Characterization and Evaluation of Agricultural Benchmark Soils from Sevilla, Spain[1]

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ABSTRACT

In Sevilla Province, southwestern Spain, benchmark soils of eight agricultural areas were defined using traditional soil pedon concepts of soil survey. The characterization emphasized morphological, chemical, and physical analyses. These eight representative soils were classified as follows: Rojo Aljarafe (Typic Rhodoxeralf), Tierranegra Campo (Typic Pelloxerert), Salino Marismas (Vertic Fluvaquent), Franco Vega (Typic Xerofluvent), Arena Terrazas (Aquic Haploxeralf), Almagra Alcores (Calcic Haploxeralf), Bujeo Campiña (Typic Chromoxerert), and Albariza Estepa (Entic Haploxeroll). By application of a computer-based soil evaluation system developed with information from a representative zone, predicted yields were calculated for wheat (*Triticum aestivum* L.), field corn (*Zea mays* L.), and cotton (*Gossypium hirsutum* L.) for the selected benchmark soils. Productivity information was transferred from the representative zone to the eight agricultural areas within Sevilla Province. Soils were ranked in the following order according to predicted yields for the three crops: Bujeo Campiña > Tierranegra Campo > Franco Vega > Salino Marismas > Rojo Aljarafe > Almagra Alcores > Albariza Estepa > Arena Terrazas.

Additional Index Words: **soil classification, soil survey, statistical model application, soil suitability.**

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IN SEVILLA PROVINCE, approximately 900 000 ha of the total area of 1.4 million ha are considered agricultural soils. Previous investigations (7, 15) emphasized soil genesis and spatial distribution of soil. There remains a great need for basic data and interpretations of representative soils in this province.

Benchmark soils are those that, because of their large extent, key position in the classification systems, or ocurrence in critical areas, are important to the understanding of soils (13). These authors also reported that it is impossible to make detailed studies of all soils because of their vast numbers. The practical approach is to obtain a thorough understanding of soil behavior thorough detailed investigations on a few important soils. Information about these benchmark soils can then be extended to those soils that are closely related in classification and geography.

Soil data need to be translated from the complex scientific language of the soil scientist to simple expressions of soil behavior that soil information users can understand. According to Bartelli (2), this constitutes soil survey interpretation. Soil evaluations, synonymous with soil survey interpretations, are predictions of performance, not recommendations for the use of soils (3). Productive capacity or expected yields are useful in predicting the suitability of any soil for agricultural use. There is a tendency to make the analysis of productivity more complete by identifying and quantifying all ecological components (17) where climate is, of course, the principal variable. However, in ecological units where natural and socio-economic factors are considered constant, evaluations of soil-productive capacity based on soil properties can supply a satisfactory estimate of variation in crop yields. At the present time, a methodology which uses computer-based models provides increased precision for estimates of expected yields from soils (9). Although the models are calibrated with soil and crop yield data relating to a representative zone, these models can be useful to transfer agronomic information to other similar areas (4).

Benchmark soils of eight agricultural areas from Sevilla Province were characterized in this study. By application of a computerized soil evaluation system (11) developed with information from a representative zone, yields of wheat (*Triticum aestivum* L.), corn (*Zea mays* L.), and cotton (*Gossypium hirsutum* L.) for the selected benchmark soils were predicted. It is intended that this paper will lead towards a Regional Soil Catalogue, which will identify, define, describe and give the agricultural and nonagricultural qualities of benchmark soils.

MATERIALS AND METHODS

The study areas are located in the Province of Sevilla, Andalucía Region, Spain. The approximate geographic coordinates are 5° 00′ to 6° 30′ W and 37° 00′ to 38° 00′ N. Elevation of the areas range from 2 to 500 m above sea level. The climate is Mediterranean, with moist and cool winters, and warm and dry summers. The average annual temperature approaches 18°C and annual rainfall is about 600 mm.

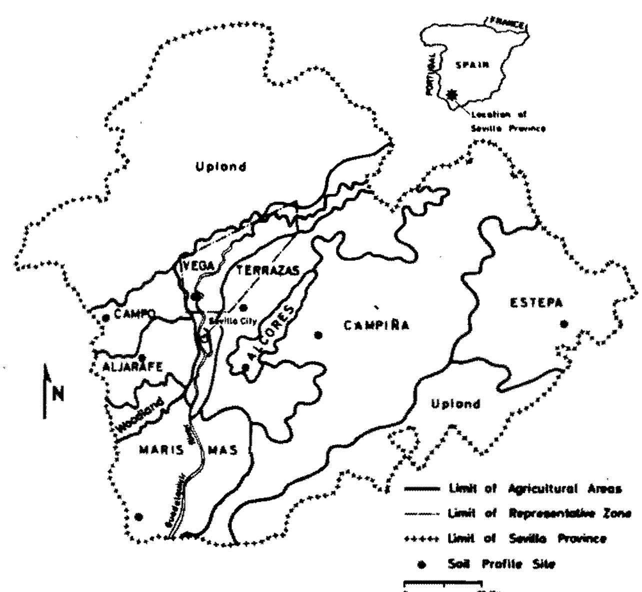

Fig. 1—Location of study soils, agricultural areas, and the representative zone within the Province of Sevilla.

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A general description of each area is summarized in Table 1.

On the basis of the completed soil survey of the Sevilla Province (7,10,15), the discussed soils were selected because they occupy large proportions of the study areas. However, inclusions of soils significantly different in each area can be recognized. Location of the selected benchmark soils and the agricultural study areas are given in Fig. 1.

Pits necessary to examine each soil were dug to a depth of 2 m. Profiles were described and sampled. Morphological descriptions were recorded following the nomenclature specified in the *Soil Survey Manual* (18). Soils were classified according to the method outlined by the Soil Survey Staff (20).

Soil pH was measured in water and in 1*N* KCl using a 1:1 soil-to liquid ratio. Organic C was determined by the Walkley-Black procedure (1). Nitrogen was analyzed by Kjeldahl digestion (19). Salinity was determined by the electrical conductivity (EC) of saturation extract (19). Carbonate content was measured by a volumetric method (19). Cation exchange capacity (CEC) was determined by the NH_4OAc method at pH 7 (19). Exchangeable Na was extracted in 1*N* NH_4OAc (8). Sodium saturation (exchangeable Na percentage, ESP) was calculated by dividing exchangeable Na by CEC. Standard procedures were used in determining bulk density by the core method, hydraulic conductivity in water saturated samples, and water retention at 1/3 and 15 bar tension (19). Particle-size distribution (fractions 2–0.2 mm, 0.2–0.02 mm, 0.02–0.002 mm, < 0.002 mm) were determined by the hydrometer method (5).

Agricultural evaluation of the selected benchmark soils was determined by application of the system developed by De la Rosa et al. (11). This system was developed in a representative zone of Sevilla Province (Fig. 1) for predicting yields of wheat, field corn, and cotton on the basis of selected soil properties when cropped under a high level of management. The procedure consisted of computing polynomial models following analyses by multiple regression (11).

RESULTS AND DISCUSSION

Soil Characterization

Profile descriptions and analytical characterization of selected benchmark soils are summarized in Tables 2 and 3. The Rojo Aljarafe profile presents strong textural profile differentiation with a red solum (A and B horizons). With increasing depth, organic matter decreases and carbonate content increases. Cation exchange capacity follows a trend similar to clay content. Although not shown, base saturation is nearly 100% in the entire profile. This soil has a moderate permeability and available water capacity. In this Mediterranean region, most of these soils (Rhodoxeralfs) have formed under climatic conditions considerably different from the present conditions (6).

The Tierranegra Campo profile is a very dark clayey soil. The dominant mineral of the clay fraction (< 2 μm) is montmorillonite (7), which contributes to a high shrink-swell potential and CEC (> 0.35 mol kg^{-1}). During dry seasons, deep cracks of considerable width develop in these soils. The carbonate content is high through the entire profile. The hydraulic conductivity is very low except in the cracks, and the available water capacity is high (> 16% by weight).

The Salino Marismas profile has a gray color and clay texture in the Alsa horizon. The clay fraction is predominantly illite in a advanced degree of alteration (14). The most important characteristic of this soil is its very high salt content (EC > 45 dS m^{-1}). The pH (<8.0) corresponds to values for saline, nonsodic soils. However, the level of exchangeable Na (ESP > 20%) is very high. The adverse physical properties, especially hydraulic conductivity, are further compounded by this high level of exchangeable Na along with the high clay content.

The Franco Vega profile shows only weak evidence of soil formation (e.g., high carbonate content and weak structure development). It has a pale brown, sandy clay loam Ap horizon moderately rich in organic matter and natural fertility. Hydraulic conductivity is moderate (~1 cm h^{-1}) through all the profile and available water capacity is moderately high.

The Arena Terrazas profile is yellowish brown and very sandy in the Ap and B1 horizons. With increasing depth, clay content and CEC increase and organic matter decreases. Only the deepest horizion (B3g) contains free carbonates. Bulk density is very high, and

Table 1—General descriptions of the agricultural areas considered in the study.

Area	Description
Aljarafe	An area of calcareous, fine-grained sandstone (Mio-Pliocene). The general relief varies from moderately undulating to level (slopes of 1–8%). Well-drained and moderately well-drained soils predominate this area. This area supports mainly olive, citrus, grapevine, and annual crops. Its approximate area is 43 000 ha.
Campo	A region of depressed surfaces of Mio-Pliocene parent material mostly calcareous, high in clay, and nearly impervious. Range in slope is 1 to 8%. The soil-drainage class is imperfectly or somewhat poorly drained. Present land-use pattern includes the following principal crops: wheat, corn, cotton, sunflower, and sugar beet. The approximate area is 25 500 ha.
Marismas	Deposits of shale (Holocene) with appreciable amounts of salts located on the lower Guadalquivir Valley. The relief is level with slopes < 3%. The soils are very poorly drained. Presently the salinity of a large part of the total area has been considerably reduced by land reclamation, and the soils are dedicated to annual crops. The approximate area is 103 500 ha.
Vega	A region of stabilized well-drained alluvial fans (Holocene), with inclusions of other physiographic Pleistocene landforms. The relief is nearly level (slopes < 3%). This area supports mainly citrus, cotton, corn, wheat, and potatoes. Its approximate area is 74 000 ha.
Terrazas	Weakly dissected fluvial terraces (Pleistocene) overlying Miocenic geological materials. The Guadalquivir River has four major terrace levels in this area, with a nearly level general relief (slopes < 3%). The soils range from well drained to poorly drained. Present land-use pattern includes the following crops: olive, wheat, corn, sunflower, and cotton. The approximate area is 133 000 ha.
Alcores	A region which contains deposits of highly calcareous sandstone (Pliocene) with isolated very old terrace landforms. The relief varies from gently undulating to level (slopes of 1–8%). The soils are well drained and moderately well drained. This area supports mainly olive, citrus, wheat and sunflower. Its approximate area is 18 000 ha.
Campiña	The area contains formations of calcareous and high clay materials (Oligo-Miocene), with inclusions of terraces of various levels. The general relief is moderately undulating (slopes of 1–8%). Somewhat poorly drained soils predominate in this area. Present land-use pattern includes annual crops, such as wheat, corn, cotton, and sunflower. The approximate area is 330 500 ha.
Estepa	A region which contains a formation of highly calcareous materials (Eo-Miocene). The relief ranges from undulating to slightly undulating (slopes of 1–16%). Well drained soils dominate the area. Olive is the most common crop, although the area also supports wheat, sunflower and corn. The approximate area is 140 000 ha.

infiltration of water is slow, especially in the argillic horizon (B2 and B3). It is interesting to note the hydromorphic characteristics of these soils with free Mn and Fe contents tending to be higher in the B horizon (16). It could be hypothesized that the absence of carbonates permits the formation of argillans to take place within the argillic horizon in response to the infrequent percolation of water.

The Almagra Alcores profile is highly weathered, and presents characteristics very similar to those of the Rojo Aljarafe soil. It also has calcareous parent materials and a red solum, sandy clay loam texture in the Ap horizon, and a maximum clay content in the B2t. The CEC is low, which suggests that the clay fraction is predominantly formed by illite and kaolinite (12). Through the profile, the physical properties follow a trend similar to that of the Rojo Aljarafe pedon.

The Bujeo Campiña profile presents strong vertic characteristics. Its solum has a dark grayish-brown color, and clay texture. Electrical conductivity levels are less than 4 dS m^{-1} in the A and C1 horizons, indicating low soluble salts. These values increase with depth and correspond to higher ESP levels. The carbonate content is very high (> 30%) through the entire profile. Physical properties are very similar to those of the Tierranegra Campo profile.

The Albariza Estepa profile is a slightly weathered soil formed on very calcareous materials, with a moderately dark grayish surface layer (A horizon). The soil is high in clay (> 35%), with a high pH. Organic C contents decrease strongly with depth. The old terms Rendzina and Xerorendzina were primarily used for defining these soils (7).

Table 2—Morphologic properties of the selected soil profiles.†

Horizon	Depth, cm	Munsell color (dry)	Texture	Structure	Consistence (moist)	Boundary
Rojo Aljarafe (Typic Rhodoxeralfs)						
Ap	0–30	5 YR 7/8	scl	f3sbk	mfr	cs
B1	30–55	5 YR 4/6	scl	m3sbk	mfi	cw
B2t	55–110	2.5 YR 4/8	sc	m3pr	mvfi	cw
B3	110–120	7.5 YR 6/8	sl	f3pr	mfi	gw
Cca	120–150	5 YR 8/2	sl	o	mfr	–
Tierranegra Campo (Typic Pelloxererts)						
Ap	0–20	10 YR 4/1	c	m3gr	mfi	gw
A1	20–60	10 YR 3/1	c	m3abk	mvfi	d
AC	60–140	10 YR 3/1	c	c3pr	mvfi	gw
C	140–170	10 YR 8/4	c	m	mvfi	–
Salino Marismas (Vertic Fluvaquents)						
A1sa	0–10	10 YR 7/1	c	c3abk	mvfi	cs
C1sa	10–20	10 YR 4/2	c	c3sbk	mvfi	cs
C2sa	20–100	7.5 YR 5/4	c	m	mefi	cs
IIC3sa	100–150	5 YR 4/1	c	m	mefi	–
Franco Vega (Typic Xerofluvents)						
Ap	0–25	10 YR 6/3	scl	m1sbk	mfr	cs
C1	25–55	10 YR 6/3	scl	m1sbk	mfr	cs
C2	55–80	10 YR 4/4	scl	o	mvfr	gs
C3	80–150	10 YR 5/4	scl	o	mvfr	–
Arena Terrazas (Aquic Haploxeralfs)						
Ap	0–25	10 YR 5/4	ls	f1cr	mfi	cs
B1	25–40	10 YR 7/6	sl	c3sbk	mfr	gw
B21tg	40–70	10 YR 5/6	sc	c3pr	mfr	d
B22tg	70–110	10 YR 5/6	sc	c3pr	mfr	gw
B3tg	110–150	10 YR 5/6	sc	c2pr	mfr	–
Almagra Alcores (Calcic Haploxeralfs)						
Ap	0–20	5 YR 4/8	scl	f3cr	mfr	gs
AB	20–45	2.5 YR 5/6	sc	c1cr	mfr	cs
B2t	45–60	2.5 YR 5/6	sc	c3abk	mfi	cs
B3ca	60–75	5 YR 5/6	sl	f3abk	mfi	gs
C1ca	75–115	5 YR 6/8	l	f2abk	mfi	gs
IIC2ca	115–200	10 YR 6/6	ls	c3bk	mfi	–
Bujeo Campiña (Typic Chromoxererts)						
Ap	0–25	2.5 Y 4/2	c	f2sbk	mfi	gs
A1	25–35	2.5 Y 4/2	c	m3abk	mvfi	gs
C1ca	35–70	2.5 Y 4/2	c	m3pr	mfi	gs
C2	70–120	2.5 Y 6/4	c	m3pr	mfi	d
C3	120–150	2.5 Y 6/6	c	m	mfi	–
Albariza Estepa (Entic Haploxerolls)						
Ap1	0–25	10 YR 5/2	c	f2cr	mfr	cs
Ap2	25–35	10 YR 7/3	c	f2cr	mfr	gs
C	35–150	7.5 YR 8/2	cl	m	mfr	–

† Symbols used are the same as given by Soil Survey Staff (1951, Agric. Handb. no. 18, p. 139–140).

Agricultural Potential Evaluation

Predicted yields for wheat, corn, and cotton crops, effective depth, depth to hydromorphic features, and the control section for each benchmark soil are given in Table 4. The applied soil evaluation system (11) assumes that field variability of crop yield is a consequence of the variability in plant genetic properties in addition to environmental factors. Spatial variability between soils in yield of a given crop grown, under the same climate and management level, is determined mainly by soil variability. The models given by De la Rosa et al. (11) were constructed to be used as submodels of possible soil-plant atmospheric models for predicting crop yields of land unit. These assumptions need to be kept in mind to discuss properly the results of soil evaluation process (Table 4), and to consider these results as preliminary.

The soil represented by Franco Vega profile (Table 4) produces the maximum predicted yield for wheat. Franco Vega soil has nearly ideal physical and chemical properties for plant growth (10). The Arena Terrazas soil produces the minimum predicted yield, not only for wheat but also for corn and cotton. This soil has unfavorable physical and chemical properties, mainly useful depth and depth to hydromorphic features, that limit root growth. The B2 horizon has a high clay content with very low hydraulic conductivity. The Bujeo Campiña and Albariza Estepa soils produce the most similar predicted yields of wheat. One serious disadvantage of the Albariza Estepa soil is the high pH in the C horizons due to the presence of carbonates (> 50%) which could cause P and minor element availability problems.

The maximum predicted yield for corn occurred on the Bujeo Campiña soil. However, irrigation can present serious problems in the Bujeo Campiña and Tierranegra Campo soils because the infiltration of water is low except in the cracks. Both soil types are among the most productive soils in Sevilla, where their somewhat poor natural drainage has been corrected by tile.

For cotton, the Tierranegra Campo soil has the best predicted yield, although a similar yield was calculated for the Bujeo Campiña soil. The presence of free carbonates in the materials of both soils could be a disadvantage in relation to P and minor element

Table 3—Chemical and physical characterization of the soil profiles.

Horizon	Depth	pH		Organic matter		EC $\times 10^3$	$CaCO_3$ equiv.	CEC	Exch. Na % (ESP)	Bulk density	Hyd. cond.	Water retention		Particle size			
		H_2O	KCl	C	N							33 kPa	1500 kPa	Coarse sand	Fine sand	Silt	Clay
	cm			%	%	dS m^{-1}	%	mol kg^{-1}	%	g cm^{-3}	cm h^{-1}	%	%	%	%	%	%
Rojo Aljarafe (Typic Rhodoxeralfs)																	
Ap	0–30	7.5	6.5	1.04	0.10	0.3	0.8	0.16	2.5	1.36	2.6	16.5	11.2	1.2	64.7	7.4	25.8
B1	30–55	7.8	6.6	0.42	0.04	1.0	0.8	0.10	2.0	1.35	2.8	14.1	8.6	0.8	73.2	2.1	22.5
B2t	55–110	7.8	6.4	0.46	0.05	1.0	2.0	0.19	2.6	1.50	1.6	20.8	12.1	0.4	59.7	3.8	35.5
B3	110–120	nd†	7.2	0.42	0.04	nd	48.0	0.08	nd	1.41	1.2	18.9	11.4	8.7	43.6	30.1	16.8
Cca	120–150	nd	7.0	0.34	0.04	nd	57.6	0.08	nd	1.50	2.1	15.9	4.2	7.8	44.6	28.6	17.7
Tierranegra Campo (Typic Pelloxererts)																	
Ap	0–20	7.7	6.8	0.80	0.09	1.1	12.8	0.40	0.5	1.43	1.7	42.1	23.5	8.7	21.8	24.1	45.8
A1	20–60	7.8	6.8	0.65	0.07	1.6	14.8	0.35	1.0	1.53	1.0	36.8	20.1	9.1	22.1	29.2	39.1
AC	60–140	8.5	7.2	0.46	0.06	1.3	22.4	0.45	1.0	1.53	0.1	38.0	20.8	8.2	12.4	26.1	52.2
C	140–170	8.4	7.1	0.50	0.05	1.3	22.4	0.42	1.7	1.48	0.1	37.1	19.7	12.0	20.0	16.5	50.0
Salino Marismas (Vertic Fluvaquents)																	
A1sa	0–10	7.5	nd	1.44	0.15	53.4	22.8	0.28	22.0	1.43	0.1	33.5	26.7	0.3	1.8	34.5	63.5
C1sa	10–20	8.0	nd	1.10	0.09	45.4	22.7	0.30	22.5	1.44	–	37.2	28.5	0.1	2.0	27.0	71.0
C2sa	20–100	8.0	nd	0.56	0.06	50.6	22.5	0.28	30.0	1.42	–	35.1	27.3	0.3	5.3	35.0	59.0
Franco Vega (Typic Xerofluvents)																	
Ap	0–25	7.7	6.9	0.95	0.09	1.9	24.5	0.11	5.0	1.41	1.0	22.4	9.1	0.9	46.5	20.5	28.5
C1	25–55	7.8	6.9	0.76	0.07	2.1	25.2	0.11	5.0	1.49	0.7	22.7	9.1	1.0	45.5	26.3	24.2
C2	55–80	8.0	7.0	0.70	0.07	1.6	27.0	0.10	3.3	1.38	1.2	20.4	7.5	0.5	57.8	18.2	20.5
C3	80–150	8.1	7.0	0.47	0.05	2.5	29.1	0.07	4.1	1.36	1.2	13.2	5.3	0.7	75.8	3.3	17.3
Arena Terrazas (Aquic Haploxeralfs)																	
Ap	0–25	6.7	5.5	0.14	0.02	3.2	–	0.05	7.0	1.61	2.1	12.7	6.8	34.2	44.4	6.4	14.7
B1	25–40	6.9	5.8	0.11	0.01	5.2	–	0.10	4.0	1.70	0.3	17.2	9.2	33.1	30.4	8.9	25.5
B21tg	40–70	7.8	6.6	0.23	0.02	4.4	–	0.23	4.1	1.79	0.1	10.0	5.4	20.4	25.4	9.2	42.6
B22tg	70–110	7.8	6.6	0.16	0.02	nd	–	0.26	7.0	1.63	–	12.0	7.1	17.3	24.0	10.5	45.2
B3tg	110–150	8.1	6.9	0.11	–	nd	8.2	0.24	6.1	1.75	–	12.5	6.9	19.5	20.0	12.1	45.4
Almagra Alcores (Calcic Haploxeralfs)																	
Ap	0–20	7.8	6.7	1.19	0.10	0.2	–	0.07	4.0	1.59	1.1	18.4	11.3	9.9	47.7	7.4	31.3
AB	20–45	8.0	6.6	0.81	0.08	0.3	–	0.08	3.7	1.43	3.3	22.3	15.7	6.9	48.7	3.1	39.7
B2t	45–60	7.9	6.6	0.50	0.05	1.2	–	0.13	2.0	1.53	0.7	26.4	18.3	4.7	45.1	5.0	43.2
B3ca	60–75	8.0	6.8	0.54	0.05	1.5	28.8	0.07	3.8	1.71	nd	20.4	11.2	6.1	36.2	24.4	28.5
C1ca	75–115	8.0	6.8	0.68	0.07	0.5	50.0	nd	nd	1.78	0.3	18.8	9.2	6.9	27.9	34.9	25.2
IIC2ca	115–200	8.1	7.0	0.40	0.04	nd	50.1	nd	nd	1.78	0.2	15.9	6.3	19.3	32.0	27.2	17.3
Bujeo Campiña (Typic Chromoxererts)																	
Ap	0–25	7.5	6.8	0.74	0.09	0.7	31.0	0.39	0.4	1.64	0.4	30.5	21.6	4.6	25.1	17.4	52.5
A1	25–35	7.6	6.7	0.63	0.08	1.1	31.4	0.38	0.7	1.63	0.2	28.7	19.9	2.8	26.4	19.5	48.7
C1ca	35–70	7.9	6.8	0.42	0.06	3.2	34.2	0.38	8.4	1.71	–	29.5	19.9	2.8	26.3	19.7	50.6
C2	70–120	7.7	7.0	0.17	0.02	5.5	32.8	0.37	14.0	1.69	0.2	27.4	18.6	2.2	32.5	23.5	39.6
Albariza Estepa (Entic Haploxerolls)																	
Ap1	0–25	8.2	7.0	0.91	0.09	0.2	48.0	0.25	0.5	1.28	6.5	26.4	14.7	12.7	17.7	25.6	41.0
Ap2	25–35	8.2	7.3	0.91	0.09	0.3	48.5	0.26	0.5	1.28	5.9	26.1	14.5	13.1	10.5	34.7	41.2
C	35–150	8.3	7.3	0.16	0.02	nd	52.2	nd	nd	1.34	3.5	25.2	15.3	20.7	9.5	30.4	36.3

† nd — not determined.

availability. The Rojo Aljarafe and Almagra Alcores soils have a moderate suitability for cotton, as well as for wheat and corn. The difference between cotton yield in both soil types is insignificant. They have somewhat unfavorable physical properties due to a high clay content in the B2 horizons.

Predicted yields for Salino Marismas soil were calculated assuming potential soil conditions following reclamation. The potential soil conditions include an upper layer of 50 cm where the salt content and sodium saturation have been considerably reduced (EC = 7 dS m^{-1} and ESP = 8%, maximum values in the calibration of De la Rosa et al. (11) models), and where the improved physical properties allowed good alteration and moderate permeability. However, the Salino Marismas soil, as characterized in Tables 2 and 3, has unfavorable physical and chemical properties that limit any crop growth.

Table 4—Estimated agricultural potential of the selected benchmark soils by application of De la Rosa et al. system.†

Soil	Useful depth	Depth to hydromorphic features	Control section (horizon)	Predicted yield		
				Wheat	Corn	Cotton
	cm	cm		kg h^{-1}	kg h^{-1}	kg h^{-1}
Rojo Aljarafe	120‡	120	B1	3130	7660	2870
Tierranegra Campo	120	120	A1	3530	7500	3600
Salino Marismas	50	50	C2sa	(5040)§	(5010)	(3800)
Franco Vega	120	120	C1	4350	7130	3150
Arena Terrazas	40	70	B1	2890	3670	2190
Almagra Alcores	120	120	AB	3100	7310	2760
Bujeo Campiña	120	120	A1	3860	7950	3430
Albariza Estepa	35	120	Ap2	3850	5680	3260

† For system polynomial models and definition of variables see De la Rosa et al. (1981).

‡ 120 cm is the maximum useful depth considered in the soil evaluation system.

§ Parentheses denote potential yield values in the case that this soil was reclaimed.

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