and Goodrich coal seams in the upper part of this stratigraphic unit).

Comparison of formation thickness between core holes 22 and 23 (summarized on Figure 5) indicates a pronounced lateral thickness change for all Pennsylvanian stratigraphic units on Walden Ridge South.

Hopefully, additional bore hole and core hole information will be obtained which should enable determination of the three dimensional morphology of these Pennsylvanian stratigraphic units.

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EFFECT OF STAND DENSITIES AND METHODS OF NITROGEN FERTILIZATION ON SOME AGRONOMIC CHARACTERS OF TRITICALE, WHEAT AND RYE

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ABSTRACT

Triticale (*X Triticosecale* Wittmack) is the first man-made hybrid (wheat x rye) and has potential to be a forage as well as grain crop in southeastern United States; but information on cultural practices such as the effect of plant densities and methods of fertilization is lacking. This experiment was conducted to study the effects of four plant densities (Normal stand vs 91, 61, and 31 plants/meter) and two methods (conventional vs foliar) of nitrogen application on plant height, seeds/spike and grain yields in triticale, wheat (*Triticum aestivum* L) and rye (*Secale cereale* L). A significant increase in plant height was recorded in triticale and wheat due to conventional nitrogen fertilization as compared to foliar application. In triticale, decrease in plant density showed a significant decrease in plant height. Results indicated that the number of seeds/spike increased significantly as the plant density decreased. Conventionally applied N gave more seeds/spike than foliar application in all three species. Conventionally fertilized plots produced 20% higher grain yields than that obtained from foliar fertilization. Increase in plant density produced significantly higher grain yield. Wheat produced highest grain yield (156 gm/plot) followed by triticale (144 gm/plot) from 'Normal stand' and 5 cm plant to plant spacings, respectively.

INTRODUCTION

Triticale (*Triticosecale* Wittmack) is a new man-made cereal crop obtained by crossing wheat (*Triticum aestivum* L.) and rye (*Secale cereale* L). Studies in the past have shown that production practices like seeding rates, row spacing and method of nitrogen fertilization do affect the performance of cereal crops (Guitard *et al*, 1961; Middleton *et al*, 1964; Rich, 1973), but similar experiments with triticale are lacking. While studying the effect of row spacing on yield and yield components in cultivars of wheat at three locations in Texas, Peters and Gilmore (1978) found that plant height, spikelets per spike and grain test weight differed significantly due to cultivars, row width and locations. Whereas Zillinsky (1974) in his investigation for soil fertility requirements for triticale found that responses of triticale to fertilizer varied from place to place and depended on the strain and residual nitrogen present in the soil. At present information is lacking regarding the effects of such cultural practices on triticale in general and in comparison to commonly grown wheat and rye of southeastern United States in particular. Therefore, the studies herein reported were initiated to determine the effects of plant densities and methods of nitrogen fertilization on yield and yield components of triticale, wheat and rye.

MATERIALS AND METHODS

Two separate field experiments each consisting of an advanced triticale line (AM 2873), "Arthur" wheat and "Wren's Abruzzi" rye were planted in single row plots of 3m long and 15 cm apart on October 6, 1977 on Decatur silty clay loam soil (*Rhodic Paleudult*) of Alabama A&M University Farm at Huntsville. The field was fertilized with 330 kg/ha of 13-13-13 grade fertilizer during land preparation. Differences in plant densities were obtained by planting three-uniformly gravity graded seeds per hill at 5, 10 and 15 cm apart in a row whereas "Normal plant density" was attained by planting seeds at 80 kg/ha. After seedlings had established, plants were thinned down to one plant/hill except 'Normal plant density' plots. The experiments were planted in a split plot design of five replications with each species as the main plot. In one experiment, $(NH_4)_2NO_3$ was applied conventionally at 60 kg/ha, in early spring of 1978. In another experiment 60 kg of N/ha were applied foliarly in two split (30 kg/ha in early spring and same in mid spring at early boot stage of crop) applications.

In late spring, five plants were tagged at random in each plot to study the plant height and number of seeds/spike, whereas grain yield was harvested from whole one row plots. The data obtained from each trait was statistically analyzed and Duncan's New Multiple Range Test was used to compare the mean effects of plant densities and methods of nitrogen fertilization on triticale, wheat and rye.

RESULTS AND DISCUSSION

The effects of plant density and methods of nitrogen fertilization on plant height, number of seeds/spike and grain yield of triticale, wheat and rye are given in Figure 1, Table 1 and 2, respectively.

For triticale, plant density had significant influence nitrogen. The mean heights under foliar nitrogen fertilization ranged from 78 cm in wheat to 145.7 cm in rye at 15 and 10 cm plant densities, respectively. This vast difference in plant height can be explained due to the genetical makeup of species. In cereals, such results have been reported by Leonard and Martin (1970) on the plant height in both methods of nitrogen fertilization (Fig. 1). Conventional nitrogen fertilization showed higher plant heights than foliar application of and have been further confirmed by Hobbs (1953) in winter wheat. While studying the effects of nitrogen on wheat he concluded that plant height variations are influenced by genetical as well as environmental conditions.

The data in Table 1 indicates that seeds/spike increased significantly as the plant density increased. This could be due to the shorter spike and availability of more nutrient/plant in the rows with less plant density. Conventionally applied nitrogen gave more seeds/spike than foliar application and the highest number of seeds was observed in rye (48.4) followed by 'AM 2873' (45.0) triticale. Wheat showed 26.1 and 23.2 seeds/spike at 5 cm and 'Normal plant densities' in conventional and foliarly applied nitrogen plots, respectively. This agrees with Hobbs (1953) who reported that nitrogen did not have a significant effect on the kernel numbers in winter wheat. He concluded that excess nitrogen could even lead to reduction in kernel numbers.

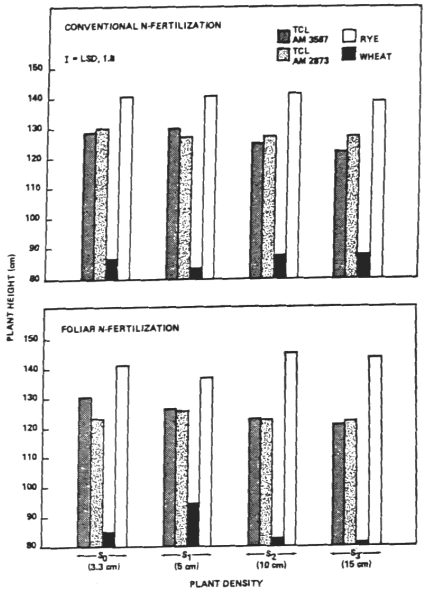

FIG. 1. *Effect of Stand Densities and Method of N-Fertilization on Plant Height in Triticale, Wheat and Rye.*

TABLE 1: *Effect of stand densities and method of N-fertilization on weight of seeds/spike in triticale, wheat and rye.*

Plant Densities	Conventional Fertilization			Foliar Fertilization		
	Triticale 'AM 2873'	Wheat "Arthur"	Rye "Wren's Abruzzi"	Triticale "AM 2873"	Wheat "Arthur"	Rye "Wren's Abruzzi"
	gm			gm		
$S_0 = 91$*	1.9 a**	0.9 b	1.1 cd	1.4 bc	0.9 a	1.3 a
$S_1 = 61$	1.8 ab	0.8 c	1.0 d	1.6 a	1.0 a	0.8 c
$S_2 = 31$	1.8 ab	1.1 a	1.2 bc	1.3 c	0.7 b	1.0 b
$S_3 = 21$	1.7 b	1.1 a	1.4 a	1.5 ab	0.7 b	1.2 a
$\bar{X}$	1.8	1.0	1.2	1.4	0.8	1.1
C.V., %	6.9	12.0	10.0	6.9	12.0	10.0

*S_0 = Normal stand (3.3 cm), S_1 = 5 cm, S_2 = 10 cm, S_3 = 15 cm.
**Means within columns followed by the same letter do not differ significantly at the 5% level as measured by DNMRT.

TABLE 2: *Effect of stand densities and method of N-fertilization on grain yield (GM/plot) in triticale, wheat and rye.*

Plant Densities	Conventional Fertilization			Foliar Fertilization		
	Triticale "AM 2873"	Wheat "Arthur"	Rye "Wren's Abruzzi"	Triticale "AM 2873"	Wheat "Arthur"	Rye "Wren's Abruzzi"
	gm			gm		
$S_o = 91$*	157.8 a**	155.1 a	125.7 a	131.1 a	134.1 a	117.4 a
$S_1 = 61$	139.3 b	64.8 b	104.1 b	98.9 b	74.8 b	103.3 b
$S_2 = 31$	110.3 c	67.2 b	92.8 c	73.2 c	23.8 c	80.1 c
$S_3 = 21$	78.7 d	39.9 c	77.5 d	46.5 d	32.1 d	65.6 d
$\overline{X}$	121.5	81.8	100.0	87.4	66.2	91.6
C.V., %	11.8	14.1	11.5	11.8	14.1	11.5

*S_o = Normal stand (3.3 cm), S_1 = 5 cm, S_2 = 10 cm, S_3 = 15 cm.
**Means within columns followed by the same letter do not differ significantly at the 5% level as measured by DNMRT.

Grain yields of each crop's cultivar were significantly affected by different plant densities (Table 2). The grain yield was higher with increased plant densities. Wheat produced highest grain yield (156 gm/plot) followed by triticale (144 gm/plot) when planted at 'Normal stand' and 5 cm plant to plant spacings, respectively. In general, the decreased yield with decreased plant density in both methods of nitrogen fertilization may probably be due to less number of plants per plot as compared to plots with 'Normal stand.' The results in triticale can be further supported by McMahon (1975) who suggested that triticale yields were little affected by a wide range of spacings and seed densities except in plots severely lodged or which had poor stand. The overall grain obtained from conventionally nitrogen fertilized plots was 20% higher than that obtained from the foliar fertilization. This could be due to better nutrient utilization of vigorously developed roots in conventionally applied nitrogen plots. This agrees with findings of other investigators (Stanford, *et al;* Wright, 1973) who concluded that the yield response to applied nitrogen depends on the amount of nitrogen already present in the soil.

CONCLUSION

Increases in plant height were significant for cultivars of each crop except triticale AM 2873 due to conventional as well as foliar nitrogen fertilization. The overall average plant height was 0.86 cm higher in conventionally applied nitrogen plots.

The number of seeds/spike increased significantly with decrease in plant population in wheat and rye but not in foliarly fertilized 'AM 2873' triticale. Grain yields significantly increased with increase in plant population under both methods of nitrogen fertilization. Mean grain yield obtained from conventionally nitrogen fertilized plots was 20% higher than that from foliarly fertilized plots.

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