attributes or protein content, triticale may achieve even higher yield levels thus becoming more attractive to farmers and processers. It is also recognized that the specific response of the species to management practices must be defined under a broad range of environmental conditions. By so doing, the most favorable cultural practices that allow the full expression of the crop's genetic potential will be known and recommended to the producer.

Hence, this study was undertaken as a preliminary investigation of the effects of genotype, environment, kernel type, and fertilizer levels on the yield, yield components, protein content and kernel characteristics of triticale.

LITERATURE REVIEW

The occurrence of abnormal, shrivelled kernels found in several triticale lines of otherwise good performance is one of the major problems inherent to the species. As a result of this deficiency, yield potential and industrial quality are limited. In addition, the relatively poorly developed kernels make the crop less attractive to the farmer and miller.

Parodi, et al. (1976) reported that the main deficiency found in triticale germplasm in Chile was low test-weight ranging from 7 to 17% lower than that of wheat. Low test weight resulted in a reduced percentage of flour extraction. Test weight was found to interact with environmental conditions, a feature that was also exhibited by the wheat cultivars used as controls in their experiments.

Efforts to improve test weight have been successful and there has been a clear trend towards obtaining higher test weights in most newly developed triticales. Zillinsky (1974) has indicated that grain development in triticale is more sensitive to environmental condition than the parental species, wheat and rye. The shrivelled grains have usually higher protein content than plump grains. He indicated that the approach used to overcome endosperm shrivelling has included the use of density gradient solutions,

visual selection, mutation induction, selection for high fertility, the use of both air column separation and the gravity table separation. Zillinsky is of the opinion that as a result of the presence of a negative association between dwarfing and plump grain, visual screening has tended to eliminate the dwarf type from breeding populations. Best results have been obtained from visual selection for plumpness in the most fertile populations. As a consequence of these efforts, CIMMYT (1974) reported a significant improvement on the hectolitre weight of their best triticale lines, which increased from 68 k/hl in 1968 to 76 k/hl in 1973.

Effect of seed size and weight on plant development and performance

The effect of seed size and weight on plant development and performance has been studied for a number of crop species by several scientists. The following review of literature will deal mainly with wheat, oats, barley, rye and triticale.

Wheat, oats, rye and barley

McDaniel (1969) reported that heavy barley seeds contained a greater initial quantity of mitochondrial protein than light seeds, and therefore produced seedlings with a greater energy production potential. This was reflected in a faster growth rate. Kneebone and Cremer (1955) evaluated

seed vigor on seedlings from various species grown under greenhouse and field conditions. They found that seed size did not affect germination rate. Large seeds, however, produced more vigorous seedlings with a faster growth rate than that of smaller seeds.

Waldron (1941) found that within spring wheat cultivars, heavy seeds (40.0 mg/kernel) produced plants that out yielded light seeds (26.6 mg/kernel) by 12% when equal numbers of seeds were planted per row, and by 10% with equal weights of seeds per row. Knott and Talukdar (1971) transferred the high seed weight from Triticum aestivum L em Tell cv. "Selkirk" to cv. "Thatcher" spring wheat by backcrossing. On average, the backcross lines with high seed weight outyielded Thatcher. However, their yields varied considerably depending on the degree of compensation of other yield components, specifically seeds per spike and spikes per plot. Weight per seed was positively correlated with number of kernels per plot.

Kikot (1973) attributed a decrease in yield from small seed to a reduction in tillering and 1000-kernel weights. Pinthus (1966) reported that seed size did not influence seedling emergence in wheat, but plants from large seeds produced 24% more grain than plants derived from small seeds. The increase yield was due almost equally to a higher number of spikes per plant and an increased number of kernels per spike. Goydani and Singh (1971) found that wheat plants