NDP-009

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CDIC NUMERIC DATA COLLECTION

Growth and Chemical Responses to CO_2 Enrichment—Virginia Pine (*Pinus Virginiana* Mill.)

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NDP-009

GROWTH AND CHEMICAL RESPONSES TO CO_2 ENRICHMENT - VIRGINIA PINE (*Pinus virginiana* Mill.)

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Oak Ridge, Tennessee 37831
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ABSTRACT

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1. NUMERIC DATA PACKAGE NAME

Growth and Chemical Responses to CO_2 Enrichment - Virginia Pine (Pinus virginiana Mill.)

2. CONTRIBUTORS

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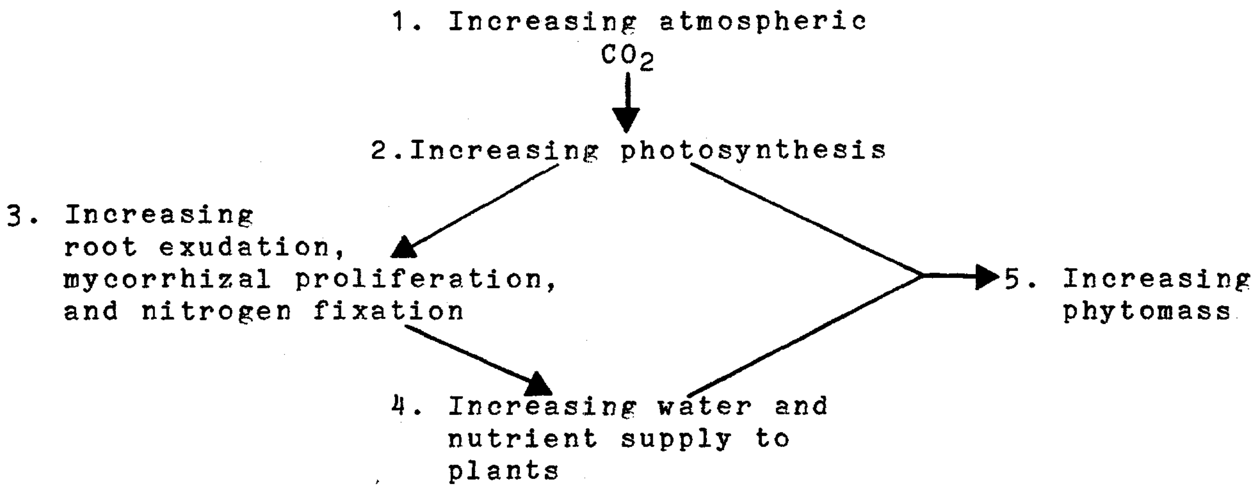
3. BACKGROUND INFORMATION

Global atmospheric CO_2 concentrations have been increasing over the past several decades and are projected to continue increasing for several more decades. Because of the fundamental role of CO_2 in the physiology of all green plants, changes in plant growth and productivity are expected. There is ample experimental evidence illustrating an increase in photosynthesis and growth with increasing CO_2 concentrations. However, much of this evidence is based on short term results and optimal growth and nutrient conditions. Kramer (1981) raised the question of whether plants growing in natural environments, which are probably more often limited by water or nutrient (especially nitrogen) deficiencies than by low CO_2, will respond to rising atmospheric CO_2 concentrations. Enhancement of plant productivity by increasing atmospheric CO_2, in a nutrient-poor environment, will only be realized if nutrient availability also increases (Pearcy and Bjorkman 1983). Rosenberg (1981) suggested that increased nutrient availability and acceleration of soil-forming processes may be a result of CO_2 fertilization through enhanced biological activity. Luxmoore (1981) proposed a mechanism whereby current nutrient and water limitations on growth might be alleviated under elevated atmospheric CO_2.

The mechanism proposed was the following:



This package covers one segment of the research performed to determine whether the proposed mechanism occurs with elevated CO_2 concentrations.

4. SOURCE AND SCOPE OF THE DATA

One hundred fifty-six one-year-old bare-rooted Virginia pine (Pinus virginiana Mill.) seedlings were planted singly in 25-cm diameter pots with six kg of air-dried sandy loam top soil (1.5% organic matter, pH=5.9) from an old field. Half of the seedlings were specifically inoculated with the mycosymbiont (Pisolithus tinctorius) and the other half became mycorrhizal with undetermined native fungal species. The seedlings were maintained in the open for 80 days during the spring (8 April - 28 June 1982) after which seventy-two pots were selected for exposure to six atmospheric CO_2 treatments. These pots had uniform seedlings in three size classes (small, medium, large) from each of the two mycosymbiont types.

Exposure of Virginia pine seedlings to CO_2 was conducted at North Carolina State University in collaboration with scientists there. The study utilized the CO_2 monitoring and injection system and cylindrical open-top field chambers (4.3 m wide and 3 m high) at North Carolina State University. Four of the six atmospheric CO_2 treatments were controlled with the CO_2 monitoring and injection system at 75, 150, 300, and 600 ppmv CO_2 above ambient (340 ppmv) in open-top chambers. The two other CO_2 treatments were at ambient levels, one with and one without an open-top chamber. Six pots (3 size classes x 2 mycorrhizal types) were mounted in support racks in each of the six CO_2 treatments, which were replicated twice in the ten open-top chambers and two chamberless positions used for the study.

At the initiation of CO_2 exposure in late June 1982, plant dry weight, height, and stem diameter were measured along with chemical content (N, P, K, Ca, Mg, Mn, Fe, Al, B, Cu, Zn, Sr, Ba) of leaf, stem, and root tissues and chemical content of soil leachate from eight pots. Soil organic matter, soil chemicals (P, K, Ca, Mg, NO_3^-, NH_4^+, soluble salts) and pH were measured on six unleached pots. The CO_2 exposures were maintained for four months (28 June - 29 October 1982), and the pots were watered periodically to bring the soil water content close to a volumetric water content of 0.22 m^3 m^{-3} (field capacity). Prior to harvest the 60 pots were watered up to field capacity and then leached with additional water. The leachate was subsampled for chemical analysis. The same plant and chemical analyses on leachate, plant tissues, and soil were obtained following exposure as those obtained at the initiation of exposure. Chemical analyses were performed by the Soil Testing and Plant Analysis Laboratory at the University of Georgia. The chemical content in the plants at the final harvest was calculated from the tissue dry weights and chemical concentration.

An analysis of variance was conducted for each of 14 chemicals (C, N, P, K, Ca, Mg, B, Al, Fe, Mn, Cu, Zn, Sr, Ba) and the main effect of CO_2 was rarely significant. The data showing the mean chemical content per plant in the elevated CO_2 treatments relative to the mean chemical content per plant in ambient CO_2 did exhibit a clear trend which was then analyzed by covariance using a linear model. Significant increases in the uptake of N, Ca, Al, Fe, Zn, and Sr occurred with CO_2 enrichment. Greater chemical uptake was associated with greater root weight. Chemical use efficiency (ratio of carbon gain per unit chemical) was reduced for Al, Fe, and Zn indicating a greater chemical uptake with elevated CO_2 relative to the increase in carbon. The nutrient use efficiencies for N and Ca were not influenced by atmospheric CO_2 enrichment. Large increases in the uptake of Zn at high CO_2 suggested an increase in rhizosphere acidification which may have resulted from proton release from roots. Potassium, phosphorus, and nitrate concentration in the pot leachate decreased with higher CO_2 levels and a similar trend was found for aluminum and magnesium. Mean plant dry weight increased from 4.4 g to 11.0 g/plant during the four month exposure period. Plant growth and nutrient uptake were not enhanced by the mycorrhizal treatment, and there was no significant open-top chamber effect at 340 ppmv CO_2.

5. APPLICATIONS OF THE DATA

The wide distribution and long life of forest vegetation increases the importance of knowing how these plants might respond to a changing atmosphere. Changes in forest productivity - whether caused by CO_2-induced climate change or direct action of the CO_2 in photosynthesis - could have important implications in forest ecology, forest economics, and forest management. Any changes in nutrient relationships in plants growing on nutrient deficient soils as a result of elevated atmospheric CO_2 levels could provide valuable insights into the potential response of forests to the global increase in atmospheric CO_2. Results obtained from this study suggest that soil-plant systems may exhibit increased nutrient and chemical retention at elevated atmospheric CO_2.

6. RESTRICTIONS AND LIMITATIONS

Open-top chambers have been shown to be very effective for the study of vegetative responses to elevated CO_2 levels. Variability is generally around $\pm$ 50 ppmv at higher CO_2 levels (+600 ppmv) and $\pm$ 30 ppmv at lower CO_2 levels (Rogers 1983). Variabilty within the open-top chambers is greater at night than during the day. One restriction of the results obtained is the lack of other studies for comparison. For example, this study did not show significant mycorrhizal treatment effects at increased CO_2 levels but this does not necessarily mean that the mycorrhizae are not affected by elevated CO_2. Replication and further analyses on other tree species are needed before definitive conclusions can be drawn concerning elevated CO_2 concentrations and plant-nutrient relationships.

7. DESCRIPTION OF DATA PROCESSING ROUTINE

Seven data retrieval routines written in FORTRAN IV for the IBM 3033 are provided along with the output generated from the execution of these retrieval routines.

8. KEYWORDS

CARBON DIOXIDE ENRICHMENT; PINES; MYCORRHIZAE; GROWTH; NUTRIENT-USE EFFICIENCY; LEACHING; ROOTS.

9. CONTENTS OF THE PACKAGE

The package contains the referenced documents (a), and fifteen files of information written in EBCDIC on magnetic tape as card images: tape information, seven retrieval codes, and seven sets of data. Total records: 1129.

a. Included in the package:

Kramer, P. J., "Carbon Dioxide Concentration, Photosynthesis, and Dry Matter Production," BioScience 31:29-33 (1981).

Luxmoore, R. J., "CO_2 and Phytomass," BioScience 31:626 (1981).

Luxmoore, R. J., E. G. O'Neill, J. M. Ells, and H. H. Rogers, "Nutrient-Uptake and Growth Responses of Virginia Pine to Elevated Atmospheric CO_2" J. Environ. Qual. (submitted).

Norby, R. J., R. J. Luxmoore, E. G. O'Neill, and D. G. Weller, "Plant Responses to Elevated Atmospheric CO_2 with Emphasis on Belowground Processes," ORNL/TM-9426 Oak Ridge National Laboratory, Oak Ridge, Tennessee, pp. 76-87 (1984).

Rogers, H. H., W. W. Heck, and A. S. Heagle, "A Field Technique for the Study of Plant Responses to Elevated Carbon Dioxide Concentrations," Air Pollut. Control Assoc. J. 33:42-44 (1983).

Rosenberg, N. J.,"The Increasing CO_2 Concentration in the Atmosphere and Its Implication on Agricultural Productivity. I. Effects on Photosynthesis, Transpiration, and Water Use Efficiency," Clim. Change 3:265-279 (1981).

b. Background Information:

Canham, A. E., and W. J. McCavish, "Some Effects of CO_2, Daylength and Nutrition on the Growth of Young Forest Tree Plants 1. In the Seedling Stage," Forestry 54:169-182 (1981).

Lindsay, W. L., Chemical Equilibria in Soils, John Wiley & Sons, New York (1979).

Lutz, J. A., C. F. Genter, and G. W. Hawkins, "Effect of Soil pH on Element Concentrations and Uptake by Maize. II. Cu, B, Zn, Mn, Mo, Al, and Fe," Agron. J. 64:583-585 (1972).

Nye, P. H., "Changes of pH Across the Rhizosphere Induced by Roots," Plant Soil 61:7-26 (1981).

Pearcy, R. W., and O. Bjorkman, "Physiological Effects," pp. 65-105 in E. R. Lemon, Ed., CO_2 and Plants, Westview Press, Boulder, Colorado. (1983).

Rogers, H. H., J. F. Thomas, and G. E. Bingham, "Responses of Agronomic and Forest Species to Elevated Atmospheric Carbon Dioxide," Science 220:428-429 (1983).

Sarkar, A. N., and R. G. Wyn Jones, "Effect of Rhizosphere pH on the Availability and Uptake of Fe, Mn, and Zn," Plant Soil 66:361-372 (1982).

Smith, W. H., "Character and Significance of Forest Tree Root Exudates," Ecology 57:324-331 (1976).

Turner, J., D. W. Cole, and S. P. Gessel, "Mineral Nutrient Accumulation and Cycling in a Stand of Red Alder (*Alnus rubra*)," J. Ecol. 64:965-974 (1976).

Wittwer, S. H., "Rising Atmospheric CO_2 and Crop Productivity," HortScience 18:667-673 (1983).

10. HOW TO OBTAIN THE PACKAGE

The documentation of NDP-9 contains a printed listing of the data retrieved by the output routine for the use of requesters who may not need the automated data.

Requests for computerized data should be accompanied by a reel of tape and special instructions for transmitting the data.

Requests should be addressed to:

Carbon Dioxide Information Center
Oak Ridge National Laboratory
Post Office Box X
Oak Ridge, Tennessee 37831

11. NUMERIC DATA PACKAGE PREPARED BY:

Carbon Dioxide Information Center
Information Resources Organization
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831

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T. A. Boden
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Computer Coordinator -
T. A. Boden

Package Coordinator -
D. M. Stokes

12. DATE OF ABSTRACT

March 1985

TAPE CONTENTS

NDP-009
March 1985

FILE NAME		Mode	Logical Records	DCB Parameters		
1.	TAPE.INFO	EBCDIC	66	VB	4240	255
2.	TABLEONE.DATA	EBCDIC	84	FB	10800	80
3.	TABLEONE.RET	EBCDIC	42	FB	4240	80
4.	TABLETWO.DAT	EBCDIC	72	FB	10800	80
5.	TABLETWO.RET	EBCDIC	35	FB	4240	80
6.	TABLEFOR.DATA	EBCDIC	216	FB	10800	80
7.	TABLEFOR.RET	EBCDIC	48	FB	4240	80
8.	TABLEFIV.DAT	EBCDIC	216	FB	10800	80
9.	TABLEFIV.RET	EBCDIC	39	FB	4240	80
10.	TABLESIX.DATA	EBCDIC	72	FB	10800	80
11.	TABLESIX.RET	EBCDIC	36	FB	4240	80
12.	TABLESEV.DATA	EBCDIC	72	FB	10800	80
13.	TABLESEV.RET	EBCDIC	29	FB	4240	80
14.	TABLE8.DATA	EBCDIC	72	FB	10800	80
15.	TABLE8.RET	EBCDIC	30	FB	4240	80
		TOTAL	1129			

NDP-9 TAPE INFORMATION

DATASET TITLE: Growth and Chemical Responses to CO_2 Enrichment - Virginia Pine (Pinus virginiana Mill.)

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SCOPE OF THE DATA: Growth and chemical responses of Virginia pine (Pinus virginiana Mill.) grown in open-top growth chambers at elevated CO_2 concentrations (+0, +75, +150, +300, +600 ppmv) were evaluated over a four month period. The seedlings were grown in nutrient-deficient (not nutrient-limited) sandy loam top soil taken from an old field. Plant dry weight, height, and stem diameter were measured prior to and following exposure to elevated CO_2 concentrations. Chemical analyses were performed on leaf, stem, and root tissues as well as leachate before and after exposure.

DATA FORMAT: Seven sets of data with accompanying FORTRAN retrieval routines are provided. Measurements of initial dry weights and nutrient concentrations, initial physical parameters, final major and minor nutrient concentrations, final chemical soil analyses, and major and minor nutrient leachate concentrations are provided.

REFERENCES

Kramer, P. J., "Carbon Dioxide Concentration, Photosynthesis, and Dry Matter Production," BioScience 31:29-33 (1981).

Luxmoore, R. J., "CO_2 and Phytomass," BioScience 31:626 (1981).

Luxmoore, R. J., E. G. O'Neill, J. M. Ells, and H. H. Rogers, "Nutrient-Uptake and Growth Responses of Virginia Pine to Elevated Atmospheric CO_2," J. Environ. Qual. (submitted).

Norby, R. J., R. J. Luxmoore, E. G. O'Neill, and D. G. Weller, "Plant Responses to Elevated Atmospheric CO_2 with Emphasis on Belowground Processes," ORNL/TM-9426 Oak Ridge National Laboratory, Oak Ridge, Tennessee, pp. 76-87 (1984).

Rogers, H. H., W. W. Heck, and A. S. Heagle, "A Field Technique for the Study of Plant Responses to Elevated Carbon Dioxide Concentrations," Air Pollut. Control Assoc. J. 33:42-44 (1983).

Rosenberg, N. J., "The Increasing CO_2 Concentration in the Atmosphere and Its Implication on Agricultural Productivity. I. Effects on Photosynthesis, Transpiration, and Water Use Efficiency," Clim. Change 3:265-279 (1981).

FORTRAN RETRIEVAL CODES TO GENERATE

TABULAR OUTPUT FROM DATA

FORTRAN retrieval code to generate Table 1. which contains the initial dry weights and nutrient concentrations of Virginia pine prior to CO_2 exposure. File name on tape is TABLEONE.RET.

```
      NIN=12
C  FORMAT HEADINGS FOR OUTPUT LISTING
      WRITE(4,20)
 20   FORMAT(1H1,'TABLE 1.  INITIAL DRY WEIGHTS AND NUTRIENT CONCENTRATI
     1ONS OF VIRGINIA PINE PRIOR TO CO2 EXPOSURE' ///
     2' KEY:'/
     3' MYC=MYCORRHIZAL TREATMENT (M)PISOLITHUS TINCTORIUS (X) NATIVE FU
     3NGI'/
     4' SZ=SIZE CLASS (LG, MED, SM)   CH=CHAMBER'/
     5' PT=PLANT PART USED FOR ANALYSIS (1) STEM (2) NEEDLE (3) ROOT'/
     6' DRYWT=GRAMS DRY WEIGHT OF PLANT PART ANALYZED'/
     7' N,P,K,CA,AND MG ARE EXPRESSED IN GRAMS PER 100 GRAMS OF SAMPLE'/
     8' MN,FE,AL,B,CU,ZN,SR,AND BA ARE EXPRESSED IN PPM.'/)
 25   CONTINUE
C   FORMAT SUBHEADINGS FOR OUTPUT LISTING
      WRITE(4,30)
 30   FORMAT(120(1H-)/1X,'MYC',1X,'SZ',1X,'CH',1X,'PT',2X,'DRYWT',3X,
     1'N',7X,'P',5X,'K',6X,'CA',5X,'MG',6X,'MN',6X,'FE',6X,'AL',6X,'B',
     16X,'CU',6X,'ZN',6X,'SR',6X,'BA',/ 120(1H-)/)
      DO 60 I=1,43
C   READ IN THE DATA
      READ(NIN,40,END=75)AMYC,ASZ,ICH,IPT,DRYWT,PCTN,PCTP,PCTK,PCTCA,
     1PCTMG,PPMMN,PPMFE,PPMAL,PPMB,PPMCU,PPMZN,PPMSR,PPMBA
 40   FORMAT(A1,1X,A2,I2,1X,I1,1X,F5.3,F4.2,1X,F5.4,1X,F5.4,
     11X,F5.4,1X,F5.4,/ F7.2,F6.2,F5.1,1X,F6.3,F6.3,
     1F6.3,F6.3,F5.2)
C   WRITE THE OUTPUT IN TABULAR FORM
      WRITE(4,50)AMYC,ASZ,ICH,IPT,DRYWT,PCTN,PCTP,PCTK,PCTCA,PCTMG,
     1PPMMN,PPMFE,PPMAL,PPMB,PPMCU,PPMZN,PPMSR,PPMBA
 50   FORMAT(2X,A1,2X,A2,1X,I2,2X,I1,2X,F5.3,2X,F4.2,2X,F5.4,2X,F5.4,
     12X,F5.4,2X,F5.4,2X,F7.2,2X,F6.2,2X,F5.1,2X,F6.3,2X,F6.3,2X,F6.3,
     12X,F6.3,2X,F5.2)
 60   CONTINUE
      WRITE(4,70)
 70   FORMAT(1H1/)
      GO TO 25
 75   CONTINUE
      WRITE(4,80)
 80   FORMAT(120(1H-)/)
      STOP
      END
```

FORTRAN retrieval code to generate Table 2. which contains the physical parameters of Virginia pine at final harvest after four months of CO_2 exposure. File name on tape is TABLETWO.RET.

```
      NIN=12
      WRITE(4,20)
 20   FORMAT(1H1,'TABLE 2.  PHYSICAL PARAMETERS OF VIRGINIA PINE AT FINA
     1L HARVEST' ///
     2' DRY WEIGHT VALUES ARE IN GRAMS, CO2 TRT IS PPMV ABOVE AMBIENT' /
     3' (340 PPMV), AND HEIGHT AND DIAMETER ARE EXPRESSED IN CM.'/
     4' MYC REPRESENTS THE MYCORRHIZAL TREATMENT; (X) NATIVE FUNGI (M)'/
     5' PISOLITHUS TINCTORIUS. SZ REPRESENTS THE SIZE CLASS (LG,MED,SM).
     5 '/)
 25   CONTINUE
      WRITE(4,30)
 30   FORMAT(76(1H-)/1X,'REPLICATE',1X,'CHAMBER',1X,'MYC',1X,'SZ',1X,
     1'CO2',1X,'HEIGHT',1X,'CANDLE',1X,'DIAMETER',6X,'DRY WEIGHT', /
     226X,'TRT',25X,'NEEDLE',2X,'STEM',2X,'ROOT',/ 76(1H-)/)
C    PRINT 42 VALUES PER PAGE
      DO 60 I=1,42
C    READ IN THE DATA
      READ(NIN,40,END=75)IREP,ICH,AMYC,ASZ,ITRT,PHGT,ICAN,DIAM,PNEED,
     1STEM,ROOT
 40   FORMAT(2X,I1,3X,I2,2X,A1,A2,3X,I3,3X,F4.1,4X,I2,4X,F3.2,3X,F3.1,
     13X,F3.1,3X,F4.1)
      WRITE(4,50)IREP,ICH,AMYC,ASZ,ITRT,PHGT,ICAN,DIAM,PNEED,STEM,ROOT
 50   FORMAT(5X,I1,7X,I2,5X,A1,2X,A2,1X,I3,2X,F4.1,4X,I2,5X,F3.2,6X,
     1F3.1,4X,F3.1,4X,F4.1)
 60   CONTINUE
      WRITE(4,70)
 70   FORMAT(1H1/)
      GO TO 25
 75   CONTINUE
      WRITE(4,80)
 80   FORMAT(76(1H-)/)
      STOP
      END
```

FORTRAN retrieval code to generate Table 4. which contains the major nutrient concentrations of Virginia pine at final harvest after four months of CO_2 exposure. File name on tape is TABLEFOR.RET.

```
      NIN=12
C     FORMAT HEADINGS FOR OUTPUT LISTING
      WRITE(4,20)
 20   FORMAT(1H1,'   TABLE 4. MAJOR NUTRIENT CONCENTRATIONS OF VIRGINIA
     1PINE AT FINAL HARVEST'//
     2' TABLE CONTAINS MAJOR NUTRIENT CONTENT OF VIRGINIA PINE GROWN AT
     2 ELEVATED CO2'/
     3' CONCENTRATIONS IN CHAMBERS AT NORTH CAROLINA STATE UNIVERSITY. D
     3ESIGN IS SPLIT'/
     4' PLOT, WITH TWO CHAMBERS FOR EACH OF FIVE CO2 LEVELS, PLUS TWO PL
     4OTS'/
     5' WITHOUT CHAMBERS.  HALF THE SEEDLINGS WERE INNOCULATED WITH THE
     5MYCOSYMBIONT'/
     6' PISOLITHUS TINCTORIUS (M) AND THE OTHER HALF WERE MYCORRHIZAL WI
     6TH NATIVE FUNGI'/
     7' (X). THERE WERE SMALL, MEDIUM, AND LARGE SIZE CLASSES.  CO2 TRT
     7IS PPM ABOVE'/
     8' AMBIENT (340 PPM).  VALUES REPRESENT GRAMS OF NUTRIENT PER 100
     8GRAMS SAMPLE.'/
     9' ANALYSES WERE DONE FOR DIFFERENT PLANT PARTS; STEM(1) NEEDLE(2)
     9ROOT(3).'/)
 25   CONTINUE
      WRITE(4,30)
 30   FORMAT(75(1H-)/1X,'REPLICATE',1X,'CHAMBER',1X,'FUNGI',1X,'SIZE',
     11X,'CO2',2X,'PLANT',5X,'P',6X,'K',6X,'CA',6X,'MG',3X,'N', / 30X,
     2'TRT',2X,'PART', / 75(1H-)/)
C     PRINT 40 VALUES PER PAGE
      DO 60 I=1,40
C     READ IN DATA
      READ(NIN,40,END=75)IREP,ICH,AFUN,ASZ,ITRT,ITYP,P,PK,CA,PMG,N
 40   FORMAT(1X,I1,2X,I2,1X,A1,1X,A2,2X,I3,2X,I1,2X,F5.4,2X,F5.4,2X,
     1F5.4,2X,F5.4,2X,F4.2)
C     WRITE THE DATA OUT
      WRITE(4,50)IREP,ICH,AFUN,ASZ,ITRT,ITYP,P,PK,CA,PMG,N
 50   FORMAT(5X,I1,7X,I2,6X,A1,4X,A2,2X,I3,4X,I1,5X,F5.4,2X,F5.4,2X,
     1F5.4,2X,F5.4,2X,F4.2)
 60   CONTINUE
      WRITE(4,70)
 70   FORMAT(1H1/)
      GO TO 25
 75   CONTINUE
      WRITE(4,80)
 80   FORMAT(75(1H-)/)
      STOP
      END
```

FORTRAN retrieval code to generate Table 5. which contains the minor nutrient concentrations of Virginia pine at final harvest after four months of CO_2 exposure. File name on tape is TABLEFIV.RET.

```
      NIN=12
C     FORMAT HEADINGS FOR OUTPUT LISTING
      WRITE(4,20)
 20   FORMAT(1H1,'TABLE 5.  MINOR NUTRIENT CONCENTRATIONS OF VIRGINIA PI
     1NE AT FINAL HARVEST'/
     2'                          (UNITS = MG/GRAM DRYWT SAMPLE)'//
     3' SOME QUANTITIES OF AL AND FE EXCEEDED THE DETECTION LIMITS OF TH
     3E'/
     4' INSTRUMENTATION.  THESE VALUES ARE REPRESENTED AS 900 WHICH IS T
     4HE'/
     5' HIGHEST LEVEL OF DETECTION AND THUS REPRESENTS THE MINIMUM CONCE
     5NTRATION'/
     6' POSSIBLE FOR AL AND FE.'/)
 25   CONTINUE
      WRITE(4,30)
 30   FORMAT(76(1H-)/1X,'REP',1X,'CH',1X,'MYC',1X,'SZ',1X,'CO2',1X,
     1'PLANT',2X,'MN',4X,'FE',5X,'AL',5X,'B',5X,'CU',5X,'ZN',5X,
     1'SR',5X,'BA', / 15X,'TRT',2X,'PART', / 76(1H-)/)
C  PRINT 45 VALUES PER PAGE
      DO 60 I=1,45
C  READ IN DATA
      READ(NIN,40,END=75)ICH,AFUN,ASZ,ITRT,ITYP,PMN,FE,AL,B,CU,ZN,SR,BA,
     1IREP
 40   FORMAT(I2,1X,A1,1X,A2,1X,I3,1X,I1,1X,F6.2,2X,F6.2,2X,F5.1,4X,
     1F6.3,1X,F7.4,2X,F5.2,2X,F6.3,3X,F6.3,1X,I1,/)
C  WRITE OUT THE DATA
      WRITE(4,50)IREP,ICH,AFUN,ASZ,ITRT,ITYP,PMN,FE,AL,B,CU,ZN,SR,BA
 50   FORMAT(1X,I1,2X,I2,2X,A1,3X,A2,1X,I3,3X,I1,2X,F6.2,1X,F6.2,1X,
     1F5.1,1X,F6.3,1X,F7.4,1X,F5.2,1X,F6.3,1X,F6.3)
 60   CONTINUE
      WRITE(4,70)
 70   FORMAT(1H1/)
      GO TO 25
 75   CONTINUE
      WRITE(4,80)
 80   FORMAT(76(1H-)/)
      STOP
      END
```

FORTRAN retrieval code to generate Table 6. which contains the soil nutrient analysis at final harvest after four months of CO_2 exposure. File name on tape is TABLESIX.RET.

```
      NIN=12
C      FORMAT HEADINGS FOR OUTPUT LISTING
      WRITE(4,20)
 20   FORMAT(1H1,'        TABLE 6. SOIL NUTRIENT ANALYSIS AT FINAL HARVE
     1ST'//
     2'  UNITS: SOLUBLE SALTS IS EXPRESSED AS A PERCENT'/
     3'         P, K, CA, MG, AND NITRATE ARE EXPRESSED IN PPM' /
     4'         CO2 TRT IS EXPRESSED AS PPMV CO2 ABOVE AMBIENT (340 PPMV
     4)'/)
 25   CONTINUE
      WRITE(4,30)
 30   FORMAT(73(1H-)/1X,'CHAMBER',1X,'REPLICATE',1X,'MYC',1X,'SIZE',1X,
     1'CO2',2X,'SOIL',2X,'P',5X,'K',5X,'CA',2X,'MG',2X,'NO3-',2X,
     1'SOLUBLE'/ 22X,'CLASS',1X,'TRT',3X,'PH',31X,'SALTS' / 73(1H-)/)
C      PRINT 40 VALUES PER PAGE
      DO 60 I=1,40
C      READ IN DATA
      READ(NIN,40,END=80) ICH,IREP,AMYC,ASZ,ITRT,PH,IP,IK,ICA,
     1IMG,INITR,SALT
 40   FORMAT(I2,3X,I1,2X,A1,1X,A2,1X,I3,2X,F3.1,2X,I2,2X,I2,2X,
     1I3,2X,I2,2X,I2,2X,F4.1)
C      PRINT DATA OUT
      WRITE(4,50) ICH,IREP,AMYC,ASZ,ITRT,PH,IP,IK,ICA,IMG,INITR,
     1SALT
 50   FORMAT(4X,I2,7X,I1,6X,A1,3X,A2,2X,I3,2X,F3.1,2X,I2,4X,I2,4X,I3,
     12X,I2,4X,I2,4X,F4.1)
 60   CONTINUE
      WRITE(4,70)
 70   FORMAT(1H1/)
      GO TO 25
 80   CONTINUE
      WRITE(4,90)
 90   FORMAT(73(1H-)/)
      STOP
      END
```

FORTRAN retrieval code to generate Table 7. which contains the elements from the soil leachate samples taken after four months of CO_2 exposure. File name on tape is TABLESEV.RET.

```
      NIN=12
C   FORMAT HEADINGS FOR OUTPUT LISTING
      WRITE(4,20)
 20   FORMAT(1H1,'       TABLE 7.  ELEMENTS FROM SOIL LEACHATE SAMPLES'/
     2'                   (UNITS=MICROGRAMS PER MILLILITER)'/)
 25   CONTINUE
      WRITE(4,30)
 30   FORMAT(76(1H-)/ 1X,'REPLICATE',3X,'MYCOR-',5X,'SIZE',1X,'CO2',3X,
     1'P',5X,'K',5X,'CA',4X,'MG',4X,'MN',5X,'FE',4X,'AL',/ 13X,'RHIZAE'
     2,4X,'CLASS',1X,'TRT',/ 76(1H-) /)
C   PRINT 42 VALUES PER PAGE
      DO 60 I=1,42
C   READ IN DATA
      READ(NIN,40,END=75)IREP,AFUN,ASZ,ITRT,P,PK,CA,PMG,PMN,FE,PAL
 40   FORMAT(2X,I1,1X,A1,1X,A2,2X,I3,3X,F4.3,2X,F4.2,2X,F5.2,2X,F4.2,4X,
     1F4.3,5X,F5.2,3X,F5.2)
C   PRINT THE DATA OUT
      WRITE(4,50)IREP,AFUN,ASZ,ITRT,P,PK,CA,PMG,PMN,FE,PAL
 50   FORMAT(5X,I1,9X,A1,8X,A2,2X,I3,1X,F4.3,2X,F4.2,2X,F5.2,2X,F4.2,2X,
     1F4.3,2X,F5.2,2X,F5.2)
 60   CONTINUE
      WRITE(4,70)
 70   FORMAT(1H1/)
      GO TO 25
 75   CONTINUE
      WRITE(4,80)
 80   FORMAT(76(1H-)/)
      STOP
      END
```

FORTRAN retrieval code to generate Table 8. which contains the additional solutes from the soil leachate samples at final harvest after four months of CO_2 exposure. File name on tape is TABLE8.RET.

```
      NIN=12
C   FORMAT HEADINGS FOR OUTPUT LISTING
      WRITE(4,20)
 20   FORMAT(1H1,'     TABLE 8.  ADDITIONAL SOLUTES FROM SOIL LEACHATE
     1SAMPLES'/
     2'                 (UNITS=MICROGRAMS PER MILLILITER)'/)
 25   CONTINUE
      WRITE(4,30)
 30   FORMAT(64(1H-)/ 1X,'REPLICATE',2X,'MYCOR-',5X,'SIZE',1X,'CO2',3X,
     1'B',4X,'ZN',5X,'NA',3X,'NH4',3X,'NO3',3X,/ 12X,'RHIZAE'
     2,4X,'CLASS',1X,'TRT',/ 64(1H-) /)
C   PRINT 45 VALUES PER PAGE
      DO 60 I=1,45
C   READ IN DATA
      READ(NIN,40,END=75)IREP,AFUN,ASZ,ITRT,B,ZN,PNA,PNH,PNO
 40   FORMAT(2X,I1,2X,A1,1X,A2,1X,I3,3X,F4.3,3X,F4.3,3X,F4.2,4X,F4.2,
     14X,F4.2)
      WRITE(4,50)IREP,AFUN,ASZ,ITRT,B,ZN,PNA,PNH,PNO
 50   FORMAT(5X,I1,9X,A1,8X,A2,2X,I3,1X,F4.3,2X,F4.3,2X,F4.2,2X,F4.2,2X,
     1F4.2)
 60   CONTINUE
      WRITE(4,70)
 70   FORMAT(1H1/)
      GO TO 25
 75   CONTINUE
      WRITE(4,80)
 80   FORMAT(64(1H-)/)
      STOP
      END
```

TABLES AND FIGURES

Tables 1, 2, 4, 5, 6, 7, and 8 are generated from the retrieval codes listed in the previous section.

Table 3 was calculated from data given in Tables 1 & 2.

Fig. 1 plots mean dry weight values calculated from Table 2 data against the CO_2 treatment levels.

Fig. 2 is a plot of the relative chemical content of thirteen plant elements as a function of atmospheric CO_2 from data given in Table 5.

TABLE 1. INITIAL DRY WEIGHTS AND NUTRIENT CONCENTRATIONS OF VIRGINIA PINE PRIOR TO CO_2 EXPOSURE

KEY:
MYC=MYCORRHIZAL TREATMENT (M)PISOLITHUS TINCTORIUS (X) NATIVE FUNGI
SZ=SIZE CLASS (LG, MED, SM) CH=CHAMBER
PT=PLANT PART USED FOR ANALYSIS (1) STEM (2) NEEDLE (3) ROOT
DRYWT=GRAMS DRY WEIGHT OF PLANT PART ANALYZED
N,P,K,CA,AND MG ARE EXPRESSED IN GRAMS PER 100 GRAMS OF SAMPLE
MN,FE,AL,B,CU,ZN,SR,AND BA ARE EXPRESSED IN PPM.

MYC	SZ	CH	PT	DRYWT	N	P	K	CA	MG	MN	FE	AL	B	CU	ZN	SR	BA
X	SM	1	2	2.080	1.17	.2186	.2890	.2307	.0741	642.30	214.10	497.2	8.827	3.913	61.120	3.341	14.73
X	SM	1	1	1.410	0.65	.2000	.3233	.1995	.0652	166.60	174.10	411.3	8.801	6.385	48.520	6.371	20.34
X	SM	1	3	0.700	0.0	.3778	.1678	.3052	.0704	170.51	900.00	900.0	19.360	12.130	52.620	8.724	52.76
X	SM	7	2	1.010	1.08	.2932	.0994	.4194	.0866	649.60	393.80	839.8	18.420	4.352	38.480	6.636	29.60
X	SM	7	1	0.710	0.43	.2738	.0982	.2708	.0922	175.60	275.00	707.0	13.910	6.438	42.240	10.540	28.84
X	SM	7	3	0.690	0.0	.3430	.0085	.3858	.0728	204.60	900.00	900.0	21.460	10.650	33.260	11.540	49.78
X	MD	2	2	2.350	0.64	.1482	.1277	.2185	.0717	504.60	160.50	529.1	8.409	2.002	24.290	1.217	11.10
X	MD	2	1	1.360	0.35	.1960	.0085	.2358	.0732	116.60	113.00	227.2	11.070	3.654	36.520	8.076	20.86
X	MD	2	3	1.070	0.63	.2830	.0085	.2938	.0614	145.00	900.00	900.0	18.034	7.596	29.860	8.578	33.34
X	MD	3	2	2.220	0.99	.1921	.1589	.2749	.0669	722.10	300.90	900.0	11.350	2.862	30.640	3.550	21.02
X	MD	3	1	2.140	0.39	.1475	.1845	.2052	.0548	177.60	141.10	483.2	9.306	3.150	21.940	5.193	21.63
X	MD	3	3	1.060	0.57	.2452	.0268	.2538	.0664	124.10	900.00	900.0	12.770	5.506	14.630	9.700	37.16
X	MD	9	2	1.204	0.84	.2574	.0085	.2232	.0638	670.00	239.00	731.0	11.420	3.904	19.620	1.157	22.38
X	MD	9	1	0.908	0.0	.1912	.0085	.1970	.0664	144.60	105.50	352.6	7.758	3.890	23.280	9.282	25.34
X	MD	9	3	0.436	0.58	.0	.0	.0	.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
X	LG	11	2	2.354	1.00	.2600	.1490	.2370	.0850	393.20	307.80	913.6	10.870	4.276	25.660	2.972	25.02
X	LG	11	1	1.858	0.0	.1660	.3920	.2230	.0760	153.00	264.40	656.5	10.730	4.585	34.760	8.098	23.60
X	LG	11	3	1.195	0.0	.2260	.0610	.2480	.0940	96.44	900.00	900.0	9.944	6.292	27.160	10.250	29.60
X	LG	13	2	3.722	1.20	.1770	.1590	.3150	.0650	593.90	193.80	531.1	10.840	3.017	51.690	3.244	11.88
X	LG	13	1	2.260	0.50	.1360	.2910	.2420	.0670	152.40	61.80	168.6	8.766	3.139	26.760	7.005	15.38
X	LG	13	3	1.903	0.61	.1493	.1164	.2765	.0675	101.20	900.00	900.0	11.880	5.726	19.520	7.975	25.10
M	SM	4	2	1.480	0.81	.1589	.1199	.2643	.0642	489.40	161.70	527.5	9.482	2.149	21.050	3.142	11.37
M	SM	4	1	1.160	0.41	.2452	.0085	.2112	.0660	186.80	214.20	619.0	12.168	6.386	20.400	4.662	24.74
M	SM	4	3	0.570	0.66	.0	.0	.0	.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
M	SM	8	2	1.080	0.89	.2926	.1178	.2878	.0882	1074.00	261.60	770.6	13.910	4.118	30.540	2.532	17.52
M	SM	8	1	1.010	0.37	.2342	.0272	.1734	.0582	184.90	188.90	512.4	7.692	4.874	21.020	6.984	24.16
M	SM	8	3	0.660	0.76	.0	.0	.0	.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
M	MD	5	2	2.330	0.76	.1904	.2144	.2776	.0707	721.50	329.80	695.8	13.000	3.192	31.920	4.220	20.34
M	MD	5	1	1.540	0.47	.1608	.3068	.1919	.0736	178.90	194.70	493.3	8.792	4.267	24.800	6.947	19.00
M	MD	5	3	1.110	0.62	.2578	.0085	.3268	.0908	186.40	900.00	900.0	11.430	4.696	13.050	14.490	43.66
M	MD	6	2	2.190	0.59	.1658	.0974	.2298	.0636	692.80	218.60	570.6	8.421	2.440	26.070	3.237	13.35
M	MD	6	1	1.080	0.29	.1916	.0085	.2280	.0610	161.98	101.40	247.0	8.192	3.650	22.900	8.066	21.66
M	MD	6	3	0.840	0.62	.2814	.0950	.2714	.0986	127.50	900.00	900.0	15.460	6.190	23.560	8.124	38.48
M	MD	10	2	1.694	0.68	.1381	.1259	.2535	.0633	449.30	199.00	543.8	9.821	2.062	20.320	4.183	15.46
M	MD	10	1	1.201	0.43	.2018	.0085	.2182	.0770	140.60	98.42	304.2	6.382	4.332	14.108	10.130	24.34
M	MD	10	3	0.370	0.60	.0	.0	.0	.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
M	LG	12	2	1.655	0.60	.1560	.1320	.2070	.0600	635.80	188.20	550.9	8.379	2.314	19.600	1.738	12.18
M	LG	12	1	1.505	0.20	.1060	.0080	.1860	.0490	156.00	87.98	253.4	5.310	2.592	15.880	7.386	18.01
M	LG	12	3	1.900	0.0	.1650	.2410	.1890	.0720	117.80	852.40	900.0	7.196	3.736	12.560	8.577	23.82
M	LG	14	2	3.398	0.60	.1300	.1620	.3170	.0590	548.60	174.60	465.0	11.670	1.992	22.610	4.380	12.07
M	LG	14	1	1.562	0.46	.1399	.3114	.2542	.0747	150.20	85.24	226.7	9.764	4.045	30.200	7.851	12.91
M	LG	14	3	1.643	0.64	.1925	.2223	.2915	.0784	103.30	900.00	900.0	13.140	7.154	23.960	8.203	24.58

TABLE 2. PHYSICAL PARAMETERS OF VIRGINIA PINE AT FINAL HARVEST

DRY WEIGHT VALUES ARE IN GRAMS, CO2 TRT IS PPMV ABOVE AMBIENT (340 PPMV), AND HEIGHT AND DIAMETER ARE EXPRESSED IN CM. MYC REPRESENTS THE MYCORRHIZAL TREATMENT; (X) NATIVE FUNGI (M) PISOLITHUS TINCTORIUS. SZ REPRESENTS THE SIZE CLASS (LG,MED,SM).

REPLICATE	CHAMBER	MYC	SZ	CO2 TRT	HEIGHT	CANDLE	DIAMETER	DRY WEIGHT NEEDLE	STEM	ROOT
1	1	X	SM	150	23.5	3	.33	2.0	1.2	5.1
1	1	M	SM	150	28.5	2	.32	0.6	1.2	0.8
1	1	X	MD	150	32.5	16	.51	3.8	3.1	8.0
1	1	M	MD	150	29.5	6	.32	1.2	1.2	2.5
1	1	X	LG	150	40.0	15	.47	3.4	3.6	5.8
1	1	M	LG	150	38.0	17	.47	3.9	3.3	11.5
1	2	X	SM	600	25.5	7	.49	1.9	2.1	8.2
1	2	M	SM	600	26.5	8	.52	1.3	1.4	3.7
1	2	X	MD	600	24.5	5	.41	3.5	2.1	7.8
1	2	M	MD	600	29.5	6	.34	2.0	1.8	5.5
1	2	X	LG	600	36.5	4	.41	3.4	2.7	5.0
1	2	M	LG	600	34.0	13	.52	6.7	3.8	18.3
1	3	X	SM	0	24.0	7	.51	3.5	2.4	7.2
1	3	M	SM	0	27.0	6	.34	1.6	1.7	5.6
1	3	X	MD	0	33.5	11	.42	2.4	2.2	4.3
1	3	M	MD	0	0.0	0	.0	0.0	0.0	0.0
1	3	X	LG	0	35.5	4	.38	1.4	1.9	2.7
1	3	M	LG	0	34.5	10	.36	0.9	1.9	3.3
1	4	X	SM	1	22.5	15	.38	1.5	1.7	3.2
1	4	M	SM	1	25.5	5	.32	1.1	1.3	2.6
1	4	X	MD	1	25.5	12	.35	4.2	3.4	7.0
1	4	M	MD	1	30.5	7	.35	1.2	1.8	4.1
1	4	X	LG	1	38.0	13	.48	2.6	3.4	11.8
1	4	M	LG	1	34.0	5	.34	1.6	1.8	4.1
1	5	X	SM	75	22.0	11	.28	1.2	1.3	1.7
1	5	M	SM	75	27.0	11	.37	1.5	1.7	3.1
1	5	X	MD	75	32.5	9	.39	3.1	2.5	7.5
1	5	M	MD	75	33.0	5	.32	1.4	1.5	3.3
1	5	X	LG	75	35.5	7	.36	1.7	2.1	4.5
1	5	M	LG	75	38.0	5	.40	1.9	2.4	8.5
1	6	X	SM	300	23.0	13	.39	1.8	1.6	3.6
1	6	M	SM	300	24.5	5	.36	1.8	1.5	3.9
1	6	X	MD	300	31.5	9	.46	3.8	3.1	6.7
1	6	M	MD	300	30.5	8	.32	2.0	1.7	6.3
1	6	X	LG	300	34.0	9	.40	2.7	2.5	5.1
1	6	M	LG	300	33.0	7	.36	1.3	1.9	3.3
2	7	X	SM	75	25.5	6	.44	2.8	1.9	7.5
2	7	M	SM	75	30.0	4	.37	1.6	1.5	3.8
2	7	X	MD	75	35.5	10	.45	3.0	3.0	6.4
2	7	M	MD	75	32.5	8	.42	2.9	2.5	5.9
2	7	X	LG	75	37.5	1	.46	2.4	3.0	5.8
2	7	M	LG	75	38.0	6	.44	3.4	2.8	7.9

ABLE 2. (CONTINUED)

EPLICATE	CHAMBER	MYC	SZ	CO2 TRT	HEIGHT	CANDLE	DIAMETER	DRY WEIGHT NEEDLE	STEM	ROOT
2	8	X	SM	1	28.0	10	.50	2.0	2.1	7.9
2	8	M	SM	1	29.5	3	.35	1.1	1.5	3.4
2	8	X	MD	1	35.5	5	.47	2.7	2.9	7.0
2	8	M	MD	1	33.0	6	.35	1.2	2.0	4.3
2	8	X	LG	1	42.5	6	.50	2.7	3.2	7.6
2	8	M	LG	1	41.0	5	.46	2.6	2.8	7.7
2	9	X	SM	600	23.0	2	.31	1.5	1.1	5.2
2	9	M	SM	600	28.0	3	.37	1.4	1.5	3.6
2	9	X	MD	600	33.5	13	.52	3.7	3.8	9.9
2	9	M	MD	600	34.0	8	.34	1.7	1.8	4.7
2	9	X	LG	600	36.0	7	.43	3.4	3.3	6.7
2	9	M	LG	600	42.0	6	.48	3.4	3.4	10.9
2	10	X	SM	150	21.5	4	.31	1.4	1.1	4.5
2	10	M	SM	150	29.5	5	.40	1.9	1.8	8.4
2	10	X	MD	150	32.0	11	.44	2.8	2.7	3.3
2	10	M	MD	150	33.0	5	.44	2.7	2.3	8.0
2	10	X	LG	150	39.0	7	.65	3.8	5.5	9.5
2	10	M	LG	150	32.0	5	.45	3.6	3.2	5.9
2	11	X	SM	0	19.0	6	.27	0.9	0.9	1.7
2	11	M	SM	0	0.0	0	.0	0.0	0.0	0.0
2	11	X	MD	0	32.5	15	.56	4.5	4.3	8.9
2	11	M	LG	0	33.5	9	.36	2.7	2.1	7.7
2	11	M	MD	0	30.5	8	.35	1.7	1.7	2.1
2	11	X	LG	0	29.0	2	.53	2.5	3.2	7.1
2	12	X	SM	300	22.5	3	.42	2.3	1.7	5.6
2	12	M	SM	300	30.5	6	.44	2.0	2.2	4.3
2	12	X	MD	300	34.5	20	.52	6.2	3.9	11.2
2	12	M	MD	300	33.0	12	.40	2.5	2.6	7.9
2	12	M	LG	300	0.0	0	.0	0.0	0.0	0.0
2	12	M	LG	300	33.5	8	.44	3.5	2.5	6.7

TABLE 3. Changes in Mean Growth Characteristics of Virginia Pine Following CO_2 Enrichment.

	Initial	Final
Height (cm)	27	31
Diameter (cm)	0.34	0.41
Candles/Plant	5.8	7.7
Dry Weight (g)	4.4	11.0
leaf	2.1	2.5
stem	1.4	2.3
root	1.0	6.2
Root/Shoot	0.3	1.3

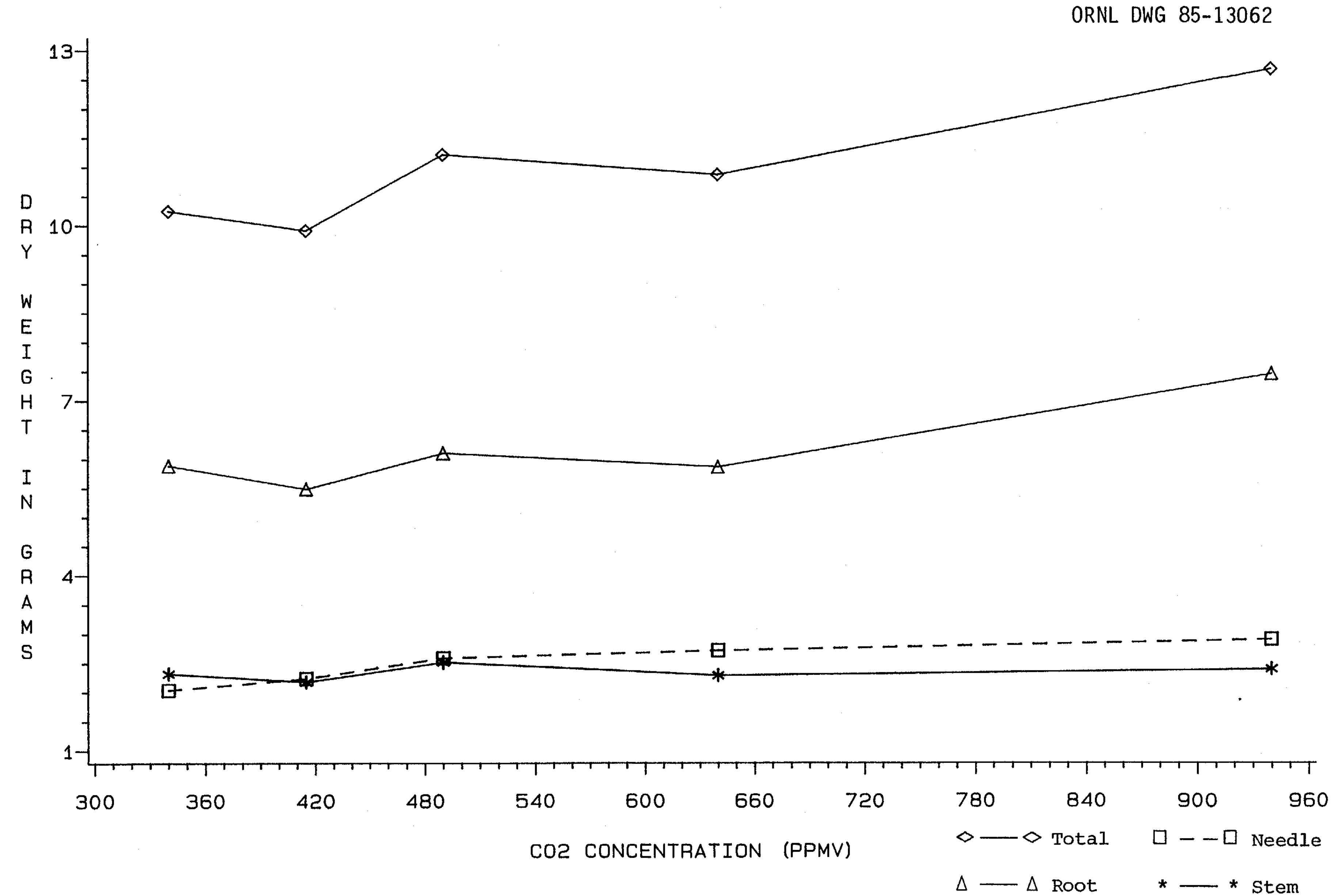

Figure 1. Mean Dry Weight Growth Response to CO_2.
Dry weight means were calculated from data given in Table 2. The points represent the mean for a CO_2 treatment level following the four month exposure period.

TABLE 4. MAJOR NUTRIENT CONCENTRATIONS OF VIRGINIA PINE AT FINAL HARVEST

TABLE CONTAINS MAJOR NUTRIENT CONTENT OF VIRGINIA PINE GROWN AT ELEVATED CO2 CONCENTRATIONS IN CHAMBERS AT NORTH CAROLINA STATE UNIVERSITY. DESIGN IS SPLIT PLOT, WITH TWO CHAMBERS FOR EACH OF FIVE CO2 LEVELS, PLUS TWO PLOTS WITHOUT CHAMBERS. HALF THE SEEDLINGS WERE INNOCULATED WITH THE MYCOSYMBIONT PISOLITHUS TINCTORIUS (M) AND THE OTHER HALF WERE MYCORRHIZAL WITH NATIVE FUNGI (X). THERE WERE SMALL, MEDIUM, AND LARGE SIZE CLASSES. CO2 TRT IS PPM ABOVE AMBIENT (340 PPM). VALUES REPRESENT GRAMS OF NUTRIENT PER 100 GRAMS SAMPLE. ANALYSES WERE DONE FOR DIFFERENT PLANT PARTS; STEM(1) NEEDLE(2) ROOT(3).

REPLICATE	CHAMBER	FUNGI	SIZE	CO2 TRT	PLANT PART	P	K	CA	MG	N
1	1	M	LG	150	2	.0909	.2082	.4119	.0949	0.66
1	1	M	LG	150	3	.0879	.0084	.2966	.0347	0.45
1	1	M	LG	150	1	.0804	.1710	.2768	.0655	0.36
1	1	X	MD	150	2	.1491	.3975	.5437	.0626	1.02
1	1	X	MD	150	3	.1756	.2438	.2730	.0513	0.60
1	1	X	MD	150	1	.0908	.2803	.2800	.0756	0.54
1	1	M	MD	150	2	.1476	.4133	.5339	.0720	1.03
1	1	M	MD	150	3	.1046	.2992	.3452	.0569	0.52
1	1	M	MD	150	1	.0757	.2914	.2643	.0753	0.39
1	1	X	LG	150	2	.1396	.4754	.4931	.0756	1.13
1	1	X	LG	150	3	.1756	.1852	.3988	.0557	0.49
1	1	X	LG	150	1	.0833	.3011	.2709	.0723	0.39
1	1	X	SM	150	2	.1267	.4949	.5092	.0624	0.84
1	1	X	SM	150	3	.1512	.1485	.3643	.0446	0.57
1	1	X	SM	150	1	.0870	.2562	.2956	.0676	0.42
1	1	M	SM	150	2	.0861	.3788	.1546	.0639	1.03
1	1	M	SM	150	1	.0804	.2827	.2288	.0601	0.58
1	1	M	SM	150	3	.0	.0	.0	.0	0.0
1	2	M	LG	600	2	.0946	.2895	.4434	.0816	1.17
1	2	M	LG	600	3	.0930	.0325	.3521	.0410	0.58
1	2	M	LG	600	1	.0906	.3174	.3167	.0981	0.72
1	2	M	MD	600	2	.1476	.5675	.4922	.0751	1.14
1	2	M	MD	600	3	.1213	.1827	.3439	.0585	0.52
1	2	M	MD	600	1	.0900	.3668	.2677	.0797	0.64
1	2	X	MD	600	2	.0877	.3235	.4686	.0512	0.68
1	2	X	MD	600	3	.1548	.2050	.3569	.0549	0.56
1	2	X	MD	600	1	.0822	.1636	.2703	.0639	0.42
1	2	X	LG	600	2	.2033	.5408	.5491	.0618	1.28
1	2	X	LG	600	3	.2138	.4159	.3610	.0699	0.55
1	2	X	LG	600	1	.0959	.2599	.2951	.0842	0.54
1	2	M	SM	600	2	.1717	.5490	.6058	.0747	1.32
1	2	M	SM	600	3	.1421	.3095	.3647	.0549	0.58
1	2	M	SM	600	1	.0836	.2803	.3222	.0794	0.64
1	2	X	SM	600	2	.0970	.2670	.6626	.0730	0.86
1	2	X	SM	600	3	.0954	.0925	.2134	.0293	0.60
1	2	X	SM	600	1	.0927	.3004	.3047	.0750	0.52
1	3	X	LG	0	2	.1525	.4980	.7423	.0939	1.52
1	3	X	LG	0	3	.1701	.4728	.4025	.0617	0.75
1	3	X	LG	0	1	.0906	.4964	.3162	.0701	0.64
1	3	X	MD	0	2	.1799	.4042	.4874	.0761	1.20

TABLE 4. (CONTINUED)

REPLICATE	CHAMBER	FUNGI	SIZE	CO2 TRT	PLANT PART	P	K	CA	MG	N
1	3	X	MD	0	3	.1119	.1893	.3317	.0493	0.56
1	3	X	MD	0	1	.0862	.2398	.2522	.0775	0.48
1	3	M	MD	0	2	.0	.0	.0	.0	0.0
1	3	M	MD	0	3	.0	.0	.0	.0	0.0
1	3	M	MD	0	1	.0	.0	.0	.0	0.0
1	3	M	LG	0	2	.1762	.6279	.7796	.0768	1.58
1	3	M	LG	0	3	.2060	.5220	.3360	.0540	0.68
1	3	M	LG	0	1	.0900	.3627	.2561	.0699	0.52
1	3	X	SM	0	2	.1441	.5031	.4487	.0691	1.28
1	3	X	SM	0	3	.1247	.2179	.3079	.0461	0.62
1	3	X	SM	0	1	.1274	.5007	.2860	.0843	0.52
1	3	M	SM	0	2	.1212	.4405	.4989	.0876	1.26
1	3	M	SM	0	3	.0976	.1539	.3721	.0458	0.41
1	3	M	SM	0	1	.0848	.2996	.2934	.0815	0.46
1	4	X	LG	1	2	.1904	.4607	.5760	.0792	1.32
1	4	X	LG	1	3	.1121	.1492	.2275	.0343	0.51
1	4	X	LG	1	1	.0927	.3631	.2798	.0656	0.39
1	4	M	MD	1	2	.1270	.4592	.5820	.0744	1.37
1	4	M	MD	1	3	.1652	.2744	.4523	.0541	0.66
1	4	M	MD	1	1	.0844	.3457	.2892	.0677	0.54
1	4	X	MD	1	2	.0934	.4985	.4390	.0752	0.92
1	4	X	MD	1	3	.2005	.2941	.3430	.0493	0.63
1	4	X	MD	1	1	.0902	.3000	.3426	.0721	0.41
1	4	M	LG	1	2	.1807	.4196	.6644	.0803	1.56
1	4	M	LG	1	3	.1847	.3872	.3889	.0589	0.63
1	4	M	LG	1	1	.1048	.4102	.3759	.0870	0.64
1	4	X	SM	1	2	.1556	.4157	.5062	.0719	1.36
1	4	X	SM	1	3	.1721	.4730	.2954	.0572	0.52
1	4	X	SM	1	1	.0821	.4703	.2967	.0819	0.58
1	4	M	SM	1	2	.1622	.5224	.5450	.0821	1.46
1	4	M	SM	1	3	.1821	.4812	.4449	.0612	0.57
1	4	M	SM	1	1	.0854	.4044	.3056	.0723	0.52
1	5	M	LG	75	2	.1801	.5391	.4769	.0754	1.45
1	5	M	LG	75	3	.0922	.0599	.2536	.0360	0.38
1	5	M	LG	75	1	.0850	.3339	.3193	.0742	0.52
1	5	X	MD	75	2	.1462	.5857	.5530	.0759	1.15
1	5	X	MD	75	3	.2021	.2517	.3792	.0569	0.60
1	5	X	MD	75	1	.0874	.3814	.2746	.0660	0.37
1	5	M	MD	75	2	.1202	.3266	.5568	.0724	0.96
1	5	M	MD	75	3	.1138	.3087	.3503	.0590	0.63

TABLE 4. (CONTINUED)

REPLICATE	CHAMBER	FUNGI	SIZE	CO2 TRT	PLANT PART	P	K	CA	MG	N
1	5	M	MD	75	1	.0807	.3709	.2720	.0741	0.44
1	5	X	LG	75	2	.2068	.4214	.5129	.0788	1.31
1	5	X	LG	75	3	.1607	.1510	.3811	.0559	0.44
1	5	X	LG	75	1	.0892	.2849	.2326	.0777	0.50
1	5	X	SM	75	2	.1734	.2011	.5025	.0836	1.19
1	5	X	SM	75	3	.1370	.3950	.3226	.0706	0.72
1	5	X	SM	75	1	.0757	.2502	.3163	.0836	0.61
1	5	M	SM	75	2	.1817	.4186	.6745	.0760	1.25
1	5	M	SM	75	3	.2078	.5666	.3996	.0719	0.63
1	6	M	LG	300	2	.1510	.5066	.4749	.0594	1.38
1	6	M	LG	300	1	.0928	.3033	.2499	.0752	0.50
1	6	M	LG	300	3	.1896	.2845	.3218	.0522	0.68
1	6	M	MD	300	2	.1220	.4204	.6023	.0846	1.19
1	6	M	MD	300	3	.1225	.1002	.3641	.0398	0.61
1	6	M	MD	300	1	.0953	.5451	.3298	.0863	0.73
1	6	X	MD	300	2	.0982	.5075	.3804	.0681	0.80
1	6	X	MD	300	3	.1396	.3608	.2459	.0566	0.54
1	6	X	MD	300	1	.0839	.2753	.2454	.0737	0.43
1	6	X	LG	300	2	.1601	.4261	.4408	.0747	1.27
1	6	X	LG	300	3	.1211	.2138	.2557	.0576	0.49
1	6	X	LG	300	1	.0970	.3095	.2786	.0943	0.49
1	6	X	SM	300	2	.1863	.5786	.5537	.0765	1.30
1	6	X	SM	300	3	.1394	.2484	.2775	.0475	0.53
1	6	X	SM	300	1	.0844	.4659	.2238	.0765	0.54
1	6	M	SM	300	2	.1790	.4514	.7134	.0823	1.19
1	6	M	SM	300	3	.1464	.3349	.4702	.0563	0.59
1	6	M	SM	300	1	.0971	.3478	.3488	.0767	0.54
2	7	M	LG	75	2	.1726	.5284	.5607	.1030	1.05
2	7	M	LG	75	3	.1920	.2892	.3659	.0563	0.58
2	7	M	LG	75	1	.0912	.2733	.2663	.0849	0.41
2	7	X	MD	75	2	.1815	.4223	.4747	.0834	1.00
2	7	X	MD	75	3	.1560	.1548	.3461	.0514	0.51
2	7	X	MD	75	1	.0939	.2490	.3230	.0787	0.33
2	7	M	MD	75	2	.0975	.5626	.5489	.0987	0.94
2	7	M	MD	75	3	.0972	.1346	.2896	.0446	0.38
2	7	M	MD	75	1	.0866	.3596	.3577	.0784	0.39
2	7	X	LG	75	2	.1450	.4745	.4987	.0786	1.30
2	7	X	LG	75	3	.1442	.3118	.3674	.0640	0.52
2	7	X	LG	75	1	.0849	.3238	.3421	.0769	0.43
2	7	X	SM	75	2	.1218	.4115	.5299	.0671	0.87

TABLE 4. (CONTINUED)

REPLICATE	CHAMBER	FUNGI	SIZE	CO2 TRT	PLANT PART	P	K	CA	MG	N
2	7	X	SM	75	3	.2060	.1558	.2903	.0494	0.47
2	7	X	SM	75	1	.0944	.3413	.2213	.0690	0.41
2	7	M	SM	75	2	.1093	.4145	.6815	.0726	1.46
2	7	M	SM	75	3	.2012	.3953	.3817	.0597	0.62
2	7	M	SM	75	1	.1057	.5684	.3149	.0803	0.77
2	8	X	LG	1	2	.1690	.5249	.5749	.0906	1.40
2	8	X	LG	1	3	.1410	.1256	.3632	.0482	0.37
2	8	X	LG	1	1	.0910	.3809	.3084	.0832	0.48
2	8	M	MD	1	2	.0944	.4109	.7006	.0949	1.23
2	8	M	MD	1	3	.1687	.2078	.3753	.0549	0.59
2	8	M	MD	1	1	.0837	.2852	.3076	.0782	0.43
2	8	X	MD	1	2	.0981	.3259	.5854	.0902	1.05
2	8	X	MD	1	3	.1016	.0666	.2594	.0413	0.43
2	8	X	MD	1	1	.0880	.2577	.3226	.0774	0.38
2	8	M	LG	1	2	.1835	.4203	.6274	.0848	1.69
2	8	M	LG	1	3	.1848	.2440	.4718	.0576	0.60
2	8	M	LG	1	1	.0880	.3254	.3146	.0848	0.56
2	8	M	SM	1	2	.0967	.3458	.4256	.0695	1.31
2	8	M	SM	1	3	.0880	.1300	.3368	.0375	0.48
2	8	M	SM	1	1	.0753	.2389	.2160	.0619	0.40
2	8	X	SM	1	2	.1423	.4305	.7340	.0848	1.34
2	8	X	SM	1	3	.0852	.0244	.2076	.0299	0.37
2	8	X	SM	1	1	.0929	.3865	.2764	.0763	0.52
2	9	X	LG	600	2	.0957	.4558	.4700	.0773	1.03
2	9	X	LG	600	3	.1100	.2214	.2894	.0541	0.36
2	9	X	LG	600	1	.0904	.3845	.3219	.0897	0.45
2	9	X	MD	600	2	.1149	.3001	.5510	.0832	1.03
2	9	X	MD	600	3	.1106	.0530	.3833	.0429	0.51
2	9	X	MD	600	1	.0847	.2379	.2308	.0840	0.39
2	9	M	MD	600	2	.0965	.3914	.6023	.0674	1.12
2	9	M	MD	600	3	.1439	.4310	.3387	.0524	0.55
2	9	M	MD	600	1	.0775	.4029	.2707	.0679	0.45
2	9	M	LG	600	2	.1315	.3717	.6170	.0633	1.37
2	9	M	LG	600	3	.1162	.1302	.4317	.0488	0.58
2	9	M	LG	600	1	.0890	.3981	.3241	.0815	0.48
2	9	X	SM	600	2	.2256	.4927	.7220	.0698	1.29
2	9	X	SM	600	3	.1216	.2705	.3039	.0514	0.48
2	9	X	SM	600	1	.0864	.4333	.2796	.0762	0.64
2	9	M	SM	600	2	.1136	.4377	.5764	.0801	1.48
2	9	M	SM	600	3	.1463	.4402	.2928	.0621	0.65

TABLE 4. (CONTINUED)

REPLICATE	CHAMBER	FUNGI	SIZE	CO2 TRT	PLANT PART	P	K	CA	MG	N
2	9	M	SM	600	1	.0865	.4359	.3245	.0829	0.64
2	10	M	LG	150	2	.1697	.4325	.5598	.1060	1.23
2	10	M	LG	150	3	.0996	.2368	.4365	.0506	0.48
2	10	M	LG	150	1	.0843	.3875	.2809	.0839	0.48
2	10	M	MD	150	2	.0987	.4876	.5906	.0911	1.11
2	10	M	MD	150	3	.1031	.1942	.3991	.0530	0.53
2	10	M	MD	150	1	.0836	.3275	.3022	.0749	0.43
2	10	X	MD	150	2	.1111	.5030	.4909	.0795	1.18
2	10	X	MD	150	3	.1457	.2770	.4038	.0543	0.55
2	10	X	MD	150	1	.0823	.3263	.2407	.0753	0.51
2	10	X	LG	150	2	.1563	.4180	.5259	.0826	1.28
2	10	X	LG	150	3	.1754	.1932	.3486	.0719	0.37
2	10	X	LG	150	1	.0894	.3511	.3231	.0976	0.53
2	10	X	SM	150	2	.0995	.1139	.3602	.0366	1.21
2	10	X	SM	150	3	.1422	.1653	.3466	.0450	0.52
2	10	X	SM	150	1	.0950	.5042	.3298	.0859	0.26
2	10	M	SM	150	2	.1559	.4992	.5264	.0747	1.18
2	10	M	SM	150	3	.1020	.1667	.2490	.0446	0.35
2	10	M	SM	150	1	.1598	.2316	.2848	.0810	0.37
2	11	M	LG	0	2	.1598	.3589	.8187	.0958	1.28
2	11	M	LG	0	3	.1547	.2264	.3314	.0536	0.51
2	11	M	LG	0	1	.0843	.1993	.2990	.0745	0.48
2	11	M	MD	0	2	.1708	.4225	.5555	.0896	1.28
2	11	M	MD	0	3	.2177	.4725	.4559	.0748	0.61
2	11	M	MD	0	1	.0864	.3451	.2710	.0803	0.42
2	11	X	MD	0	3	.1648	.2597	.3179	.0536	0.55
2	11	X	MD	0	2	.1168	.5668	.4336	.0878	0.88
2	11	X	MD	0	1	.0879	.2782	.2472	.0778	0.42
2	11	X	LG	0	2	.1393	.5370	.4342	.0824	1.21
2	11	X	LG	0	3	.1648	.1573	.3525	.0462	0.42
2	11	X	LG	0	1	.0907	.3927	.3124	.0859	0.46
2	11	X	SM	0	2	.1578	.5034	.4749	.0737	0.62
2	11	X	SM	0	3	.2209	.6679	.3782	.0668	0.65
2	11	X	SM	0	1	.0	.0	.0	.0	0.39
2	11	M	SM	0	2	.0	.0	.0	.0	0.0
2	11	M	SM	0	3	.0	.0	.0	.0	0.0
2	11	M	SM	0	1	.0	.0	.0	.0	0.0
2	12	M	LG	300	2	.1441	.3912	.6900	.0906	1.21
2	12	M	LG	300	3	.1274	.2495	.3930	.0574	0.56
2	12	M	LG	300	1	.0852	.4332	.3094	.0793	0.47

TABLE 4. (CONTINUED)

REPLICATE	CHAMBER	FUNGI	SIZE	CO2 TRT	PLANT PART	P	K	CA	MG	N
2	12	M	MD	300	2	.1246	.5351	.6344	.1205	1.23
2	12	M	MD	300	3	.1044	.1581	.3591	.0502	0.42
2	12	M	MD	300	1	.0759	.2990	.2928	.0949	0.54
2	12	X	MD	300	2	.0997	.5238	.3159	.0736	0.60
2	12	X	MD	300	3	.1138	.0701	.2681	.0401	0.40
2	12	X	MD	300	1	.0986	.3595	.2633	.0741	0.32
2	12	X	LG	300	2	.0	.0	.0	.0	0.0
2	12	X	LG	300	3	.0	.0	.0	.0	0.0
2	12	X	LG	300	1	.0	.0	.0	.0	0.0
2	12	M	SM	300	2	.1348	.4043	.7937	.1235	1.11
2	12	M	SM	300	3	.2063	.4338	.4413	.0738	0.75
2	12	M	SM	300	1	.0884	.4774	.3468	.0824	0.56
2	12	X	SM	300	2	.1902	.4007	.5716	.0628	0.84
2	12	X	SM	300	3	.2062	.3094	.3269	.0537	0.52
2	12	X	SM	300	1	.0801	.3767	.2787	.0651	0.41

TABLE 5. MINOR NUTRIENT CONCENTRATIONS OF VIRGINIA PINE AT FINAL HARVEST (UNITS = MG/GRAM DRYWT SAMPLE)

SOME QUANTITIES OF AL AND FE EXCEEDED THE DETECTION LIMITS OF THE INSTRUMENTATION. THESE VALUES ARE REPRESENTED AS 900 WHICH IS THE HIGHEST LEVEL OF DETECTION AND THUS REPRESENTS THE MINIMUM CONCENTRATION POSSIBLE FOR AL AND FE.

REP	CH	MYC	SZ	CO2 TRT	PLANT PART	MN	FE	AL	B	CU	ZN	SR	BA
1	1	M	LG	150	2	209.50	75.08	143.8	17.860	0.9458	17.97	6.478	9.562
1	1	M	LG	150	3	124.10	900.00	900.0	6.240	2.4470	29.73	9.608	34.060
1	1	M	LG	150	1	87.32	79.71	229.3	10.120	2.0000	35.10	8.183	11.700
1	1	X	MD	150	2	615.90	192.60	552.0	24.130	1.9640	62.28	10.240	23.680
1	1	X	MD	150	3	50.59	900.00	900.0	6.678	7.8450	52.90	7.951	39.640
1	1	X	MD	150	1	96.10	71.75	178.8	8.450	3.4080	68.32	8.459	17.780
1	1	M	MD	150	2	639.10	210.60	489.3	30.910	0.9813	22.70	9.547	19.950
1	1	M	MD	150	3	60.48	900.00	900.0	9.120	5.7620	34.93	15.200	52.040
1	1	M	MD	150	1	92.06	59.78	195.4	6.595	1.9440	37.30	11.980	21.400
1	1	X	LG	150	2	259.90	86.78	169.6	22.120	0.9056	30.33	10.400	12.250
1	1	X	LG	150	3	117.00	900.00	900.0	10.670	8.1230	65.43	13.930	51.710
1	1	X	LG	150	1	123.50	73.35	182.6	9.962	1.8720	59.80	9.567	14.510
1	1	X	SM	150	2	498.40	239.40	321.2	19.360	1.1080	34.03	9.613	13.200
1	1	X	SM	150	3	65.95	900.00	900.0	6.844	6.1550	59.38	11.290	50.890
1	1	X	SM	150	1	99.49	102.20	231.8	7.775	1.8070	58.50	11.730	14.710
1	1	M	SM	150	2	254.40	165.30	170.4	8.588	0.7097	13.61	3.703	3.072
1	1	M	SM	150	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	1	M	SM	150	1	98.59	168.50	450.7	7.131	1.0580	24.23	8.361	16.920
1	2	M	LG	600	2	334.00	105.20	300.4	27.810	1.1190	32.46	8.307	11.620
1	2	M	LG	600	3	46.06	900.00	900.0	3.513	10.3200	47.95	7.856	27.240
1	2	M	LG	600	1	127.20	62.57	163.4	11.190	8.4160	62.76	9.822	12.830
1	2	M	MD	600	2	457.50	150.50	380.9	31.210	2.6570	34.96	9.528	21.000
1	2	M	MD	600	3	56.45	900.00	900.0	8.546	8.3860	44.69	9.840	42.620
1	2	M	MD	600	1	114.60	70.23	199.2	6.565	2.5230	50.39	10.880	17.210
1	2	X	MD	600	2	290.00	78.69	182.6	12.540	0.8819	53.86	9.679	14.550
1	2	X	MD	600	3	80.11	900.00	900.0	8.160	9.5370	56.11	15.090	48.600
1	2	X	MD	600	1	63.12	46.86	132.0	6.389	3.4970	34.55	8.480	13.790
1	2	X	LG	600	2	515.10	173.00	364.7	26.600	1.3280	45.45	11.430	21.910
1	2	X	LG	600	3	86.14	900.00	900.0	13.540	8.2100	56.78	14.620	45.110
1	2	X	LG	600	1	128.50	91.67	211.2	10.690	2.2380	70.76	9.113	19.970
1	2	M	SM	600	2	675.20	225.10	684.1	54.530	2.1120	50.11	15.230	26.390
1	2	M	SM	600	3	41.68	900.00	900.0	9.347	7.3000	29.18	10.840	41.120
1	2	M	SM	600	1	84.23	101.40	365.3	5.671	1.9210	50.49	13.580	22.660
1	2	X	SM	600	2	366.70	225.70	335.5	20.870	1.0130	55.64	13.800	22.830
1	2	X	SM	600	3	41.79	900.00	900.0	5.871	5.0150	45.83	6.898	29.930
1	2	X	SM	600	1	78.53	92.21	210.3	10.520	3.0210	65.99	9.816	18.450
1	3	X	LG	0	2	233.40	197.40	127.6	34.830	2.6570	21.62	15.130	16.820
1	3	X	LG	0	3	47.63	900.00	900.0	12.830	5.2530	39.15	12.590	42.460
1	3	X	LG	0	1	61.81	71.49	169.4	9.983	4.0630	40.99	11.260	15.670
1	3	X	MD	0	2	571.80	262.10	452.5	30.010	1.8400	39.87	7.741	20.440
1	3	X	MD	0	3	47.00	900.00	900.0	9.405	4.4930	21.44	9.677	36.740
1	3	X	MD	0	1	115.40	126.20	245.4	7.698	2.1240	48.57	9.603	16.640
1	3	M	LG	0	2	482.90	115.70	279.9	50.220	2.4490	47.37	22.280	30.200
1	3	M	LG	0	3	34.75	900.00	900.0	8.152	6.2110	29.92	12.060	40.750
1	3	M	LG	0	1	78.16	57.87	208.5	7.601	2.8950	52.12	9.456	16.360

TABLE 5. (CONTINUED)

REP	CH	MYC	SZ	CO2 TRT	PLANT PART	MN	FE	AL	B	CU	ZN	SR	BA
1	3	X	SM	0	2	464.40	141.20	466.6	27.580	2.3790	53.46	9.886	22.570
1	3	X	SM	0	3	46.06	900.00	900.0	3.954	8.1970	38.60	9.257	34.900
1	3	X	SM	0	1	101.50	85.28	215.6	8.920	3.0960	62.78	10.090	17.000
1	3	M	SM	0	2	284.60	119.30	277.1	28.440	1.8180	19.03	8.931	14.240
1	3	M	SM	0	3	44.82	900.00	900.0	7.850	6.0670	28.95	10.800	39.870
1	3	M	SM	0	1	75.56	49.00	175.8	8.997	2.8040	47.76	9.478	14.350
1	4	X	LG	1	2	559.00	188.80	402.4	27.130	2.0040	62.94	11.840	20.130
1	4	X	LG	1	3	39.71	900.00	900.0	5.817	7.2230	35.79	7.000	25.780
1	4	X	LG	1	1	103.10	111.70	304.4	10.520	2.3110	60.34	8.974	20.900
1	4	M	MD	1	2	479.00	220.60	304.4	36.380	2.1350	20.10	11.460	17.220
1	4	M	MD	1	3	73.71	900.00	900.0	12.480	11.3400	42.06	15.350	53.410
1	4	M	MD	1	1	118.40	77.43	212.7	8.459	4.2710	47.06	9.872	17.000
1	4	X	MD	1	2	361.00	145.40	419.6	13.900	1.3800	40.75	8.407	14.580
1	4	X	MD	1	3	49.87	900.00	900.0	9.682	10.8800	55.56	10.710	45.890
1	4	X	MD	1	1	53.34	102.40	260.1	8.963	3.4430	51.19	10.060	17.160
1	4	M	LG	1	2	659.00	220.20	501.3	33.040	1.6610	31.10	16.640	21.240
1	4	M	LG	1	3	54.43	900.00	900.0	10.220	11.1300	31.47	11.890	36.750
1	4	M	LG	1	1	98.63	57.69	199.3	10.210	3.6970	59.78	11.510	16.980
1	4	X	SM	1	2	545.60	261.00	565.5	21.050	2.0780	30.91	10.050	22.840
1	4	X	SM	1	3	36.67	900.00	900.0	11.170	7.5660	28.27	9.335	44.880
1	4	X	SM	1	1	76.82	104.90	292.5	7.602	2.7170	46.12	14.660	25.850
1	4	M	SM	1	2	339.40	241.00	250.1	26.930	1.1050	18.44	14.530	18.300
1	4	M	SM	1	3	55.74	900.00	900.0	11.440	7.5700	33.53	15.000	57.760
1	4	M	SM	1	1	98.77	81.77	258.3	10.010	2.5810	37.58	11.000	22.890
1	5	M	LG	75	2	278.00	198.60	191.1	28.190	1.7610	21.43	10.390	16.130
1	5	M	LG	75	3	63.92	900.00	900.0	6.465	5.1110	14.56	8.041	33.170
1	5	M	LG	75	1	92.39	69.88	176.1	6.373	2.3630	46.67	10.760	14.070
1	5	X	MD	75	2	280.90	126.40	173.0	24.860	2.3450	45.62	12.940	17.690
1	5	X	MD	75	3	148.60	900.00	900.0	11.870	11.4700	35.61	11.340	50.270
1	5	X	MD	75	1	97.03	110.00	248.4	9.057	3.3500	52.80	10.920	16.400
1	5	M	MD	75	2	691.30	275.00	489.0	23.700	1.2450	25.38	12.590	17.390
1	5	M	MD	75	3	56.63	900.00	900.0	9.353	6.8480	26.05	14.870	53.860
1	5	M	MD	75	1	102.60	129.60	332.3	6.298	2.3230	45.56	11.910	17.450
1	5	X	LG	75	2	565.00	172.90	401.1	25.720	1.6740	26.97	9.092	15.960
1	5	X	LG	75	3	59.96	900.00	900.0	10.110	7.2360	19.26	10.270	48.000
1	5	X	LG	75	1	90.62	59.29	205.2	7.858	2.3110	48.07	8.873	19.210
1	5	X	SM	75	2	129.90	332.50	657.7	23.960	1.1440	55.23	9.080	21.150
1	5	X	SM	75	3	58.41	900.00	900.0	11.500	3.9540	16.18	11.530	52.720
1	5	X	SM	75	1	95.32	130.90	371.2	8.753	1.7610	35.50	15.830	27.570
1	5	M	SM	75	2	669.20	324.30	623.3	44.430	2.3720	29.37	16.960	33.650
1	5	M	SM	75	3	50.57	900.00	900.0	12.090	6.9060	33.63	16.210	55.440
1	6	M	LG	300	2	546.40	280.20	298.1	27.280	1.0950	24.40	12.080	15.240
1	6	M	LG	300	3	46.77	900.00	900.0	9.050	11.0900	39.03	11.340	52.480
1	6	M	LG	300	1	121.50	126.70	343.0	8.239	2.2340	56.26	9.544	22.840
1	6	M	MD	300	2	456.90	109.60	294.2	36.000	1.7270	42.32	11.420	16.030

TABLE 5. (CONTINUED)

REP	CH	MYC	SZ	CO2 TRT	PLANT PART	MN	FE	AL	B	CU	ZN	SR	BA
1	6	M	MD	300	3	61.90	900.00	900.0	8.335	7.5080	29.27	10.040	47.190
1	6	M	MD	300	1	99.28	88.68	231.3	9.860	4.1390	61.48	11.720	17.010
1	6	X	MD	300	2	313.00	80.23	222.9	19.850	1.4050	34.59	7.893	11.280
1	6	X	MD	300	3	47.24	900.00	900.0	8.407	8.9860	30.04	9.036	32.840
1	6	X	MD	300	1	75.41	101.30	258.0	7.498	3.4650	43.34	8.318	13.040
1	6	X	LG	300	2	325.30	126.30	298.2	36.070	1.7990	27.04	10.140	18.780
1	6	X	LG	300	3	89.62	900.00	900.0	8.250	6.4800	32.56	10.180	50.470
1	6	X	LG	300	1	121.80	95.74	253.3	11.120	2.6930	56.01	9.203	18.220
1	6	X	SM	300	2	660.90	264.50	582.3	32.850	2.7420	55.57	11.790	19.720
1	6	X	SM	300	3	94.60	900.00	900.0	6.916	9.6330	41.93	10.370	38.960
1	6	X	SM	300	1	62.46	99.29	219.5	4.746	4.5160	63.23	11.250	13.760
1	6	M	SM	300	2	389.50	259.50	297.7	31.760	1.4170	28.07	16.130	18.880
1	6	M	SM	300	3	62.31	900.00	900.0	8.325	8.1810	47.02	15.860	46.490
1	6	M	SM	300	1	91.81	97.98	248.0	8.426	3.1100	51.43	9.129	19.070
2	7	M	LG	75	2	260.00	99.53	333.2	27.490	2.5020	23.91	8.663	18.850
2	7	M	LG	75	3	45.03	900.00	900.0	9.800	13.3600	59.74	8.038	35.340
2	7	M	LG	75	1	75.60	31.38	114.1	9.235	2.6940	50.07	7.912	14.550
2	7	X	MD	75	2	537.90	184.30	412.7	20.810	1.3750	40.73	11.760	22.990
2	7	X	MD	75	3	80.40	900.00	900.0	11.420	6.9050	64.46	11.080	49.140
2	7	X	MD	75	1	125.00	111.90	264.9	10.100	3.6450	57.88	9.459	18.170
2	7	M	MD	75	2	170.00	129.20	153.0	29.330	1.6620	23.28	10.820	15.240
2	7	M	MD	75	3	47.74	900.00	900.0	9.243	4.0190	22.86	7.146	32.020
2	7	M	MD	75	1	61.90	87.91	258.4	10.220	2.7360	42.04	11.020	17.260
2	7	X	LG	75	2	467.10	166.60	482.8	30.960	1.6350	29.94	9.202	16.660
2	7	X	LG	75	3	79.94	900.00	900.0	11.420	5.7250	56.59	12.120	40.110
2	7	X	LG	75	1	93.22	108.80	276.1	8.014	1.9700	58.40	11.950	18.310
2	7	X	SM	75	2	471.60	121.00	272.7	21.250	1.5520	57.96	9.909	17.840
2	7	X	SM	75	3	79.24	900.00	900.0	10.570	15.6600	68.06	7.472	46.240
2	7	X	SM	75	1	69.54	59.07	148.4	7.535	2.6620	57.47	7.318	12.290
2	7	M	SM	75	3	45.29	900.00	900.0	11.320	7.3750	45.52	11.200	49.890
2	7	M	SM	75	1	93.77	93.67	237.0	8.955	2.8720	63.13	11.760	23.170
2	8	X	LG	1	3	300.50	113.00	213.0	33.970	1.8700	24.79	11.730	16.530
2	8	X	LG	1	2	128.30	900.00	900.0	10.540	3.7360	23.84	10.920	43.140
2	8	X	LG	1	1	123.10	69.50	203.1	9.105	1.9930	67.63	10.490	15.670
2	8	M	MD	1	2	342.90	232.10	333.0	30.430	1.0410	27.52	18.500	24.880
2	8	M	MD	1	3	85.79	900.00	900.0	12.290	5.1930	46.87	11.830	53.550
2	8	M	MD	1	1	84.51	87.53	220.1	8.843	2.6730	52.61	9.043	19.710
2	8	X	MD	1	2	362.00	135.60	333.3	16.930	1.5930	29.55	13.670	22.720
2	8	X	MD	1	3	87.18	900.00	900.0	8.647	4.3200	47.02	8.076	48.260
2	8	X	MD	1	1	105.80	102.60	285.0	8.051	2.3520	54.16	10.480	20.670
2	8	M	LG	1	2	562.60	168.50	431.9	43.180	2.7130	33.69	11.680	18.240
2	8	M	LG	1	3	60.25	900.00	900.9	9.396	11.7500	46.64	10.530	39.750
2	8	M	LG	1	1	149.25	62.99	196.0	7.507	3.2680	61.37	13.670	18.830
2	8	M	SM	1	2	480.80	186.20	612.4	23.970	1.4500	29.38	7.689	12.570
2	8	M	SM	1	3	30.18	900.00	900.0	6.025	3.7700	21.55	10.480	38.360

TABLE 5. (CONTINUED)

REP	CH	MYC	SZ	CO2 TRT	PLANT PART	MN	FE	AL	B	CU	ZN	SR	BA
2	8	M	SM	1	1	89.63	60.64	207.4	4.386	0.9780	30.23	8.343	15.370
2	8	X	SM	1	2	411.70	189.10	477.1	31.890	2.3910	56.68	18.630	29.940
2	8	X	SM	1	3	50.82	900.00	900.0	3.659	5.8800	47.91	7.187	30.790
2	8	X	SM	1	1	54.06	52.04	156.1	8.275	3.8410	63.65	9.133	16.280
2	9	X	LG	600	2	290.50	112.80	349.8	21.810	1.3450	59.27	9.246	13.830
2	9	X	LG	600	3	63.57	900.00	900.0	6.618	4.6570	43.57	9.582	28.920
2	9	X	LG	600	1	137.70	163.70	447.8	11.780	3.9240	59.98	9.311	17.730
2	9	X	MD	600	2	262.70	106.20	288.2	27.100	1.0970	28.51	9.716	13.840
2	9	X	MD	600	3	78.49	900.00	900.0	6.659	10.6900	63.90	10.740	45.900
2	9	X	MD	600	1	123.80	62.19	220.8	9.231	2.6830	48.40	8.848	12.520
2	9	M	MD	600	2	337.80	137.80	294.7	26.000	1.5460	38.31	12.420	17.850
2	9	M	MD	600	3	69.09	900.00	900.0	11.200	9.1780	35.87	11.060	40.420
2	9	M	MD	600	1	78.02	67.22	183.1	8.676	2.3940	47.93	10.690	16.510
2	9	M	LG	600	2	399.30	264.70	356.9	38.320	1.3140	28.35	11.760	13.770
2	9	M	LG	600	3	73.33	900.00	900.0	9.243	8.4030	38.57	11.870	40.640
2	9	M	LG	600	1	180.50	58.71	189.5	11.400	2.5170	54.55	10.030	16.340
2	9	X	SM	600	2	675.50	218.60	548.8	38.070	2.0670	57.75	16.750	33.120
2	9	X	SM	600	3	44.11	900.00	900.0	7.276	6.1110	29.92	9.245	35.840
2	9	X	SM	600	1	96.39	70.04	275.4	5.268	1.9860	46.32	10.590	20.930
2	9	M	SM	600	2	294.70	156.30	277.2	42.790	1.4360	38.98	12.920	22.700
2	9	M	SM	600	3	29.15	900.00	900.0	7.956	8.5320	29.80	9.301	31.600
2	9	M	SM	600	1	77.93	66.07	251.9	8.435	4.0820	50.13	12.460	21.460
2	10	M	LG	150	2	456.60	156.80	408.4	32.260	1.6650	34.90	9.786	16.930
2	10	M	LG	150	3	48.49	900.00	900.0	5.916	9.9320	30.21	12.180	35.960
2	10	M	LG	150	1	106.20	67.45	197.5	10.160	2.6250	58.49	10.310	16.050
2	10	M	MD	150	2	309.80	114.80	328.5	28.550	1.6700	32.03	14.020	19.750
2	10	M	MD	150	3	59.09	900.00	900.0	6.515	10.9500	39.86	13.090	41.980
2	10	M	MD	150	1	79.06	87.40	221.2	9.582	3.2920	50.49	9.648	14.140
2	10	X	MD	150	2	354.50	97.62	305.3	32.410	1.7800	19.18	9.411	14.950
2	10	X	MD	150	3	53.67	900.00	900.0	10.740	8.8020	38.11	10.190	42.260
2	10	X	MD	150	1	70.57	51.99	170.9	5.822	3.7610	41.32	9.672	14.680
2	10	X	LG	150	2	468.60	140.20	391.1	26.510	1.5880	21.74	8.051	13.090
2	10	X	LG	150	3	110.80	900.00	900.0	10.590	8.9030	39.86	10.970	47.120
2	10	X	LG	150	1	133.00	106.30	237.3	10.060	4.7000	40.18	11.300	18.760
2	10	X	SM	150	2	282.70	135.80	283.9	17.710	1.3870	18.87	6.607	17.300
2	10	X	SM	150	3	51.28	900.00	900.0	10.800	4.8640	26.76	9.764	51.800
2	10	X	SM	150	1	89.80	113.90	276.6	8.385	3.2750	57.94	10.370	22.780
2	10	M	SM	150	2	415.20	244.70	478.7	27.700	2.6280	30.19	9.172	26.400
2	10	M	SM	150	3	38.43	900.00	900.0	7.410	6.0030	24.19	5.411	34.370
2	10	M	SM	150	1	88.50	80.60	232.0	5.306	2.3040	44.06	9.082	22.860
2	11	M	LG	0	2	431.30	206.10	411.1	38.070	2.2800	33.69	18.400	30.270
2	11	M	LG	0	3	68.86	900.00	900.0	10.590	11.4500	36.35	9.981	43.590
2	11	M	LG	0	1	106.70	77.08	202.9	10.360	2.1460	50.85	9.474	16.440
2	11	M	MD	0	2	561.30	191.40	507.2	31.450	2.1720	32.34	10.230	19.700
2	11	M	MD	0	3	58.43	900.00	900.0	14.530	10.0500	44.05	12.660	56.370

TABLE 5. (CONTINUED)

REP	CH	MYC	SZ	CO2 TRT	PLANT PART	MN	FE	AL	B	CU	ZN	SR	BA
2	11	M	MD	0	1	98.57	109.30	299.4	6.473	2.2740	51.71	11.390	17.510
2	11	X	MD	0	2	230.20	87.28	275.9	26.850	2.4180	31.11	7.903	13.150
2	11	X	MD	0	3	77.57	900.00	900.0	8.159	12.4400	59.56	9.657	40.570
2	11	X	MD	0	1	74.25	68.38	168.2	7.535	3.2590	49.47	6.738	12.550
2	11	X	LG	0	2	367.50	202.50	263.4	29.340	1.3040	20.18	8.290	11.790
2	11	X	LG	0	3	73.50	900.00	900.0	8.159	10.4700	48.45	9.951	57.350
2	11	X	LG	0	1	101.20	61.47	156.9	11.260	3.4490	50.90	9.283	17.550
2	11	X	SM	0	2	572.50	226.20	504.2	28.390	2.1860	54.91	9.212	22.090
2	11	X	SM	0	3	48.67	900.00	900.0	10.940	10.0600	62.53	15.780	56.320
2	11	X	SM	0	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	11	M	SM	0	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	11	M	SM	0	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	11	M	SM	0	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	12	M	LG	300	2	366.60	172.30	384.7	28.700	2.2940	35.68	13.060	20.830
2	12	M	LG	300	3	76.31	900.00	900.0	10.420	12.1900	68.18	11.240	44.390
2	12	M	LG	300	1	113.00	65.51	226.1	10.320	3.6230	62.54	10.480	17.240
2	12	M	MD	300	2	396.70	202.80	546.3	32.350	2.4220	40.30	12.030	20.320
2	12	M	MD	300	3	68.27	900.00	900.0	8.740	8.8820	45.95	9.036	44.340
2	12	M	MD	300	1	115.40	124.70	389.1	9.392	3.7890	68.14	11.120	17.920
2	12	X	MD	300	2	279.30	108.50	336.7	13.890	1.2760	29.43	4.650	11.980
2	12	X	MD	300	3	75.27	900.00	900.0	7.671	10.3300	45.44	7.021	38.990
2	12	X	MD	300	1	94.97	103.20	243.2	10.640	2.6270	49.52	7.585	15.210
2	12	X	LG	300	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	12	X	LG	300	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	12	X	LG	300	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	12	M	SM	300	2	584.40	186.40	511.4	32.900	3.0390	40.44	14.730	22.910
2	12	M	SM	300	3	92.46	900.00	900.0	12.630	15.1200	67.87	12.330	50.600
2	12	M	SM	300	1	74.38	45.70	163.3	9.595	6.0450	49.46	9.188	15.510
2	12	X	SM	300	2	471.00	123.00	337.4	18.900	1.3220	42.65	11.850	23.670
2	12	X	SM	300	3	66.68	900.00	900.0	10.540	9.5160	74.61	9.727	40.930
2	12	X	SM	300	1	83.01	65.17	199.1	6.035	2.9660	62.00	12.940	19.950

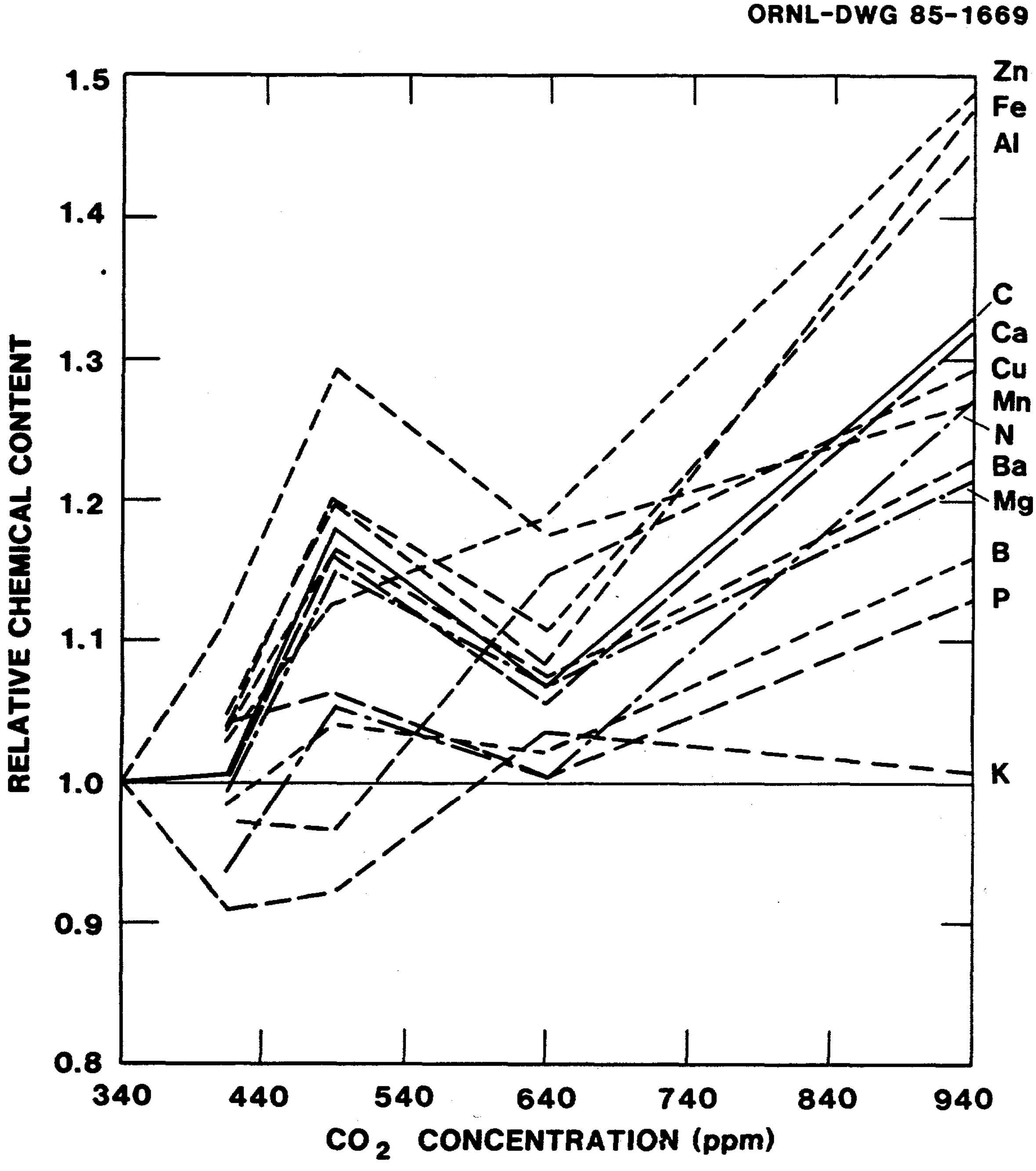

Figure 2. Relative Chemical Content of Thirteen Plant Elements as a Function of Atmospheric CO_2. Data for Al and Fe are approximate. (*Source*: Luxmoore, R. J., et al., "Nutrient-Uptake and Growth Responses of Virginia Pine to Elevated Atmospheric CO_2," submitted to *J. Environmental Quality*).

TABLE 6. SOIL NUTRIENT ANALYSIS AT FINAL HARVEST

UNITS: SOLUBLE SALTS IS EXPRESSED AS A PERCENT
P, K, CA, MG, AND NITRATE ARE EXPRESSED IN PPM
CO2 TRT IS EXPRESSED AS PPMV CO2 ABOVE AMBIENT (340 PPMV)

CHAMBER	REPLICATE	MYC	SIZE CLASS	CO2 TRT	SOIL PH	P	K	CA	MG	NO3-	SOLUBLE SALTS
1	1	M	LG	150	6.1	7	26	632	26	3	6.2
1	1	X	MD	150	5.8	8	35	529	23	7	7.1
1	1	M	MD	150	5.9	8	23	513	20	3	4.8
1	1	X	LG	150	6.0	7	31	652	26	3	6.2
1	1	X	SM	150	6.1	7	35	637	25	3	5.7
1	1	M	SM	150	5.9	7	38	500	18	3	5.0
2	1	M	LG	600	5.9	7	26	655	26	4	7.5
2	1	M	MD	600	6.1	8	40	721	31	3	5.0
2	1	X	MD	600	6.0	7	26	636	27	4	5.4
2	1	X	LG	600	5.7	8	33	581	23	3	6.4
2	1	M	SM	600	5.8	7	28	525	19	7	5.2
2	1	X	SM	600	6.0	7	39	630	25	3	5.7
3	1	X	LG	0	6.0	7	28	600	23	4	6.2
3	1	X	MD	0	5.9	7	33	601	25	4	5.9
3	1	M	LG	0	6.1	7	24	650	26	7	5.3
3	1	X	SM	0	5.8	7	28	562	20	3	5.9
3	1	M	SM	0	6.1	8	31	645	26	7	5.1
3	1	M	MD	0	0.0	0	0	0	0	0	0.0
4	1	X	LG	1	5.9	8	31	593	22	4	6.2
4	1	M	MD	1	6.0	9	33	581	22	11	5.3
4	1	X	MD	1	6.2	12	42	655	28	4	4.9
4	1	M	LG	1	5.8	7	28	482	16	3	5.6
4	1	X	SM	1	5.7	11	29	487	18	11	5.3
4	1	M	SM	1	5.9	8	24	563	24	7	5.9
5	1	M	LG	75	5.9	8	27	611	26	7	4.8
5	1	X	MD	75	5.8	8	19	620	23	4	4.7
5	1	M	MD	75	5.9	7	31	520	23	3	5.4
5	1	X	LG	75	5.9	8	28	590	20	4	5.2
5	1	X	SM	75	5.9	8	26	573	23	4	5.1
5	1	M	SM	75	5.9	8	29	567	22	7	5.1
6	1	M	LG	300	5.8	6	21	263	8	7	7.0
6	1	M	MD	300	6.0	8	24	489	21	4	7.0
6	1	X	MD	300	6.1	8	42	659	26	4	11.0
6	1	X	LG	300	5.9	9	34	617	24	4	7.6
6	1	X	SM	300	6.1	8	26	754	30	4	5.4
6	1	M	SM	300	6.0	9	36	668	29	3	5.7
7	2	M	LG	75	6.0	9	36	881	38	3	5.5
7	2	X	MD	75	5.7	8	26	546	21	4	4.9
7	2	M	MD	75	6.0	7	23	676	27	7	5.1
7	2	X	LG	75	6.0	8	29	671	27	7	5.9

TABLE 6. (CONTINUED)

CHAMBER	REPLICATE	MYC	SIZE CLASS	CO2 TRT	SOIL PH	P	K	CA	MG	NO3-	SOLUBLE SALTS
7	2	X	SM	75	6.1	8	31	626	22	4	5.2
7	2	M	SM	75	6.0	6	29	554	20	11	4.9
8	2	X	LG	1	5.9	7	32	632	25	4	6.2
8	2	M	MD	1	6.2	10	26	601	24	7	4.5
8	2	X	MD	1	6.0	7	35	602	22	4	5.7
8	2	M	LG	1	6.1	6	28	584	21	7	4.3
8	2	M	SM	1	6.1	7	30	574	20	3	4.7
8	2	X	SM	1	6.1	7	21	576	22	7	4.9
9	2	X	LG	600	5.9	7	28	581	22	4	6.0
9	2	X	MD	600	6.0	7	31	600	22	4	5.3
9	2	M	MD	600	6.1	7	25	582	20	4	4.9
9	2	M	LG	600	6.1	6	10	613	24	3	5.2
9	2	X	SM	600	6.1	6	22	495	17	7	4.7
9	2	M	SM	600	5.8	8	27	470	16	3	4.5
10	2	M	LG	150	6.0	7	22	627	24	7	4.2
10	2	M	MD	150	6.0	7	30	607	23	3	4.9
10	2	X	MD	150	5.8	6	22	472	16	4	5.3
10	2	X	LG	150	5.8	12	34	573	22	3	5.3
10	2	X	SM	150	6.2	10	30	832	46	4	5.9
10	2	M	SM	150	6.0	6	30	590	23	3	4.9
11	2	M	LG	0	6.1	7	30	558	19	3	4.8
11	2	M	MD	0	6.1	7	39	591	23	3	4.3
11	2	X	MD	0	6.2	6	20	616	24	14	5.3
11	2	X	LG	0	6.3	10	25	858	48	4	5.7
11	2	X	SM	0	6.1	6	26	488	18	7	4.3
11	2	M	SM	0	0.0	0	0	0	0	0	0.0
12	2	M	LG	300	6.1	7	25	595	23	4	4.3
12	2	M	MD	300	6.2	7	26	591	23	11	4.6
12	2	X	MD	300	6.0	6	32	605	25	3	7.2
12	2	M	SM	300	6.2	7	25	647	26	7	4.7
12	2	X	SM	300	5.9	7	27	538	18	3	4.7
12	2	X	LG	300	0.0	0	0	0	0	0	0.0

TABLE 7. ELEMENTS FROM SOIL LEACHATE SAMPLES (UNITS=MICROGRAMS PER MILLILITER)

REPLICATE	MYCOR-RHIZAE	SIZE CLASS	CO2 TRT	P	K	CA	MG	MN	FE	AL
1	M	LG	150	.150	2.68	10.70	1.35	.028	9.23	19.50
1	X	MD	150	.098	1.53	15.00	1.49	.028	10.40	23.70
1	M	MD	150	.024	1.68	11.90	1.25	.009	3.08	7.98
1	X	LG	150	.009	1.33	10.30	1.27	.009	4.29	10.40
1	X	SM	150	.023	1.16	12.30	1.41	.009	4.15	11.10
1	M	SM	150	.009	1.77	11.10	1.14	.009	2.13	5.55
1	M	LG	600	.009	0.70	7.92	0.94	.009	3.43	8.41
1	M	MD	600	.089	2.13	13.00	1.41	.019	8.41	15.70
1	X	MD	600	.021	1.99	14.80	1.59	.009	4.54	11.10
1	X	LG	600	.150	1.24	11.40	1.21	.025	9.68	20.30
1	M	SM	600	.150	1.68	15.20	1.41	.019	8.11	18.90
1	X	SM	600	.150	2.40	10.60	1.21	.025	10.20	20.20
1	X	LG	0	.250	2.87	16.60	1.83	.028	12.10	28.50
1	X	MD	0	.250	2.38	15.30	1.70	.028	13.10	28.20
1	M	MD	0	.0	0.0	0.0	0.0	.0	0.0	0.0
1	M	LG	0	.220	1.87	13.80	1.59	.028	10.20	26.10
1	X	SM	0	.120	2.16	12.90	1.30	.015	6.21	13.30
1	M	SM	0	.120	2.20	14.00	1.53	.019	7.36	18.10
1	X	LG	1	.057	1.25	12.10	1.18	.009	3.59	8.11
1	M	MD	1	.190	2.21	11.80	1.29	.028	8.95	23.50
1	X	MD	1	.110	1.77	9.82	1.18	.019	8.00	17.10
1	M	LG	1	.210	3.25	11.70	1.34	.040	7.93	19.50
1	X	SM	1	.140	2.08	12.80	1.32	.022	7.15	17.20
1	M	SM	1	.240	2.29	13.10	1.54	.028	10.00	28.00
1	M	LG	75	.082	2.37	10.30	1.18	.015	5.93	14.80
1	X	MD	75	.170	1.97	12.20	1.34	.022	8.39	20.20
1	M	MD	75	.120	1.82	12.10	1.38	.015	5.90	15.00
1	X	LG	75	.200	2.44	12.80	1.42	.028	9.40	24.90
1	X	SM	75	.036	3.14	15.50	1.54	.009	1.95	5.43
1	M	SM	75	.052	2.04	9.98	1.04	.009	4.03	9.24
1	M	LG	300	.120	2.52	13.20	1.34	.022	8.04	19.10
1	M	MD	300	.080	2.88	16.40	1.67	.015	5.66	14.30
1	X	MD	300	.170	2.10	15.00	1.70	.028	10.80	25.70
1	X	LG	300	.044	1.47	13.00	1.48	.012	5.80	13.10
1	X	SM	300	.160	1.52	13.40	1.42	.022	9.20	21.20
1	M	SM	300	.130	2.07	13.40	1.37	.018	7.92	18.30
2	X	MD	75	.120	2.35	14.40	1.61	.014	5.45	11.40
2	M	LG	75	.056	2.00	7.92	1.15	.014	2.21	5.72
2	M	MD	75	.220	3.16	14.00	1.71	.026	10.70	25.90
2	X	LG	75	.140	2.21	15.50	1.74	.014	6.48	16.10
2	X	SM	75	.190	3.01	11.90	1.27	.017	7.23	14.20
2	M	SM	75	.130	1.58	10.50	1.14	.020	6.80	17.20

TABLE 7. (CONTINUED)

REPLICATE	MYCOR-RHIZAE	SIZE CLASS	CO2 TRT	P	K	CA	MG	MN	FE	AL
2	X	LG	1	.180	1.62	9.46	1.08	.020	8.69	16.50
2	M	MD	1	.160	1.78	12.00	1.19	.017	6.79	15.90
2	X	MD	1	.094	2.29	12.70	1.33	.014	6.28	13.30
2	M	LG	1	.160	1.14	10.30	1.17	.020	8.98	20.40
2	X	SM	1	.094	2.08	10.30	1.18	.014	5.46	14.80
2	M	SM	1	.061	0.92	11.00	1.16	.011	4.84	12.60
2	X	LG	600	.009	0.97	8.88	1.01	.009	1.77	4.72
2	X	MD	600	.088	1.72	13.30	1.61	.017	7.61	18.60
2	M	LG	600	.009	1.64	11.10	1.26	.009	2.98	7.94
2	M	LG	600	.066	0.91	12.30	1.61	.009	4.19	9.83
2	X	SM	600	.076	0.83	11.70	1.15	.017	6.69	16.50
2	M	SM	600	.022	0.49	11.60	1.08	.009	3.50	9.35
2	M	LG	150	.036	1.39	9.43	1.14	.009	3.16	7.85
2	M	MD	150	.120	1.83	14.40	1.60	.020	8.34	19.50
2	X	MD	150	.090	1.28	14.20	1.60	.035	8.14	17.20
2	X	LG	150	.088	0.82	16.00	1.67	.020	9.18	20.70
2	X	SM	150	.190	1.88	14.80	1.56	.026	10.60	25.40
2	M	SM	150	.170	2.36	10.70	1.28	.020	7.53	19.60
2	M	LG	0	.078	1.67	12.50	1.39	.017	7.96	17.90
2	M	MD	0	.160	1.91	13.20	1.53	.020	10.00	23.20
2	X	MD	0	.014	1.08	11.20	1.32	.009	4.97	11.20
2	X	LG	0	.150	1.86	13.10	1.45	.026	10.10	23.10
2	X	SM	0	.087	1.41	12.30	1.34	.014	6.23	16.70
2	M	SM	0	.0	0.0	0.0	0.0	.0	0.0	0.0
2	M	LG	300	.009	1.48	8.61	1.14	.009	2.08	5.67
2	M	MD	300	.110	2.71	12.20	1.49	.017	7.10	16.70
2	X	MD	300	.120	1.27	14.10	1.59	.020	8.09	19.20
2	X	LG	300	.0	0.0	0.0	0.0	.0	0.0	0.0
2	M	SM	300	.130	2.08	13.10	1.54	.014	7.68	18.10
2	X	SM	300	.087	1.87	10.60	1.21	.014	5.20	12.50

TABLE 8. ADDITIONAL SOLUTES FROM SOIL LEACHATE SAMPLES (UNITS=MICROGRAMS PER MILLILITER)

REPLICATE	MYCOR- RHIZAE	SIZE CLASS	CO2 TRT	B	ZN	NA	NH4	NO3
1	M	LG	150	.009	.140	5.29	0.70	1.75
1	X	MD	150	.016	.130	6.86	0.53	1.75
1	M	MD	150	.011	.061	6.54	0.35	0.70
1	X	LG	150	.009	.083	6.32	0.88	1.23
1	X	SM	150	.009	.110	6.59	0.18	0.70
1	M	SM	150	.009	.057	5.98	0.88	2.45
1	M	LG	600	.011	.024	6.17	1.05	1.05
1	M	MD	600	.018	.017	5.83	0.88	0.53
1	X	MD	600	.023	.018	6.41	1.93	0.88
1	X	LG	600	.014	.023	5.64	0.88	0.35
1	M	SM	600	.023	.022	6.12	1.05	1.23
1	X	SM	600	.014	.045	5.05	0.70	0.88
1	X	LG	0	.021	.061	6.72	1.40	2.63
1	X	MD	0	.016	.037	6.78	0.70	2.28
1	M	MD	0	.0	.0	0.0	0.0	0.0
1	M	LG	0	.018	.038	6.00	1.23	1.75
1	X	SM	0	.016	.017	6.28	1.93	0.70
1	M	SM	0	.009	.023	6.04	1.75	2.45
1	X	LG	1	.009	.011	5.58	1.23	1.05
1	M	MD	1	.021	.023	5.36	0.53	1.23
1	X	MD	1	.009	.031	6.09	0.70	1.75
1	M	LG	1	.040	.035	5.80	0.35	1.75
1	X	SM	1	.026	.019	6.17	0.18	1.05
1	M	SM	1	.014	.032	5.93	0.88	2.28
1	M	LG	75	.009	.018	5.70	0.09	1.23
1	X	MD	75	.018	.020	5.62	0.18	1.23
1	M	MD	75	.021	.032	6.23	0.35	1.40
1	X	LG	75	.011	.027	5.39	0.53	1.75
1	M	LG	75	.009	.009	6.17	1.05	4.55
1	M	SM	75	.009	.010	5.77	0.88	0.35
1	M	LG	300	.009	.037	5.56	0.70	1.93
1	M	MD	300	.021	.310	6.25	1.40	0.53
1	X	MD	300	.011	.084	6.49	1.23	1.23
1	X	LG	300	.009	.031	5.78	0.18	1.23
1	X	SM	300	.018	.044	5.78	0.35	1.40
1	M	SM	300	.011	.026	5.51	0.09	0.70
2	M	LG	75	.013	.290	6.18	0.35	1.05
2	M	MD	75	.025	.120	6.42	0.35	1.23
2	X	LG	75	.030	.068	7.09	0.35	1.40
2	X	SM	75	.033	.042	6.04	0.09	1.05
2	M	SM	75	.020	.023	5.96	0.53	0.88
2	X	LG	1	.011	.025	4.79	0.70	0.18
2	X	MD	75	.018	.200	7.11	0.09	1.05
2	M	MD	1	.018	.019	5.77	0.70	1.40
2	X	MD	1	.020	.032	6.04	0.35	1.05

TABLE 8. (CONTINUED)

REPLICATE	MYCOR-RHIZAE	SIZE CLASS	CO2 TRT	B	ZN	NA	NH4	NO3
2	M	LG	1	.013	.027	5.82	0.18	0.88
2	M	SM	1	.018	.052	5.92	0.70	0.70
2	X	SM	1	.013	.021	6.44	0.09	0.18
2	X	LG	600	.009	.083	6.15	0.18	1.05
2	X	MD	600	.011	.160	6.99	0.35	1.05
2	M	MD	600	.009	.023	6.66	0.09	1.05
2	M	LG	600	.009	.120	6.24	0.53	1.58
2	X	SM	600	.009	.022	6.34	1.93	0.09
2	M	SM	600	.023	.014	5.57	0.53	1.05
2	M	LG	150	.009	.026	6.32	1.75	0.09
2	M	MD	150	.018	.022	6.83	1.05	1.05
2	X	MD	150	.030	.028	7.13	0.88	1.05
2	X	LG	150	.020	.023	7.02	1.40	1.93
2	X	SM	150	.023	.021	6.33	0.70	1.23
2	M	SM	150	.009	.025	5.71	0.88	0.09
2	M	LG	0	.013	.020	6.39	0.70	1.40
2	M	MD	0	.018	.083	6.12	0.09	1.40
2	X	MD	0	.009	.016	6.84	0.88	1.05
2	X	LG	0	.023	.023	6.54	0.18	1.05
2	X	SM	0	.030	.020	6.88	0.53	1.05
2	M	SM	0	.0	.0	0.0	0.0	0.0
2	M	LG	300	.013	.140	6.54	1.23	0.35
2	M	MD	300	.025	.085	6.19	0.18	1.58
2	X	MD	300	.011	.160	6.75	0.53	1.23
2	X	LG	300	.0	.0	0.0	0.0	0.0
2	M	SM	300	.009	.160	6.42	0.09	1.23
2	X	SM	300	.013	.074	6.09	0.35	1.05

rl fruits removed. dg