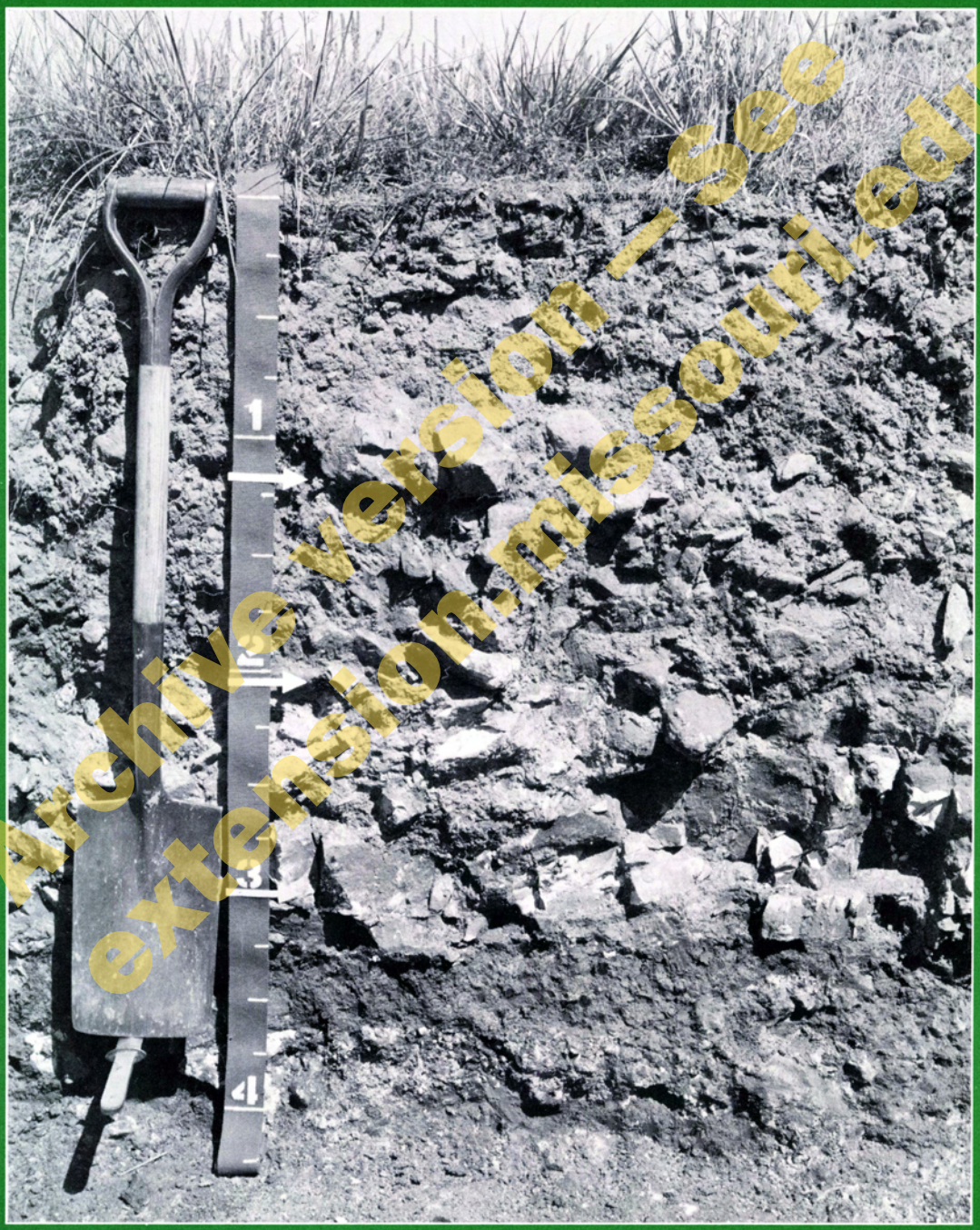
Soil Productivity Indices and Soil Properties of Some Major Soil Series of the Missouri Ozarks



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On the Cover: Profile of the Creldon soil series.

Soil Productivity Indices and Soil Properties of Some Major Soil Series of the Missouri Ozarks

by
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United States Department of Agriculture
Soil Conservation Service
And
State of Missouri Department
of Natural Resources

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INTRODUCTION

This report presents a method for arriving at a productivity index (PI) for major soils of the Missouri Ozarks that are underlain by carbonate rocks. The PI model was developed by Kiniry, Scrivner and Keener (1983). It was explained and applied to soils of Missouri in University of Missouri Extension Circular 947 (EC947) entitled "Soil Productivity Indices and Soil Properties for Farm-Field Sites in Missouri" (Scrivner, Conkling and Koenig, 1985a). Soils of the Missouri Ozarks were not included in EC947 because the soils studied were in farm-fields of corn or soybeans. Neither crop is grown extensively in the Missouri Ozarks.

In the productivity index model, the suitability of the soil for root growth is indexed for each soil layer using sufficiencies of three soil properties: potential available water capacity (PAWC), soil acidity (pHs), and bulk density. A sufficiency of 1.00 indicates no root restrictions associated with a soil property while a sufficiency of 0.00 indicates total root restriction.

Equations and tables for converting soil property data into sufficiencies were provided in EC947. Thus, the need was for measured or estimated values of PAWC, pHs and density for soils of the Ozarks.

The approach was first to decide which soil series were the major ones in the Missouri Ozarks. This was accomplished by utilizing the National Resource Inventory (NRI) data provided by the USDA Soil Conservation Service. The Geographic Resources Center (GRC) at University of Missouri-Columbia analyzed this data base and calculated areas of major soil series. We then used the soil description of the typical pedon for each of these soil series to identify soil horizons, their thicknesses and their textural compositions. Input values of PAWC were estimated from soil texture. Input values for pHs and density were estimated by a process of compiling soil characterization studies that have been done on Missouri Ozark soils and applying results to the typical pedons. Later sections of this report describe the methodology for compiling and applying the characterization studies. The last step in the approach was the computation of PI's that represent an index for the type locations for each major soil series as selected by soil scientists.

MAJOR SOIL SERIES OF THE MISSOURI OZARKS

Major soils were determined from National Resource Inventory (NRI) data. The counties that represent the Ozarks are shown on the Major Land Systems map in Figure 1 (page 6). Those counties approximate Major Land Resource Area 116 (USDA Soil Conservation Service, 1981). Analysis of the data from all NRI sampling sites falling within the 42-county area shows that fifteen soil series make up 70 percent of the land. Those fifteen soil series are listed in Table 1 (page 7) in order of their estimated aerial extent. Only three of the fifteen major series were without carbonate rock beneath the soil or earth materials (regolith). Those are Coulstone, which is underlain by sandstone, and Cedargap and Midco, both of which are formed from alluvium on floodplains. The combined area of the three series amounts to 6.1 percent of the total area. The Goss and Goss-Stony areas are one soil series. Thus, eleven soil series underlain by carbonate rock are estimated to constitute over 63 percent of the Ozark counties. Those eleven soil series were selected for estimation of PI's.

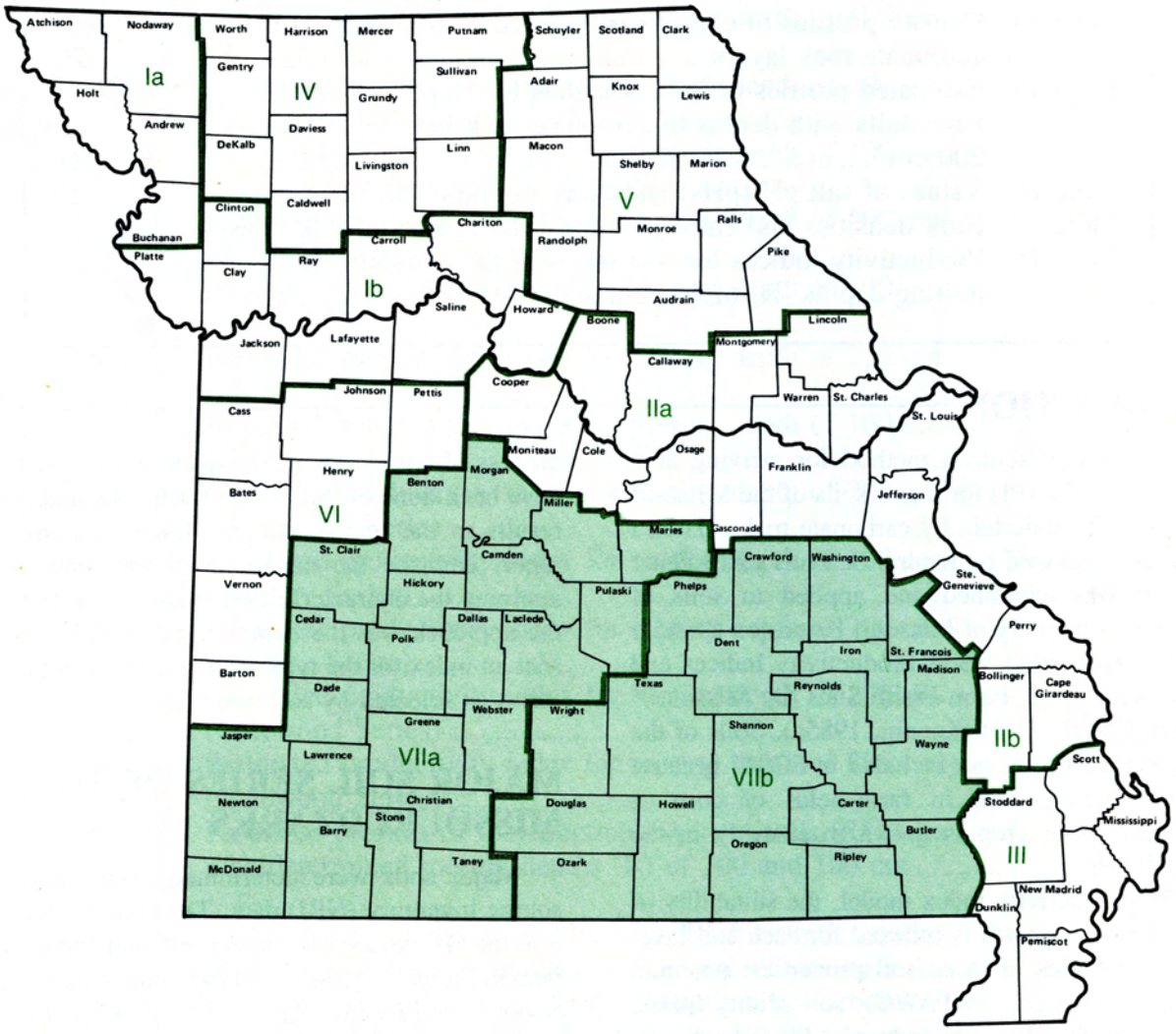

Figure 1. Major Land Systems Map of Missouri with Ozark Counties shaded.

MAJOR LAND SYSTEMS OF MISSOURI

I Western Missouri Deep Loess
- Ia Northwest
- Ib West-central

II Eastern Missouri River Hills
- IIa East-central
- IIb Southeast

III Southeastern Missouri Delta

IV North-Central Missouri Loess-Till

V Northeastern Missouri

VI Southwestern Missouri Prairies

VII Ozarks
- VIIa Western Ozarks
- VIIb Eastern Ozarks

Table 1. Fifteen Major Soil Series of Missouri Ozark Counties Ranked According to Estimated Percent of the Total 42-County Area.

Soil Series	Estimated Percent of Total Area
Clarksville	20.0*
Doniphan	11.0*
Goss	7.7*
Wilderness	4.9*
Lebanon	4.4*
Viraton	4.2*
Gasconade	3.4*
Coulstone	2.4
Nixa	2.3*
Cedargap	2.1
Captina	1.6*
Midco	1.6
Goss-Stony	1.4*
Gatewood	1.3*
Eldon	1.3*
TOTAL	69.6

*Areas with soils having carbonate rock beneath the regolith (soil and earth materials above bedrock).

Table 2. Soil Series of the Missouri Ozarks Underlain by Carbonate Rock but Representing Less Area Than Any of the Fifteen Major Soil Series

Soil Series	Estimated Percent of Total Area
Bardley	1.1
Creldon	1.0
Hoberg	0.9
Keeno	0.9
Claiborne	0.9
Gepp	0.6
Peridge	0.5
Pembroke	0.3
Needleye	0.3
Macedonia	0.2
Plato	0.1
TOTAL	6.8

An additional eleven soil series that are underlain by carbonate rock are identified in Table 2 (page 7). They combine for 6.8 percent of the total area and represent important variations in soils underlain by carbonate rock. PI's are therefore included.

The 22 soil series selected for estimated PI's represent a broad spectrum of Ozark soils. Their differences or similarities can be related to the following four major variables:

(1) Textural composition including content of chert rock which is related to PAWC.
(2) Presence or absence of an acid and dense root-restricting subsoil layer called a fragipan.
(3) Depth to carbonate rock, which influences soil pH and density.
(4) Organic carbon content which reflects past influences of forest or prairie vegetation.

In the sections that follow, methods for estimating soil property input data will be described for various combinations of these variables.

The nomenclature defined in Taxonomy (Soil Survey Staff, 1975) is designed to indicate various combinations of the four major soil variables. Table 3 (page 8) arrays the 22 soil series according to great soil groups and lists the family and subgroup names.

METHODS FOR ESTIMATING SOIL PROPERTIES FOR SOIL SERIES

Each soil series that is recognized in the National Cooperative Soil Survey has an official series description that was prepared by soil scientists for the typical pedon at a site chosen as the type location. The official series descriptions were used to identify all soil horizons, their thicknesses, and their textural compositions, including amounts of coarse fragments. For soil series having fragipans (those classified as Fragiudalfs or Fragiudults in Table 3), the description was used to locate the soil depths to the top and bottom of the fragipan. If depth to carbonate rock was described, this information was recorded.

The information from the description of the typical pedon was used to estimate profiles of input values of PAWC, pHs and density. The PI for the soil series was calculated from those values. The intent of this methodology was to estimate a PI for a specific site that represented the central concept of each series. Soil series have allowable ranges in characteristics, and some variation in PI should be expected. In addition, soil mapping units contain inclusions of soils that may qualify as several different soil series or as soils not yet identified as constituting a soil series.

Table 3. Soil Series of the Missouri Ozarks Grouped According to Soil Taxonomy (Soil Survey Staff, 1975).

Soil Series	Family	Subgroup
FRAGIUDALFS		
Lebanon	fine, mixed, mesic	Typic Fragiudalf
Viraton	fine-loamy, siliceous, mesic	Typic Fragiudalf
Wilderness	loamy-skeletal, siliceous, mesic	Typic Fragiudalf
Creldon	fine, mixed, mesic	Mollic Fragiudalf
Hoberg	fine-loamy, siliceous, mesic	Mollic Fragiudalf
Keeno	loamy-skeletal, siliceous, mesic	Mollic Fragiudalf
Plato	fine, mixed, mesic	Aquic Fragiudalf
FRAGIUDULTS		
Captina	fine-silty, mixed, mesic	Typic Fragiudult
Needleye	fine-silty, mixed, mesic	Aquic Fragiudult
Nixa	loamy-skeletal, siliceous, mesic	Glossic Fragiudult
PALEUDULTS		
Macedonia	clayey, mixed, mesic	Typic Paleudult
Doniphan	clayey, mixed, mesic	Typic Paleudult
Claiborne	fine-loamy, siliceous, mesic	Typic Paleudult
Clarksville	loamy-skeletal, siliceous, mesic	Typic Paleudult
PALEUDALFS		
Gepp	very-fine, mixed, mesic	Typic Paleudalf
Goss	clayey-skeletal, mixed, mesic	Typic Paleudalf
Peridge	fine-silty, mixed, mesic	Typic Paleudalf
Pembroke	fine-silty, mixed, mesic	Mollic Paleudalf
Eldon	clayey-skeletal, mixed, mesic	Mollic Paleudalf
HAPLUDALFS AND HAPLUDOLLS (Carbonate Rock at <1m depth)		
Gasconade	clayey-skeletal, mixed, mesic	Lithic Hapludoll
Bardley	very-fine, mixed, mesic	Typic Hapludalf
Gatewood	very-fine, mixed, mesic	Typic Hapludalf

Estimates of PAWC

PAWC was estimated from the textural class name described for each horizon and was corrected for the estimated volume of coarse fragments. Table 4 shows the median value of PAWC that was assigned to the fines (<2mm). Table 4 (page 9) was developed from the work of Ruppert (1970), who described PAWC in limestone-derived soils in terms of a field-measured upper limit, currently defined as the drained upper limit (DUL) by Ratliff et al. (1983). Ruppert's lower limit was the fractional volume of water at -15 bar soil moisture potential.

The value of PAWC was corrected for the described coarse fragment content by the equation:

$PAWC_{soil} = (PAWC_{fines})$ (1-fract. Vol Co. Frag) [1]

In some cases, the fractional volume of coarse fragments was estimated from the S.C.S. form 5 interpretation sheet that accompanies each soil series description. This was done only if the description suggested that coarse fragments were present but failed to provide estimated volumes.

Estimates of pHs

Estimates of pHs values for each of the 22 soil series were determined from a compilation of soil characterization studies in the Missouri Ozarks. The studies selected characterized the entire soil profile to the extent that the soil could be classified according to Taxonomy (Soil Survey Staff 1975).

The distribution of pHs values within a profile was assembled using the apparent dominant profile feature or features as a relative baseline. These features were presence or absence of a fragipan, depth to carbonate rock, classification as Alfisol vs Ultisol, and classification as Typic versus Mollic subgroups which are related to forest versus prairie-forest vegetative histories, respectively.

Table 4. Estimates of PAWC by Soil Textural Classes (Ruppert, 1970).

Textural Class Name	Range of PAWC	Median PAWC
Silt	.206-.232	.219
Silt loam, loam very fine sandy loam	.172-.206	.189
Silty clay loam and clay loam	.144-.172	.158
Clay and silty clay	.078-.144	.111

A series of six tables (Tables 5 through 10) (pages 10-15) presents the results of our data compilation. Each table presents the pHs profiles for referenced studies. Values of pHs are by 10 cm increments. The mean for each 10 cm layer and the value of one standard deviation are also presented. The pHs profile for each soil series was estimated from the mean found in the appropriate table or tables as follows:

Soils with carbonate rock at depths >3m

Typic Fragiudalfs (see Table 5)
Mollic Fragiudalfs (see Table 10)
Typic Fragiudults (see Table 6)
Paleudults (see Table 7)

Soils with carbonate rock at depths >2m

Paleudalfs, Paleudults and Hapludalfs (see Table 9)

Soils with carbonate rock between 2 and 3m depth

Layers adjacent to carbonate rock (see Table 9)

Use no more than the last eight values shown for 200 cm depth to carbonate rock. (The exact number of values is determined by matching with values estimated from the surface downward.)

Layers from the surface downward

Use the appropriate table according to soil classification (Tables 5, 6, 7 or 10). Identify that depth increment at which the two tables list pHs as differing by no more than 0.2 units. Use Table 9 below that depth and the appropriate table above that depth.

These procedures will estimate pHs to depths greater than required for calculation of PIs and to depths greater than described in soil series descriptions. In addition, pHs is very likely to be related to landscape position and water-flow patterns over and through the soils. It is hoped that this method of estimating the pHs profiles will be a first step in discovering the order that exists in Ozark landscapes. The pHs profiles could become criteria for phases of soil series.

Profiles of pHs for typic subgroups of Fragiudalfs, Fragiudults and Paleudults. Figure 2 (page 25) provides a comparison of the pHs profiles presented in Tables 5, 6 and 7. The Ultisols (Fragiudults and Paleudults) are similar, and there was no significant difference between the means of pHs at any depth. Fragiudalfs had significantly (5 percent level) lower values of pHs in the uppermost 140 cm. The Fragiudalfs had relatively high values of pHs below 170 cm depth, which for the small sample size, were not significantly different (5 percent level).

Profiles of pHs and depth to carbonate rock. Figure 3 (page 25) shows plots of estimated pHs profiles with depths to carbonate rock of 50, 100, 150, and 200 cm (Table 9). The estimated profiles represent a first approximation made from nine profile characterizations that are referenced and summarized in Table 8. The pHs profiles in layers adjacent to carbonate rock were first reported by Scrivner (1960). Findings in that study are compatible with values estimated in Table 9. Ruppert (1970) reported on a Bardley-Gasconade landscape in which depth to carbonate rock was a variable. His data on the Gasconade soil (Lithic Hapludoll) were also used to formulate the estimates in Table 9.

Profiles of pHs for mollic subgroups of Fragiudalfs. Mollic subgroups of Fragiudalfs represent former prairie areas of the Ozarks. The Creldon, Hoberg and Keeno series are examples (Table 3). Typic subgroups of Fragiudalfs or Fragiudults are thought to have formed under a forest canopy. Mollic subgroups have darker colors and more organic matter incorporated in the mineral soil than do Typic subgroups. It appears that pHs profiles are different for Mollic subgroups. Figure 4 (page 25) provides a comparison of Mollic versus Typic subgroups in a study in Newton County Missouri by S.C.S. (1981b, Table 10). The higher values of pHs in Mollic Fragiudalfs in the surface 30 cm may be due to liming. Higher values between the depths of 90 and 180 cm are not due to liming, and the differences are significant at the 5 percent level. A comparison of the pHs values of Mollic Fragiudalfs with the Typic Fragiudalfs shown in Figure 2 leads to a similar conclusion.

Scrivner and Cooper (1985) summarized carbon studies in Missouri soils. Figure 5 (page 25) is from their summary of soils similar to those studied in Newton County. Greater values of pHs and lower amounts of organic carbon in the 0-10 cm and 10-20 cm depths of the Mollic subgroups may reflect the effects of agricultural practices such as cultivation or liming.

Table 5. Profiles of pHs for Fragiudalfs. Pedons with Loess over Clayey and Cherty Materials and with Depth to Carbonate Rock Greater than 3 Meters.

			Stuart (1979)				McNabb (1972)					SCS Lake Ozark (1981)			Scrivner (1960)			Mean	±
			Pit 4	Pit 5	Pit 6	Pit 7	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	001	002	006	1	2	3		
			pHs																
	0	10	4.2	3.9	4.1	4.2	4.2	3.7	3.6	4.9	3.9	5.7	4.0	4.4	4.3	4.4	4.3	4.2	0.5
	10	20	4.1	3.9	4.1	4.0	4.1	3.6	4.3	4.1	4.1	4.5	3.9	4.0	3.8	4.2	4.0	4.0	0.2
	20	30	4.1	3.9	3.9	4.0	4.0	4.2	3.9	4.0	4.2	4.5	3.9	4.0	3.8	3.8	3.9	4.0	0.2
S	30	40	4.0	3.9	3.9	4.0	4.0	4.2	3.9	4.0	4.2	3.9	3.9	4.0	3.7	3.8	3.7	3.9	0.1
O	40	50	3.9	3.8	3.8	4.0	3.9	3.9	3.9	3.9	4.2	3.9	3.9	3.9	3.7	3.7	3.7	3.9	0.1
I	50	60	3.8	3.8	3.9	4.0	3.7	3.6	3.7	3.8	4.1	3.9	3.8	3.9	3.6	3.6	3.7	3.8	0.2
L	60	70	3.9	3.9	3.9	4.0	3.5	3.5	3.7	3.5	3.7	3.9	3.8	3.9	3.5	3.6	3.6	3.7	0.2
	70	80	4.0	3.9	3.9	4.0	3.6	3.5	3.5	3.3	3.5	3.9	3.8	3.9	3.5	3.4	3.6	3.7	0.2
D	80	90	4.0	3.9	4.0	3.9	3.6	3.5	3.5	3.2	3.5	3.9	3.8	4.0	3.5	3.4	3.6	3.7	0.3
E	90	100		3.8	3.9	4.0	3.5	3.7	3.5	3.2	3.6	3.7	3.8	4.0	3.5	3.5	3.6	3.7	0.2
P	100	110		3.9	3.9	4.1	3.5	3.7	3.5	3.5		3.7	4.0	4.0	3.5	3.3	3.8	3.7	0.2
T	110	120		3.9	3.9	4.0	3.5	3.7	3.7			3.7	4.0	4.0	3.5	3.3	3.8	3.8	0.2
H	120	130		3.9	3.8	3.9	3.5	3.7	3.7			3.7	4.0	4.0	3.5	3.3	3.8	3.7	0.2
	130	140				3.8	3.5	3.9				3.9	4.0	4.4	4.4	3.3		3.9	0.4
I	140	150					3.5	3.9				3.9	4.0	4.4	4.4	3.3		3.9	0.4
N	150	160					3.8					3.9	4.0	4.4	4.4	3.5		4.0	0.4
	160	170					3.8					3.9	4.7	4.4	4.4	3.5		4.1	0.4
C	170	180										4.3	4.7	4.4	4.4	3.5		4.3	0.4
M	180	190										4.3	4.7	5.1	4.4	3.5		4.4	0.6
	190	200										4.3	4.7	5.1		3.6		4.4	0.6
	200	210										4.7	5.0	5.1		3.6		4.6	0.7
	210	220										4.7	5.0	5.1		3.6		4.6	0.7
	220	230										4.7	5.0	5.1		3.9		4.7	0.5
	230	240										4.7	5.0	5.1		3.9		4.7	0.5
	240	250										4.7	5.0	5.1		3.9		4.7	0.5
	250	260										5.2	5.0	5.1		4.2		4.9	0.5
	260	270										5.2		5.6		4.2		5.0	0.7
	270	280										5.2		5.6		4.2		5.0	0.7
	280	290										5.2		5.6		4.4		5.1	0.6
	290	300										5.2		5.6		4.4		5.1	0.6

Table 6. Profiles of pHs of Fragiudults. Pedons with Loess over Clayey and Cherty Materials and with Depth to Carbonate Rock Greater than 3 Meters.

			SCS-Newton-Co. (1981)				SCS Texas Co (1985)	Mean	±
			(001)	(004)	(005)	(007)	(004)		
	0	10	4.6	6.6	4.2	4.6	4.3	4.9	1.0
	10	20	4.5	5.9	4.3	4.1	4.3	4.6	.7
	20	30	4.4	5.1	4.3	4.1	4.1	4.4	.4
S	30	40	4.2	4.4	4.2	4.0	4.0	4.2	.2
O	40	50	4.1	4.1	4.2	3.9	3.9	4.0	.1
I	50	60	4.1	4.1	4.2	3.9	4.0	4.1	.1
L	60	70	3.9	4.0	4.2	4.0	3.8	4.0	.2
	70	80	3.9	3.9	4.1	4.0	3.8	3.9	.1
D	80	90	4.0	3.8	4.1	4.0	3.8	3.9	.1
E	90	100	4.0	3.6	4.1	4.0	3.8	3.9	.2
P	100	110	4.0	3.6	4.1	4.0	3.7	3.9	.2
T	110	120	4.0	3.6	4.1	4.0	3.7	3.9	.2
H	120	130	4.0	3.8	4.1	4.0	3.7	3.9	.2
	130	140	3.9	3.8	4.1	4.0		4.0	.1
C	140	150	3.9	3.8	4.1	4.0		4.0	.1
M	150	160	3.9	3.8		4.0		3.9	.1
	160	170	3.9			4.0		4.0	.1
	170	180	3.9			4.2		4.0	.2
	180	190	3.9			4.2		4.0	.2
	190	200	3.9			4.2		4.0	.2
	200	210	3.9			4.2		4.0	.2
	210	220	4.2			4.2		4.2	0
	220	230	4.2			4.2		4.2	0
	230	240	4.2					4.2	-
	240	250	4.2					4.2	-
	250	260	4.2					4.2	-
	260	270	4.2					4.2	-
	270	280	4.2					4.2	-
	280	290	4.2					4.2	-
	290	300	4.2					4.2	-

Table 7. Profiles of pHs for Paleudults. Pedons with Depth to Carbonate Rock Greater than 3 Meters.

			SCS-Lake Ozark (1981)			Stuart (1979)			Simon	Ruppert	Miller	SCS Texas Co.(1985)			Mean	±
			003	004	005	Pit 1	Pit 3	Pit 8	(1981) 3	(1970) Wi2	(1965)	-001	-008	-009		
	0	10	4.3	4.4	4.1	4.2	3.9	4.2	4.5	-	6.2	4.1	4.1	4.3	4.4	0.6
	10	20	4.4	4.4	4.2	4.1	4.1	4.1	4.4	-	5.5	3.9	4.2	4.1	4.3	0.4
	20	30	4.5	4.3	4.3	4.1	4.1	4.1	4.3	-	5.1	3.9	4.0	4.0	4.2	0.3
	30	40	4.4	4.3	4.2	4.1	4.1	4.1	4.3	-	5.1	3.9	3.9	3.8	4.2	0.4
S	40	50	4.4	4.3	4.2	4.0	4.1	4.0	4.2	-	5.1	3.9	3.9	3.8	4.2	0.4
O	50	60	4.1	4.4	4.2	4.1	4.1	4.1	4.2	-	-	3.9	3.8	3.9	4.1	0.2
I	60	70	4.1	4.4	4.2	4.1	4.1	4.1	4.2	-	-	3.8	3.8	3.9	4.1	0.2
L	70	80	4.1	4.6	4.2	4.1	4.1	4.0	4.1	3.6	-	3.8	3.8	3.7	4.0	0.3
	80	90	4.1	4.6	4.2	4.0	4.0	4.0	4.1	3.6	4.8	3.8	3.8	3.7	4.0	0.4
D	90	100	4.2	4.5	4.2	4.0	4.0	4.0	4.1	3.5	4.8	3.8	3.8	3.7	4.0	0.4
E	100	110	4.2	4.2	4.2	3.9	4.0	3.9	4.1	3.5	4.1	3.7	3.8	3.7	3.9	0.2
P	110	120	4.2	4.2	4.2	3.9	4.0	3.8	4.1	3.6	4.1	3.7	3.7	3.7	3.9	0.2
T	120	130	4.2	4.2	4.2	4.0		3.8	4.1	3.6	4.1	3.7	3.7	3.7	3.9	0.2
H	130	140	4.0	4.2	4.2	4.1		3.8	4.0	3.6	4.1	3.7	3.7	3.6	3.9	0.2
	140	150	4.0	4.2	4.2				4.0	3.6	4.1	3.7	3.6	3.6	3.9	0.3
I	150	160	4.0	4.2	4.2				4.0	3.5	4.1		3.6	3.6	3.9	0.3
N	160	170		4.2	4.2					3.5	3.9			3.6	3.9	0.3
	170	180		4.2	4.2					3.3	3.9			3.6	3.8	0.4
C	180	190		4.4	4.2					3.3	3.9			3.6	3.9	0.4
M	190	200		4.4	4.1					3.4	3.9			3.6	3.9	0.4
	200	210		4.4	4.1					3.4	3.9			3.7	3.9	0.4
	210	220		4.4	4.1					3.4	3.9			3.7	3.9	0.4
	220	230		4.4	4.1					3.4	3.9			3.7	3.9	0.4
	230	240		4.4	4.1					3.4	3.9				4.0	0.4
	240	250		4.4	4.1					3.4	3.9				4.0	0.4
	250	260		4.3						3.4	3.9				3.9	0.4
	260	270		4.3						3.4	3.9				3.9	0.4
	270	280		4.3						3.4	3.9				3.9	0.4
	280	290		4.3						3.4	3.9				3.9	0.4
	290	300		4.3						3.4	3.9				3.9	0.4

SOIL DEPTH IN CM

Table 8. pHs Profiles of Paleudalfs and Hapludalfs with Depths to Carbonate Rock Less than 3 Meters.

			Miller (1965)	Brydon (1956)	SWRC (1969)	Miller (1965)	SCS Texas Co.(1985) (005)	(007)	(006)	Ruppert (1970)	Simon (1981)
			cm Depth to Carbonate Rock								
			258	254	150	128	93	82	65	84	79
			pHs								
	0	10	7.0	5.8	5.4	7.0	5.7	6.2	5.4	5.8	5.5
	10	20	4.9	5.8	4.6	6.8	5.5	4.8	5.4	4.3	4.7
	20	30	5.1	5.7	4.0	6.2	5.1	4.8	5.3	4.3	4.5
	30	40	4.7	4.1	4.0	6.2	4.9	5.1	5.4	4.3	4.6
S	40	50	4.5	4.1	4.0	4.7	5.3	5.7	5.8	4.1	4.5
O	50	60	4.4	4.1	4.1	4.7	5.9	6.5	6.0	4.1	4.5
I	60	70	4.4	4.1	4.1	4.7	5.9	6.5	6.7	4.5	4.7
L	70	80	4.4	4.1	4.1	4.9	7.6	7.6		6.2	6.3
	80	90	4.5	4.1	4.1	4.9	7.6				
D	90	100	4.5	4.1	4.1	6.2					
E	100	110	4.5	4.1	4.7	6.2					
P	110	120	4.5	4.1	4.7	7.2					
T	120	130	4.3	4.1		7.2					
H	130	140	4.3	4.4							
	140	150	4.3	5.1							
I	150	160	4.3	5.1							
N	160	170	4.3	6.1							
	170	180	6.1	6.5							
C	180	190	6.1	6.5							
M	190	200	6.1	7.1							
	200	210	6.1	7.3							
	210	220	6.1	7.3							
	220	230	6.1	7.3							
	230	240	6.1	7.3							
	240	250	6.1	7.7							
	250	260	7.1								
	260	270									
	270	280									
	280	290									
	290	300									

Table 9. Estimated Profiles of pHs for Soils with Depths to Carbonate Rock between 10 and 200 cm.

			pHs																	
	0	10	7.3	7.3	7.0	6.7	6.5	6.3	6.1	5.9	5.7	5.5	5.4	5.3	5.2	5.1	5.0	4.9	4.8	4.7	4.6	4.5
	10	20		7.3	7.3	6.7	6.2	5.7	5.5	5.3	5.1	4.9	4.8	4.7	4.7	4.6	4.6	4.5	4.5	4.4	4.4	4.4
S	20	30			7.3	7.2	6.2	5.5	5.2	5.1	4.9	4.8	4.7	4.6	4.6	4.5	4.5	4.4	4.4	4.3	4.3	4.3
O	30	40				7.3	7.2	6.2	5.3	5.2	4.9	4.8	4.7	4.6	4.6	4.5	4.5	4.4	4.4	4.3	4.3	4.3
I	40	50					7.3	7.2	6.2	5.3	5.0	4.9	4.7	4.6	4.6	4.5	4.5	4.4	4.4	4.3	4.3	4.3
L	50	60						7.3	7.2	6.2	5.3	5.0	4.7	4.6	4.5	4.4	4.4	4.3	4.3	4.2	4.2	4.2
	60	70							7.3	7.2	6.2	5.3	4.7	4.6	4.5	4.4	4.4	4.3	4.3	4.2	4.2	4.2
D	70	80								7.4	7.2	6.2	5.3	4.7	4.5	4.4	4.3	4.2	4.2	4.1	4.1	4.1
E	80	90									7.5	7.2	6.2	5.3	4.7	4.4	4.3	4.2	4.2	4.1	4.1	4.1
P	90	100										7.6	7.2	6.2	5.3	4.7	4.4	4.3	4.2	4.1	4.1	4.1
T	100	110											7.6	7.2	6.2	5.3	4.7	4.4	4.2	4.1	4.1	4.1
H	110	120												7.6	7.2	6.2	5.3	4.7	4.4	4.2	4.1	4.1
	120	130													7.6	7.2	6.2	5.5	4.7	4.4	4.2	4.1
I	130	140														7.6	7.2	6.2	5.3	4.7	4.4	4.2
N	140	150															7.6	7.2	6.2	5.3	4.7	4.4
	150	160																7.6	7.2	6.2	5.3	4.7
C	160	170																	7.6	7.2	6.2	5.3
M	170	180																		7.6	7.2	6.2
	180	190																			7.6	7.2
	190	200																				7.6
			10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200

Depth to Carbonate Rock in cm.

Table 10. Profiles of pHs for Selected Pedons in Newton County, MO; SCS Newton Co. (1981)

			Typic, Glossic and Umbric Fragiudults						Mollic Fragiudalfs				
			001	004	005	007	Mean	± pHs	002	006	003	Mean	±
	0	10	4.6	6.6	4.2	4.6	5.0	1.1	6.6	6.5	6.7	6.6	0.1
	10	20	4.5	5.9	4.3	4.1	4.7	0.8	6.6	6.5	6.3	6.5	0.2
	20	30	4.4	5.1	4.3	4.1	4.5	0.4	5.8	4.2	5.8	5.3	0.9
	30	40	4.2	4.4	4.2	4.0	4.2	0.2	5.1	4.2	4.6	4.6	0.4
S	40	50	4.1	4.1	4.2	3.9	4.1	0.1	4.2	3.9	4.3	4.1	0.2
O	50	60	4.1	4.1	4.2	3.9	4.1	0.1	4.0	4.0	4.0	4.0	0.0
I	60	70	3.9	4.0	4.2	4.0	4.0	0.1	4.0	4.0	4.0	4.0	0.0
L	70	80	3.9	3.9	4.1	4.0	4.0	0.1	4.1	-	4.2	4.2	0.1
	80	90	4.0	3.8	4.1	4.0	4.0	0.1	4.1	-	4.2	4.2	0.1
D	90	100	4.0	3.6	-	4.0	3.9	0.2	4.1	4.5	4.4	4.3	0.2
E	100	110	4.0	3.6	-	4.0	3.9	0.2	4.1	4.5	4.4	4.3	0.2
P	110	120	4.0	3.6	4.1	4.0	3.9	0.2	4.1	4.5	4.5	4.4	0.2
T	120	130	4.0	3.8	4.1	4.0	4.0	0.1	4.2	4.7	4.5	4.5	0.2
H	130	140	3.9	3.8	4.1	4.0	4.0	0.1	4.2	4.7	4.5	4.5	0.2
	140	150	3.9	3.8	4.1	4.0	4.0	0.1	4.2	4.7	4.5	4.5	0.2
I	150	160	3.9	3.8		4.0	3.9	0.1	4.2	4.7	4.5	4.5	0.2
N	160	170	3.9			4.0	4.0	0.1		4.7	4.5	4.6	0.1
	170	180	3.9			4.2	4.0	0.2		4.7	4.5	4.6	0.1
C	180	190	3.9			4.2	4.0	0.2		4.7	4.4	4.6	0.2
M	190	200	3.9			4.2	4.0	0.2		4.7	4.4	4.6	0.2
	200	210	3.9			4.2	4.0	0.2		4.7	4.4	4.6	0.2
	210	220	4.2			4.2	4.2	0.0			4.4	4.4	-
	220	230	4.2			4.2	4.2	0.0			4.4	4.4	-
	230	240	4.2				4.2	-			4.4	4.4	-
	240	250	4.2				4.2	-			4.4	4.4	-
	250	260	4.2				4.2	-			4.4	4.4	-
	260	270	4.2				4.2	-			4.4	4.4	-
	270	280	4.2				4.2	-			4.6	4.6	-
	280	290	4.2				4.2	-			4.7	4.7	-
	290	300	4.3				4.3	-			4.7	4.7	-

Estimates of Soil Bulk Density

Estimates of bulk density values, like those for pHs, were determined from a compilation of soil characterization studies in the Missouri Ozarks. Profiles of bulk densities were assigned based on the presence or absence of fragipan layers and, where present, on the depths to the top and bottom of the fragipan horizon. This procedure permitted the use of the soil series description to identify critical depths when estimates were made of the bulk density values for the 22 soil series.

In soils lacking fragipan layers, the bulk density profiles appeared to be similar where depth to carbonate rock was greater than 3 m. However, densities in layers adjacent to carbonate rock are relatively low, and this relationship required quantification.

A series of five tables (Tables 11-15) (pages 17-21) presents the results of our data compilation. Three of the tables (Tables 11, 12 and 15) present mean values by 10 cm depth increments that were used as estimated values for the 22 soil series. The appropriate table for each soil series was determined from soil classification and from depth to carbonate rock. The appropriate tables were as follows:

Fragiudalfs and Fragiudults (Table 11).

Paleudalfs and Paleudults with carbonate rock at depths >2m (Table 12).

Hapludalf and Paleudalfs with carbonate rock between 10 cm and 200 cm (Table 15).

Profiles of Density for Fragiudalfs and Fragiudults

Table 11 presents means for 10 cm depth increments as well as the referenced profiles of values that were compiled to calculate the means. Table 11 was used in estimating densities in soils having fragipans by using the series description to identify the top and the bottom of the fragipan. Mean values from Table 11 were then assigned to each 10 cm layer starting at (1) the surface of the soil, (2) the top of the fragipan, and (3) the bottom of the fragipan. When soil series depths were such that estimated values from uppermost layers overlapped underlying layers, the overlapping values from the uppermost layers were ignored. For example, if the soil series described the top of the fragipan at 50 cm depth, the first five density values below the surface were used. The sixth density value was estimated to be 1.69 g/cm^3, which is the mean value for the top 10 cm of fragipan horizons. Interpolation was used to arrive at density values when the top or bottom of the fragipan was not at a multiple of 10 cm depth from the surface.

Profiles of Density for Paleudults and Paleudalfs

Table 12 presents the profiles of density values from ten referenced studies. All study sites are presumed to have had depths to carbonate rock of greater than 200 cm. The mean of each 10 cm depth increment was used as the estimated density values for all Paleudults and for all Paleudalfs except for those with carbonate rock at depths less than 200 cm.

Profiles of density in soils with carbonate rock at depths between 10 and 200 cm. Tables 13, 14 and 15 present the summary of referenced soil characterization studies. Table 13 shows that as depth to carbonate rock decreases, the density values also decrease. Table 14 utilizes the same characterization studies, but references the soil layers to the carbonate rock rather than to the land surface. The means between 0 and 100 cm above the carbonate rock suggest that relatively low densities are characteristic in those zones. Tables 13 and 14 were used to approximate bulk density profiles as a function of depth to carbonate rock. The erratic profile of means and the small number of input values (Table 14) led to an estimate of 1.19 g/cm^3 for the first 60 cm above carbonate rock and 1.29 g/cm^3 for the next 40 cm. The approximated profile values are shown in Table 15 and were used for soil series with described depths to carbonate rock.

Table 11. Density Profiles, <2mm Fraction of Fragiudalfs and Fragiudults. Pedons with Loess over Clayey and Cherty Materials and Depth to Carbonate Rock Greater than 3 Meters.

			Fragiudalfs																Fragiudults						
				Stuart(1979)				McNabb(1972)					Scrivner (1960)		Doll (1976)	Miller (1965)	SCS Newton Co. (1981)			SCS Newton Co.(1981)				SCS TexasCo. (1985)	Mean	±
			Pit 4	Pit 5	Pit 6	Pit 7	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	1	2			002	006	003	(001)	(004)	(005)	(007)	(004)		
			g/cm^3																						
Depth below Surface	0	10	1.42	1.34	1.25	1.40	1.15	1.12	1.14	1.14	1.15	1.36	1.25	1.21	1.45	1.48	1.28	1.40	1.50	1.50	1.30	1.10	1.30	1.30	.13
	10	20	1.43	1.40	1.38	1.39	1.24	1.46	1.25	1.24	1.38	1.41	1.36	1.26	1.45	1.48	1.28	1.40	1.58	1.50	1.40	1.10	1.30	1.37	.11
	20	30	1.42	1.44	1.35	1.41	1.34	1.36	1.37	1.28	1.38	1.41	1.32	1.26		1.40	1.30	1.40	1.54	1.50	1.40	1.10	1.36	1.37	.09
	30	40	1.45		1.41	1.46	1.34	1.36	1.37	1.28	1.38	1.45	1.20	1.14		1.36	1.30	1.37	1.50	1.51	1.40	1.30	1.32	1.36	.09
	40	50	1.43		1.44	1.29	1.48	1.42	1.37	1.36	1.44	-	1.25	1.14		1.33	1.36	1.37	1.50	1.50		1.30	1.32	1.37	.10
	50	60			1.51		1.46	1.46	1.44	1.36		1.33		1.14		1.40	1.40	1.48	1.50				1.32	1.40	.10
	60	70					1.49	1.54	1.44			1.41				1.40	1.10	1.48						1.41	.14
	70	80						1.54																1.54	
Depth below top of Fragipan	0	10	1.66	1.64	1.88	1.97	1.69	1.66	1.68	1.55	1.56	1.71	1.66	1.79	1.78	1.70	1.68	1.59	1.57	1.55	1.87	1.61	1.63	1.69	.11
	10	20	1.87	1.85	1.75	1.81	1.69	1.66	1.68	1.57		1.79	1.66	1.79	1.78	1.70	1.68	1.59	1.57	1.60	2.07	1.82	1.63	1.73	.12
	20	30	1.59	1.72	1.56	1.55	1.70	1.70	1.68	1.71		1.79	1.63			1.70	1.68	1.63		1.60		1.82		1.67	.08
	30	40	1.55	1.78		1.65	1.70	1.70	1.68	1.71						1.70	1.60	1.63						1.67	.06
	40	50		1.59			1.70	1.70								1.70	1.60							1.66	.06
	50	60					1.70	1.70									1.60							1.67	.06
	60	70					1.70	1.70									1.60							1.67	.06
	70	80					1.70	1.57									1.60							1.62	.07
Depth below bottom of Fragipan	0	10		1.34	1.38	1.54					1.44		1.39	1.44		1.40	1.32	1.40	1.54	1.45	1.45	1.38		1.42	.07
	10	20		1.30	1.35	-					1.44		1.39	1.44		1.40	1.32	1.40	1.51	1.23	1.19	1.38		1.36	.09
	20	30		1.30	1.31	1.44							1.29	1.44		1.40	1.32	1.56	1.51	1.23	1.19	1.40		1.36	.11
	30	40		1.31	1.27	1.39							1.29	1.34		1.40		1.56		1.23	-	1.40		1.35	.10
	40	50		1.34	1.24	1.32							1.25	1.34				1.56		1.21	-	1.40		1.33	.11
	50	60											1.25					1.56		1.21	1.49	1.40		1.38	.15
	60	70											1.25					1.48		1.21	1.49	1.40		1.37	.13
	70	80																1.29		1.21	1.49	1.40		1.35	.12
	80	90																1.29			1.49	1.40		1.39	.10
	90	100																							

Table 12. Density Profiles for <2 mm Fraction of Paleudults and Paleudalfs

			Stuart (1979) Pit 1	Stuart (1979) Pit 3	Stuart (1979) Pit 8	Ruppert (1970) Wi2	Miller (1965)	Miller (1965)	SCS Texas Co. (1985) 001	SCS Texas Co. (1985) 008	SCS Texas Co. (1985) 009	Brydon (1956)	Mean	±
								g/cm^3						
	0	10	1.48	1.42	1.34	1.51	1.41	1.40	1.37	1.41	1.39	1.39	1.41	.05
	10	20	1.53	1.49	1.39	1.51	1.41	1.40	1.37	1.41	1.39	1.38	1.43	.06
S	20	30	1.38	1.44	1.44	-		1.54	1.37	1.41	1.40	1.35	1.42	.06
O	30	40	1.38	1.48	1.43	-		1.54	1.38	-	1.40	1.40	1.43	.06
I	40	50	1.46	1.38	1.38	-			1.36	-	1.41	1.41	1.40	.04
L	50	60	1.52	1.49	1.34	-			1.34	1.53	1.41	1.45	1.44	.08
	60	70	1.38	1.40	1.27	-			1.34	1.53	1.41	1.42	1.39	.08
D	70	80	1.36	1.39	1.24	1.39			1.34	1.53	1.39	1.40	1.38	.08
E	80	90	1.36	1.30	1.28	1.39			1.34	1.36	1.39	1.44	1.36	.05
P	90	100	1.34	1.33	1.31	1.40			1.34	1.20	1.39	1.46	1.35	.08
T	100	110	1.47	1.41	1.31	1.40			1.22	1.20	1.37	1.46	1.36	.10
H	110	120	1.34	1.30	1.23	-			1.22	1.20	1.37	1.43	1.30	.09
	120	130	1.29		1.24	-			1.22	1.20	1.37	1.43	1.29	.09
I	130	140	1.38		1.24	1.42				1.20	1.38	1.37	1.33	.09
N	140	150			1.25	1.42					1.38	1.23	1.32	.09
	150	160				-					1.38	1.23	1.30	.11
C	160	170				1.49					1.39	1.16	1.35	.17
M	170	180				1.49					1.39	1.13	1.34	.18
	180	190									1.39	1.13	1.26	.18
	190	200									1.39	1.14	1.26	.18

Table 13. Density Profiles of Paleudalfs and Hapludalfs with Depths to Carbonate Rock Less than 3 Meters Compared to the Means for 10 Paleudults with Depths of Greater than 3 Meters.

			Mean for 10 Paleudults	Brydon (1956)	Miller (1965)	SCS Texas Co. (1985) (005)	SCS Texas Co. (1985) (007)	Ruppert (1970) Ca_1	Ruppert (1970) Ca_2	Ruppert (1970) Ca_4	Ruppert (1970) Ga
			cm Depth to Rock								
			>300	254	128	93	82	107	84	61	36
	0	10	1.41	1.39	1.37	1.30	-	1.33	1.40	-	.90
	10	20	1.43	1.39	-	1.30	-	1.33	1.40	-	.90
S	20	30	1.42	1.35	-	1.30	1.27	1.33	1.40	1.14	.90
O	30	40	1.43	1.40	-	1.15	1.27	-	-	1.14	
I	40	50	1.40	1.41	-	1.15	1.28	-	1.10	1.26	
L	50	60	1.44	1.45	-	1.16	1.30	1.26	1.10		
	60	70	1.39	1.42	-	1.16	1.30	1.26	1.10		
D	70	80	1.38	1.40	1.44			1.33	1.10		
E	80	90	1.36	1.44	1.44			1.32			
P	90	100	1.35	1.46							
T	100	110	1.36	1.46							
H	110	120	1.30	1.43							
	120	130	1.29	1.43							
I	130	140	1.33	1.37							
N	140	150	1.32	1.23							
	150	160	1.30	1.23							
C	160	170	1.35	1.16							
M	170	180	1.34	1.13							
	180	190	1.26	1.13							
	190	200	1.26	1.14							
	200	210		1.14							
	210	220		1.14							
	220	230		1.14							
	230	240		1.14							

Table 14. Density Profiles in Clayey Materials (BT & C Horizons) Above Carbonate Rock Layers

cm of soil above Carbonate Rock		Brydon (1956)	SCS Texas Co. (1985)		Ruppert (1970)			Mean
			005	007	Ca_1	Ca_2	Ca_4	
		g/cm^3						
90	100	1.23			1.33			1.28
80	90	1.23	1.30		-	1.40		1.31
70	80	1.16	1.30		-	1.40		1.29
60	70	1.13	1.30		1.26	1.40		1.27
50	60	1.13	1.15	1.27	1.26	-		1.20
40	50	1.14	1.15	1.27	1.33	1.10		1.20
30	40	1.14	1.16	1.28	1.32	1.10	1.14	1.19
20	30	1.14	1.16	1.30		1.10	1.14	1.17
10	20	1.14		1.30		1.10	1.26	1.20
0	10	1.14						1.14

Table 15. Estimated Profiles of Bulk Densities for Hapludalfs and Paleudalfs with Depths to Carbonate Rock between 10 and 200 cm.

			Bulk Densities in g/cm^3																	
	0	10	1.19	1.19	1.19	1.19	1.19	1.19	1.29	1.29	1.29	1.29	1.32	1.32	1.32	1.32	1.32	1.32	1.36	1.36	1.36
	10	20		1.19	1.19	1.19	1.19	1.19	1.19	1.29	1.29	1.29	1.29	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.36	1.36
S	20	30			1.19	1.19	1.19	1.19	1.19	1.19	1.29	1.29	1.29	1.29	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.36
O	30	40				1.19	1.19	1.19	1.19	1.19	1.19	1.29	1.29	1.29	1.29	1.32	1.32	1.32	1.32	1.32	1.32	1.32
I	40	50					1.19	1.19	1.19	1.19	1.19	1.19	1.29	1.29	1.29	1.29	1.32	1.32	1.32	1.32	1.32	1.32
L	50	60						1.19	1.19	1.19	1.19	1.19	1.19	1.29	1.29	1.29	1.29	1.32	1.32	1.32	1.32	1.32
	60	70							1.19	1.19	1.19	1.19	1.19	1.19	1.29	1.29	1.29	1.29	1.32	1.32	1.32	1.32
D	70	80								1.19	1.19	1.19	1.19	1.19	1.19	1.29	1.29	1.29	1.29	1.32	1.32	1.32
E	80	90									1.19	1.19	1.19	1.19	1.19	1.19	1.29	1.29	1.29	1.29	1.32	1.32
P	90	100										1.19	1.19	1.19	1.19	1.19	1.19	1.29	1.29	1.29	1.29	1.32
T	100	110											1.19	1.19	1.19	1.19	1.19	1.19	1.29	1.29	1.29	1.29
H	110	120												1.19	1.19	1.19	1.19	1.19	1.19	1.29	1.29	1.29
	120	130													1.19	1.19	1.19	1.19	1.19	1.19	1.29	1.29
I	130	140														1.19	1.19	1.19	1.19	1.19	1.29	1.29
N	140	150															1.19	1.19	1.19	1.19	1.19	1.19
	150	160																1.19	1.19	1.19	1.19	1.19
C	160	170																	1.19	1.19	1.19	1.19
M	170	180																		1.19	1.19	1.19
	180	190																			1.19	1.19
	190	200																				1.19
			10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200

Depth to Carbonate Rock in cm.

PRODUCTIVITY INDICES FOR 22 SOIL SERIES OF THE MISSOURI OZARKS

In the productivity index approach (Kiniry et al. 1983; Scrivner, Conkling and Koenig, 1985a), the suitability of the soil for root growth is indexed for each soil layer in terms of sufficiencies of three soil properties, PAWC, pHs and bulk density. A sufficiency of 1.00 indicates no root restrictions associated with a soil property, while a sufficiency of 0.00 indicates total root restriction. The three sufficiency values for each layer are multiplied together and then by a weighting factor (RI) that is the estimated fraction of roots that would be in the layer if the entire soil was ideal. The products for all layers are summed to the depth of rooting R. That sum is the PI, and it has possible values between 1.000 and 0.000.

The profiles of estimated soil properties were converted to sufficiency values according to equations presented by Kiniry et al. (1983), and Scrivner, Conkling and Koenig (1985a). Sufficiency of PAWC is 1.00 if PAWC is equal to or greater than 0.20 cm/cm. Sufficiency of PAWC is PAWC/0.20 if PAWC is less than 0.20 cm. Tables 16 and 17 (pages 22 and 23) show sufficiency values for various values of pHs and bulk density, respectively. Values of pHs greater than 5.5 and values of bulk density less than 1.30 were assigned sufficiencies of 1.00.

Table 16. Values of salt pH (pHs) and corresponding sufficiencies.

pHs	Suff	pHs	Suff
5.5	1.00	4.4	.65
5.4	.98	4.3	.61
5.3	.97	4.2	.56
5.2	.95	4.1	.52
5.1	.94	4.0	.47
5.0	.92	3.9	.43
4.9	.88	3.8	.38
4.8	.83	3.7	.34
4.7	.79	3.6	.30
4.6	.74	3.5	.25
4.5	.70	3.4	.21

The results of applying the productivity index approach are presented in a series of 44 figures (pages 26-69), two for each of the 22 soil series. One figure shows the PI when the weighting factor (RI) was for a rooting depth of 100 cm. That weighting factor has been found to provide the best prediction of corn yields by those who have used the PI approach or modifications of it (Larson et al. 1983; Pierce et al. 1983; Pierce et al. 1984; Rijsberman and Wolman 1984). The second figure for each soil series shows the PI when the weighting factor (RI) was for a rooting depth of 200 cm. Each of the 44 figures is accompanied by the tabular listing of soil property input values and sufficiencies.

Sufficiencies of pHs in the 0-10 and 10-20 cm layers were set equal to 1.00 regardless of the value of pHs. This was done so that all soils could be compared on the basis of having been limed. A later section, "Possible Interpretations from the 44 PI Figures," discusses this variation further.

Table 18 shows the PI's for all 22 soil series for both rooting depths. Inspection of Table 18 (page 24) will reveal the fact that the PI for each soil is lower for R = 200 cm than for R = 100 cm. In addition, the differences between the two PI's for each soil vary, and the array of soils from highest to lowest differs depending upon the weighting factor (RI) used.

In the PI approach, the value of R (100 cm versus 200 cm, for example) was conceived to be plant-determined. The weighting factor for each R was the estimated fraction of roots in each 10 cm increment if the soil was ideal to the depth of R. Figure 50 (page 70) from Kiniry et al. (1983) contrasts the two weighting factors. The weighting factor is derived by integration of an equation developed by Horn (1971). The value of R in Horn's equation is a variable, and weighting factors for any value of R can be generated by the procedures described by Kiniry et al. (1983). As R increases, the weightings for surface layers decrease, and those for subsoil layers increase.

At this time, it is not clear which weighting is proper for crops grown on soils of the Ozarks. This could be answered if on-site soils and yield data were available. We have included the PI for R = 200 cm because of the extensive areas of forest in the Ozarks. If the PI is to reflect yield in forests, it may be that even greater values of R will be applicable. It may be that the PI's shown in Table 18 for R = 100 cm reflect

productivity for annual crops or even for young trees. PI's for R = 200 cm or some other greater R may be better correlated with productivity of perennial crops.

PI's and Yields

There is a paucity of data sets in which both soil properties and yields have been determined for specific sites. This remains a need for the future. Validity of the PI model cannot be tested without such data. Therefore, our estimated productivity indices are presented as a model that may someday be useful in quantifying the relationships between soils and potential yields.

It is possible that our input values and calculated values need to be, and will be, questioned. One soil series, the Clarksville, will be used as an example. Table 18 and Figures 32 and 33 show the Clarksville series to have the lowest PI of all of the major soils. This does not agree with general observations of forest growth. It appears that Clarksville slopes are more productive than summits and shoulders where soils such as Wilderness, Nixa or Lebanon (soils with fragipans) exist.

The Clarksville series description estimated coarse fragments to constitute 80 percent of the soil throughout a major portion of the profile. That estimate has now been revised to 65 percent. Measured volumes of coarse fragments are difficult and a paucity of data exists. Maximum values of measured volumes of chert or other coarse fragments were reported as 58 and 74 percent (Scrivner 1960); 56 percent (Miller 1965); 45 percent (Doll 1976); and 37 percent (Simon 1981). From those studies, an average volume of 50 to 55 percent appears to describe layers with large amounts of coarse fragments. If those values were used in the Clarksville series description, the calculated PI would be higher.

POSSIBLE INTERPRETATIONS FROM THE 44 PI FIGURES

Figure 6 is the first of the 44 figures depicting the PI for a soil series. It is for the Lebanon series and a rooting depth of 100 cm. The graphic plot on the right hand side of Figure 6 shows the predicted rooting pattern for the Lebanon profile in black. The shaded bars depict the magnitude of root restriction. The sufficiency columns show the magnitude of root restrictions associated with each of the three soil properties. For the Lebanon series, the greatest root restriction appears to be associated with low pHs.

The sufficiency of pHs was set equal to 1.00 in both the 0-10 and 10-20 cm depth increments even though the values of pHs were 4.2 and 4.0 respectively. In effect, the PI has been calculated for a system in which the pHs of the 0-10 and 10-20 cm layer is 5.5 or greater, the target pHs in liming (Buchholz 1983). All of the PI's were calculated in a similar manner in order to eliminate pHs as a variable in the two most heavily weighted layers. Readers can calculate the PI for the Lebanon series or others by using Table 16 to determine the appropriate sufficiency of pHs. In the case of the Lebanon series, sufficiencies would be 0.56 for the 0-10 cm layer and 0.47 for the 10-20 cm layer. Recalculation of the PI gives a value of 0.370 as contrasted to the 0.595 shown for a limed Lebanon series. Liming of forested areas is not common. However, the PI approach, if accurate for forests, predicts increased productivity from liming acid soils. Research to test the validity of our prediction is lacking. The PI model does, however, provide a method for estimating the effects of soil modifications such as liming. They are discussed in EC947 (Scrivner, Conkling and Koenig, 1985a).

Erosion is a form of soil modification. The PI model can be used to estimate the effects of erosion. Scrivner, Koenig, and Conkling (1985b) have described the procedure that can be applied to soils of the Missouri Ozarks. The PI model has been modified and used successfully to assess the long-term effects of erosion in areas other than Missouri (Larson et al. 1983; Pierce et al. 1983; Rijsberman and Wolman 1984).

Table 17. Bulk densities and corresponding sufficiencies of bulk density.

Bulk Dens. (g/cm^3)	SUFF	Bulk Dens. (g/cm^3)	SUFF	Bulk Dens. (g/cm^3)	SUFF
1.30	1.00	1.47	.88	1.64	.54
1.31	.99	1.48	.87	1.65	.50
1.32	.98	1.49	.87	1.66	.47
1.33	.98	1.50	.86	1.67	.44
1.34	.97	1.51	.85	1.68	.40
1.35	.96	1.52	.85	1.69	.37
1.36	.96	1.53	.84	1.70	.34
1.37	.95	1.54	.83	1.71	.30
1.38	.94	1.55	.83	1.72	.27
1.39	.93	1.56	.80	1.73	.24
1.40	.93	1.57	.77	1.74	.20
1.41	.92	1.58	.73	1.75	.17
1.42	.91	1.59	.70	1.76	.14
1.43	.91	1.60	.67	1.77	.10
1.44	.90	1.61	.63	1.78	.07
1.45	.89	1.62	.60	1.79	.04
1.46	.89	1.63	.57	1.80	.00

Table 18. Productivity Indices for Soil Series of the Missouri Ozarks for Rooting Depths (R) of 100 cm and 200 cm.

Soil Series by Great Groups	Productivity Indices	
FRAGIUDALFS	**R = 100 cm**	**R = 200 cm**
Lebanon (Figures 6 and 7)	.595	.441
Viraton (Figures 8 and 9)	.555	.411
Wilderness (Figures 10 and 11)	.381	.253
Creldon (Figures 12 and 13)	.662	.493
Hoberg (Figures 14 and 15)	.641	.470
Keeno (Figures 16 and 17)	.579	.441
Plato (Figures 18 and 19)	.553	.399
FRAGIUDULTS		
Captina (Figures 20 and 21)	.635	.473
Needleye (Figures 22 and 23)	.615	.459
Nixa (Figures 24 and 25)	.365	.261
PALEUDULTS		
Macedonia (Figures 26 and 27)	.597	.464
Doniphan (Figures 28 and 29)	.310	.278
Claiborne (Figures 30 and 31)	.543	.452
Clarksville (Figures 32 and 33)	.296	.245
PALEUDALFS		
Gepp (Figures 34 and 35)	.439	.383
Goss (Figures 36 and 37)	.436	.348
Peridge (Figures 38 and 39)	.603	.493
Pembroke (Figures 40 and 41)	.658	.558
Eldon (Figures 42 and 43)	.467	.387
HAPLUDALFS AND HAPLUDOLLS (Carbonate Rock at <1m depth)		
Gasconade (Figures 44 and 45)	.352	.227
Bardley (Figures 46 and 47)	.428	.313
Gatewood (Figures 48 and 49)	.565	.426

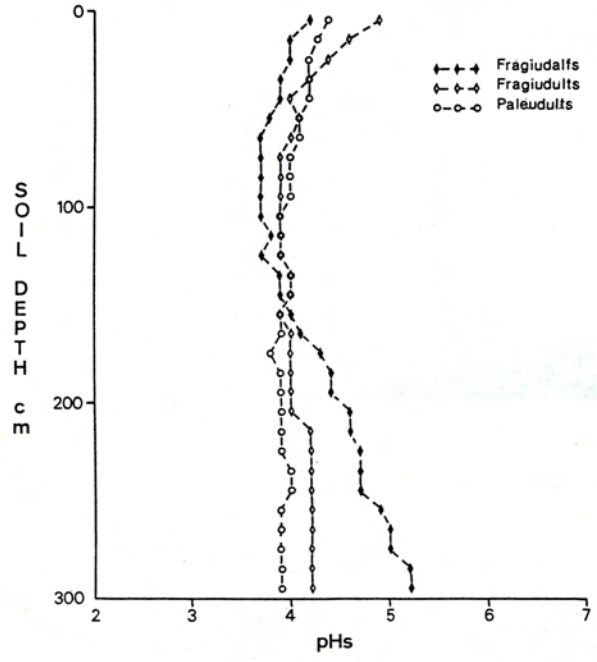

Figure 2. Profiles of pHs for Fragiudalfs, Fragiudults, and Paleudults with depth to carbonate rock greater than 3m.

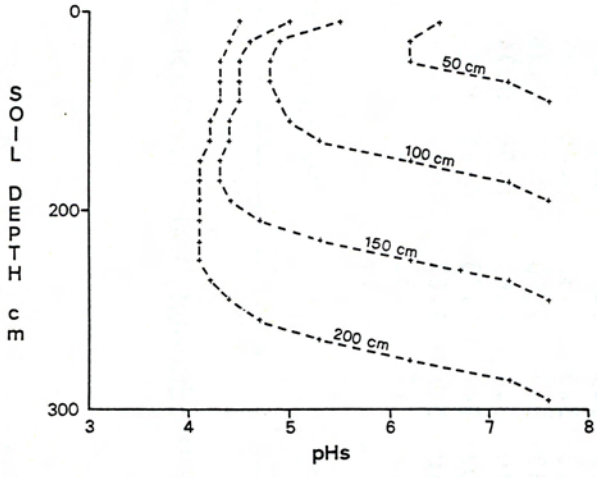

Figure 3. Plots of estimated profiles of pHs for soils with carbonate rock at 50, 100, 150, and 200 cm depth. (See Table 9.)

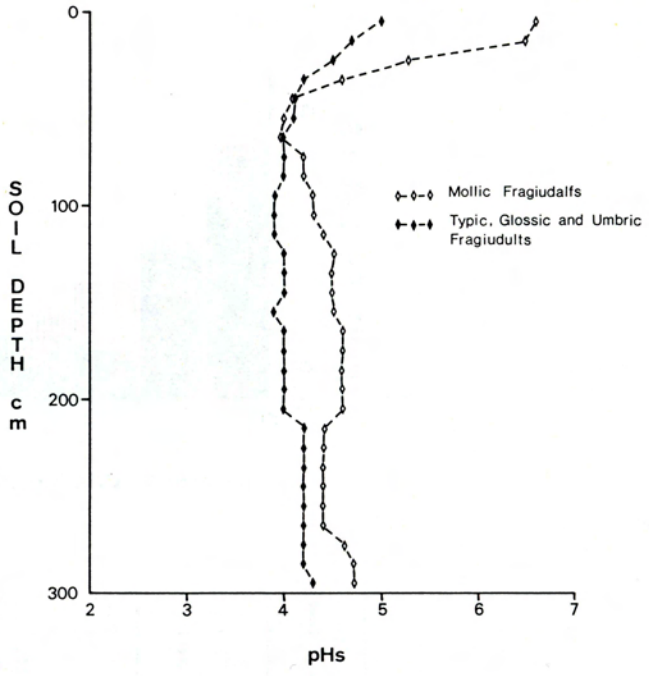

Figure 4. Profile of pHs for Mollic Fragiudalfs compared to that for Typic, Glossic and Umbric Fragiudults. From Newton County Missouri Fragipan Study. SCS (1981).

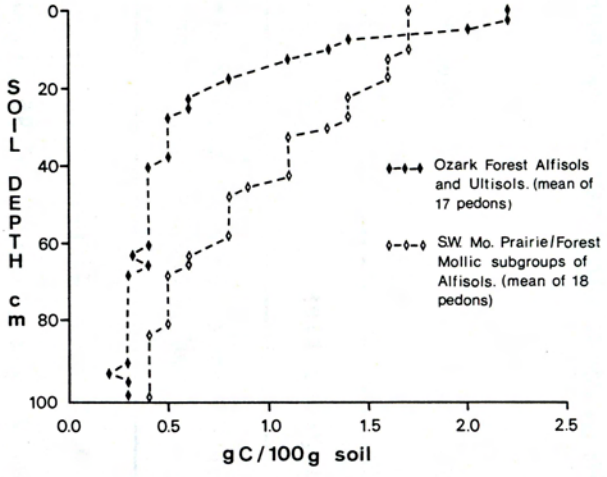

Figure 5. Profile distributions of organic carbon within soils formed under forest and prairie/forest transition canopies in southern Missouri. (From Scrivner and Cooper 1985).

Lebanon Series Rev. BWT 9/13/78

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	-	0.19	4.2	1.30	0.95	1.00	1.00	0.314	0.298
10- 20	-	0.19	4.0	1.37	0.95	1.00	0.95	0.196	0.177
20- 30	-	0.17	4.0	1.37	0.85	0.47	0.95	0.143	0.054
30- 40	-	0.11	3.9	1.37	0.55	0.43	0.95	0.108	0.024
40- 50	-	0.13	3.9	1.37	0.65	0.43	0.95	0.082	0.022
50- 60	0.09	0.13	3.8	1.40	0.65	0.38	0.93	0.061	0.014
60- 70	0.45	0.10	3.7	1.69	0.50	0.34	0.37	0.044	0.003
70- 80	0.41	0.09	3.7	1.73	0.45	0.34	0.24	0.030	0.001
80- 90	0.35	0.10	3.7	1.67	0.50	0.34	0.44	0.017	0.001
90-100	0.30	0.08	3.7	1.42	0.40	0.34	0.91	0.005	0.001
							Productivity Index =	1.000	0.595

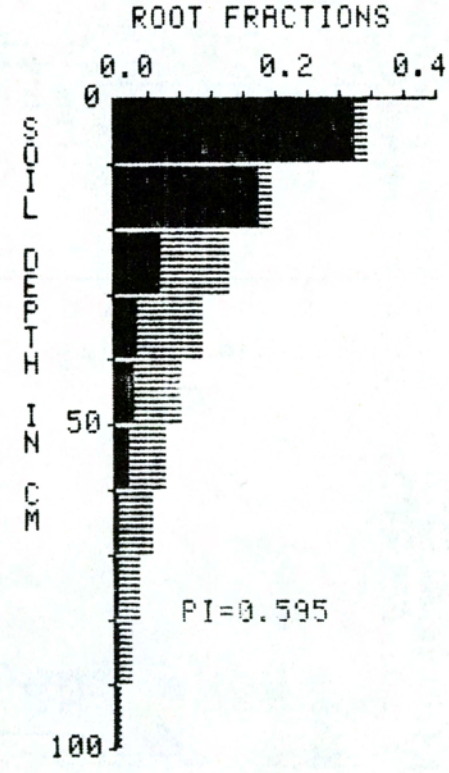

Figure 6. Estimated Productivity Index for Rooting Depth of 100 cm.

Lebanon Series Rev. BWT 9/13/78

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	-	0.19	4.2	1.30	0.95	1.00	1.00	0.190	0.180
10- 20	-	0.19	4.0	1.37	0.95	1.00	0.95	0.132	0.119
20- 30	-	0.17	4.0	1.37	0.85	0.47	0.95	0.105	0.040
30- 40	-	0.11	3.9	1.37	0.55	0.43	0.95	0.088	0.020
40- 50	-	0.13	3.9	1.37	0.65	0.43	0.95	0.076	0.020
50- 60	0.09	0.13	3.8	1.40	0.65	0.38	0.93	0.065	0.015
60- 70	0.45	0.10	3.7	1.69	0.50	0.34	0.37	0.057	0.004
70- 80	0.41	0.09	3.7	1.73	0.45	0.34	0.24	0.050	0.002
80- 90	0.35	0.10	3.7	1.67	0.50	0.34	0.44	0.043	0.003
90-100	0.30	0.08	3.7	1.42	0.40	0.34	0.91	0.038	0.005
100-110	0.15	0.09	3.7	1.36	0.45	0.34	0.96	0.033	0.005
110-120	0.05	0.11	3.8	1.36	0.55	0.38	0.96	0.028	0.006
120-130	0.05	0.11	3.7	1.35	0.55	0.34	0.96	0.024	0.004
130-140	0.05	0.11	3.9	1.33	0.55	0.43	0.98	0.020	0.005
140-150	0.05	0.11	3.9	1.38	0.55	0.43	0.94	0.016	0.004
150-160	0.05	0.11	4.0	1.37	0.55	0.47	0.95	0.013	0.003
160-170	0.05	0.11	4.1	1.35	0.55	0.52	0.96	0.010	0.003
170-180	0.05	0.11	4.3	1.39	0.55	0.61	0.93	0.007	0.002
180-190	0.05	0.11	4.4	1.39	0.55	0.65	0.93	0.004	0.001
190-200	0.05	0.11	4.4	1.39	0.55	0.65	0.93	0.001	0.000
							Productivity Index =	1.000	0.441

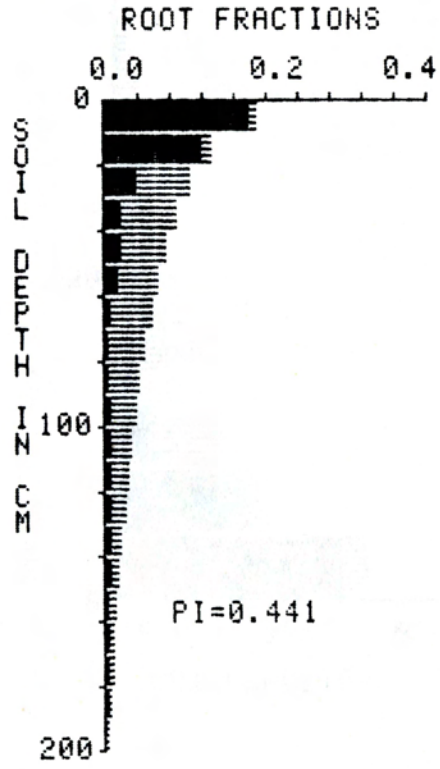

Figure 7. Estimated Productivity Index for Rooting Depth of 200 cm.

Viraton Series Rev. GDR-HEH-BWT 6/12/79

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.05	0.18	5.5	1.30	0.90	1.00	1.00	0.314	0.283
10- 20	0.05	0.18	5.5	1.37	0.90	1.00	0.95	0.196	0.168
20- 30	0.12	0.15	4.0	1.37	0.75	0.47	0.95	0.143	0.049
30- 40	0.28	0.11	3.9	1.37	0.55	0.43	0.95	0.108	0.024
40- 50	0.28	0.14	3.9	1.37	0.70	0.43	0.95	0.082	0.023
50- 60	0.65	0.07	3.8	1.69	0.35	0.38	0.37	0.061	0.003
60- 70	0.65	0.07	3.7	1.73	0.35	0.34	0.24	0.044	0.001
70- 80	0.65	0.07	3.7	1.67	0.35	0.34	0.44	0.030	0.002
80- 90	0.65	0.07	3.7	1.67	0.35	0.34	0.44	0.017	0.001
90-100	0.05	0.11	3.7	1.42	0.55	0.34	0.91	0.005	0.001
							Productivity Index =	1.000	0.555

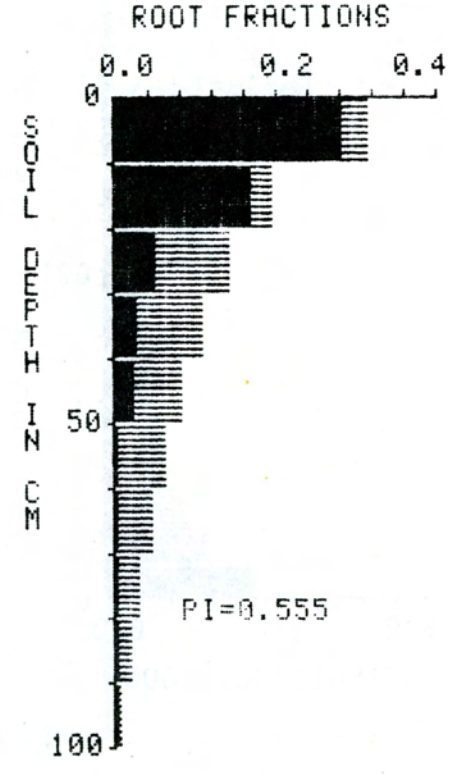

Figure 8. Estimated Productivity Index for Rooting Depth of 100 cm.

Viraton Series Rev. GDR-HEH-BWT 6/12/79

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.05	0.18	5.5	1.30	0.90	1.00	1.00	0.190	0.171
10- 20	0.05	0.18	5.5	1.37	0.90	1.00	0.95	0.132	0.113
20- 30	0.12	0.15	4.0	1.37	0.75	0.47	0.95	0.105	0.035
30- 40	0.28	0.11	3.9	1.37	0.55	0.43	0.95	0.088	0.020
40- 50	0.28	0.14	3.9	1.37	0.70	0.43	0.95	0.076	0.022
50- 60	0.65	0.07	3.8	1.69	0.35	0.38	0.37	0.065	0.003
60- 70	0.65	0.07	3.7	1.73	0.35	0.34	0.24	0.057	0.002
70- 80	0.65	0.07	3.7	1.67	0.35	0.34	0.44	0.050	0.003
80- 90	0.65	0.07	3.7	1.67	0.35	0.34	0.44	0.043	0.002
90-100	0.05	0.11	3.7	1.42	0.55	0.34	0.91	0.038	0.006
100-110	0.05	0.11	3.7	1.36	0.55	0.34	0.96	0.033	0.006
110-120	0.05	0.11	3.8	1.36	0.55	0.38	0.96	0.028	0.006
120-130	0.05	0.11	3.7	1.35	0.55	0.34	0.96	0.024	0.004
130-140	0.05	0.11	3.9	1.33	0.55	0.43	0.98	0.020	0.005
140-150	0.05	0.11	3.9	1.38	0.55	0.43	0.94	0.016	0.004
150-160	0.05	0.11	4.0	1.37	0.55	0.47	0.95	0.013	0.003
160-170	0.05	0.11	4.1	1.35	0.55	0.52	0.96	0.010	0.003
170-180	0.05	0.11	4.3	1.39	0.55	0.61	0.93	0.007	0.002
180-190	0.05	0.11	4.4	1.39	0.55	0.65	0.93	0.004	0.001
190-200	0.05	0.11	4.4	1.39	0.55	0.65	0.93	0.001	0.000
							Productivity Index =	1.000	0.411

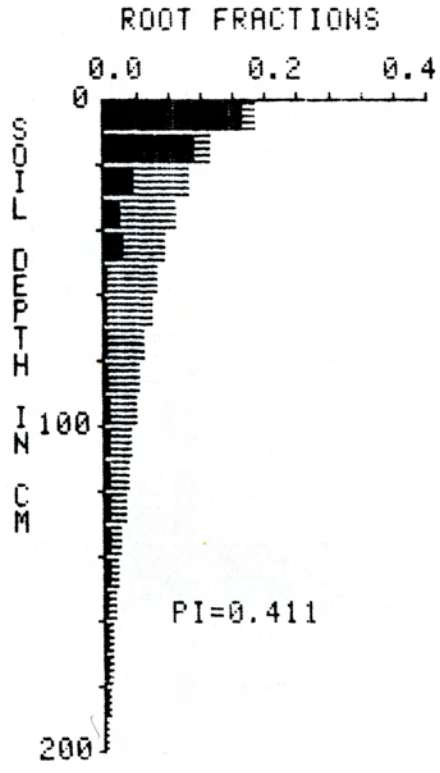

Figure 9. Estimated Productivity Index for Rooting Depth of 200 cm.

Wilderness Series Rev. BWT 1/8/80

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.20	0.15	4.2	1.30	0.75	1.00	1.00	0.314	0.236
10- 20	0.38	0.11	4.0	1.37	0.55	1.00	0.95	0.196	0.102
20- 30	0.55	0.07	4.0	1.37	0.35	0.47	0.95	0.143	0.022
30- 40	0.55	0.07	3.9	1.37	0.35	0.43	0.95	0.108	0.015
40- 50	0.72	0.05	3.9	1.69	0.25	0.43	0.37	0.082	0.003
50- 60	0.80	0.04	3.8	1.73	0.20	0.38	0.24	0.061	0.001
60- 70	0.80	0.04	3.7	1.67	0.20	0.34	0.44	0.044	0.001
70- 80	0.80	0.03	3.7	1.67	0.15	0.34	0.44	0.030	0.001
80- 90	0.80	0.03	3.7	1.67	0.15	0.34	0.44	0.017	0.000
90-100	0.80	0.03	3.7	1.57	0.15	0.34	0.77	0.005	0.000
							Productivity Index =	1.000	0.381

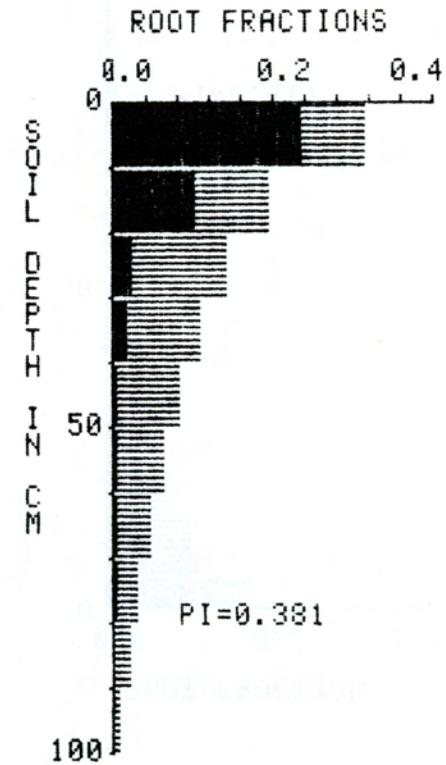

Figure 10. Estimated Productivity Index for Rooting Depth of 100 cm.

Wilderness Series Rev. BWT 1/8/80

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.20	0.15	4.2	1.30	0.75	1.00	1.00	0.190	0.142
10- 20	0.38	0.11	4.0	1.37	0.55	1.00	0.95	0.132	0.069
20- 30	0.55	0.07	4.0	1.37	0.35	0.47	0.95	0.105	0.016
30- 40	0.55	0.07	3.9	1.37	0.35	0.43	0.95	0.088	0.012
40- 50	0.72	0.05	3.9	1.69	0.25	0.43	0.37	0.076	0.003
50- 60	0.80	0.04	3.8	1.73	0.20	0.38	0.24	0.065	0.001
60- 70	0.80	0.04	3.7	1.67	0.20	0.34	0.44	0.057	0.002
70- 80	0.80	0.03	3.7	1.67	0.15	0.34	0.44	0.050	0.001
80- 90	0.80	0.03	3.7	1.67	0.15	0.34	0.44	0.043	0.001
90-100	0.80	0.03	3.7	1.57	0.15	0.34	0.77	0.038	0.001
100-110	0.80	0.02	3.7	1.42	0.10	0.34	0.91	0.033	0.001
110-120	0.80	0.02	3.8	1.36	0.10	0.38	0.96	0.028	0.001
120-130	0.80	0.02	3.7	1.36	0.10	0.34	0.96	0.024	0.001
130-140	0.80	0.02	3.9	1.35	0.10	0.43	0.96	0.020	0.001
140-150	0.80	0.02	3.9	1.33	0.10	0.43	0.98	0.016	0.001
150-160	0.80	0.02	4.0	1.38	0.10	0.47	0.94	0.013	0.000
160-170	0.80	0.02	4.1	1.37	0.10	0.52	0.95	0.010	0.000
170-180	0.80	0.02	4.3	1.35	0.10	0.61	0.96	0.007	0.000
180-190	0.80	0.02	4.4	1.39	0.10	0.65	0.93	0.004	0.000
190-200	0.80	0.02	4.4	1.39	0.10	0.65	0.93	0.001	0.000
							Productivity Index =	1.000	0.253

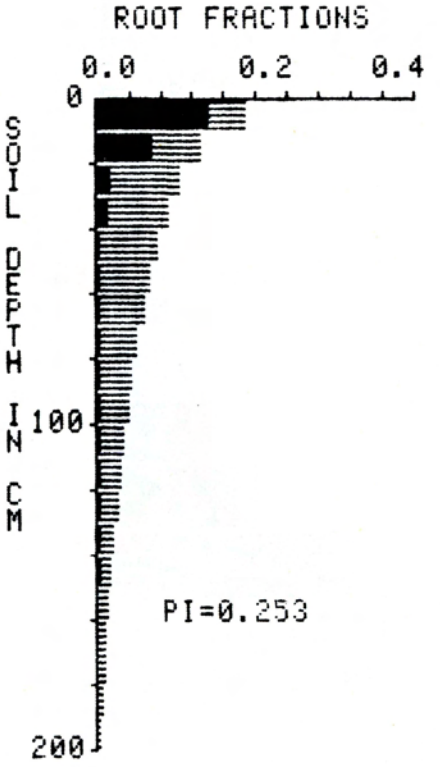

Figure 11. Estimated Productivity Index for Rooting Depth of 200 cm.

Creldon Series Rev. HEH-JHL-BWT 1/8/80

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.02	0.18	6.6	1.30	0.90	1.00	1.00	0.314	0.283
10- 20	0.02	0.18	6.5	1.37	0.90	1.00	0.95	0.196	0.168
20- 30	0.04	0.17	5.3	1.37	0.85	0.97	0.95	0.143	0.112
30- 40	0.05	0.13	4.6	1.36	0.65	0.74	0.96	0.108	0.050
40- 50	0.05	0.10	4.1	1.37	0.50	0.52	0.95	0.082	0.020
50- 60	0.05	0.10	4.0	1.40	0.50	0.47	0.93	0.061	0.013
60- 70	0.07	0.13	4.0	1.52	0.65	0.47	0.85	0.044	0.011
70- 80	0.10	0.14	4.2	1.73	0.70	0.56	0.24	0.030	0.003
80- 90	0.40	0.09	4.2	1.67	0.45	0.56	0.44	0.017	0.002
90-100	0.60	0.06	4.3	1.67	0.30	0.61	0.44	0.005	0.000
							Productivity Index =	1.000	0.662

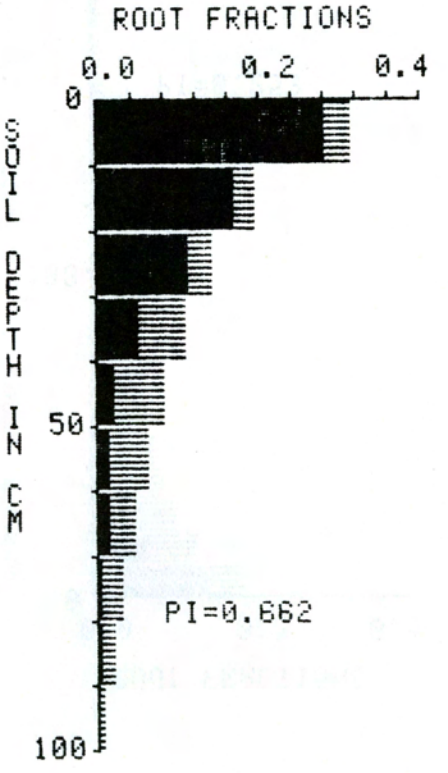

Figure 12. Estimated Productivity Index for Rooting Depth of 100 cm.

Creldon Series Rev. HEH-JHL-BWT 1/8/80

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.02	0.18	6.6	1.30	0.90	1.00	1.00	0.190	0.171
10- 20	0.02	0.18	6.5	1.37	0.90	1.00	0.95	0.132	0.113
20- 30	0.04	0.17	5.3	1.37	0.85	0.97	0.95	0.105	0.082
30- 40	0.05	0.13	4.6	1.36	0.65	0.74	0.96	0.088	0.041
40- 50	0.05	0.10	4.1	1.37	0.50	0.52	0.95	0.076	0.019
50- 60	0.05	0.10	4.0	1.40	0.50	0.47	0.93	0.065	0.014
60- 70	0.07	0.13	4.0	1.52	0.65	0.47	0.85	0.057	0.015
70- 80	0.10	0.14	4.2	1.73	0.70	0.56	0.24	0.050	0.005
80- 90	0.40	0.09	4.2	1.67	0.45	0.56	0.44	0.043	0.005
90-100	0.60	0.06	4.3	1.67	0.30	0.61	0.44	0.038	0.003
100-110	0.66	0.05	4.3	1.52	0.25	0.61	0.85	0.033	0.004
110-120	0.70	0.05	4.4	1.36	0.25	0.65	0.96	0.028	0.004
120-130	0.70	0.05	4.5	1.36	0.25	0.70	0.96	0.024	0.004
130-140	0.58	0.06	4.5	1.35	0.30	0.70	0.96	0.020	0.004
140-150	0.45	0.06	4.5	1.33	0.30	0.70	0.98	0.016	0.003
150-160	0.45	0.06	4.5	1.38	0.30	0.70	0.94	0.013	0.002
160-170	0.45	0.06	4.6	1.37	0.30	0.74	0.95	0.010	0.002
170-180	0.45	0.06	4.6	1.35	0.30	0.74	0.96	0.007	0.001
180-190	0.45	0.06	4.6	1.39	0.30	0.74	0.93	0.004	0.001
190-200	0.45	0.06	4.6	1.39	0.30	0.74	0.93	0.001	0.000
							Productivity Index =	1.000	0.493

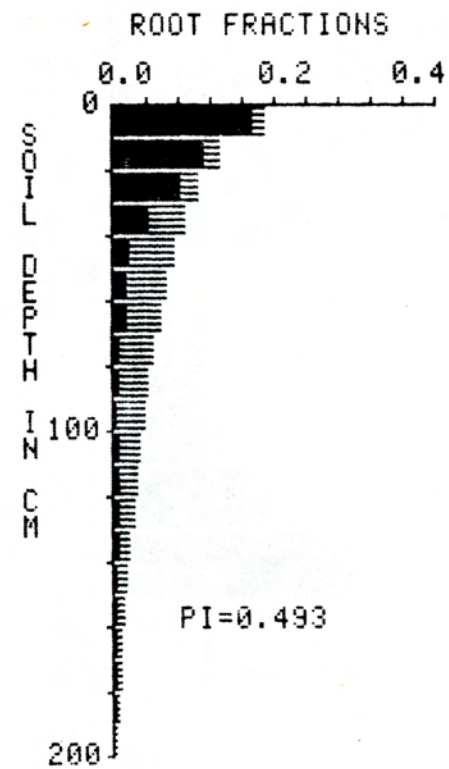

Figure 13. Estimated Productivity Index for Rooting Depth of 200 cm.

Hoberg Series Rev. HEH-BWT 11/15/79

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.05	0.18	6.6	1.30	0.90	1.00	1.00	0.314	0.283
10- 20	0.05	0.17	6.5	1.37	0.85	1.00	0.95	0.196	0.158
20- 30	0.05	0.15	5.3	1.37	0.75	0.97	0.95	0.143	0.099
30- 40	0.07	0.15	4.6	1.36	0.75	0.74	0.96	0.108	0.058
40- 50	0.08	0.14	4.1	1.37	0.70	0.52	0.95	0.082	0.028
50- 60	0.36	0.10	4.0	1.52	0.50	0.47	0.85	0.061	0.012
60- 70	0.78	0.03	4.0	1.73	0.15	0.47	0.24	0.044	0.001
70- 80	0.78	0.03	4.2	1.67	0.15	0.56	0.44	0.030	0.001
80- 90	0.78	0.03	4.2	1.67	0.15	0.56	0.44	0.017	0.001
90-100	0.78	0.03	4.3	1.66	0.15	0.61	0.47	0.005	0.000
							Productivity Index =	1.000	0.641

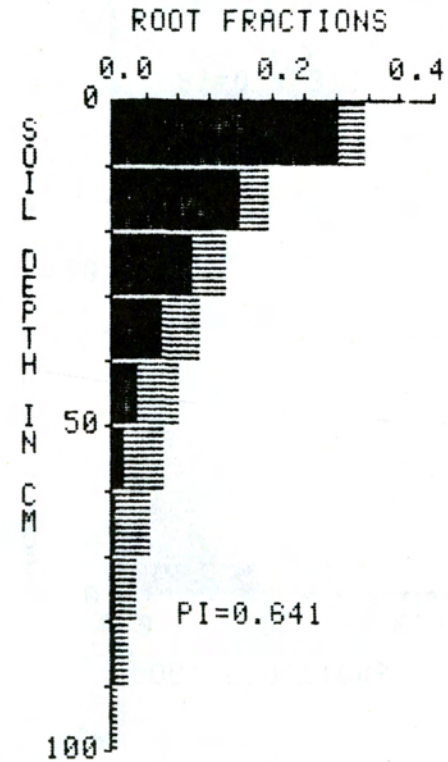

Figure 14. Estimated Productivity Index for Rooting Depth of 100 cm.

Hoberg Series Rev. HEH-BWT 11/15/79

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.05	0.18	6.6	1.30	0.90	1.00	1.00	0.190	0.171
10- 20	0.05	0.17	6.5	1.37	0.85	1.00	0.95	0.132	0.106
20- 30	0.05	0.15	5.3	1.37	0.75	0.97	0.95	0.105	0.072
30- 40	0.07	0.15	4.6	1.36	0.75	0.74	0.96	0.088	0.047
40- 50	0.08	0.14	4.1	1.37	0.70	0.52	0.95	0.076	0.026
50- 60	0.36	0.10	4.0	1.52	0.50	0.47	0.85	0.065	0.013
60- 70	0.78	0.03	4.0	1.73	0.15	0.47	0.24	0.057	0.001
70- 80	0.78	0.03	4.2	1.67	0.15	0.56	0.44	0.050	0.002
80- 90	0.78	0.03	4.2	1.67	0.15	0.56	0.44	0.043	0.002
90-100	0.78	0.03	4.3	1.66	0.15	0.61	0.47	0.038	0.002
100-110	0.78	0.03	4.3	1.67	0.15	0.61	0.44	0.033	0.001
110-120	0.77	0.04	4.4	1.64	0.20	0.65	0.54	0.028	0.002
120-130	0.72	0.08	4.5	1.36	0.40	0.70	0.96	0.024	0.006
130-140	0.72	0.08	4.5	1.36	0.40	0.70	0.96	0.020	0.005
140-150	0.72	0.08	4.5	1.35	0.40	0.70	0.96	0.016	0.004
150-160	0.72	0.08	4.5	1.33	0.40	0.70	0.98	0.013	0.004
160-170	0.72	0.08	4.6	1.38	0.40	0.74	0.94	0.010	0.003
170-180	0.72	0.08	4.6	1.37	0.40	0.74	0.95	0.007	0.002
180-190	0.72	0.08	4.6	1.35	0.40	0.74	0.96	0.004	0.001
190-200	0.72	0.08	4.6	1.39	0.40	0.74	0.93	0.001	0.000
							Productivity Index =	1.000	0.470

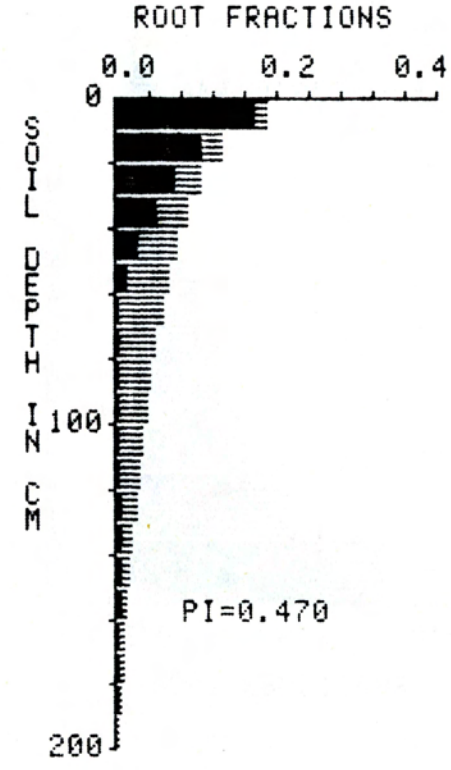

Figure 15. Estimated Productivity Index for Rooting Depth of 200 cm.

Keeno Series Rev. MWA-HEH-JHL-BWT 11/15/79

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.22	0.15	6.6	1.30	0.75	1.00	1.00	0.314	0.236
10- 20	0.22	0.15	6.5	1.37	0.75	1.00	0.95	0.196	0.140
20- 30	0.22	0.15	5.3	1.37	0.75	0.97	0.95	0.143	0.099
30- 40	0.22	0.15	4.6	1.36	0.75	0.74	0.96	0.108	0.058
40- 50	0.42	0.11	4.1	1.37	0.55	0.52	0.95	0.082	0.022
50- 60	0.52	0.09	4.0	1.40	0.45	0.47	0.93	0.061	0.012
60- 70	0.55	0.07	4.0	1.41	0.35	0.47	0.92	0.044	0.007
70- 80	0.61	0.07	4.2	1.60	0.35	0.56	0.67	0.030	0.004
80- 90	0.70	0.06	4.2	1.73	0.30	0.56	0.24	0.017	0.001
90-100	0.70	0.06	4.3	1.67	0.30	0.61	0.44	0.005	0.000
							Productivity Index =	1.000	0.579

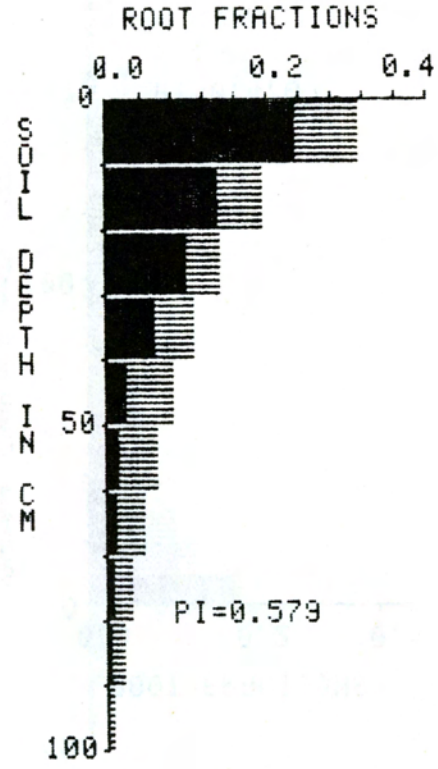

Figure 16. Estimated Productivity Index for Rooting Depth of 100 cm.

Keeno Series Rev. MWA-HEH-JHL-BWT 11/15/79

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.22	0.15	6.6	1.30	0.75	1.00	1.00	0.190	0.142
10- 20	0.22	0.15	6.5	1.37	0.75	1.00	0.95	0.132	0.094
20- 30	0.22	0.15	5.3	1.37	0.75	0.97	0.95	0.105	0.072
30- 40	0.22	0.15	4.6	1.36	0.75	0.74	0.96	0.088	0.047
40- 50	0.42	0.11	4.1	1.37	0.55	0.52	0.95	0.076	0.021
50- 60	0.52	0.09	4.0	1.40	0.45	0.47	0.93	0.065	0.013
60- 70	0.55	0.07	4.0	1.41	0.35	0.47	0.92	0.057	0.009
70- 80	0.61	0.07	4.2	1.60	0.35	0.56	0.67	0.050	0.006
80- 90	0.70	0.06	4.2	1.73	0.30	0.56	0.24	0.043	0.002
90-100	0.70	0.06	4.3	1.67	0.30	0.61	0.44	0.038	0.003
100-110	0.70	0.06	4.3	1.52	0.30	0.61	0.85	0.033	0.005
110-120	0.70	0.04	4.4	1.36	0.20	0.65	0.96	0.028	0.003
120-130	0.70	0.08	4.5	1.36	0.40	0.70	0.96	0.024	0.006
130-140	0.70	0.08	4.5	1.35	0.40	0.70	0.96	0.020	0.005
140-150	0.70	0.08	4.5	1.33	0.40	0.70	0.98	0.016	0.004
150-160	0.70	0.08	4.5	1.38	0.40	0.70	0.94	0.013	0.003
160-170	0.70	0.08	4.6	1.37	0.40	0.74	0.95	0.010	0.003
170-180	0.70	0.08	4.6	1.35	0.40	0.74	0.96	0.007	0.002
180-190	0.70	0.08	4.6	1.39	0.40	0.74	0.93	0.004	0.001
190-200	0.70	0.08	4.6	1.39	0.40	0.74	0.93	0.001	0.000
							Productivity Index =	1.000	0.441

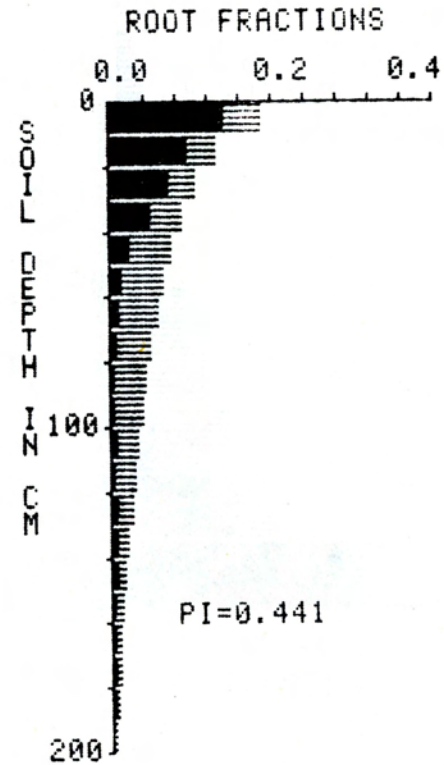

Figure 17. Estimated Productivity Index for Rooting Depth of 200 cm.

Plato Series Rev. DWW-KDV 3/2/83

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.05	0.18	5.5	1.30	0.90	1.00	1.00	0.314	0.283
10- 20	0.09	0.16	5.5	1.37	0.80	1.00	0.95	0.196	0.149
20- 30	0.12	0.14	4.0	1.37	0.70	0.47	0.95	0.143	0.045
30- 40	0.12	0.14	3.9	1.36	0.70	0.43	0.96	0.108	0.031
40- 50	0.12	0.11	3.9	1.37	0.55	0.43	0.95	0.082	0.018
50- 60	0.12	0.13	3.8	1.40	0.65	0.38	0.93	0.061	0.014
60- 70	0.12	0.14	3.7	1.41	0.70	0.34	0.92	0.044	0.010
70- 80	0.46	0.10	3.7	1.63	0.50	0.34	0.57	0.030	0.003
80- 90	0.70	0.06	3.7	1.73	0.30	0.34	0.24	0.017	0.000
90-100	0.70	0.06	3.7	1.67	0.30	0.34	0.44	0.005	0.000
							Productivity Index =	1.000	0.553

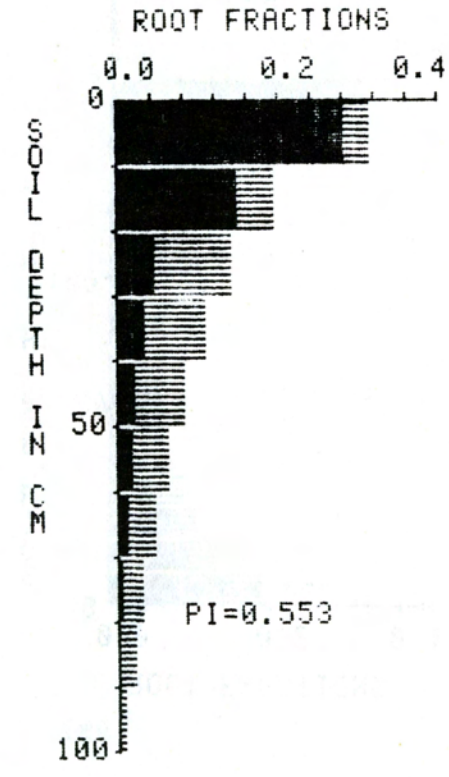

Figure 18. Estimated Productivity Index for Rooting Depth of 100 cm.

Plato Series Rev. DWW-KDV 3/2/83

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.05	0.18	5.5	1.30	0.90	1.00	1.00	0.190	0.171
10- 20	0.09	0.16	5.5	1.37	0.80	1.00	0.95	0.132	0.100
20- 30	0.12	0.14	4.0	1.37	0.70	0.47	0.95	0.105	0.033
30- 40	0.12	0.14	3.9	1.36	0.70	0.43	0.96	0.088	0.025
40- 50	0.12	0.11	3.9	1.37	0.55	0.43	0.95	0.076	0.017
50- 60	0.12	0.13	3.8	1.40	0.65	0.38	0.93	0.065	0.015
60- 70	0.12	0.14	3.7	1.41	0.70	0.34	0.92	0.057	0.012
70- 80	0.46	0.10	3.7	1.63	0.50	0.34	0.57	0.050	0.005
80- 90	0.70	0.06	3.7	1.73	0.30	0.34	0.24	0.043	0.001
90-100	0.70	0.06	3.7	1.67	0.30	0.34	0.44	0.038	0.002
100-110	0.70	0.06	3.7	1.67	0.30	0.34	0.44	0.033	0.001
110-120	0.64	0.06	3.8	1.59	0.30	0.38	0.70	0.028	0.002
120-130	0.50	0.06	3.7	1.36	0.30	0.34	0.96	0.024	0.002
130-140	0.50	0.06	3.9	1.36	0.30	0.43	0.96	0.020	0.002
140-150	0.26	0.08	3.9	1.35	0.40	0.43	0.96	0.016	0.003
150-160	0.20	0.09	4.0	1.33	0.45	0.47	0.98	0.013	0.003
160-170	0.20	0.09	4.1	1.38	0.45	0.52	0.94	0.010	0.002
170-180	0.20	0.09	4.3	1.37	0.45	0.61	0.95	0.007	0.002
180-190	0.20	0.09	4.4	1.35	0.45	0.65	0.96	0.004	0.001
190-200	0.20	0.09	4.4	1.39	0.45	0.65	0.93	0.001	0.000
							Productivity Index =	1.000	0.399

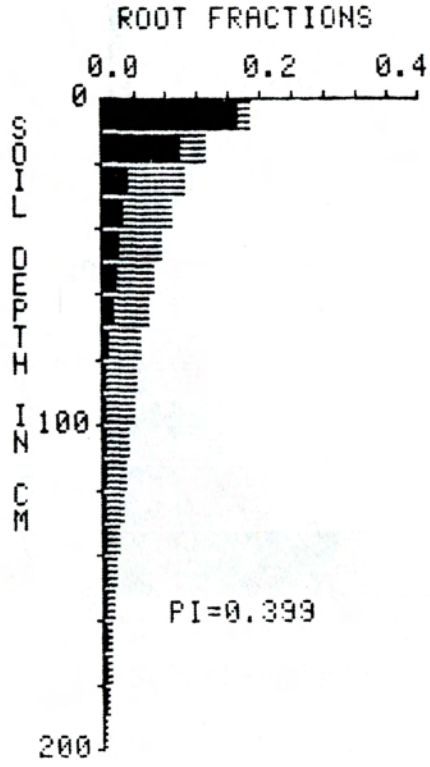

Figure 19. Estimated Productivity Index for Rooting Depth of 200 cm.

Captina Series Rev. LAQ 4/77

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.05	0.18	5.5	1.30	0.90	1.00	1.00	0.314	0.283
10- 20	0.05	0.18	5.5	1.37	0.90	1.00	0.95	0.196	0.168
20- 30	0.05	0.18	4.4	1.37	0.90	0.65	0.95	0.143	0.079
30- 40	0.05	0.17	4.2	1.36	0.85	0.56	0.96	0.108	0.049
40- 50	0.05	0.15	4.0	1.37	0.75	0.47	0.95	0.082	0.027
50- 60	0.05	0.15	4.1	1.40	0.75	0.52	0.93	0.061	0.022
60- 70	0.28	0.11	4.0	1.66	0.55	0.47	0.47	0.044	0.005
70- 80	0.44	0.09	3.9	1.73	0.45	0.43	0.24	0.030	0.001
80- 90	0.44	0.09	3.9	1.67	0.45	0.43	0.44	0.017	0.001
90-100	0.44	0.09	3.9	1.67	0.45	0.43	0.44	0.005	0.000
							Productivity Index =	1.000	0.635

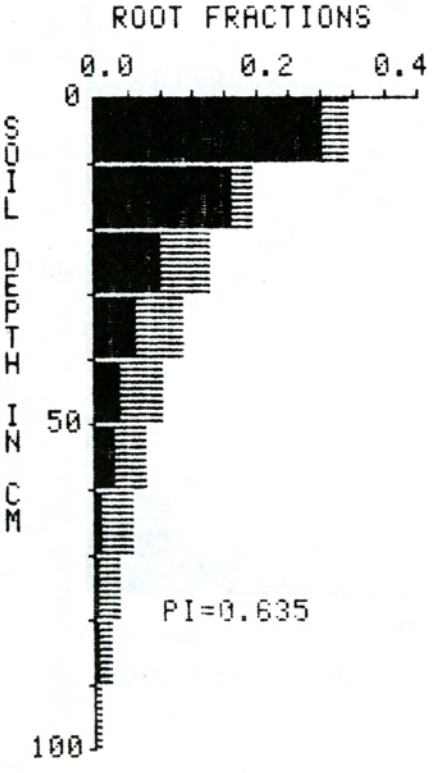

Figure 20. Estimated Productivity Index for Rooting Depth of 100 cm.

Captina Series Rev. LAQ 4/77

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.05	0.18	5.5	1.30	0.90	1.00	1.00	0.190	0.171
10- 20	0.05	0.18	5.5	1.37	0.90	1.00	0.95	0.132	0.113
20- 30	0.05	0.18	4.4	1.37	0.90	0.65	0.95	0.105	0.058
30- 40	0.05	0.17	4.2	1.36	0.85	0.56	0.96	0.088	0.040
40- 50	0.05	0.15	4.0	1.37	0.75	0.47	0.95	0.076	0.025
50- 60	0.05	0.15	4.1	1.40	0.75	0.52	0.93	0.065	0.024
60- 70	0.28	0.11	4.0	1.66	0.55	0.47	0.47	0.057	0.007
70- 80	0.44	0.09	3.9	1.73	0.45	0.43	0.24	0.050	0.002
80- 90	0.44	0.09	3.9	1.67	0.45	0.43	0.44	0.043	0.004
90-100	0.44	0.09	3.9	1.67	0.45	0.43	0.44	0.038	0.003
100-110	0.44	0.09	3.9	1.66	0.45	0.43	0.47	0.033	0.003
110-120	0.44	0.09	3.9	1.67	0.45	0.43	0.44	0.028	0.002
120-130	0.44	0.09	3.9	1.67	0.45	0.43	0.44	0.024	0.002
130-140	0.13	0.14	4.0	1.56	0.70	0.47	0.80	0.020	0.005
140-150	0.17	0.13	4.0	1.36	0.65	0.47	0.96	0.016	0.005
150-160	0.26	0.12	3.9	1.36	0.60	0.43	0.96	0.013	0.003
160-170	0.26	0.12	4.0	1.35	0.60	0.47	0.96	0.010	0.003
170-180	0.26	0.12	4.0	1.33	0.60	0.47	0.98	0.007	0.002
180-190	0.26	0.12	4.0	1.38	0.60	0.47	0.94	0.004	0.001
190-200	0.26	0.12	4.0	1.37	0.60	0.47	0.95	0.001	0.000
							Productivity Index =	1.000	0.473

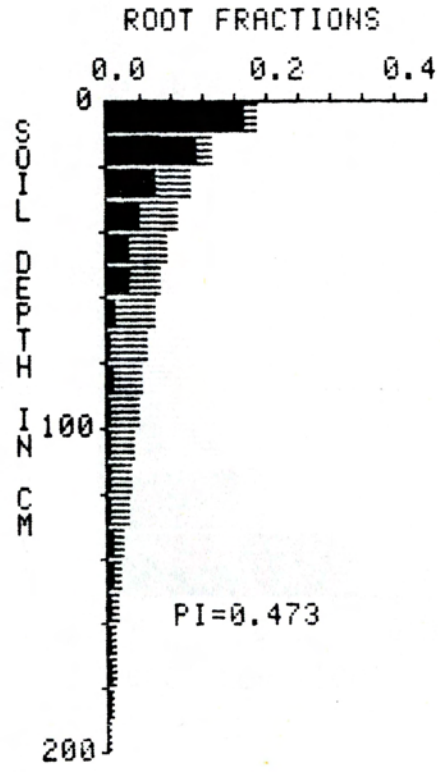

Figure 21. Estimated Productivity Index for Rooting Depth of 200 cm.

Needleye Series Rev. HEH-BWT 11/15/79

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.05	0.18	5.5	1.30	0.90	1.00	1.00	0.314	0.283
10- 20	0.05	0.17	5.5	1.37	0.85	1.00	0.95	0.196	0.158
20- 30	0.05	0.15	4.4	1.37	0.75	0.65	0.95	0.143	0.066
30- 40	0.05	0.15	4.2	1.36	0.75	0.56	0.96	0.108	0.044
40- 50	0.05	0.15	4.0	1.37	0.75	0.47	0.95	0.082	0.027
50- 60	0.08	0.14	4.1	1.40	0.70	0.52	0.93	0.061	0.021
60- 70	0.10	0.14	4.0	1.41	0.70	0.47	0.92	0.044	0.013
70- 80	0.43	0.09	3.9	1.63	0.45	0.43	0.57	0.030	0.003
80- 90	0.65	0.06	3.9	1.73	0.30	0.43	0.24	0.017	0.000
90-100	0.53	0.06	3.9	1.57	0.30	0.43	0.77	0.005	0.000
							Productivity Index =	1.000	0.615

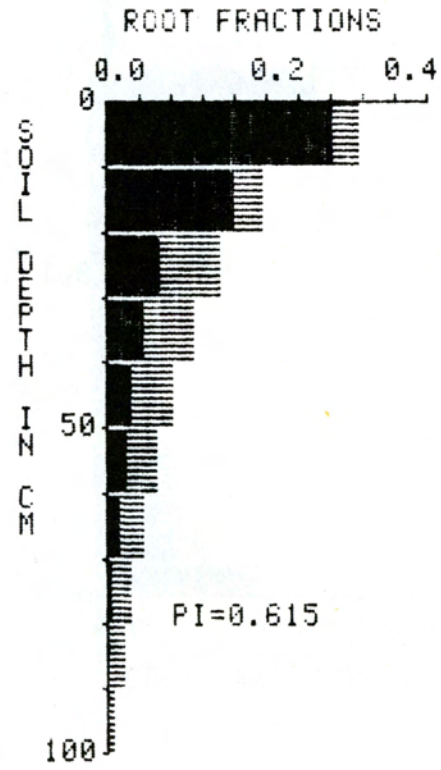

Figure 22. Estimated Productivity Index for Rooting Depth of 100 cm.

Needleye Series Rev. HEH-BWT 11/15/79

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.05	0.18	5.5	1.30	0.90	1.00	1.00	0.190	0.171
10- 20	0.05	0.17	5.5	1.37	0.85	1.00	0.95	0.132	0.106
20- 30	0.05	0.15	4.4	1.37	0.75	0.65	0.95	0.105	0.049
30- 40	0.05	0.15	4.2	1.36	0.75	0.56	0.96	0.088	0.035
40- 50	0.05	0.15	4.0	1.37	0.75	0.47	0.95	0.076	0.025
50- 60	0.08	0.14	4.1	1.40	0.70	0.52	0.93	0.065	0.022
60- 70	0.10	0.14	4.0	1.41	0.70	0.47	0.92	0.057	0.017
70- 80	0.43	0.09	3.9	1.63	0.45	0.43	0.57	0.050	0.006
80- 90	0.65	0.06	3.9	1.73	0.30	0.43	0.24	0.043	0.001
90-100	0.53	0.06	3.9	1.57	0.30	0.43	0.77	0.038	0.004
100-110	0.35	0.07	3.9	1.36	0.35	0.43	0.96	0.033	0.005
110-120	0.35	0.07	3.9	1.36	0.35	0.43	0.96	0.028	0.004
120-130	0.35	0.07	3.9	1.35	0.35	0.43	0.96	0.024	0.003
130-140	0.35	0.07	4.0	1.33	0.35	0.47	0.98	0.020	0.003
140-150	0.35	0.07	4.0	1.38	0.35	0.47	0.94	0.016	0.002
150-160	0.35	0.07	3.9	1.37	0.35	0.43	0.95	0.013	0.002
160-170	0.35	0.07	4.0	1.35	0.35	0.47	0.96	0.010	0.002
170-180	0.35	0.07	4.0	1.39	0.35	0.47	0.93	0.007	0.001
180-190	0.35	0.07	4.0	1.39	0.35	0.47	0.93	0.004	0.001
190-200	0.35	0.07	4.0	1.39	0.35	0.47	0.93	0.001	0.000
							Productivity Index =	1.000	0.459

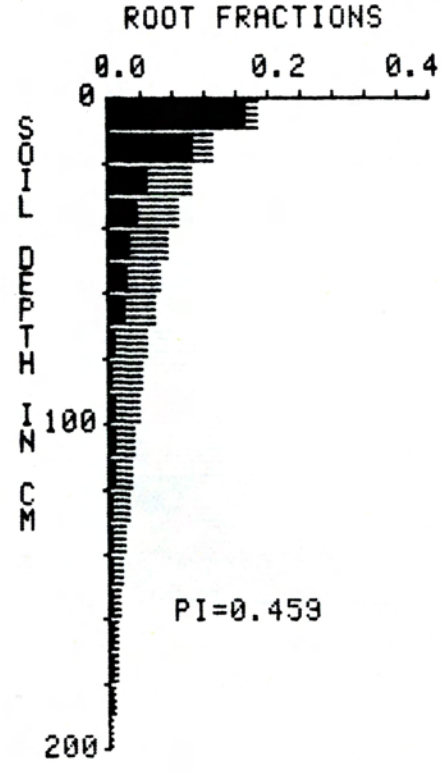

Figure 23. Estimated Productivity Index for Rooting Depth of 200 cm.

Nixa Series Rev. LAQ 4/77

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.40	0.11	5.5	1.30	0.55	1.00	1.00	0.314	0.173
10- 20	0.40	0.11	5.5	1.37	0.55	1.00	0.95	0.196	0.102
20- 30	0.44	0.10	4.4	1.37	0.50	0.65	0.95	0.143	0.044
30- 40	0.60	0.07	4.2	1.36	0.35	0.56	0.96	0.108	0.020
40- 50	0.60	0.07	4.0	1.37	0.35	0.47	0.95	0.082	0.013
50- 60	0.64	0.07	4.1	1.52	0.35	0.52	0.85	0.061	0.009
60- 70	0.70	0.06	4.0	1.73	0.30	0.47	0.24	0.044	0.001
70- 80	0.70	0.06	3.9	1.67	0.30	0.43	0.44	0.030	0.002
80- 90	0.70	0.06	3.9	1.67	0.30	0.43	0.44	0.017	0.001
90-100	0.70	0.06	3.9	1.66	0.30	0.43	0.47	0.005	0.000
							Productivity Index =	1.000	0.365

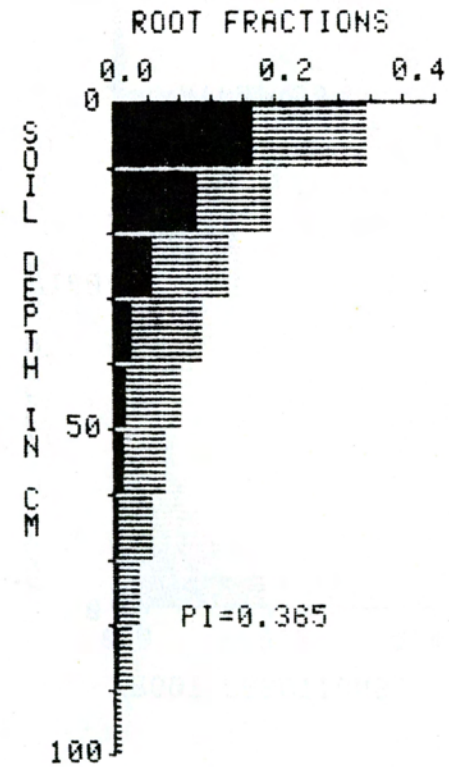

Figure 24. Estimated Productivity Index for Rooting Depth of 100 cm.

Nixa Series Rev. LAQ 4/77

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.40	0.11	5.5	1.30	0.55	1.00	1.00	0.190	0.104
10- 20	0.40	0.11	5.5	1.37	0.55	1.00	0.95	0.132	0.069
20- 30	0.44	0.10	4.4	1.37	0.50	0.65	0.95	0.105	0.032
30- 40	0.60	0.07	4.2	1.36	0.35	0.56	0.96	0.088	0.016
40- 50	0.60	0.07	4.0	1.37	0.35	0.47	0.95	0.076	0.012
50- 60	0.64	0.07	4.1	1.52	0.35	0.52	0.85	0.065	0.010
60- 70	0.70	0.06	4.0	1.73	0.30	0.47	0.24	0.057	0.002
70- 80	0.70	0.06	3.9	1.67	0.30	0.43	0.44	0.050	0.003
80- 90	0.70	0.06	3.9	1.67	0.30	0.43	0.44	0.043	0.002
90-100	0.70	0.06	3.9	1.66	0.30	0.43	0.47	0.038	0.002
100-110	0.70	0.06	3.9	1.67	0.30	0.43	0.44	0.033	0.002
110-120	0.78	0.04	3.9	1.47	0.20	0.43	0.88	0.028	0.002
120-130	0.80	0.03	3.9	1.36	0.15	0.43	0.96	0.024	0.001
130-140	0.80	0.03	4.0	1.36	0.15	0.47	0.96	0.020	0.001
140-150	0.80	0.03	4.0	1.35	0.15	0.47	0.96	0.016	0.001
150-160	0.80	0.03	3.9	1.33	0.15	0.43	0.98	0.013	0.001
160-170	0.80	0.03	4.0	1.38	0.15	0.47	0.94	0.010	0.001
170-180	0.80	0.03	4.0	1.37	0.15	0.47	0.95	0.007	0.000
180-190	0.80	0.03	4.0	1.35	0.15	0.47	0.96	0.004	0.000
190-200	0.80	0.03	4.0	1.39	0.15	0.47	0.93	0.001	0.000
							Productivity Index =	1.000	0.261

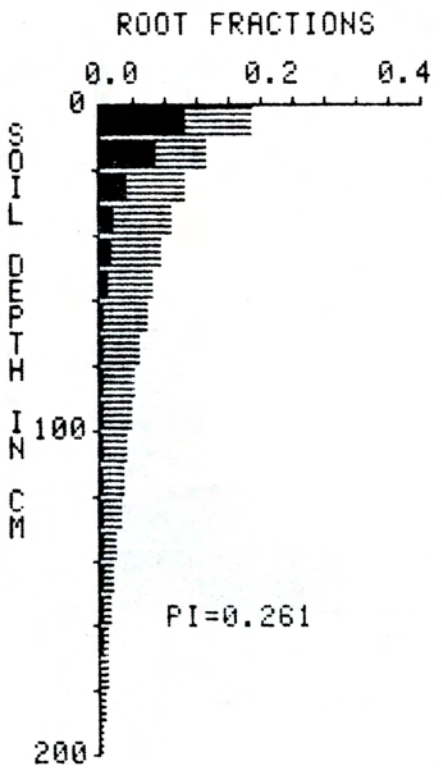

Figure 25. Estimated Productivity Index for Rooting Depth of 200 cm.

Macedonia Series Rev. TMC-LHG-MKP-RLG 1/14/80

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.02	0.18	5.5	1.41	0.90	1.00	0.92	0.314	0.260
10- 20	0.04	0.18	5.5	1.43	0.90	1.00	0.91	0.196	0.160
20- 30	0.06	0.18	4.2	1.42	0.90	0.56	0.91	0.143	0.066
30- 40	0.12	0.16	4.2	1.43	0.80	0.56	0.91	0.108	0.044
40- 50	0.20	0.13	4.2	1.40	0.65	0.56	0.93	0.082	0.028
50- 60	0.06	0.11	4.1	1.44	0.55	0.52	0.90	0.061	0.016
60- 70	0.05	0.10	4.1	1.39	0.50	0.52	0.93	0.044	0.011
70- 80	0.05	0.10	4.0	1.38	0.50	0.47	0.94	0.030	0.007
80- 90	0.05	0.10	4.0	1.36	0.50	0.47	0.96	0.017	0.004
90-100	0.03	0.11	4.0	1.35	0.55	0.47	0.96	0.005	0.001
							Productivity Index =	1.000	0.597

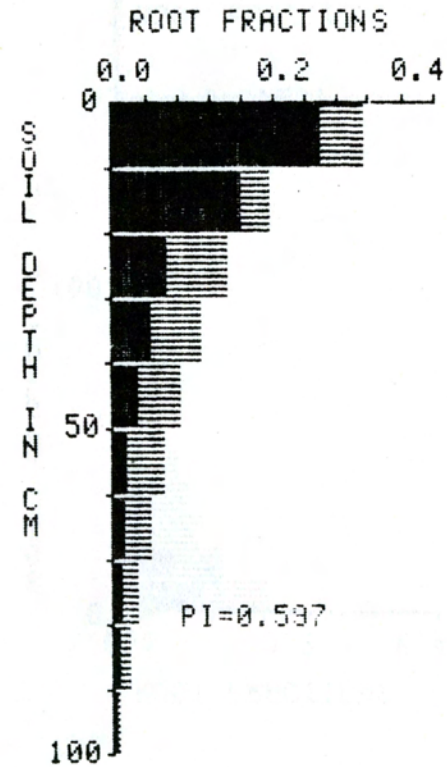

Figure 26. Estimated Productivity Index for Rooting Depth of 100 cm.

Macedonia Series Rev. TMC-LHG-MKP-RLG 1/14/80

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.02	0.18	5.5	1.41	0.90	1.00	0.92	0.190	0.157
10- 20	0.04	0.18	5.5	1.43	0.90	1.00	0.91	0.132	0.108
20- 30	0.06	0.18	4.2	1.42	0.90	0.56	0.91	0.105	0.048
30- 40	0.12	0.16	4.2	1.43	0.80	0.56	0.91	0.088	0.036
40- 50	0.20	0.13	4.2	1.40	0.65	0.56	0.93	0.076	0.026
50- 60	0.06	0.11	4.1	1.44	0.55	0.52	0.90	0.065	0.017
60- 70	0.05	0.10	4.1	1.39	0.50	0.52	0.93	0.057	0.014
70- 80	0.05	0.10	4.0	1.38	0.50	0.47	0.94	0.050	0.011
80- 90	0.05	0.10	4.0	1.36	0.50	0.47	0.96	0.043	0.010
90-100	0.03	0.11	4.0	1.35	0.55	0.47	0.96	0.038	0.009
100-110	0.03	0.11	3.9	1.36	0.55	0.43	0.96	0.033	0.007
110-120	0.03	0.11	3.9	1.30	0.55	0.43	1.00	0.028	0.007
120-130	0.33	0.07	3.9	1.29	0.35	0.43	1.00	0.024	0.004
130-140	0.33	0.07	3.9	1.33	0.35	0.43	0.98	0.020	0.003
140-150	0.33	0.07	3.9	1.32	0.35	0.43	0.98	0.016	0.002
150-160	0.33	0.07	3.9	1.30	0.35	0.43	1.00	0.013	0.002
160-170	0.33	0.07	3.9	1.35	0.35	0.43	0.96	0.010	0.001
170-180	0.33	0.07	3.8	1.34	0.35	0.38	0.97	0.007	0.001
180-190	0.33	0.07	3.9	1.26	0.35	0.43	1.00	0.004	0.001
190-200	0.33	0.07	3.9	1.26	0.35	0.43	1.00	0.001	0.000
							Productivity Index =	1.000	0.464

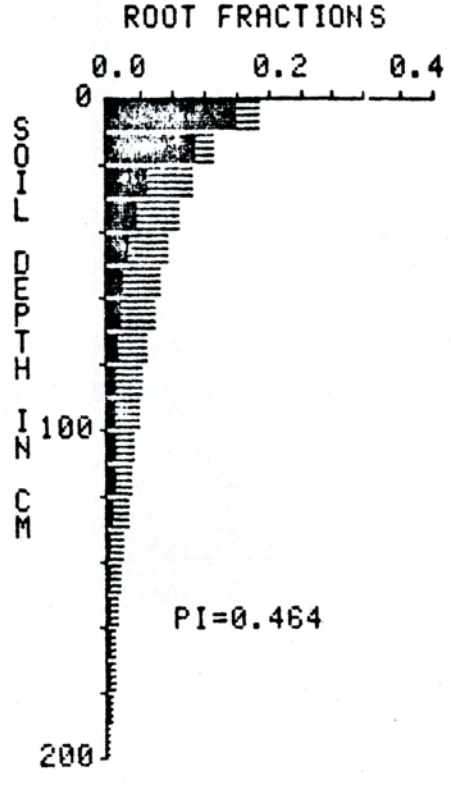

Figure 27. Estimated Productivity Index for Rooting Depth of 200 cm.

Doniphan Series Rev. BWT 6/27/79

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.58	0.08	4.4	1.41	0.40	1.00	0.92	0.314	0.116
10- 20	0.60	0.08	4.3	1.43	0.40	1.00	0.91	0.196	0.071
20- 30	0.60	0.08	4.2	1.42	0.40	0.56	0.91	0.143	0.029
30- 40	0.15	0.13	4.2	1.43	0.65	0.56	0.91	0.108	0.036
40- 50	0.10	0.10	4.1	1.40	0.50	0.56	0.93	0.082	0.021
50- 60	0.10	0.10	4.1	1.44	0.50	0.52	0.90	0.061	0.014
60- 70	0.10	0.10	4.0	1.39	0.50	0.52	0.93	0.044	0.011
70- 80	0.07	0.10	4.0	1.38	0.50	0.47	0.94	0.030	0.007
80- 90	0.07	0.10	4.0	1.36	0.50	0.47	0.96	0.017	0.004
90-100	0.07	0.10	3.9	1.35	0.50	0.43	0.96	0.005	0.001
							Productivity Index =	1.000	0.310

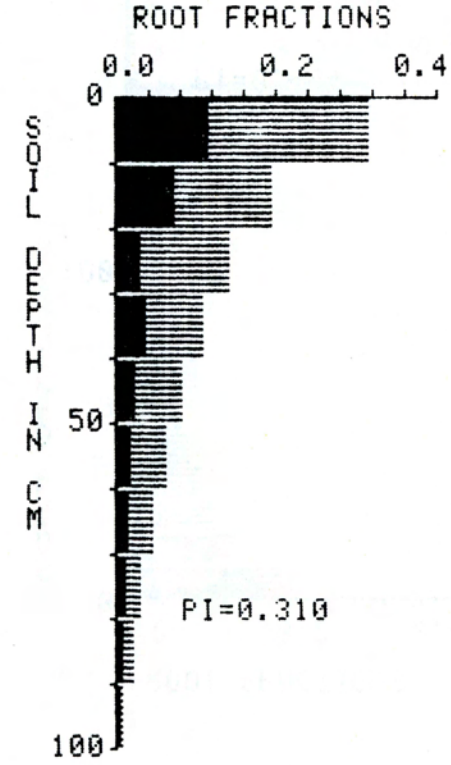

Figure 28. Estimated Productivity Index for Rooting Depth of 100 cm.

Doniphan Series Rev. BWT 6/27/79

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.58	0.08	4.4	1.41	0.40	1.00	0.92	0.190	0.070
10- 20	0.60	0.08	4.3	1.43	0.40	1.00	0.91	0.132	0.048
20- 30	0.60	0.08	4.2	1.42	0.40	0.56	0.91	0.105	0.021
30- 40	0.15	0.13	4.2	1.43	0.65	0.56	0.91	0.088	0.029
40- 50	0.10	0.10	4.1	1.40	0.50	0.56	0.93	0.076	0.020
50- 60	0.10	0.10	4.1	1.44	0.50	0.52	0.90	0.065	0.015
60- 70	0.10	0.10	4.0	1.39	0.50	0.52	0.93	0.057	0.014
70- 80	0.07	0.10	4.0	1.38	0.50	0.47	0.94	0.050	0.011
80- 90	0.07	0.10	4.0	1.36	0.50	0.47	0.96	0.043	0.010
90-100	0.07	0.10	3.9	1.35	0.50	0.43	0.96	0.038	0.008
100-110	0.07	0.10	3.9	1.36	0.50	0.43	0.96	0.033	0.007
110-120	0.07	0.10	3.9	1.30	0.50	0.43	1.00	0.028	0.006
120-130	0.07	0.10	3.9	1.29	0.50	0.43	1.00	0.024	0.005
130-140	0.07	0.10	3.9	1.33	0.50	0.43	0.98	0.020	0.004
140-150	0.07	0.10	3.9	1.32	0.50	0.43	0.98	0.016	0.003
150-160	0.07	0.10	3.9	1.30	0.50	0.43	1.00	0.013	0.003
160-170	0.07	0.10	3.9	1.35	0.50	0.43	0.96	0.010	0.002
170-180	0.07	0.10	3.8	1.34	0.50	0.38	0.97	0.007	0.001
180-190	0.07	0.10	3.9	1.26	0.50	0.43	1.00	0.004	0.001
190-200	0.07	0.10	3.9	1.26	0.50	0.43	1.00	0.001	0.000
							Productivity Index =	1.000	0.278

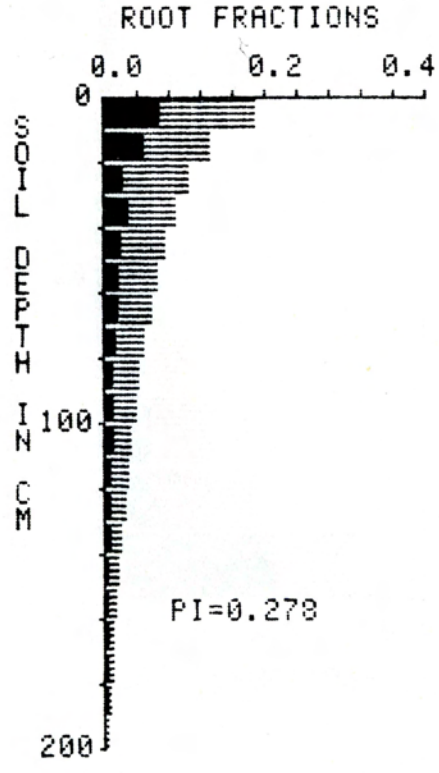

Figure 29. Estimated Productivity Index for Rooting Depth of 200 cm.

Claiborne Series Rev. CLM-CHP 5/77

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.20	0.15	5.5	1.41	0.75	1.00	0.92	0.314	0.217
10- 20	0.20	0.15	5.5	1.43	0.75	1.00	0.91	0.196	0.134
20- 30	0.08	0.17	4.2	1.42	0.85	0.56	0.91	0.143	0.062
30- 40	0.08	0.17	4.2	1.43	0.85	0.56	0.91	0.108	0.047
40- 50	0.08	0.15	4.2	1.40	0.75	0.56	0.93	0.082	0.032
50- 60	0.08	0.14	4.1	1.44	0.70	0.52	0.90	0.061	0.020
60- 70	0.08	0.14	4.1	1.39	0.70	0.52	0.93	0.044	0.015
70- 80	0.10	0.14	4.0	1.38	0.70	0.47	0.94	0.030	0.009
80- 90	0.10	0.14	4.0	1.36	0.70	0.47	0.96	0.017	0.005
90-100	0.10	0.14	4.0	1.35	0.70	0.47	0.96	0.005	0.002
							Productivity Index =	1.000	0.543

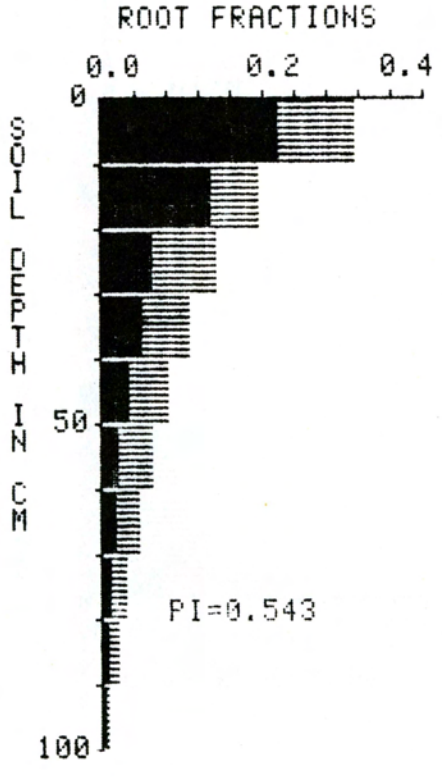

Figure 30. Estimated Productivity Index for Rooting Depth of 100 cm.

Claiborne Series Rev. CLM-CHP 5/77

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.20	0.15	5.5	1.41	0.75	1.00	0.92	0.190	0.131
10- 20	0.20	0.15	5.5	1.43	0.75	1.00	0.91	0.132	0.090
20- 30	0.08	0.17	4.2	1.42	0.85	0.56	0.91	0.105	0.045
30- 40	0.08	0.17	4.2	1.43	0.85	0.56	0.91	0.088	0.038
40- 50	0.08	0.15	4.2	1.40	0.75	0.56	0.93	0.076	0.030
50- 60	0.08	0.14	4.1	1.44	0.70	0.52	0.90	0.065	0.021
60- 70	0.08	0.14	4.1	1.39	0.70	0.52	0.93	0.057	0.019
70- 80	0.10	0.14	4.0	1.38	0.70	0.47	0.94	0.050	0.015
80- 90	0.10	0.14	4.0	1.36	0.70	0.47	0.96	0.043	0.014
90-100	0.10	0.14	4.0	1.35	0.70	0.47	0.96	0.038	0.012
100-110	0.10	0.14	3.9	1.36	0.70	0.43	0.96	0.033	0.010
110-120	0.09	0.13	3.9	1.30	0.65	0.43	1.00	0.028	0.008
120-130	0.08	0.10	3.9	1.29	0.50	0.43	1.00	0.024	0.005
130-140	0.08	0.10	3.9	1.33	0.50	0.43	0.98	0.020	0.004
140-150	0.08	0.10	3.9	1.32	0.50	0.43	0.98	0.016	0.003
150-160	0.08	0.10	3.9	1.30	0.50	0.43	1.00	0.013	0.003
160-170	0.08	0.10	3.9	1.35	0.50	0.43	0.96	0.010	0.002
170-180	0.09	0.10	3.8	1.34	0.50	0.38	0.97	0.007	0.001
180-190	0.15	0.09	3.9	1.26	0.45	0.43	1.00	0.004	0.001
190-200	0.15	0.09	3.9	1.26	0.45	0.43	1.00	0.001	0.000
							Productivity Index =	1.000	0.452

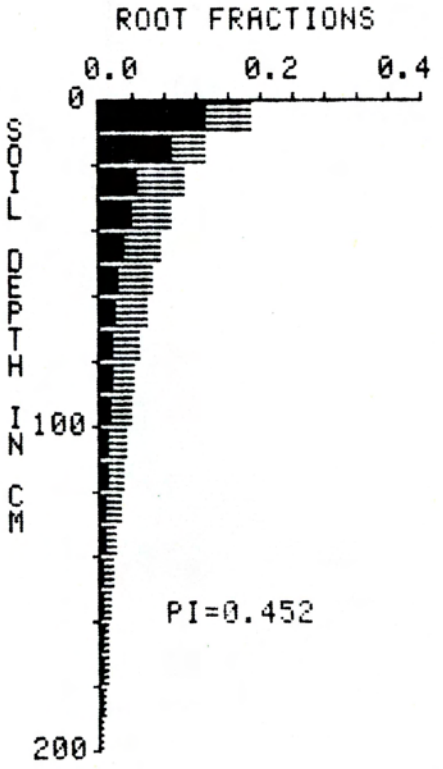

Figure 31. Estimated Productivity Index for Rooting Depth of 200 cm.

Clarksville Series Rev. BWT 1/80

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.50	0.09	5.5	1.41	0.45	1.00	0.92	0.314	0.130
10- 20	0.50	0.09	5.5	1.43	0.45	1.00	0.91	0.196	0.080
20- 30	0.50	0.09	4.2	1.42	0.45	0.56	0.91	0.143	0.033
30- 40	0.60	0.07	4.2	1.43	0.35	0.56	0.91	0.108	0.019
40- 50	0.65	0.06	4.2	1.40	0.30	0.56	0.93	0.082	0.013
50- 60	0.65	0.06	4.1	1.44	0.30	0.52	0.90	0.061	0.008
60- 70	0.65	0.06	4.1	1.39	0.30	0.52	0.93	0.044	0.006
70- 80	0.65	0.06	4.0	1.38	0.30	0.47	0.94	0.030	0.004
80- 90	0.65	0.06	4.0	1.36	0.30	0.47	0.96	0.017	0.002
90-100	0.51	0.08	4.0	1.35	0.40	0.47	0.96	0.005	0.001
							Productivity Index =	1.000	0.296

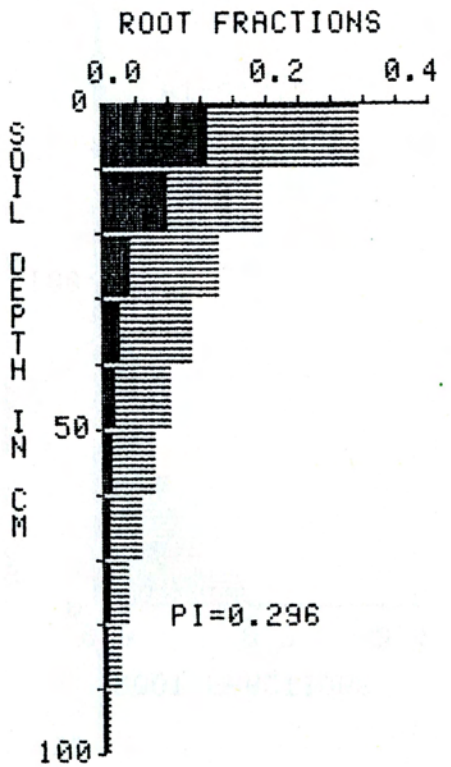

Figure 32. Estimated Productivity Index for Rooting Depth of 100 cm.

Clarksville Series Rev. BWT 1/80

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.50	0.09	5.5	1.41	0.45	1.00	0.92	0.190	0.079
10- 20	0.50	0.09	5.5	1.43	0.45	1.00	0.91	0.132	0.054
20- 30	0.50	0.09	4.2	1.42	0.45	0.56	0.91	0.105	0.024
30- 40	0.60	0.07	4.2	1.43	0.35	0.56	0.91	0.088	0.016
40- 50	0.65	0.06	4.2	1.40	0.30	0.56	0.93	0.076	0.012
50- 60	0.65	0.06	4.1	1.44	0.30	0.52	0.90	0.065	0.009
60- 70	0.65	0.06	4.1	1.39	0.30	0.52	0.93	0.057	0.008
70- 80	0.65	0.06	4.0	1.38	0.30	0.47	0.94	0.050	0.007
80- 90	0.65	0.06	4.0	1.36	0.30	0.47	0.96	0.043	0.006
90-100	0.51	0.08	4.0	1.35	0.40	0.47	0.96	0.038	0.007
100-110	0.30	0.11	3.9	1.36	0.55	0.43	0.96	0.033	0.007
110-120	0.32	0.10	3.9	1.30	0.50	0.43	1.00	0.028	0.006
120-130	0.50	0.06	3.9	1.29	0.30	0.43	1.00	0.024	0.003
130-140	0.50	0.06	3.9	1.33	0.30	0.43	0.98	0.020	0.002
140-150	0.50	0.06	3.9	1.32	0.30	0.43	0.98	0.016	0.002
150-160	0.50	0.06	3.9	1.30	0.30	0.43	1.00	0.013	0.002
160-170	0.65	0.04	3.9	1.35	0.20	0.43	0.96	0.010	0.001
170-180	0.65	0.04	3.8	1.34	0.20	0.38	0.97	0.007	0.000
180-190	0.65	0.04	3.9	1.26	0.20	0.43	1.00	0.004	0.000
190-200	0.65	0.04	3.9	1.26	0.20	0.43	1.00	0.001	0.000
							Productivity Index =	1.000	0.245

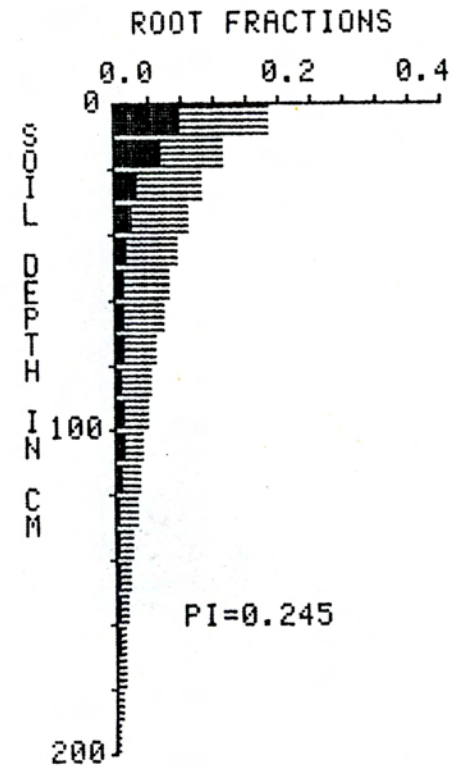

Figure 33. Estimated Productivity Index for Rooting Depth of 200 cm.

Gepp Series Rev. LAQ 9/79

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.35	0.12	5.5	1.36	0.60	1.00	0.96	0.314	0.181
10- 20	0.32	0.12	5.5	1.36	0.60	1.00	0.96	0.196	0.113
20- 30	0.30	0.11	4.3	1.32	0.55	0.61	0.98	0.143	0.047
30- 40	0.07	0.10	4.3	1.32	0.50	0.61	0.98	0.108	0.032
40- 50	0.07	0.10	4.3	1.32	0.50	0.61	0.98	0.082	0.024
50- 60	0.07	0.10	4.2	1.32	0.50	0.56	0.98	0.061	0.017
60- 70	0.07	0.10	4.2	1.32	0.50	0.56	0.98	0.044	0.012
70- 80	0.07	0.10	4.1	1.32	0.50	0.52	0.98	0.030	0.008
80- 90	0.07	0.10	4.1	1.32	0.50	0.52	0.98	0.017	0.004
90-100	0.07	0.10	4.1	1.29	0.50	0.52	1.00	0.005	0.001
							Productivity Index =	1.000	0.439

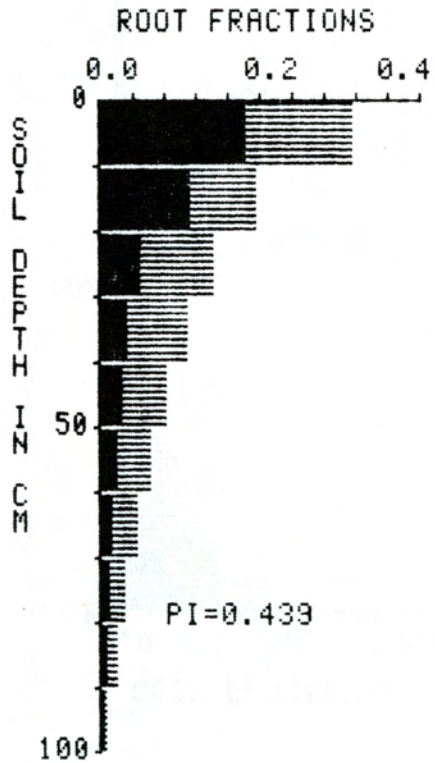

Figure 34. Estimated Productivity Index for Rooting Depth of 100 cm.

Gepp Series Rev. LAQ 9/79

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.35	0.12	5.5	1.36	0.60	1.00	0.96	0.190	0.109
10- 20	0.32	0.12	5.5	1.36	0.60	1.00	0.96	0.132	0.076
20- 30	0.30	0.11	4.3	1.32	0.55	0.61	0.98	0.105	0.034
30- 40	0.07	0.10	4.3	1.32	0.50	0.61	0.98	0.088	0.026
40- 50	0.07	0.10	4.3	1.32	0.50	0.61	0.98	0.076	0.023
50- 60	0.07	0.10	4.2	1.32	0.50	0.56	0.98	0.065	0.018
60- 70	0.07	0.10	4.2	1.32	0.50	0.56	0.98	0.057	0.016
70- 80	0.07	0.10	4.1	1.32	0.50	0.52	0.98	0.050	0.013
80- 90	0.07	0.10	4.1	1.32	0.50	0.52	0.98	0.043	0.011
90-100	0.07	0.10	4.1	1.29	0.50	0.52	1.00	0.038	0.010
100-110	0.13	0.10	4.1	1.29	0.50	0.52	1.00	0.033	0.008
110-120	0.15	0.09	4.1	1.29	0.45	0.52	1.00	0.028	0.006
120-130	0.15	0.09	4.2	1.29	0.45	0.56	1.00	0.024	0.006
130-140	0.15	0.09	4.4	1.19	0.45	0.65	1.00	0.020	0.006
140-150	0.15	0.09	4.7	1.19	0.45	0.79	1.00	0.016	0.006
150-160	0.15	0.09	5.3	1.19	0.45	0.97	1.00	0.013	0.006
160-170	0.15	0.09	6.2	1.19	0.45	1.00	1.00	0.010	0.004
170-180	0.15	0.09	7.2	1.19	0.45	1.00	1.00	0.007	0.003
180-190	0.15	0.09	7.6	1.19	0.45	1.00	1.00	0.004	0.002
190-200	1.00	0.00	-	-	0.00	0.00	0.00	0.001	0.000
							Productivity Index =	1.000	0.383

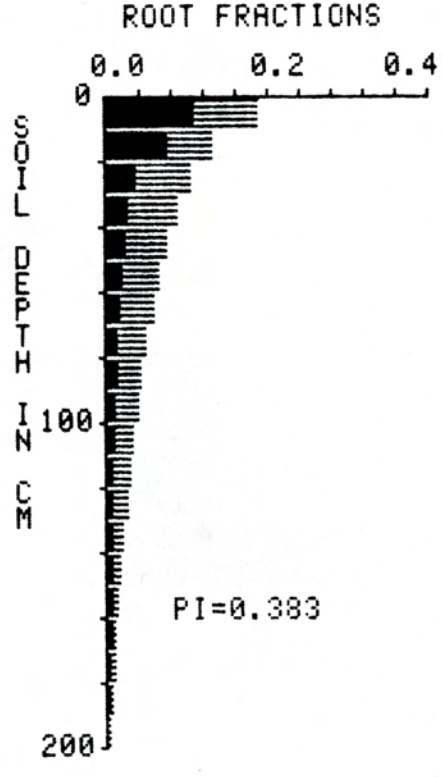

Figure 35. Estimated Productivity Index for Rooting Depth of 200 cm.

Goss Series Rev. FCW-FLG-RLG 10/29/79

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.15	0.16	5.5	1.36	0.80	1.00	0.96	0.314	0.241
10- 20	0.40	0.11	5.5	1.32	0.55	1.00	0.98	0.196	0.106
20- 30	0.65	0.07	4.3	1.32	0.35	0.61	0.98	0.143	0.030
30- 40	0.65	0.07	4.3	1.32	0.35	0.61	0.98	0.108	0.022
40- 50	0.65	0.06	4.3	1.32	0.30	0.61	0.98	0.082	0.015
50- 60	0.65	0.04	4.2	1.32	0.20	0.56	0.98	0.061	0.007
60- 70	0.65	0.04	4.2	1.32	0.20	0.56	0.98	0.044	0.005
70- 80	0.34	0.07	4.1	1.32	0.35	0.52	0.98	0.030	0.005
80- 90	0.30	0.08	4.1	1.29	0.40	0.52	1.00	0.017	0.004
90-100	0.30	0.08	4.1	1.29	0.40	0.52	1.00	0.005	0.001
							Productivity Index =	1.000	0.436

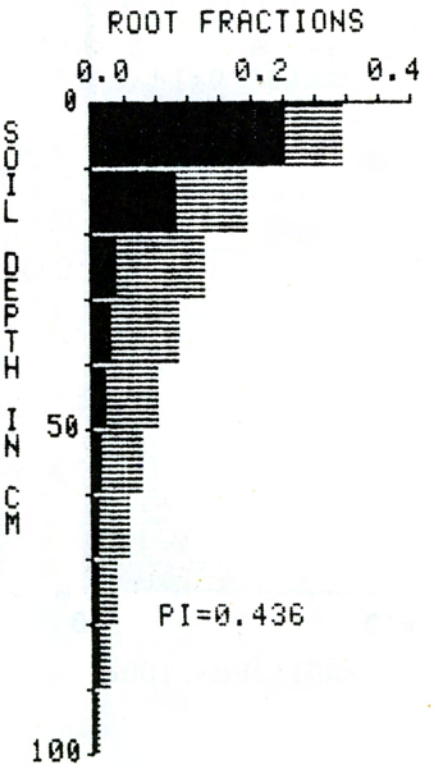

Figure 36. Estimated Productivity Index for Rooting Depth of 100 cm.

Goss Series Rev. FCW-FLG-RLG 10/29/79

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.15	0.16	5.5	1.36	0.80	1.00	0.96	0.190	0.146
10- 20	0.40	0.11	5.5	1.32	0.55	1.00	0.98	0.132	0.071
20- 30	0.65	0.07	4.3	1.32	0.35	0.61	0.98	0.105	0.022
30- 40	0.65	0.07	4.3	1.32	0.35	0.61	0.98	0.088	0.018
40- 50	0.65	0.06	4.3	1.32	0.30	0.61	0.98	0.076	0.014
50- 60	0.65	0.04	4.2	1.32	0.20	0.56	0.98	0.065	0.007
60- 70	0.65	0.04	4.2	1.32	0.20	0.56	0.98	0.057	0.006
70- 80	0.34	0.07	4.1	1.32	0.35	0.52	0.98	0.050	0.009
80- 90	0.30	0.08	4.1	1.29	0.40	0.52	1.00	0.043	0.009
90-100	0.30	0.08	4.1	1.29	0.40	0.52	1.00	0.038	0.008
100-110	0.30	0.08	4.1	1.29	0.40	0.52	1.00	0.033	0.007
110-120	0.30	0.08	4.2	1.29	0.40	0.56	1.00	0.028	0.006
120-130	0.30	0.08	4.4	1.19	0.40	0.65	1.00	0.024	0.006
130-140	0.34	0.07	4.7	1.19	0.35	0.79	1.00	0.020	0.006
140-150	0.45	0.06	5.3	1.19	0.30	0.97	1.00	0.016	0.005
150-160	0.45	0.06	6.2	1.19	0.30	1.00	1.00	0.013	0.004
160-170	0.45	0.06	7.2	1.19	0.30	1.00	1.00	0.010	0.003
170-180	0.72	0.03	7.6	1.19	0.15	1.00	1.00	0.007	0.001
180-190	1.00	0.00	-	-	0.00	0.00	0.00	0.004	0.000
190-200	1.00	0.00	-	-	0.00	0.00	0.00	0.001	0.000
							Productivity Index =	1.000	0.348

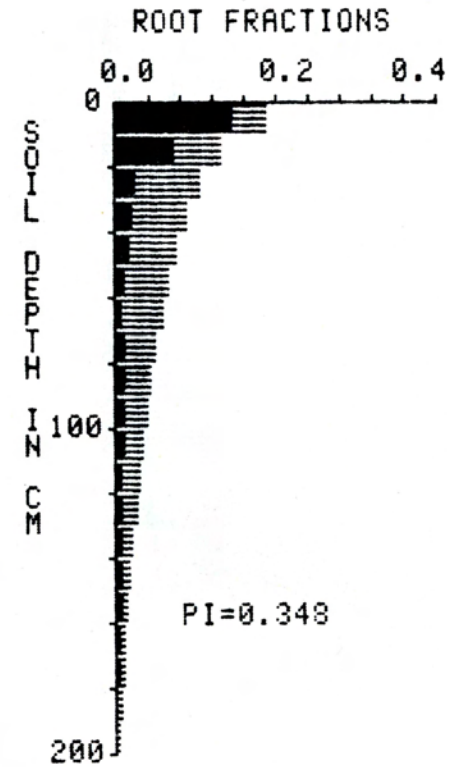

Figure 37. Estimated Productivity Index for Rooting Depth of 200 cm.

Peridge Series Rev. LAQ 9/79

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.05	0.18	5.5	1.41	0.90	1.00	0.92	0.314	0.260
10- 20	0.05	0.18	5.5	1.43	0.90	1.00	0.91	0.196	0.160
20- 30	0.05	0.15	4.2	1.42	0.75	0.56	0.91	0.143	0.055
30- 40	0.05	0.15	4.2	1.43	0.75	0.56	0.91	0.108	0.041
40- 50	0.05	0.15	4.2	1.40	0.75	0.56	0.93	0.082	0.032
50- 60	0.05	0.15	4.1	1.44	0.75	0.52	0.90	0.061	0.021
60- 70	0.05	0.15	4.1	1.39	0.75	0.52	0.93	0.044	0.016
70- 80	0.05	0.15	4.0	1.38	0.75	0.47	0.94	0.030	0.010
80- 90	0.05	0.15	4.0	1.36	0.75	0.47	0.96	0.017	0.006
90-100	0.05	0.15	4.0	1.35	0.75	0.47	0.96	0.005	0.002
							Productivity Index =	1.000	0.603

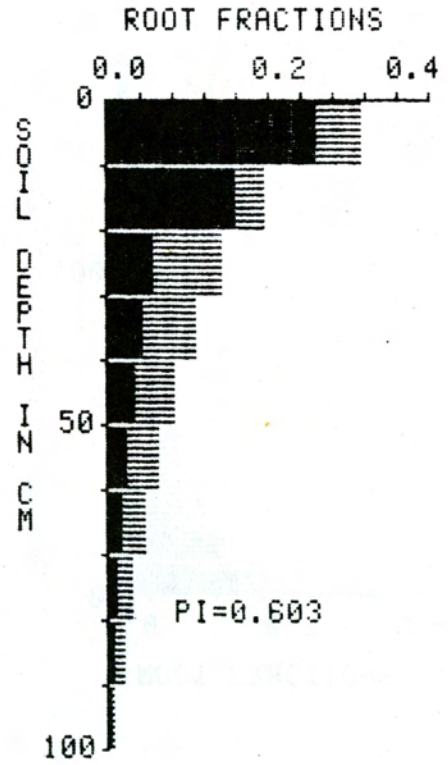

Figure 38. Estimated Productivity Index for Rooting Depth of 100 cm.

Peridge Series Rev. LAQ 9/79

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.05	0.18	5.5	1.41	0.90	1.00	0.92	0.190	0.157
10- 20	0.05	0.18	5.5	1.43	0.90	1.00	0.91	0.132	0.108
20- 30	0.05	0.15	4.2	1.42	0.75	0.56	0.91	0.105	0.040
30- 40	0.05	0.15	4.2	1.43	0.75	0.56	0.91	0.088	0.034
40- 50	0.05	0.15	4.2	1.40	0.75	0.56	0.93	0.076	0.030
50- 60	0.05	0.15	4.1	1.44	0.75	0.52	0.90	0.065	0.023
60- 70	0.05	0.15	4.1	1.39	0.75	0.52	0.93	0.057	0.021
70- 80	0.05	0.15	4.0	1.38	0.75	0.47	0.94	0.050	0.016
80- 90	0.05	0.15	4.0	1.36	0.75	0.47	0.96	0.043	0.014
90-100	0.05	0.15	4.0	1.35	0.75	0.47	0.96	0.038	0.013
100-110	0.11	0.14	3.9	1.36	0.70	0.43	0.96	0.033	0.010
110-120	0.25	0.12	3.9	1.30	0.60	0.43	1.00	0.028	0.007
120-130	0.25	0.12	3.9	1.29	0.60	0.43	1.00	0.024	0.006
130-140	0.25	0.11	3.9	1.33	0.55	0.43	0.98	0.020	0.005
140-150	0.25	0.08	3.9	1.32	0.40	0.43	0.98	0.016	0.003
150-160	0.25	0.08	3.9	1.30	0.40	0.43	1.00	0.013	0.002
160-170	0.25	0.08	3.9	1.35	0.40	0.43	0.96	0.010	0.002
170-180	0.25	0.08	3.8	1.34	0.40	0.38	0.97	0.007	0.001
180-190	0.25	0.08	3.9	1.26	0.40	0.43	1.00	0.004	0.001
190-200	0.25	0.08	3.9	1.26	0.40	0.43	1.00	0.001	0.000
							Productivity Index =	1.000	0.493

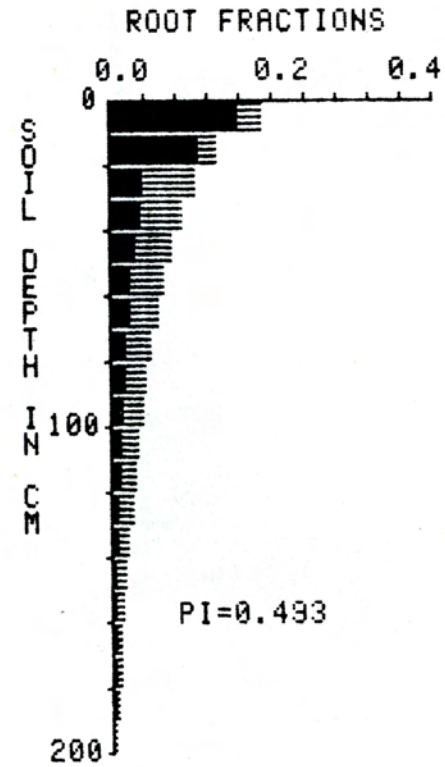

Figure 39. Estimated Productivity Index for Rooting Depth of 200 cm.

Pembroke Series Rev. JHW-JHN 9/22/72

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.05	0.18	6.6	1.41	0.90	1.00	0.92	0.314	0.260
10- 20	0.05	0.18	6.5	1.43	0.90	1.00	0.91	0.196	0.160
20- 30	0.05	0.16	5.3	1.42	0.80	0.97	0.91	0.143	0.101
30- 40	0.05	0.15	4.6	1.43	0.75	0.74	0.91	0.108	0.054
40- 50	0.05	0.15	4.1	1.40	0.75	0.52	0.93	0.082	0.030
50- 60	0.05	0.15	4.0	1.44	0.75	0.47	0.90	0.061	0.019
60- 70	0.05	0.15	4.0	1.39	0.75	0.47	0.93	0.044	0.014
70- 80	0.05	0.15	4.2	1.38	0.75	0.56	0.94	0.030	0.012
80- 90	0.09	0.14	4.2	1.36	0.70	0.56	0.96	0.017	0.006
90-100	0.12	0.14	4.3	1.35	0.70	0.61	0.96	0.005	0.002
							Productivity Index =	1.000	0.658

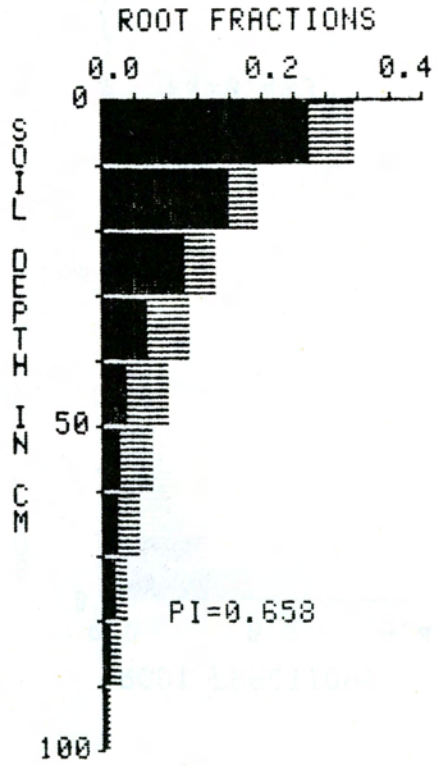

Figure 40. Estimated Productivity Index for Rooting Depth of 100 cm.

Pembroke Series Rev. JHW-JHN 9/22/72

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.05	0.18	6.6	1.41	0.90	1.00	0.92	0.190	0.157
10- 20	0.05	0.18	6.5	1.43	0.90	1.00	0.91	0.132	0.108
20- 30	0.05	0.16	5.3	1.42	0.80	0.97	0.91	0.105	0.074
30- 40	0.05	0.15	4.6	1.43	0.75	0.74	0.91	0.088	0.044
40- 50	0.05	0.15	4.1	1.40	0.75	0.52	0.93	0.076	0.028
50- 60	0.05	0.15	4.0	1.44	0.75	0.47	0.90	0.065	0.021
60- 70	0.05	0.15	4.0	1.39	0.75	0.47	0.93	0.057	0.019
70- 80	0.05	0.15	4.2	1.38	0.75	0.56	0.94	0.050	0.020
80- 90	0.09	0.14	4.2	1.36	0.70	0.56	0.96	0.043	0.016
90-100	0.12	0.14	4.3	1.35	0.70	0.61	0.96	0.038	0.016
100-110	0.12	0.14	4.3	1.36	0.70	0.61	0.96	0.033	0.014
110-120	0.12	0.11	4.4	1.30	0.55	0.65	1.00	0.028	0.010
120-130	0.12	0.10	4.5	1.29	0.50	0.70	1.00	0.024	0.008
130-140	0.12	0.10	4.5	1.33	0.50	0.70	0.98	0.020	0.007
140-150	0.12	0.10	4.5	1.32	0.50	0.70	0.98	0.016	0.005
150-160	0.12	0.10	4.5	1.30	0.50	0.70	1.00	0.013	0.004
160-170	0.12	0.10	4.6	1.35	0.50	0.74	0.96	0.010	0.004
170-180	0.12	0.10	4.6	1.34	0.50	0.74	0.97	0.007	0.002
180-190	0.12	0.10	4.6	1.26	0.50	0.74	1.00	0.004	0.001
190-200	0.12	0.10	4.6	1.26	0.50	0.74	1.00	0.001	0.000
							Productivity Index =	1.000	0.558

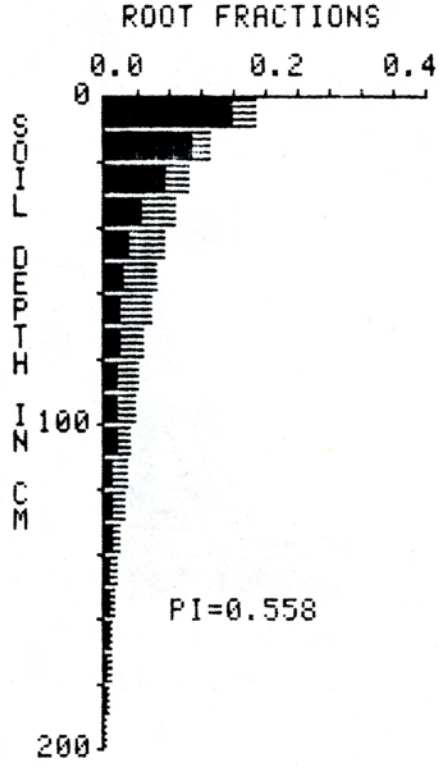

Figure 41. Estimated Productivity Index for Rooting Depth of 200 cm.

Eldon Series Rev. BWT 6/6/80

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.20	0.15	6.6	1.41	0.75	1.00	0.92	0.314	0.217
10- 20	0.20	0.15	6.5	1.43	0.75	1.00	0.91	0.196	0.134
20- 30	0.40	0.10	5.3	1.42	0.50	0.97	0.91	0.143	0.063
30- 40	0.60	0.06	4.6	1.43	0.30	0.74	0.91	0.108	0.022
40- 50	0.62	0.06	4.1	1.40	0.30	0.52	0.93	0.082	0.012
50- 60	0.70	0.05	4.0	1.44	0.25	0.47	0.90	0.061	0.006
60- 70	0.61	0.04	4.0	1.39	0.20	0.47	0.93	0.044	0.004
70- 80	0.55	0.05	4.2	1.38	0.25	0.56	0.94	0.030	0.004
80- 90	0.10	0.10	4.2	1.36	0.50	0.56	0.96	0.017	0.004
90-100	0.10	0.10	4.3	1.35	0.50	0.61	0.96	0.005	0.001
							Productivity Index =	1.000	0.467

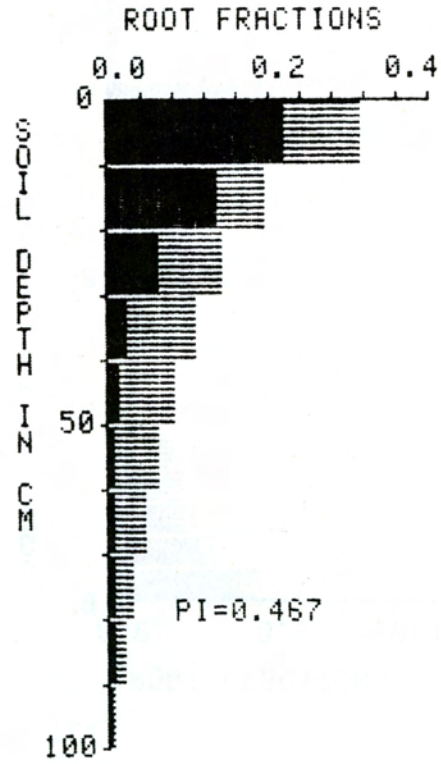

Figure 42. Estimated Productivity Index for Rooting Depth of 100 cm.

Eldon Series Rev. BWT 6/6/80

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.20	0.15	6.6	1.41	0.75	1.00	0.92	0.190	0.131
10- 20	0.20	0.15	6.5	1.43	0.75	1.00	0.91	0.132	0.090
20- 30	0.40	0.10	5.3	1.42	0.50	0.97	0.91	0.105	0.046
30- 40	0.60	0.06	4.6	1.43	0.30	0.74	0.91	0.088	0.018
40- 50	0.62	0.06	4.1	1.40	0.30	0.52	0.93	0.076	0.011
50- 60	0.70	0.05	4.0	1.44	0.25	0.47	0.90	0.065	0.007
60- 70	0.61	0.04	4.0	1.39	0.20	0.47	0.93	0.057	0.005
70- 80	0.55	0.05	4.2	1.38	0.25	0.56	0.94	0.050	0.006
80- 90	0.10	0.10	4.2	1.36	0.50	0.56	0.96	0.043	0.012
90-100	0.10	0.10	4.3	1.35	0.50	0.61	0.96	0.038	0.011
100-110	0.10	0.10	4.3	1.36	0.50	0.61	0.96	0.033	0.010
110-120	0.10	0.10	4.4	1.30	0.50	0.65	1.00	0.028	0.009
120-130	0.10	0.10	4.5	1.29	0.50	0.70	1.00	0.024	0.008
130-140	0.10	0.10	4.5	1.33	0.50	0.70	0.98	0.020	0.007
140-150	0.10	0.10	4.5	1.32	0.50	0.70	0.98	0.016	0.005
150-160	0.10	0.10	4.5	1.30	0.50	0.70	1.00	0.013	0.004
160-170	0.10	0.10	4.6	1.35	0.50	0.74	0.96	0.010	0.004
170-180	0.10	0.10	4.6	1.34	0.50	0.74	0.97	0.007	0.002
180-190	0.10	0.10	4.6	1.26	0.50	0.74	1.00	0.004	0.001
190-200	0.10	0.10	4.6	1.26	0.50	0.74	1.00	0.001	0.000
							Productivity Index =	1.000	0.387

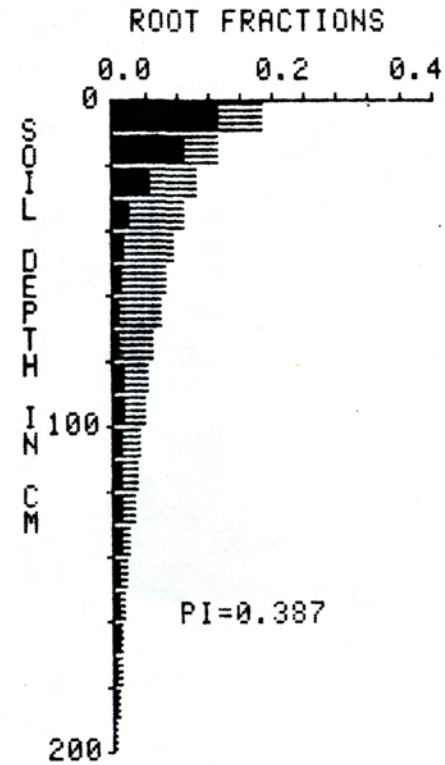

Figure 43. Estimated Productivity Index for Rooting Depth of 200 cm.

Gasconade Series Rev. BWT 9/80

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.20	0.13	6.7	1.19	0.65	1.00	1.00	0.314	0.204
10- 20	0.28	0.11	6.7	1.19	0.55	1.00	1.00	0.196	0.108
20- 30	0.60	0.04	7.2	1.19	0.20	1.00	1.00	0.143	0.029
30- 40	0.76	0.02	7.3	1.19	0.10	1.00	1.00	0.108	0.011
40- 50	1.00	0.00	-	-	0.00	0.00	0.00	0.082	0.000
50- 60	1.00	0.00	-	-	0.00	0.00	0.00	0.061	0.000
60- 70	1.00	0.00	-	-	0.00	0.00	0.00	0.044	0.000
70- 80	1.00	0.00	-	-	0.00	0.00	0.00	0.030	0.000
80- 90	1.00	0.00	-	-	0.00	0.00	0.00	0.017	0.000
90-100	1.00	0.00	-	-	0.00	0.00	0.00	0.005	0.000
							Productivity Index =	1.000	0.352

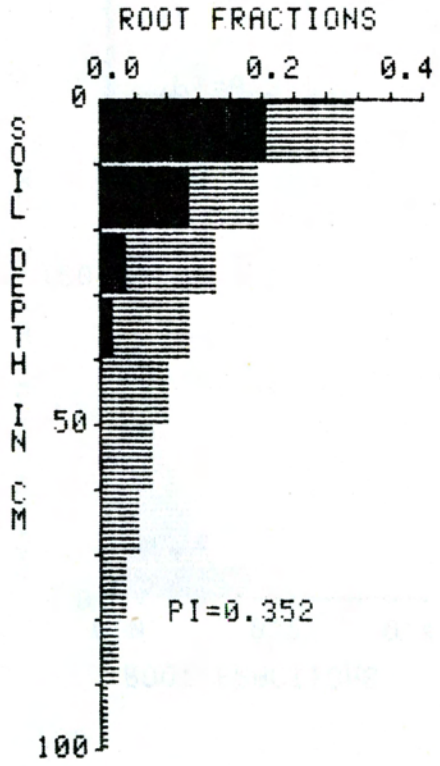

Figure 44. Estimated Productivity Index for Rooting Depth of 100 cm.

Gasconade Series Rev. BWT 9/80

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.20	0.13	6.7	1.19	0.65	1.00	1.00	0.190	0.124
10- 20	0.28	0.11	6.7	1.19	0.55	1.00	1.00	0.132	0.073
20- 30	0.60	0.04	7.2	1.19	0.20	1.00	1.00	0.105	0.021
30- 40	0.76	0.02	7.3	1.19	0.10	1.00	1.00	0.088	0.009
40- 50	1.00	0.00	-	-	0.00	0.00	0.00	0.076	0.000
50- 60	1.00	0.00	-	-	0.00	0.00	0.00	0.065	0.000
60- 70	1.00	0.00	-	-	0.00	0.00	0.00	0.057	0.000
70- 80	1.00	0.00	-	-	0.00	0.00	0.00	0.050	0.000
80- 90	1.00	0.00	-	-	0.00	0.00	0.00	0.043	0.000
90-100	1.00	0.00	-	-	0.00	0.00	0.00	0.038	0.000
100-110	1.00	0.00	-	-	0.00	0.00	0.00	0.033	0.000
110-120	1.00	0.00	-	-	0.00	0.00	0.00	0.028	0.000
120-130	1.00	0.00	-	-	0.00	0.00	0.00	0.024	0.000
130-140	1.00	0.00	-	-	0.00	0.00	0.00	0.020	0.000
140-150	1.00	0.00	-	-	0.00	0.00	0.00	0.016	0.000
150-160	1.00	0.00	-	-	0.00	0.00	0.00	0.013	0.000
160-170	1.00	0.00	-	-	0.00	0.00	0.00	0.010	0.000
170-180	1.00	0.00	-	-	0.00	0.00	0.00	0.007	0.000
180-190	1.00	0.00	-	-	0.00	0.00	0.00	0.004	0.000
190-200	1.00	0.00	-	-	0.00	0.00	0.00	0.001	0.000
							Productivity Index =	1.000	0.227

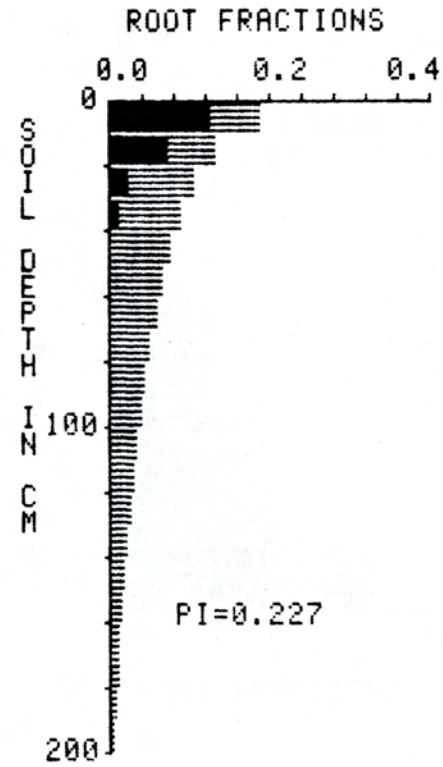

Figure 45. Estimated Productivity Index for Rooting Depth of 200 cm.

Bardley Series Rev. BWT 5/82

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.35	0.12	6.1	1.29	0.60	1.00	1.00	0.314	0.188
10- 20	0.65	0.07	5.5	1.19	0.35	1.00	1.00	0.196	0.069
20- 30	0.31	0.08	5.2	1.19	0.40	0.95	1.00	0.143	0.054
30- 40	0.31	0.08	5.3	1.19	0.40	0.97	1.00	0.108	0.042
40- 50	0.31	0.08	6.2	1.19	0.40	1.00	1.00	0.082	0.033
50- 60	0.31	0.08	7.2	1.19	0.40	1.00	1.00	0.061	0.024
60- 70	0.31	0.08	7.3	1.19	0.40	1.00	1.00	0.044	0.018
70- 80	1.00	0.00	-	-	0.00	0.00	0.00	0.030	0.000
80- 90	1.00	0.00	-	-	0.00	0.00	0.00	0.017	0.000
90-100	1.00	0.00	-	-	0.00	0.00	0.00	0.005	0.000
							Productivity Index =	1.000	0.428

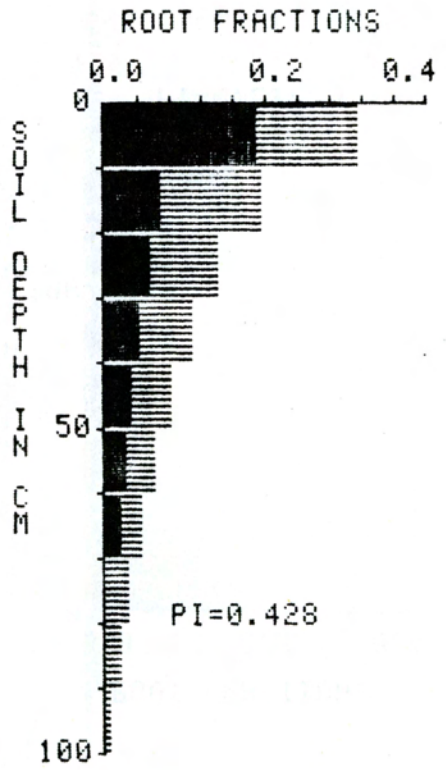

Figure 46. Estimated Productivity Index for Rooting Depth of 100 cm.

Bardley Series Rev. BWT 5/82

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.35	0.12	6.1	1.29	0.60	1.00	1.00	0.190	0.114
10- 20	0.65	0.07	5.5	1.19	0.35	1.00	1.00	0.132	0.046
20- 30	0.31	0.08	5.2	1.19	0.40	0.95	1.00	0.105	0.040
30- 40	0.31	0.08	5.3	1.19	0.40	0.97	1.00	0.088	0.034
40- 50	0.31	0.08	6.2	1.19	0.40	1.00	1.00	0.076	0.030
50- 60	0.31	0.08	7.2	1.19	0.40	1.00	1.00	0.065	0.026
60- 70	0.31	0.08	7.3	1.19	0.40	1.00	1.00	0.057	0.023
70- 80	1.00	0.00	-	-	0.00	0.00	0.00	0.050	0.000
80- 90	1.00	0.00	-	-	0.00	0.00	0.00	0.043	0.000
90-100	1.00	0.00	-	-	0.00	0.00	0.00	0.038	0.000
100-110	1.00	0.00	-	-	0.00	0.00	0.00	0.033	0.000
110-120	1.00	0.00	-	-	0.00	0.00	0.00	0.028	0.000
120-130	1.00	0.00	-	-	0.00	0.00	0.00	0.024	0.000
130-140	1.00	0.00	-	-	0.00	0.00	0.00	0.020	0.000
140-150	1.00	0.00	-	-	0.00	0.00	0.00	0.016	0.000
150-160	1.00	0.00	-	-	0.00	0.00	0.00	0.013	0.000
160-170	1.00	0.00	-	-	0.00	0.00	0.00	0.010	0.000
170-180	1.00	0.00	-	-	0.00	0.00	0.00	0.007	0.000
180-190	1.00	0.00	-	-	0.00	0.00	0.00	0.004	0.000
190-200	1.00	0.00	-	-	0.00	0.00	0.00	0.001	0.000
							Productivity Index =	1.000	0.313

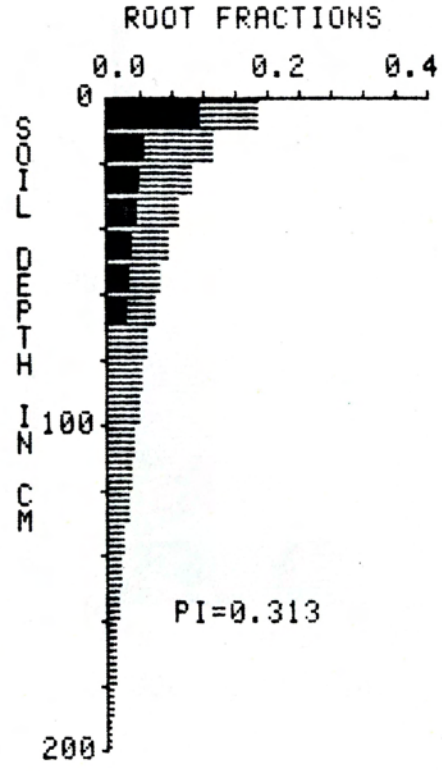

Figure 47. Estimated Productivity Index for Rooting Depth of 200 cm.

Gatewood Series Rev. BWT 6/81

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.22	0.15	5.7	1.29	0.75	1.00	1.00	0.314	0.236
10- 20	0.08	0.12	5.5	1.29	0.60	1.00	1.00	0.196	0.118
20- 30	0.05	0.10	4.9	1.29	0.50	0.88	1.00	0.143	0.063
30- 40	0.05	0.10	4.9	1.19	0.50	0.88	1.00	0.108	0.048
40- 50	0.07	0.10	5.0	1.19	0.50	0.92	1.00	0.082	0.038
50- 60	0.15	0.09	5.3	1.19	0.45	0.97	1.00	0.061	0.027
60- 70	0.15	0.09	6.2	1.19	0.45	1.00	1.00	0.044	0.020
70- 80	0.35	0.07	7.2	1.19	0.35	1.00	1.00	0.030	0.010
80- 90	0.48	0.06	7.5	1.19	0.30	1.00	1.00	0.017	0.005
90-100	1.00	0.00	-	-	0.00	0.00	0.00	0.005	0.000
							Productivity Index =	1.000	0.565

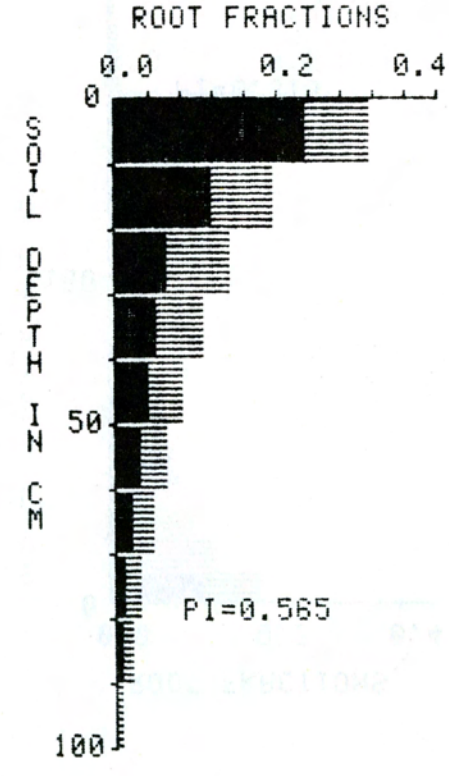

Figure 48. Estimated Productivity Index for Rooting Depth of 100 cm.

Gatewood Series Rev. BWT 6/81

Depth	Soil Properties				Sufficiencies			Root Fraction	
	Coarse Fragments	PAWC	Salt pH	Bulk Density	PAWC	Salt pH	Bulk Density	Ideal Soil	This Soil
cm	>2mm	cm/cm		g/cm3				(RI)	
0- 10	0.22	0.15	5.7	1.29	0.75	1.00	1.00	0.190	0.142
10- 20	0.08	0.12	5.5	1.29	0.60	1.00	1.00	0.132	0.079
20- 30	0.05	0.10	4.9	1.29	0.50	0.88	1.00	0.105	0.046
30- 40	0.05	0.10	4.9	1.19	0.50	0.88	1.00	0.088	0.039
40- 50	0.07	0.10	5.0	1.19	0.50	0.92	1.00	0.076	0.035
50- 60	0.15	0.09	5.3	1.19	0.45	0.97	1.00	0.065	0.028
60- 70	0.15	0.09	6.2	1.19	0.45	1.00	1.00	0.057	0.026
70- 80	0.35	0.07	7.2	1.19	0.35	1.00	1.00	0.050	0.018
80- 90	0.48	0.06	7.5	1.19	0.30	1.00	1.00	0.043	0.013
90-100	1.00	0.00	-	-	0.00	0.00	0.00	0.038	0.000
100-110	1.00	0.00	-	-	0.00	0.00	0.00	0.033	0.000
110-120	1.00	0.00	-	-	0.00	0.00	0.00	0.028	0.000
120-130	1.00	0.00	-	-	0.00	0.00	0.00	0.024	0.000
130-140	1.00	0.00	-	-	0.00	0.00	0.00	0.020	0.000
140-150	1.00	0.00	-	-	0.00	0.00	0.00	0.016	0.000
150-160	1.00	0.00	-	-	0.00	0.00	0.00	0.013	0.000
160-170	1.00	0.00	-	-	0.00	0.00	0.00	0.010	0.000
170-180	1.00	0.00	-	-	0.00	0.00	0.00	0.007	0.000
180-190	1.00	0.00	-	-	0.00	0.00	0.00	0.004	0.000
190-200	1.00	0.00	-	-	0.00	0.00	0.00	0.001	0.000
							Productivity Index =	1.000	0.426

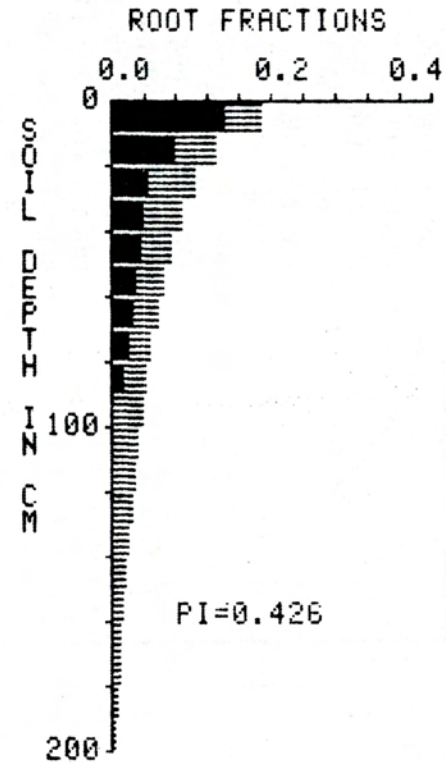

Figure 49. Estimated Productivity Index for Rooting Depth of 200 cm.

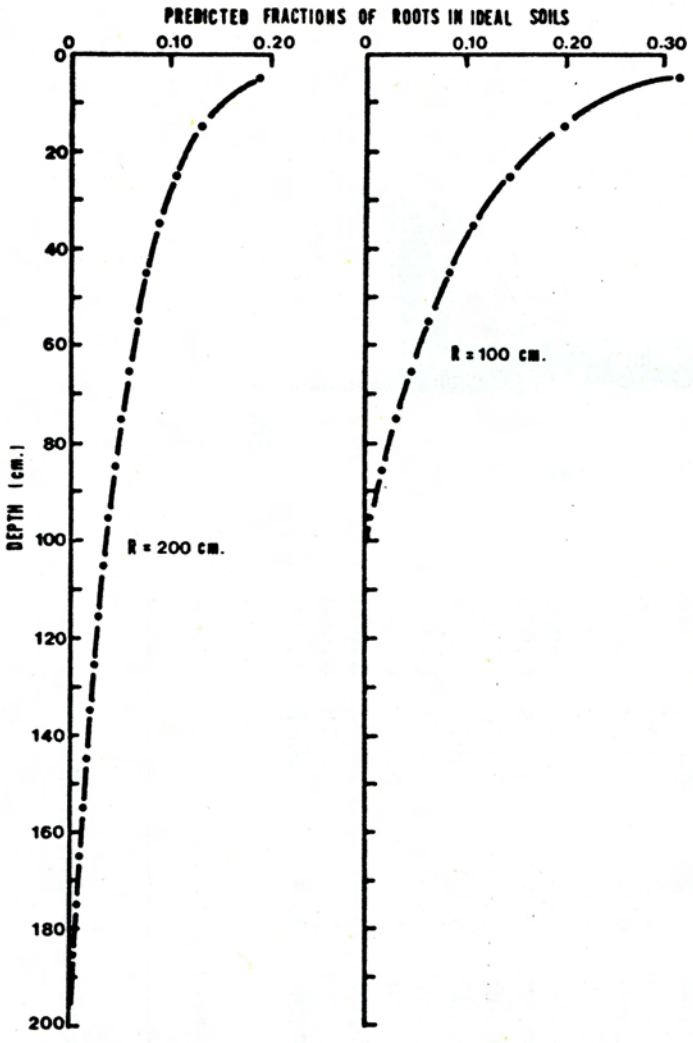

Figure 50. Predicted profiles of root fractions in ideal soils (RI's) for plant-determined rooting depths (R) of 200 cm and 100 cm. The predicted fractions constitute a weighting factor when used to calculate the productivity index (PI).

SUMMARY

The 44 figures showing the PI analyses (Figures 6-49) represent the achievement of our objective, which was to provide estimates of productivity indices for soils of the Missouri Ozarks. They are presented for consideration and evaluation by any person interested in describing soil resources.

The authors believe that their greatest contribution may lie in the methodology for determining input values for soil properties. A series of eleven tables (Tables 5-15) compile the existing soil research data into predicted profiles of pHs and density. The compilation was by groups of soils having various combinations of features thought to be related to input values for the PI approach. Tables 5-10 relate estimates of pHs profiles to depths to carbonate rock, presence or absence of a fragipan layer, and to elements of Soil Taxonomy. Tables 11-15 relate estimates of density profiles to presence or absence of fragipan horizons, depth to carbonate rock, and elements of Soil Taxonomy.

It is hoped that this report has brought to light some order that exists in a unique resource area of Missouri. It is also hoped that for the student of soil science, the questions raised will outnumber the answers provided.

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