STRUCTURE—SOUTHERN CUMBERLAND PLATEAU

In general, the structure of the Southern Cumberland Plateau geomorphic area is that of an asymmetrical syncline with relatively steep dips on the eastern limb and a low dip on the western limb. The northeast-southwest trending synclinal axis is near the eastern erosional edge of the plateau.

STRATIGRAPHIC FRAMEWORK

Figures 3 and 4 are panel diagrams, based on core data, which indicate the subsurface stratigraphic framework of the Pennsylvanian Crab Orchard Mountains Group in a local area on the eastern margin of the Southern Cumberland Plateau. Further, it has been noted that the thickest (most complete) stratigraphic section in this geomorphic area is situated over the synclinal axis. Figures 3 and 4 are located in the vicinity of this axis.

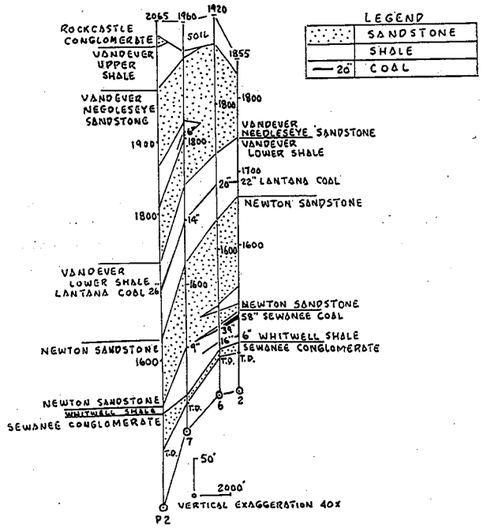

FIG. 3. *Panel diagram showing Pennsylvanian Stratigraphic Framework of Crab Orchard Mountains Group, Bledsoe County, Tennessee.*

In addition, these cores were drilled with the view of determining the thickness of the Sewanee and/or Richland Coal seams in the Whitwell Shale. It is standard drilling practice to penetrate the upper few feet of the Sewanee Conglomerate in order to insure that the entire Whitwell interval has been sampled. The Sewanee Conglomerate is, in general, a silica-cemented sedimentary quartzite and therefore presents drilling problems both with respect to the wearing out of drill bits as well as a significant increase in the time required to drill through this stratigraphic unit.

Rockcastle Conglomerate—uppermost stratigraphic unit in the Crab Orchard Mountains Group and has an erosional upper surface indicated in hole P2 (Fig. 3) and in holes 10 and 11 (Fig. 4).

Vandever Upper Shale—entire thickness is present in hole P2 (Fig. 3) and holes 9, 10, 11 and 12 (Fig. 4) and ranges in thickness from 15 feet in hole 11 to 70 feet in hole P2 which indicates a general thickening of this stratigraphic unit to the south or southeast. No coal was encountered in this unit.

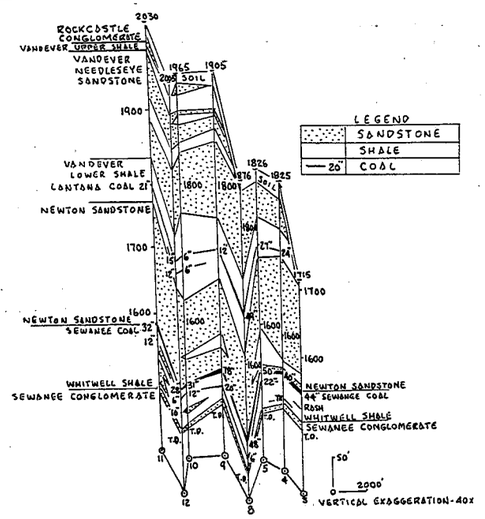

FIG. 4. *Panel diagram showing Pennsylvanian Stratigraphic Framework of Crab Orchard Mountains Group, Bledsoe County, Tennessee.*

Vandever Needleseye Sandstone—complex stratigraphic unit that consists of thin to thick sandstones and lensing shales. Total thickness is in holes 7 and P2 (Fig. 3) and 9, 10, 11 and 12 (Fig. 4). The range in thickness is from 170 feet in hole 10 to over 270 feet in hole P2. Again, this indicates a thickening to the south or southeast.

Vandever Lower Shale—largely a shale unit with persistent Lantana Coal horizon which ranges in thickness from 6 inches in hole 12 to 49 inches in hole 8. Entire thickness is present in holes 2, 6, 7 and P2 (Fig. 3) and 4, 5, 8, 9, 10, 11 and 12 (Fig. 4), and the range in thickness is from just over 40 feet in hole 4 to 130 feet in holes 8 and P2 which indicates a general thickening to the south.

Newton Sandstone—a thick sandstone unit with shale lenses near the base. The shale is thickest (60 feet) in hole 5 (Fig. 4). The complete thickness of this unit is present in all holes and ranges from 100 feet thick in hole P2 to over 200 feet in hole 2. These observations indicate a thinning to the south.

Whitwell Shale—unit thickness is present in all holes. Thickness of the Whitwell ranges from over 100 feet in hole 11 to over 10 feet in hole P2 which suggests a southward thinning. Holes 10 and 11 show sandstone lenses in the Whitwell. There may be as many as four coal horizons in the Whitwell, but the seam of major interest is the Sewanee Coal situated at the top of the Whitwell just below the Newton Sandstone. The thickness of the Sewanee Coal ranges from 9 inches in hole 7 to 78 inches in hole 9.

Sewanee Conglomerate—only the upper few feet of the Sewanee Conglomerate is present in all holes.

CONCLUSIONS

It has been noted that stratigraphic units in the Crab Orchard Mountains Group near the eastern margin of the Southern Cumberland Plateau in Bledsoe County, Tennessee show a relatively large thickness variation (morphologic change) over a small area. Vandever stratigraphic units thicken southward; whereas, the Newton Sandstone and Whitwell Shale thin to the south. The Sewanee Coal Seam occurs in the Whitwell as a locally thick seam which likely formed in a small depositional basin that thinned to the south.

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SUBSURFACE STRATIGRAPHIC FRAMEWORK OF CRAB ORCHARD MOUNTAIN AND GIZZARD GROUPS (PENNSYLVANIAN) ON WALDEN RIDGE (SOUTH) IN BLEDSOE, HAMILTON AND RHEA COUNTIES, WEST OF GRAYSVILLE, TENNESSEE

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ABSTRACT

A number of bore holes in Pennsylvanian rocks on Walden Ridge South west of Graysville, Tennessee, enabled development of a localized, subsurface stratigraphic framework with marked thickness variation of stratigraphic units, as well as, an east-west geologic cross-section indicating the asymmetric synclinal nature of this part of the Cumberland Plateau.

INTRODUCTION

Recently obtained bore hole (air rotary) and core hole data from Walden Ridge South in Bledsoe, Hamilton and Rhea Counties west of Graysville, Tennessee, have enabled establishment of a subsurface stratigraphic framework for the lower Pennsylvanian Crab Orchard Mountain and Gizzard Groups.

STRATIGRAPHY

C. W. Wilson and others (1956) presented the following stratigraphic subdivision of Pennsylvanian rocks in southern Tennessee:

Crab Orchard Mountain		Rockcastle Conglomerate
	Vandever Formation	Upper Shale
		Needleseye Sandstone
		Lower Shale
		Newton Sandstone
		Whitwell Shale
		Sewanee Conglomerate
Gizzard Group		Signal Point Shale
		Warren Point Sandstone
		Raccoon Mountain Formation

STRATIGRAPHIC FRAMEWORK

Figure 1 indicates the geographic location of the Brayton and Graysville quadrangles on Walden Ridge South in Bledsoe, Hamilton and Rhea Counties, Tennessee. Bore hole and core hole locations, indicated on Figure 2, are situated in northwestern Hamilton County.

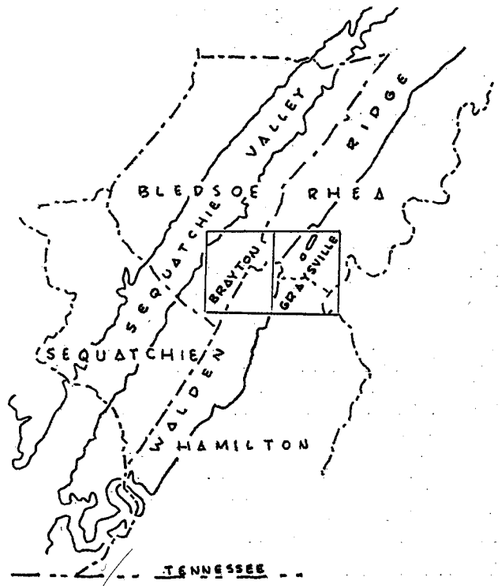

FIG. 1. *Location of Brayton and Graysville Quadrangles on Walden Ridge (South), Tennessee.*

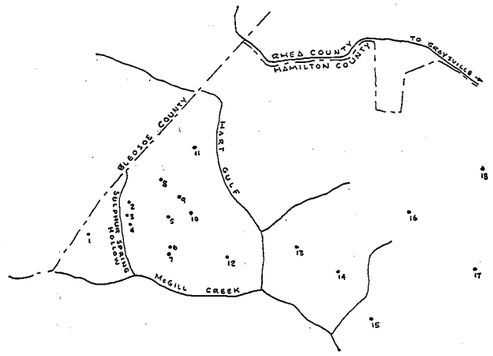

FIG. 2. *Diagram indicating location of bore holes on Walden Ridge South, Northwestern Hamilton County West of Graysville, Tennessee.*

Figure 3 is a panel diagram showing the subsurface distribution of stratigraphic units belonging to the Pennsylvanian Crab Orchard Mountain and Gizzard Groups:

Rockcastle Conglomerate—has an erosional upper surface and is indicated in holes 8, 9 and 14.

Vandever Upper Shale—present in holes 1-15 with entire thickness in holes 8, 9 and 14 where it ranges from 90 feet to 110 feet thick.

Vandever Needleseye Sandstone—entire thickness in holes 1-15. Thickness ranges from 60 feet in holes 1 and 9 to 120 fet in holes 12 and 13. This unit appears to thicken eastward.

Lower Vandever Shale—holes 1-16 contain the entire thickness of this unit which ranges from 110 feet in hole 12 to 190 feet in hole 16. This unit appears to thicken eastward.

Newton Sandstone—present in holes 1-18, with entire thickness in holes 1-16 and erosional upper surface in holes 17 and 18. This unit is thin in holes 8-14 and ranges in thickness from 10 feet in hole 11 to 100 feet in hole 16. This unit appears to thicken eastward.

Whitwell Shale—entire thickness is present in holes 1-18 with the exception of hole 14. This unit appears to thicken eastward and ranges in thickness from 20 feet in hole 16 to 110 feet in holes 15 and 17. The Richland Coal is present in all holes with the exception of hole 14 which was not drilled deep enough to intersect the coal.

Sewanee Conglomerate—present in all holes (1-18) except hole 14. Usual drilling practice is to drill into the upper part of the Sewanee Conglomerate to be sure that the entire Whitwell Shale thickness has been determined. Holes 3, 4 and 6 penetrated the entire thickness of the Sewanee Conglomerate and in these holes it ranges from 60 to 80 feet thick.

Signal Point Shale—entire thickness of 50 feet is present in hole 6.

Warren Point Sandstone—this unit is 120 feet thick in hole 6. A shale layer, approximately 40 feet thick is situated in the middle of the Warren Point.

Raccoon Mountain Formation—approximately 270 feet of this unit is represented in hole 6. Two shale units are present in this formation, the upper shale is 60 feet thick (contains Nelson coal horizon) and the lower is 80 feet thick. A sandstone unit 120 feet thick is present in the Raccoon Mountain Formation. The Raccoon Mountain overlies the Mississippian Pennington Formation in a transitional relationship. The Pennington Formation is distinguished by dark-green siltstone and shale.

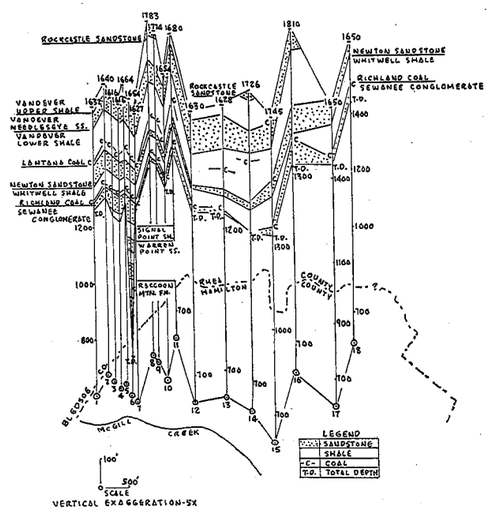

FIG. 3. *Panel diagram indicating subsurface distribution of Pennsylvanian Crab Orchard Mountains Group and Gizzard Group in Northwestern Hamilton County, Tennessee.*

DISCUSSION

Figure 3 shows that stratigraphic units in the Crab Orchard Mountain Group appear to thicken eastward; however, they show what is likely three-dimensional, localized, depositional thickening and thinning, but at least part of the apparent eastward thickening is due to the fact that they are part of the westward-dipping east limb of the asymmetric Walden Ridge syncline. That is to say, drilling has not determined true stratigraphic thickness.

GEOLOGIC CROSS-SECTION OF WALDEN RIDGE SOUTH

Figure 1 shows the location of the Brayton and Graysville quadrangles in Bledsoe, Hamilton and Rhea Counties over Walden Ridge South in southeastern Tennessee.

The location of three bore holes in Pennsylvanian rocks on Walden Ridge (South) in Bledsoe and Rhea Counties, Tennessee, is indicated on Figure 4.

Bore hole 21, which is a composite of 30 blast holes, is located on the western margin of Walden Ridge (South) near Pitts Gap.

Core hole 22 is situated above an abandoned strip mine and is located several hundred yards north of Pikeville Road which leads to Brayton and Pitts Gap.

Core hole 23 is located near Laurel Brook Sanitarium, on top of the Cumberland Plateau, in the northwestern corner of the Graysville quadrangle.

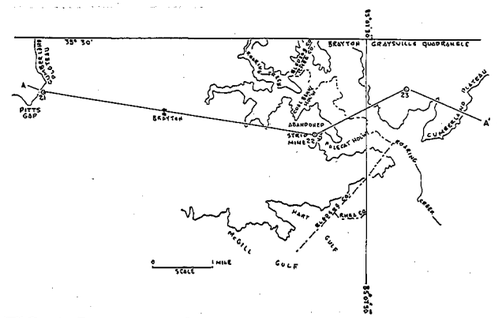

FIG. 4. *Location of bore holes on Brayton and Graysville Quadrangles, Bledsoe and Rhea Counties, Tennessee.*

Data from three bore holes are summarized on Figure 5 which is an east-west geologic cross-section of Walden Ridge South located near Graysville, Tennessee. The line of cross-section is indicated on Figure 4.

The structure of Walden Ridge South is that of an asymmetric syncline with its axis situated near the eastern margin. Further, the Pennsylvanian stratigraphic sequence, ranging from the Rockcastle Conglomerate down through the Raccoon Mountain Formation, is given on Figure 5.

Bore hole 21—is a composite of blast holes situated behind the highwall of a reclaimed strip mine located near Pitts Gap, Tennessee. Stratigraphic units penetrated here include the lower part of the Pennsylvanian Newton Sandstone and the Whitwell Shale which contains mineable thicknesses of both the Sewanee and Richland coal seams.

Core hole 22—This hole penetrated the entire thickness (1025′) of Pennsylvanian rocks from the lower portion of the Rockcastle Conglomerate to the base of the Raccoon Mountain Formation.

Formation thicknesses in this hole are: (1) 51′ of Rockcastle Conglomerate (with what is considered as a stray seam, because it probably is not the Nemo, or the Morgan Springs Seam—it is this stray seam that has been stripped near core hole 22), (2) 104′ of Vandever Upper Shale (the No. 12 coal is located near the top of this stratigraphic unit), (3) 225′ of Vandever Needleseye Sandstone, (4) 125′ of Vandever Lower Shale, (5) 70′ of Newton Sandstone, (6) 40′ of Whitwell Shale (with the Richland coal near the base of this stratigraphic unit), (7) 182′ of Sewanee Conglomerate, (8) 9′ of Signal Point Shale, (9) 133′ of Warren Point Sandstone and (10) 87′ of Raccoon Mountain Formation (with the Nelson and Goodrich coal seams situated in the upper part of this stratigraphic unit).

Core hole 23—This hole penetrated 1178′ of Pennsylvanian rocks extending from the lower part of the Rockcastle Conglomerate through the Raccoon Mountain Formation. Stratigraphic unit thicknesses are: (1) 70′ of Rockcastle Conglomerate, (2) 142′ of Vandever Upper Shale, (3) 62′ of Vandever Needleseye Sandstone, (4) 14′ of Vandever Lower Shale, (5) 220′ of Newton Sandstone, (6) 130′ of Whitwell Shale (with the Richland coal near the base of this stratigraphic unit), (7) 173′ of Sewanee Conglomerate, (8) 151′ of Signal Point Shale (with the No. 7 coal near the top and the No. 6 near the base of this stratigraphic unit), (9) 74′ of Warren Point Sandstone and (10) 140′ of Raccoon Mountain Formation (with the Nelson

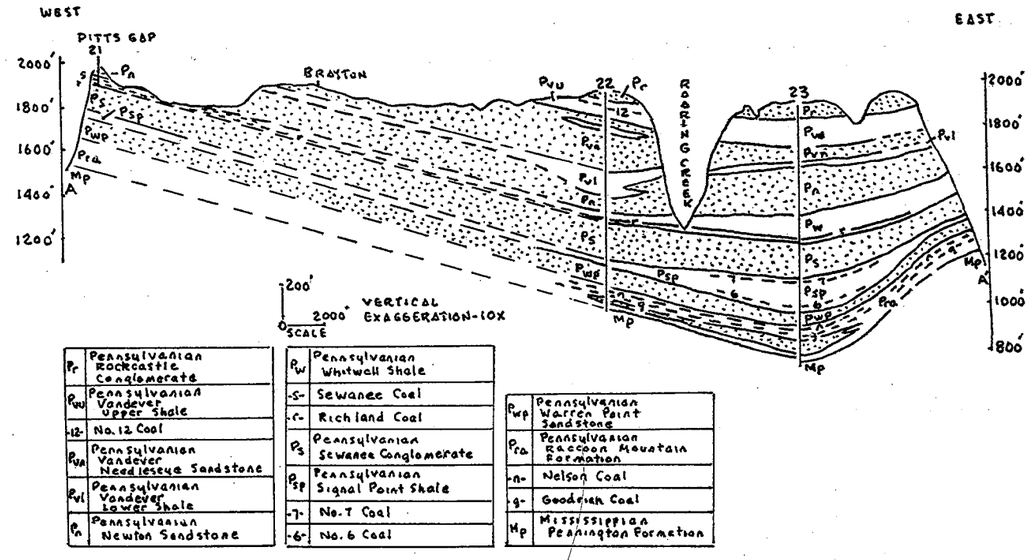

FIG. 5. *East-West geologic cross-section of Walden Ridge (South), Bledsoe and Rhea Counties, Tennessee.*

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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Wilson, C. W., Jr., Jewell, J. W., and Luther, E. T., 1956. Pennsylvanian geology of the cumberland plateau: Tennessee Division Geology Folio, 21 p.

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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.

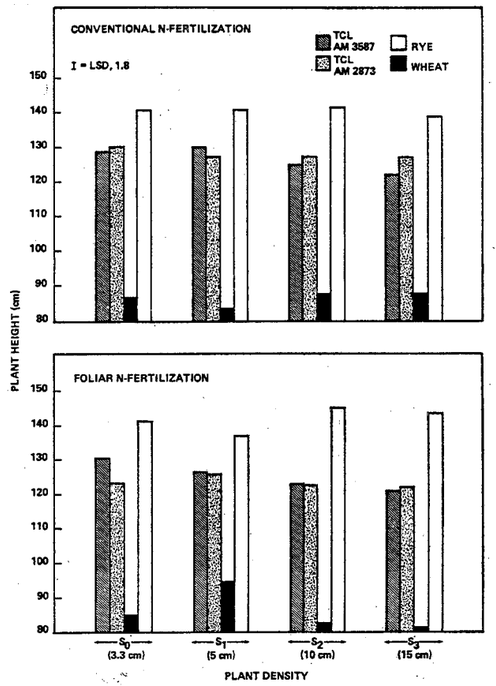

FIG. 1. *Effect of Stand Densities and Method of N-Fertilization on Plant Height in Triticale, Wheat and Rye.*

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		
$S_o = 91$*	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_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.