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Decrease in durum wheat area and varietal change in Spain from 1888-1963

Fernando Martínez-Moreno, and Ignacio Solís

Universidad de Sevilla, Dep. Agronomía, ETSIA. Ctra de Utrera km1, 41013 Sevilla.

This is the first study to attempt to discriminate the historical durum wheat area in Spain from 1888 to 1963, which is unknown. The work done has been difficult since the agricultural statistics before 1964 account for only (all) wheat area. The data generated by this study are important for understanding the historical evolution of this crop in Spain.

Abstract

Martínez-Moreno, F., and Solís, I. 2022. Decrease in durum wheat area and varietal change in Spain from 1888-1963. Int. J. Agric. Nat. Resour. 123-129. Durum wheat is a wheat species traditionally cultivated in southern and eastern Spain. Its cultivated area in the country before 1964 is unknown. In this study, an estimation of the Spanish acreage of durum wheat from 1888-1963 was reckoned using several sources of information: wheat area by province, descriptions of the prevailing wheat varieties in each province, and estimations from the *Servicio Nacional del Trigo* (National Service of the Wheat). Six reference seasons were examined (1888, 1898, 1920, 1935, 1950, and 1957). In 1888-1950, the durum wheat cultivated area was estimated to be approximately 16-19% of the total wheat cultivated in Spain (approximately 700,000 ha), which decreased after 1950. This decrease was caused by the introduction of new varieties of bread wheat and the removal of durum wheat varieties of inferior quality. In addition, a species similar to durum, rivet wheat, was also cultivated, of which there were approximately 140,000 by the end of the 19th century, which gradually decreased to almost null by the 1970s.

JEL codes: Q10, N5

Keywords: Landrace, Servicio Nacional del Trigo, *Triticum*, *Triticum turgidum*.

Introduction

Durum wheat (*Triticum turgidum* L. subsp. *durum* (Desf.) Husn.) is a traditional crop of the Mediterranean Basin. From the milling of the kernel, semolina is obtained, which is the raw material of several foods, including pasta, couscous, and several types of flat breads (Elias

& Manthey, 2005). Durum wheat is a tetraploid wheat ($2n=28$), while common wheat is hexaploid ($2n=42$). Other subspecies of *Triticum turgidum* L. cultivated in the past included rivet or poulard wheat (*T. turgidum* subsp. *turgidum*) and emmer (*T. turgidum* subsp. *dicoccon*).

Durum wheat was sown in all the Mediterranean Basin in Roman times, especially since the Republic, when it steadily replaced emmer, the main

wheat species in that region until 500-300 BCE (Before Common Era). Durum wheat (named by Latin writers as *robustus* or simply, *triticum*, i.e., wheat, since it was the main species) was the most common type of wheat. From the 1st century ACE (After Common Era), another wheat species, bread wheat (*Triticum aestivum* L. subsp. *aestivum*) (*siligo*), penetrated strongly from the northern side of the Roman Empire (Martínez-Moreno et al., 2020). The flour provided by the latter species has good qualities to make leavened and spongy bread. Bread wheat entered Spain by the north, and most of these bread wheat varieties were facultative or winter type. This wheat occupied the central and northern parts of the Iberian Peninsula, while durum wheat (with the majority of spring varieties, although sown in late fall) became the prevailing crop in the south and the east (with milder winters) (Martínez-Moreno et al., 2020). In the times of Al-Andalus, it is likely that durum wheat was more cultivated in Spain, and new varieties arrived from the Mediterranean Levant through the Arab corridor since it was the main wheat species of the Arabs. In fact, there are references of durum wheat cultivation in Toledo and Saragossa, reaching areas that were somewhat distant from its usual growing area (Watson, 1983). After the *Reconquista* (Reconquest), G. Alonso de Herrera continued citing their cultivation in the south and the east during the 16th century (Alonso de Herrera, 1818), and this distribution pattern continued up to the beginning of the 20th century; to some extent, it continues today (Martínez-Moreno & Solís, 2017). During the 16th and 17th centuries, records of wheat purchases from Barbary or Maghreb (Morocco, Algeria, and Tunisia) to the Balearic Islands due to poor harvests were reported (Vidal, 1976). As it is known that all wheat from northern Africa until the mid-19th century was durum wheat (Martínez-Moreno et al., 2020), these exchanges were made with this species, and part of the grain was used for the next seasonal planting, increasing the diversity of landraces that existed in the south and east of the Iberian Peninsula. In fact, most Spanish durum wheat landraces are genetically

similar to landraces from the west Mediterranean basin, especially from the Maghreb and Sicily (Soriano et al., 2016).

At the end of the 18th century, J.A. Valcárcel described the wheat cultivated in Spain, and when citing the varieties of the east (*Claro*, *Rubión*, *Racimal*, etc.) and in Andalusia (*Fanfarrones*, *del Milagro*, etc.), he clearly refers to durum wheat (Valcárcel, 1767). The works of the botanists S.R. Clemente and M. Lagasca at the beginning of the 19th century are key to understanding the wheat landraces and the provinces in which they were sown. Part of this work was published as an appendix in the 1818 reissue of the book *Agricultura General* (General Agriculture) by Alonso de Herrera (Alonso de Herrera, 1818; Téllez & Alonso, 1952). It was the first description of durum wheat as a distinct species in Spain, and the main varieties were *Raspinegro*, *Fanfarrón*, *Recio*, *Rubio*, *Morisco*, *Alonso*, etc. The most cited provinces regarding durum wheat cultivation were (in decreasing order): Almería, Granada, Valencia, Jaén, Albacete, Murcia, Córdoba, and Seville, all in the south and the east of the Iberian Peninsula. Along with these provinces, the main durum wheat-growing provinces in the 10 seasons of 1964-2019 (official statistics) are provided in Table 1. There was also a small portion of durum wheat in the interior of the country, where *Álaga* stood out, one of the few winter- or facultative-type varieties with cold tolerance, and it was grown in León, Logroño, and Burgos (Gadea, 1954). Another information source on durum wheat in Spain is the study of the landraces collection preserved by the National Plant Genetic Resources (Centro Nacional de Recursos Fitogenéticos, CRF). The provinces from which more durum wheat samples were collected in the several missions were (in decreasing order) Murcia, Córdoba, Almería, Granada, and Badajoz (CRF, 2022; Ruiz et al., 2012).

To understand the changes in durum wheat acreage, it is also important to analyze the evolution of the other subspecies of *T. turgidum*, especially

Table 1. Most important provinces regarding durum wheat cultivation in Spain (1,000 ha).

Rank	1818 ¹	1964 ²	1968	1974	1980	1984	1990	2005	2010	2015	2019
1	Almeria (11)	Leon (61.8)	Guadalajara (92.4)	Albacete (20.9)	Burgos (15.0)	Seville (35.9)	Cordova (45.2)	Saragossa (226.2)	Saragossa (150.5)	Saragossa (97.7)	Saragossa (73.5)
2	Granada (9)	Albacete (39.9)	Albacete (30.9)	Saragossa (13.8)	Seville (15.0)	Cordova (31.4)	Seville (38.0)	Seville (185.7)	Seville (127.1)	Seville (95.1)	Seville (68.4)
3	Valencia (6)	Jaen (22.5)	Badajoz (25.0)	Murcia (11.2)	Malaga (13.0)	Malaga (19.5)	Saragossa (26.1)	Cordova (136.0)	Cordova (71.2)	Cordova (53.0)	Cadiz (43.5)
4	Jaen (5)	Seville (22.4)	Murcia (13.9)	Burgos (11.4)	Cordova (9.0)	Cadiz (17.1)	Cadiz (25.6)	Badajoz (96.2)	Cadiz (61.2)	Cadiz (49.6)	Cordova (36.2)
5	Albacete (3)	Cadiz (19.3)	Cadiz (11.5)	Jaen (11.1)	Jaen (7.5)	Jaen (11.1)	Jaen (13.2)	Cadiz (85.3)	Malaga (20.7)	Malaga (15.3)	Malaga (11.4)
6	Cordova (3)	Malaga (18.9)	Seville (11.5)	Malaga (9.3)	Cadiz (7.0)	Burgos (7.5)	Malaga (9.1)	Toledo (44.4)	Badajoz (13.6)	Huelva (10.7)	Huelva (9.7)
7	Murcia (3)	Badajoz (18.8)	Malaga (9.4)	Huesca (6.6)	Saragossa (6.8)	Granada (4.8)	Badajoz (8.0)	Malaga (35.4)	Huelva (12.4)	Jaen (6.4)	Badajoz (5.6)
8	Seville (3)	Cordova (13.0)	Jaen (8.7)	Cadiz (5.8)	Granada (6.6)	Saragossa (3.1)	Granada (6.0)	Granada (24.6)	Jaen (10.5)	Badajoz (6.4)	Jaen (4.5)
9	Ciudad Real (2)	Murcia (9.9)	Avila (8.0)	Cordova (3.6)	Badajoz (4.7)	Huesca (2.9)	Burgos (3.3)	Jaen (21.9)	Toledo (4.7)	Huesca (3.6)	Huesca (2.8)
10	Badajoz (1)	Salamanca (5.0)	Cordova (6.1)	Badajoz (2.9)	Albacete (3.5)	Pontevedra (2.1)	Navarra (3.0)	Huelva (18.0)	Huesca (3.6)	Granada (2.3)	Toledo (2.1)
11	Cuenca (1)	Almeria (5.0)	Almeria (5.3)	Salamanca (1.7)	Almeria (1.5)	Badajoz (2.1)	Murcia (1.9)	Navarra (13.7)	Granada (3.3)	Toledo (2.0)	Granada (1.7)
12	Huelva (1)	Huelva (3.0)	Salamanca (5.0)	Valladolid (1.7)	Murcia (1.3)	Albacete (2.1)	Albacete (1.5)	Burgos (10.1)	Teruel (1.6)	Teruel (1.2)	Valladolid (1.2)
DW area	~750	256.1	246.7	133.9	97.1	151.3	189.9	910.4	488.3	347.9	266.6
Total wheat area	~4,000.0	4,136.5	3,962.9	3,163.4	2,698.5	2,305.6	2,006.6	2,274.1	1,434.3	2,176.4	1,918.4
% DW area	~18,8	6.2	6.2	4.2	3.6	6.6	9.5	40.0	34.0	18.2	13.9

¹Source: Téllez & Alonso (1952). Between the parentheses, the number of references to provinces where durum wheat varieties are sown is cited. Logrono, Leon, Malaga, Castellon, and Balearic I. provinces also had one reference. ²Source: MAPA (2022).

rivet wheat, which was sown especially in the north and east of the country (Navarra, Aragon, and Catalonia regions). They were adapted to cool and humid areas, and most landraces were of facultative or winter type. With the ground grain, semolina was obtained, which was mainly used to make *fideos* (a kind of thin and short noodle), although the whole grain could be boiled and used as rice. The rivet plants were tall, large and relatively high yielding. For instance, according to Sánchez-Monge (1957), the *Redondillo de Fuentesauco* landrace was 1.66 m tall. The grain was poor in gluten but high in starch, and it was one of the sources of starch at the time. Its acreage decreased slightly from the second half of the 19th century to the civil war time (1936-1939) and then decreased with more intensity from that time, when it was replaced first by durum wheat

varieties of higher quality and later by bread wheat varieties of higher yield. Most of the rivet varieties were collected in the first half of the 20th century in several missions, and according to M. Gadea, they had generally poor grain quality and great tillering ability (Gadea, 1954). N.I. Vavilov described the high diversity of durum and rivet wheat in his expedition to Spain in 1927. He stated that durum wheat from southern Spain shared common traits with durum wheat from French North Africa and southern Italy: high productivity, good tillering ability, large grain, late ripening, and resistance to rust diseases. The rivet wheat of Spain was also abundant (as in Portugal and Italy) and was characterized by strong development and height, leafiness, winter facultative growth habit, low cold tolerance, high yield, and late ripening (Vavilov, 1951).

Landraces of rivet were *Radondell* (or *Redondell* or *Rodonell*), *Cascalvo*, and *Cañivano*. Sometimes, durum and rivet appeared mixed in the same fields. In fact, the varieties *Bascuñana*, *Blancal de Nules* or *Fartó* are sometimes classified as rivet but other times as durum wheat in the books of Gadea and Sánchez-Monge (Gadea, 1954; Sánchez-Monge, 1957). The genetic similarity between durum and rivet wheat is so high that Oliveira et al. (2012a) concluded that both subspecies (*durum* and *turgidum*) share a common genetic background and are indistinguishable from the genetic point of view.

Emmer wheat was sown less frequently than rivet wheat and was cultivated in the mountainous areas of the provinces of Asturias, Burgos, Navarra, and Barcelona. It is difficult to estimate the national acreage, but it was over 3,000 ha during the 19th century. From the end of that century, its cultivation decreased, and similar to rivet, the decrease was more pronounced after the Civil War. Currently, it is only sown in Asturias, where it is called *Pavía*, *Pavía* or *Povida*.

At the end of the 19th and beginning of the 20th century, the national wheat acreage was approximately four million ha, and durum wheat landraces were still being cultivated in the south and east of the country. The main uses of semolina were bread making and *fideos* (Rivero, 2013). In the 1930s, 1940s, and 1950s, there were attempts to characterize the wheat landraces of Spain to select the best ones in every region. The book *Trigos españoles* (Spanish wheats) by M. Gadea described 176 landraces of durum wheat in Spain (Gadea, 1954), while E. Sánchez-Monge defined the features of 110 landraces in his *Catálogo genético de trigos españoles* (Genetic Catalog of Spanish Wheats) (Sánchez-Monge, 1957). Most of these landraces are currently preserved in different gene banks of the CRF. Since the 1940s, seeds of foreign varieties of durum and bread wheat have been imported, and breeding programs have been implemented to obtain new cultivars by crossing.

One of the questions about durum wheat in Spain is its acreage from the end of the 19th century to the early 1960s. From the end of the 19th century, there have been reliable statistics on wheat acreage by province, but they do not distinguish between bread and durum wheat (Gallego et al., 1991). This article intends to estimate the durum and rivet wheat area from 1888 to 1963, as well as to explain the causes of the changes in the cultivated area of this crop.

Sources of information and methodology

For the historical wheat area in each province, data from Barquín (1999), from the book *Estadísticas históricas de la producción agraria española* (Historical Statistics of Spanish Agricultural Production), 1859-1935 (Gallego et al., 1991), and from the *Anuario de estadística agraria del Ministerio de Agricultura, Pesca y Alimentación* (Agricultural Statistics Yearbook of the Ministry of Agriculture, Fish and Food) were extracted (MAPA, 2022).

To estimate durum and rivet wheat area, a calculation for six seasons in two different periods was carried out:

- Period 1888-1939: seasons 1888 (Barquín, 1999; Dirección General de Agricultura, Industria y Comercio, 1891), 1898 (first season of reliable wheat statistics in the provinces of Spain), 1920, and 1935. To estimate the durum wheat percentage from this period, we relied on the study of J. Cascón and B. del Valle. A book written in 1895 about wheat by the Spaniard agronomist José Cascón (a translation into Spanish of a conference given by H.L. de Vilmorin and commented by him) presents in the Appendix a table with a list of the most widely sown wheat species and varieties in each province of Spain, except the Canary Islands, in the period 1886-1890 (Cascón, 1895). To describe durum wheat, he used the classification of the *Trigos de la Ceres Hispanica* (Wheats of the Hispanic Ceres) (Alonso de Her-

ra, 1818; Téllez & Alonso, 1952), where the species (or better, group of varieties with common morphological features) of durum wheat at the time were *Triticum gaertnerianum*, *T. cevallos*, *T. platystachyum*, *T. fastuosum*, *T. durum*, and *T. cochleare*. In another column of the table, a list of common names of varieties is provided. Those corresponding to durum wheat are *Álaga*, *Alonso*, *Enano Blanco*, *Macanda*, *Macolo*, *Moro*, *Moruno*, *Murciano*, *Pintón*, *Raspinegro*, *Raspi-blanco*, *Recio*, *Rubión*, *Salmerón*, and *Tremés*. The rivet wheat matched with *T. turgidum* and *T. linneanum*, with varieties such as *Redondell* or *Radonell*. Information from the Memoirs of the Geological Map Commission was also obtained, written by several agronomists from 1875 to 1890 (Rivero, 2013; del Valle, 1927).

A 0-9 cultivation scale was elaborated with a rough percentage of durum wheat area in each province according to the following information: if cultivation of the wheat species (durum or rivet) is cited in a particular province, and names and number of varieties of those wheat species cited in a province. Then, comments regarding the cultivation and the extent of cultivation of the wheat species and varieties in the provinces are also found ('little cultivated', 'durum wheat is the one that is sown preferably', 'no variety is mentioned', etc.). With all this information, the scale has the following indices: 0. It is not cultivated (0%); 1. Very little is cultivated (5%); 2. Little is cultivated (10%); 3. Some is grown (20%); 4. It is cultivated (30%); 5. It is widely cultivated (40%); 6. It is grown a lot (50%); 7. It is cultivated preferably (60%); 8. It is mainly cultivated (70%); 9. It is cultivated almost exclusively (80%). The index intends to estimate the provincial and national areas of durum wheat. A maximum limit of 80% wheat area was set since in all the provinces of Spain, a minimum percentage of bread wheat was grown, which was necessary to compensate for the deficiencies in the baking quality of the semolina for bread making, which was a basic food in the country (Rivero, 2013).

- Period 1940-1963: seasons 1950 and 1957. The same above indices apply for this period, which relied on the studies by Gadea (1954) and the *Servicio Nacional del Trigo* (SNT) (National Wheat Service) (1950, 1958, 1962). Interestingly, the study by SNT (1950) presents a table with a percentage of durum wheat to all wheat by 1949 in all provinces, and it is actually the only numerical data of area by different wheat class existing in Spain before 1964, the first year where national statistics separate the areas of the two most important wheat species (Table 2).

Throughout the period 1888-1963, slight changes in both durum and rivet wheat were recorded. There is evidence that during 1888-1950, durum wheat acreage did not change much (Rivero, 2013). Therefore, a constant percentage of durum wheat area until 1950 (with fluctuations only with changes in the wheat, all, and area of each province) and then a linear reduction up to 142,900 ha in 1970 (official data) were assumed (MAPA, 2022). To calculate the rivet wheat area, we worked on the supposition of a linear reduction in the percentage of one-third from 1888 to 1940 and then another, more pronounced linear reduction from 1941 to 0 in 1975 (SNT, 1958).

Estimates of durum wheat cultivated area in the main producing provinces of Spain

The national wheat area was variable throughout the six seasons evaluated (3.30 million ha in 1888, 3.90 million ha in 1898, 4.15 million ha in 1920, 4.55 million in 1935, 4.08 million ha in 1950 and 4.06 million ha in 1957). Each province was analyzed separately, mainly following Cascón's comments (1895) in the period 1898-1935. At the end of the comment for each province, the index value with durum and rivet wheat was indicated between parentheses:

Table 2. Percentages of wheat classes in Spain by province in 1949.

Province	Red and coarse	Candeal and alike	Aragon and alike	Durum	Various
Alava	99.5	0	0	0	0.5
Albacete	4	92	4	0	0
Alicante	0	90	0	10	0
Almeria	0.5	35.5	0	64	0
Avila	1	99	0	0	0
Badajoz	24	12	1	63	0
Baleares	0	100	0	0	0
Barcelona	10	90	0	0	0
Burgos	87	11	2	0	0
Caceres	0	59.5	0	40	0.5
Cadiz	0	13	0	87	0
Castellon	89	0	0	10	1
Ciudad Real	4	90.5	2	3.5	0
Cordova	0	16	0	84	0
Coruna (La)	0	100	0	0	0
Cuenca	4	90	6	0	0
Gerona	75	25	0	0	0
Granada	11	19	0	70	0
Guadalajara	1	85	13.5	0.5	0
Guipuzcoa	0	100	0	0	0
Huelva	0	30	0	65	5
Huesca	0	0	99.5	0	0.5
Jaen	0	10	0	90	0
Leon	93	4.5	2.5	0	0
Lerida	0	50	50	0	0
Logrono	1	98	1	0	0
Lugo	0	100	0	0	0
Madrid	0.5	52.5	27	20	0
Malaga	5.5	4.5	0	90	0
Murcia	0	45	0	55	0
Navarra	6	0	94	0	0
Orense	0	100	0	0	0
Oviedo	0	100	0	0	0
Palencia	87	9	4	0	0
Pontevedra	0	100	0	0	0
Salamanca	15	78	7	0	0
Santander	0	100	0	0	0
Segovia	5	95	0	0	0
Seville	0	1	0	99	0
Soria	30.5	69	0	0	0.5
Tarragona	26	74	0	0	0
Teruel	5	40	50.5	0.5	4
Toledo	1	89	3	7	0
Valencia	18	82	0	0	0
Valladolid	3	86.5	10	0.5	0
Vizcaya	0	100	0	0	0
Zamora	10	78.5	10	0	1.5
Saragossa	0	0	99	0	1
National average	14.93	56.75	10.12	17.90	0.30

Source: SNT (1950).

North and central Spain (Galicia, Asturias, Basque Country, Navarre, Catalonia, Castile and Leon, Castile-La Mancha)

- Alava: durum wheat ‘begins to be cultivated, [but it is] little cultivated’. Rivet is more frequent (0/2).
- Albacete: *Enano Claro*, *Macanda*, and *Rubión* durum wheat varieties are sown, although rivet wheat is predominant, with varieties such as *Claro de Balazote* and *Rubión de Higuera* (1/1).
- Asturias: in this province, rivet wheat is planted with different varieties, such as *Boroñón de Salas* (0/2). Emmer and spelt wheat are also cultivated in Asturias at that time in Oviedo province.
- Avila: rivet wheat is named (0/1).
- Barcelona: *Forment* durum wheat and rivets such as *Redonell de Vich* (1/2) are sown.
- Burgos: the *Álaga* variety is planted. According to Prieto and Ramos, *Royón* and *Raspinegro* are planted to a lesser extent (1/1).
- Ciudad Real: the cultivation of durum wheat is mentioned (3/0).
- Cuenca: the *Raspinegro* variety of durum wheat is reported (2/0).
- Gerona: rivet wheat is sown to a certain extent (0/2).
- Guadalajara: some rivet wheat is sown (0/1).
- Huesca: Huesca is one of the provinces where more rivet wheat is sown, with a variety from Jaca (0/1).
- Leon: the *Corricasa* and *Álaga* varieties of durum and some rivet wheats are sown. The *Álaga* variety is observed in both durum and rivet wheats, which suggests mixing in this landrace (1/2).
- Lerida: some rivet wheat is sown, such as the *De Coure* variety (0/1).
- Logrono: some rivet wheat is planted, such as the *Marroquí* variety (0/2).
- Madrid: some rivet wheat is grown, such as the *Rubio* variety (0/1).
- Navarra: Navarra is one of the provinces with the most rivet wheat planted, such as the *Navarra de Fao* and *Racimudo de Corella* varieties (0/2).
- Salamanca: the *Rubión* durum wheat variety is grown, and there is some rivet wheat (1/1).
- Soria: some rivet wheat is sown, such as *Blanquillo* and *Royal* varieties (0/2).
- Tarragona: rivet wheat is sown in this province (0/3).
- Saragossa: some rivet wheat is sown (0/1).

South (Andalusia and Extremadura)

- Almeria: ‘durum wheat is the one that is grown preferably’, with *Raspiblanco*, *Raspinegro*, and *Moruno*. There are also rivet varieties such as the *Cañivano de Berja* and the *Moro del Río Almanzora* (7/1).
- Badajoz: *Rubio* and *Raspinegro* durum wheat varieties are sown, as well as the rivet wheat varieties *Sietespiguín*, *Almendral*, and *Ordenado extremeño* (4/1).
- Caceres: there is a small area of durum wheat (1/0).
- Cadiz: although Cascón does not name durum wheat, he mentions *Alonso* and *Obispado* varieties and the cultivation of the *Raspinegro* and *Alonso* or *Salmerón* varieties in 1887 (8/0).
- Cordova: the sowing of the durum wheat varieties *Alonso*, *Rubio*, *Berberisco*, *Álaga*, *Macolo*, and *Salmerón* is reported. Rivet wheat is also mentioned (7/1).
- Granada: durum wheat varieties are planted (*Alonso*, *Trujillo*, *Cuchareta*, *Moruno*) (7/0).

- Huelva: durum wheat varieties such as *Blanquillo*, *Rojal* and *Moruno* (6/0) are sown.

- Jaen: ‘as in Cordova, there are many species of wheat, although durum wheat abounds and there is some rivet wheat’, such as *Barqueño* from Alcalá la Real (7/1).

- Malaga: almost all planted wheat in this province is durum wheat, with varieties such as *Blanquillo* (8/0).

- Seville: the province with the most durum wheat area in Spain. Many varieties of this species are planted (*Macolo*, *Semental*, *Raspinegro*, *Recio*, *Colorado*, *Cascalvo*, *Berberisco*, *Cortezano*, *Verdial fuerte*, *Rubio*, etc.) (9/0).

East (Murcia, Valencia, and Balearic Islands)

- Alicante: the varieties *Moruno*, *Rubión*, *Rojo*, *Blançal*, etc., are planted (3/0).

- Balearic Islands: the durum varieties *Moro*, *Blat mort*, and *Pintat* or *Rosí* and the rivet wheat *D’ariso* are named (1/2).

- Castellon: although Cascón does not mention this province regarding durum wheat, Lagasca and Clemente did mention the presence of rivet wheat in this province as *Puro* or *Rubión de Segorbe* (0/2).

- Murcia: a wide number of wheat varieties are sown, including *Raspinegros* and *Rubiones* (durum wheat). According to del Valle (1927), a large amount of durum wheat is grown, although there is some rivet, such as the *Grosell de Monteagudo* variety (5/1).

- Valencia: Durum wheat varieties such as *Rojal*, *Raspinegro*, *Rubión*, *Majoma*, *Charrell*, *Moro* or *Morisco* are sown, as well as rivet varieties such as *Blançal de Albaida*, *Maseta*, *Cañivano* and *Pinet enano* (2/1).

The Canary Islands (a two-province region) was considered a simple province in this study since the data were given jointly. There is no reference in the Cascón table or in Rivero (2013), but a part of the wheat area was planted with durum wheat, with landraces such as *Morisco de Tenerife* and *Morisco de Canarias* (Oliveira et al., 2012b) (3/0).

The results of the indices and estimated areas of the period 1888-1939 are shown in Table 3. The presence of durum and/or rivet wheat was recorded in 36 provinces in 1888-1939 (22 provinces with durum wheat). According to our hypothesis, the rivet area decreased from 1888, while that of durum decreased from 1950. While the Cascón table described 17 provinces where rivet wheat was grown (especially in Catalonia, Aragon, and Castile and Leon) (Cascón, 1895), up to 27 provinces have been recorded (Rivero, 2013), some of them with small acreages. Regarding durum wheat cultivation, it should be noted that six provinces had an index of 1, four had an index of 7, three provinces had an index of 3, two provinces had indices of 2 and 8, and only one province had indices of 4, 5, 6, and 9. With respect to rivet wheat, the most frequent index was 1 (in 15 provinces), while index 2 was registered in 11 provinces. Only one province (Tarragona) had an index of 3. As the percentage of durum wheat area was considered constant until 1950, its area only fluctuated according to the (all) wheat area of each province in each year. The durum wheat area in 1888 was 627,700 ha (19% of the total), with the most important cultivating provinces (in decreasing order) being Seville, Cordova, Malaga, and Jaen. In 1898, the area was estimated at 770,000 ha (19.7% of the total wheat), with Jaen, Seville, Malaga, and Cordova as the provinces with the largest planted areas. For 1920, the total area of durum wheat was estimated at 676,100 ha, 13.3% of the total wheat cultivated in Spain during that campaign. In this year, the provinces with the largest cultivated areas were Seville, Granada, Cadiz, and Jaen. In 1935, the estimated durum wheat area was 714,000 ha, 15.7% of the total, with Seville, Granada, Cordova, and Badajoz as the most impor-

tant provinces for this crop. The rivet wheat area ranged between 139,500 ha in 1898 and 113,800 ha in 1935, which accounted for 3.6% and 2.5% of all wheat, respectively. Badajoz, Palencia, Burgos, Albacete, Castellon, Navarra, and Murcia were the most important growing provinces of rivet wheat.

The results of the durum and rivet wheat areas during 1940-1963 are shown in Table 4. The durum wheat cultivation indices are preserved, with minor exceptions. For this period, the province of Cuenca was removed from that table, and Toledo (1/0) was added, while small changes were recorded

Table 3. Estimation of durum wheat area in three seasons of the period from 1888-1939 (1,000 ha).

Province	Índex durum/ turgidum	% dur.	% turg.	Wheat area (1888)	Durum wheat area	Rivet wheat area	Wheat area (1898)	Durum wheat area	Rivet wheat area	Wheat area (1920) ²	Durum wheat area	Rivet wheat area	Wheat area (1935)	Durum wheat area	Rivet wheat area
Alava	0 / 2	0	10	17.7	0	1.8	20.0	0	1.9	25.4	0	1.9	26.9	0	1.8
Albacete	1 / 1	5	5	169.4	8.5	8.5	137.0	6.8	6.4	211.7	10.6	7.9	216.5	10.8	7.1
Alicante	3 / 0	20	0	18.7	3.7	3.7	14.4	2.9	0	35.5	7.1	0	20.6	4.1	0
Almeria	7 / 1	60	5	23.8	14.3	15.5	26.4	15.80	1.2	28.7	17.2	1.1	40.1	24.0	1.3
Asturias	0 / 2	0	10	7.5	0	0.8	7.5	0	0.7	11.5	0	0.9	8.0	0	0.5
Avila	0 / 1	0	5	65.0	0	3.3	49.3	0	2.3	66.7	0	2.5	66.7	0	2.2
Badajoz	4 / 1	30	5	111.7	33.6	5.6	134.5	40.4	12.6	160.2	48.1	12.0	189.2	56.8	12.4
Barcelona	1 / 2	5	10	35.3	1.8	3.5	41.9	2.1	3.9	37.0	1.9	2.8	37.0	1.9	2.4
Burgos	1 / 1	5	5	303.3	15.2	15.2	192.3	9.6	9.0	210.0	10.5	7.8	201.3	10.1	6.6
Caceres	1 / 0	5	0	89.3	4.5	4.5	91.2	4.6	0	130.0	6.5	0	179.7	9.0	0
Cadiz	8 / 0	70	0	103.3	72.3	72.3	92.4	64.7	0	98.8	69.2	0	72.4	50.7	0
Castellon	0 / 2	0	10	95.0	0	9.5	47.8	0	4.5	44.8	0	3.3	44.6	0	2.9
Ciudad Real	3 / 0	20	0	77.9	15.6	0	115.8	23.2	0	148.5	29.7	0	209.6	41.9	0
Cordova	7 / 1	60	5	80.7	48.4	52.4	145.3	87.2	6.8	103.5	62.1	3.9	118.7	71.2	3.9
Cuenca	2 / 0	10	0	84.4	8.4	8.4	90.2	9.0	0	176.0	17.6	0	280.0	28.0	0
Gerona	0 / 2	0	10	12.4	0	1.2	32.3	0	3.0	30.40	0	2.3	31.5	0	2.1
Granada	7 / 0	60	0	158.0	94.8	94.8	88.6	53.2	0	129.2	77.5	0	143.5	86.1	0
Guadalajara	0 / 1	0	5	116.7	0	5.8	85.0	0	4.0	97.9	0	3.7	120.5	0	4.0
Huelva	6 / 0	50	0	60.6	30.3	30.3	18.0	9.0	0	30.0	15.0	0	40.7	20.4	0
Huesca	0 / 1	0	5	124.4	0	6.2	152.7	0	7.1	116.8	0	4.4	144.7	0	4.8
Jaen	7 / 1	60	5	56.6	33.9	2.8	211.7	127.0	9.9	106.3	63.80	4.0	107.4	64.4	3.5
Leon	1 / 2	5	10	48.9	2.4	7.3	60.4	3.0	5.7	63.1	3.2	4.7	105.5	5.3	6.9
Lerida	0 / 1	0	5	104.5	0	5.2	74.4	0	3.5	95.8	0	3.6	96.7	0	3.2
Logrono	0 / 2	0	10	28.5	0	2.9	36.1	0	3.4	35.7	0	2.7	39.9	0	2.6
Madrid	0 / 1	0	5	50.4	0	2.5	67.0	0	3.1	95.0	0	3.5	74.7	0	2.5
Malaga	8 / 0	70	0	64.9	45.4	45.4	141.7	99.2	0	80.7	56.5	0	85.5	59.9	0
Murcia	5 / 1	40	5	116.8	46.7	52.6	159.6	63.8	7.5	88.9	35.5	3.3	56.8	22.7	1.9
Navarra	0 / 2	0	10	48.1	0	4.8	67.3	0	6.3	96.1	0	7.2	120.5	0	7.9
Palencia	0 / 2	0	10	83.8	0	4.8	109.0	0	10.2	123.2	0	9.2	143.7	0	9.4
Salamanca	1 / 1	5	5	124.4	6.2	6.2	111.3	5.6	5.2	134.6	6.7	5.0	144.2	7.2	4.7
Seville	9 / 0	80	0	145.9	116.7	0	156.7	125.4	0	148.6	118.9	0	160.0	128.0	0
Soria	0 / 2	0	10	46.9	0	4.7	46.2	0	4.3	62.4	0	4.7	80.6	0	5.3
Tarragona	0 / 3	0	20	22.2	0	4.4	24.4	0	4.6	22.2	0	3.3	27.9	0	3.7
Valencia	2 / 1	10	5	111.0	11.1	5.6	37.9	3.8	1.8	40.5	4.1	1.5	34.2	3.4	1.1
Saragossa	0 / 1	0	5	157.1	0	7.9	114.4	0	5.4	173.1	0	6.5	174.0	0	5.7
I. Baleares	1 / 2	5	10	55.0	2.8	5.5	55.2	2.8	5.2	51.6	2.6	3.9	50.2	2.5	3.3
I. Canarias	3 / 0	20	0	55.3	11.1	0	55.3	11.1	0	59.9	12.0	0	28.3	5.7	0

¹Sources: For indices: Cascón (1895) and del Valle (1927). The percentage of rivet wheat was reduced to 4.90% in 1898, 15.69% in 1920 and 23.04% in 1935 with respect to the original percentage in 1888. For acreage: Barquín (1999) for 1888 and Gallego et al., (1991) for the rest of the years. The acreages of Asturias and I. Canarias did not appear in 1888; therefore, the data from 1898 were assigned to these provinces.

in Cáceres (3/0), Madrid (2/1) and Tarragona (1/3). All these provinces had little tradition of planting durum wheat. In 1950, the calculated durum wheat area was 677,600 ha, which represented 16.6% of the total wheat area, with Seville, Cordova, Granada, and Badajoz being the provinces where this crop was planted the most. By 1957, the area was reduced to 534,800 ha (13.2%). The provinces with the largest durum wheat area at the time were Seville, Cordova, Granada, and Badajoz. Rivet

wheat was cultivated in 70,800 ha in 1950 and only 55,400 ha in 1957. The most important rivet wheat-growing provinces were Badajoz, Palencia, and Navarra.

The first official data on durum wheat area in Spain were published in 1964, but at the 1st National Congress of Agricultural Engineering in 1950, it was estimated that the durum wheat area for that campaign was 17.9% of the national

Table 4. Estimation of the durum and rivet areas in two seasons of the 1940-1963 period (1,000 ha).

Province	Index durum/ rivet	% durum	% rivet	Wheat area (1950)	Durum wheat area	Rivet wheat area	% durum	% rivet	Wheat area (1957) ²	Durum wheat area	Rivet wheat area
Alava	0 / 2	0	5.0	22.4	0	1.0	0.0	3.6	24.3	0	0.8
Albacete	1 / 1	5	5.0	176.6	8.8	3.9	3.6	3.6	185.0	6.7	3.0
Alicante	3 / 0	20	0.0	24.3	4.9	0.0	14.4	0.0	24.5	3.5	0
Almería	7 / 1	60	2.5	30.2	18.1	0.7	43.2	1.8	99.5	43.0	1.6
Asturias	0 / 2	0	5.0	8.8	0	0.4	0.0	3.6	7.3	0	0.2
Avila	0 / 1	0	2.5	65.8	0	1.5	0.0	1.8	67.0	0	1.1
Badajoz	4 / 2	30	5.0	190.3	57.1	8.5	21.6	3.6	207.5	44.9	6.7
Barcelona	1 / 2	5	9.9	31.9	1.6	1.4	3.6	7.1	32.6	1.2	1.0
Burgos	1 / 1	5	5.0	187.0	9.4	4.2	3.6	3.6	184.0	6.6	3.0
Cáceres	3 / 0	20	0.0	148.5	29.7	0.0	14.4	0.0	160.8	23.2	0
Cádiz	8 / 0	70	0.0	83.5	58.4	0.0	50.4	0.0	85.8	43.3	0
Castellón	0 / 2	0	5.0	30.2	0	1.3	0.0	3.6	33.9	0	1.1
Ciudad Real	3 / 0	30	0.0	175.1	35.0	0.0	14.4	0.0	191.1	27.5	0
Cordova	7 / 1	60	2.5	132.0	79.2	2.9	43.2	1.8	135.4	58.5	2.2
Gerona	0 / 2	0	9.9	30.5	0	1.4	0.0	7.1	29.7	0	1.0
Granada	7 / 0	60	0.0	130.9	78.5	0.0	43.2	0.0	128.2	55.4	0
Guadalajara	0 / 1	0	5.0	98.6	0	2.2	0.0	3.6	105.8	0	1.7
Huelva	6 / 0	50	0.0	38.1	19.1	0.0	36.0	0.0	41.1	14.8	0
Huesca	0 / 1	0	9.9	118.8	0	2.6	0.0	7.1	120.0	0	1.9
Jaén	7 / 1	60	2.5	97.6	58.6	2.2	43.2	1.8	100.9	43.6	1.6
Leon	1 / 2	5	5.0	92.6	4.9	4.4	3.6	3.6	97.5	3.5	3.1
Lerida	0 / 1	0	9.9	95.6	0	2.1	0.0	7.1	96.8	0	1.6
Logroño	0 / 2	0	5.0	33.3	0	1.5	0.0	3.6	43.8	0	1.4
Madrid	2 / 1	10	2.5	63.7	6.4	1.4	7.2	1.8	75.5	5.4	1.2
Málaga	8 / 0	70	0.0	66.8	46.8	0.0	50.4	0.0	66.8	33.7	0
Murcia	5 / 1	40	2.5	48.5	19.4	1.1	28.8	1.8	39.7	11.5	0.6
Navarra	0 / 2	0	14.9	129.0	0	5.8	0.0	10.7	127.4	0	4.1
Palencia	0 / 2	0	5.0	131.5	0	5.9	0.0	3.6	147.1	0	4.7
Salamanca	1 / 1	5	2.5	141.1	7.1	3.1	3.6	1.8	153.5	5.5	2.5
Seville	9 / 0	80	0.0	153.6	122.9	0.0	57.6	0.0	163.8	94.4	0
Soria	0 / 2	0	5.0	64.1	0	2.9	0.0	3.6	73.9	0	2.4
Tarragona	1 / 3	1	9.9	19.0	0.2	1.7	0.7	7.1	23.5	0.2	1.5
Toledo	1 / 0	1	0.0	183.8	1.8	0.0	0.7	0.0	199.8	1.4	0
Valencia	2 / 1	10	5.0	42.3	4.2	0.9	7.2	3.6	42.9	3.1	0.7
Saragossa	0 / 1	0	5.0	179.2	0	4.0	0.0	3.6	217.0	0	3.5
I. Baleares	1 / 2	5	5.0	44.0	2.2	2.0	3.6	3.6	45.0	1.6	1.4
I. Canarias	3 / 0	20	0.0	17.1	3.4	0.0	14.4	0.0	15.3	2.2	0

Sources: Cascón (1895), del Valle (1927), and SNT (1950, 1958, and 1962).

wheat area, which entails 730,337 ha, only approximately 53,000 ha more than our estimate (SNT, 1950). In 1958, based on SNT statistical data, it was reported that the planted area of the durum wheat variety *Fartó* was 208,534 ha, and that of *Senatore Cappelli* was 205,433 ha (SNT, 1958). They were the only durum wheat varieties that were part of the 12 most widely sown wheat varieties in Spain and with more than 100,000 hectares of cultivated acreage. The sum of these 12 varieties represents 2,903,787 ha, of which durum wheat (represented by these two varieties) adds up to 413,967 ha, representing 14.26% of the total wheat area. As the national area of wheat in 1957 was 4,059,430 ha, 14.26% would correspond to 587,805 ha of durum wheat, a figure close but slightly higher than the 534,812 ha obtained in our estimate (and also indicating that the rest of the varieties were cultivated in very small acreages).

Evolution of the national durum wheat area in 1888-1963

The calculated area of durum wheat at the end of the 19th century was approximately 700,000 ha, 19% of the national wheat area, a higher figure

than was initially thought. This percentage was maintained during most of the 19th and beginning of the 20th century (perhaps a slight decrease after the Civil War), but later, it receded from 1950 (Table 5). By 1957, the durum wheat acreage dropped to 13.2% of the national area of wheat. This area was approximately four million ha in the period 1800-1960, with a decrease during 1880-1896, caused by the importation of grain at low prices from the United States and Russia (e.g., the average wheat area in the period 1891-1896 was only 3,400,000 ha) (Rivero, 2013).

At the end of the 19th and the beginning of the 20th century, a selection of landraces with better quality flour and semolina was carried out along the country. Thus, in Castile, the *Candeales* and *Chamorros* (bread wheat) landraces increased their cultivated areas, as in Aragon and Catalonia the *Jejas* or *Xexas* (bread wheat), and in Andalusia, Extremadura, and Levante the *Fanfarrones* and *Recios* (durum wheat) (Rivero, 2013). These landraces had higher milling quality and were more suitable for the incipient Spanish flour and semolina industry. The rivet and emmer acreages continued to recede (Abela, 1877), but durum wheat did not decrease much at the time; only a few varieties were planted in roughly the same

Table 5. Areas and percentages of durum and rivet wheat in three seasons of the period 1888-1964 (1,000 ha).

Area/year	1888	1898	1920	1935	1950	1957
Total wheat area	3,300.0	3,900.0	4,149.9	4,554.2	4,080.1	4,377.8
Durum wheat	627.7	770.0	676.1	714.0	677.6	534.8
Rivet wheat	138.2	139.5	117.2	113.8	70.8	55.4
Durum+rivet wheat	765.9	909.5	793.3	827.8	748.4	590.3
% durum/durum+rivet	82.0	84.7	85.2	86.3	90.5	90.6
% rivet/durum+rivet	18.0	15.3	14.8	13.7	9.5	9.4
% durum/wheat	19.0	19.7	16.3	15.7	16.6	12.2
% rivet/wheat	4.2	3.6	2.8	2.5	1.7	1.3
% durum+rivet/wheat	23.2	23.3	19.1	17.2	18.3	13.5

area since the end of the 19th century (Rivero, 2013). In addition, the wheat areas of several provinces with more durum wheat cultivation in the south and the east, such as Murcia and Jaen, decreased since the cultivation of fruit trees and vegetables deprived wheat of the best soils, leaving it only in the mountainous areas (Rivera, 2013). In Jaen, the area cultivated with olive trees increased from 87,078 ha in 1858 to 193,144 ha in 1888 and 300,000 ha in 1929, largely at the expense of the previous wheat area (Zambrana, 1987). Therefore, although the percentage of provincial area planted with durum wheat remained the same, the total area decreased slightly.

After the Civil War (1936-1939), the problem of wheat supply increased, partly due to the isolation of Spain during the Franco regime (although Argentina and the USA sent wheat to Spain) and partly due to unfavorable weather conditions (such as the drought of 1944-1946) (SNT, 1958). In 1953, a national Cereal Production Intensification Plan was established, ‘fostering the use of fertilizers and selected seeds to increase wheat yields...’ (López Bellido, 1991). New cultivars were imported to increase yields and quality, but most were bread wheats, although some durum wheats also arrived. This is how the bread wheat cultivars *Florence Aurore* and *Pané-247* arrived in 1951, while in 1955, the Italian cultivars (also bread wheat) *Mara*, *Impeto*, and *Funo* were introduced (SNT, 1958). In durum wheat, the Italian cultivar *Senatore Cappelli* was quite successful in Spain in the 1940s and 1950s. All contributed to an increase in Spanish wheat production. At the Jerez de la Frontera Farm (Cadiz), J.B. Camacho carried out crosses between *Senatore Cappelli* and some Andalusian landraces to obtain new quality and more productive cultivars, such as *Ledesma* (from *Rubio de Belalcázar*), *Andalucía 344* (from *Manchón de Alcalá la Real*) and *Híbrido D* (from *Colorado de Jerez*), which had some success in the 1950s and 1960s (Royo & Briceño-Félix, 2011). Despite this breeding effort, durum wheat in Spain fell

back after 1950 due to the good characteristics of the new bread wheat cultivars. As stated in the 1958 publication of the National Service of the Wheat, ‘in durum wheats, research and creative agronomic action have been relatively delayed compared to those of bread wheats, and only price disparity can stimulate the cultivation of durum wheats... for farmers find new bread wheat varieties more advantageous to cultivate’ and ‘...the *Senatore Cappelli* sees its demand diminished by farmers, and although its excellent semolina quality advises not to reduce its area of cultivation; the desire of growers to sow decreases due to the better economic results obtained by other more productive bread wheat varieties’ (SNT, 1958). A typification of wheat varieties was also introduced to improve quality and eliminate lower quality wheats, such as the rivet landraces and some durum wheat varieties (such as *Amorós* and *Fartó*), which were in type 5 (‘hard and coarse semihard grain’) (SNT, 1958). In 1957, the durum wheat area was still considerable (534,800 ha according to our estimate), and the most important varieties were the Alicante landrace *Fartó* (208,534 ha) and *Senatore Cappelli* (205,433 ha). *Fartó* was a durum wheat landrace (or a mixture of durum and rivet wheat) that, due to its flour-baker characteristics and gypsum fracture, could not be considered a semolina wheat but a bread wheat (SNT, 1962). By 1964 (the first year of official statistics from the Ministry of Agriculture where durum wheat data are separated), the area had fallen to 256,100 ha (MAPA, 2022). There was a decrease of approximately 280,000 ha in seven years, from 1957 to 1964, which implied a linear decrease of approximately 40,000 ha per year.

Durum wheat in Spain after 1964

Interestingly, in the durum wheat area of 1964 (first year of separation of Statistics of the Spanish Ministry of Agriculture from bread wheat), the province with the largest durum wheat acreage was Leon, a province without a tradition of

durum wheat planting, with almost a quarter of the national area (61,800 ha of 256,100 total ha). In addition, in 1968, cultivation in Leon disappeared, and Guadalajara Province appeared as the first area planted with durum wheat, another province without a tradition of cultivation of this crop (MAPA, 2022). The explanations for such high acreage in these provinces could be that cultivated facultative durum wheat varieties such as *Alaga* were popular in these cold-winter provinces, that part of the acreage could be planted with rivet wheat (unlikely because at that time the area sown was small in these provinces), or that the data were simply wrong, and part of the durum wheat was actually bread wheat varieties with semihard kernels. If so, the durum wheat acreage at that time was still lower than the reported area (approximately 200,000 ha).

Regarding other countries (especially in the Mediterranean Basin, an area with a long tradition of this crop), the data on durum wheat area compared to bread wheat are, as in Spain, quite recent. In most instances, it is only read as 'wheat cultivated area', and the wheat species are not distinguished until very recent data, although recent works are attempting to estimate the durum wheat area in the 19th and 20th centuries globally (Martínez-Moreno et al., 2022). The only exception is Italy, where there was a distinction in the official statistics from 1921 onward, probably because there was a clear differentiation between the north and center (with a high proportion of bread wheat) and the south (with a high proportion of durum wheat) (Anuario di statistica agraria, 2022). In most of North Africa, durum wheat was the predominant species; the Arabic name for this species was *gamh*, which means wheat (Abdelkader, 2014; Ammar et al., 2011). Therefore, there was no need to separate the wheat species in this region (Martínez-Moreno & Solís, 2020). They have not been separated until very recently, and in many cases, the statistics do not permit the separation of bread from durum wheat. Even today, bread wheat and durum wheat are not distinguished in the FAO crop statistics section (FAOSTAT, 2022).

In the 1960s, the Green Revolution took place at CIMMYT (Centro Internacional de Mejoramiento de Maíz y Trigo, International Maize and Wheat Improvement Center), an organization located in Mexico and where new high-yielding wheat cultivars were obtained (initially intended for developing countries with a wheat tradition, such as India and Pakistan). These cultivars consisted of dwarf or semidwarf plants (depending on whether they had two or one dwarfing gene, respectively) that were resistant to lodging. They were also insensitive to the photoperiod, so they could be planted in areas of different latitudes (cultivars with high adaptability). The bread wheat cultivars *Cajeme*, *Yécora*, *Anza*, and *Siete Cerros* have been very popular in Spain (mainly in the south) since the early 1970s, since the southern and eastern sides of the Mediterranean Basin are areas within the mega-environment corresponding to WANA countries (one of CIMMYT target regions), and the percentage of bread wheat cultivated area in Spain increased from 1960-1980. The durum vs. bread wheat area in the studied period (1888-2020) is depicted in Figure 1. Shortly after starting the bread wheat breeding program, CIMMYT initiated a small durum wheat breeding program to improve the yield of this popular crop in the WANA countries. The program was successful, and thus, cultivars such as *Cocorit 71*, *Mexicali 75* and *Yavaros 79* emerged that would soon be planted in southern Spain and reached 90% of the durum wheat cultivated area in the 1980s and 1990s (Royo & Briceño-Félix, 2011; Martínez & Solís, 2017). The Spanish landraces vanished from the fields, but fortunately, they were able to be collected and are currently kept at the CRF-INIA at Finca La Canaleja (Alcalá de Henares, Madrid).

From the late 1960s and early 1970s, there was a program to promote feed grains (through the *Planes de Desarrollo*, Development Plans, of 1964-67 and 1968-71) to supply the growing meat industry. Maize, sorghum and, above all, barley were favored, and the wheat area decreased from 4.2 million ha in 1966 to 2 million

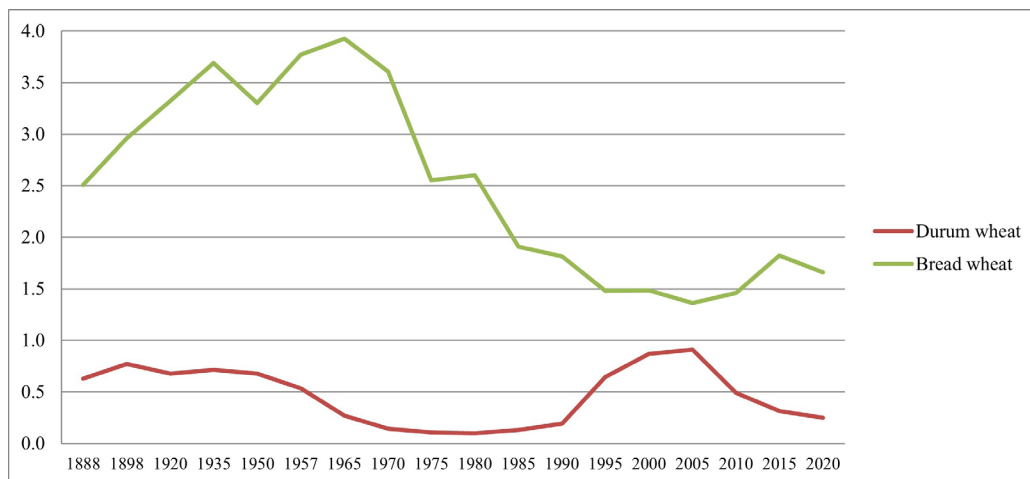


Figure 1. Durum vs. bread wheat area in Spain (1888-2020).

Sources: Barquín (1999), Gallego et al. (1991), and MAPA (2022)

ha in 1985 (López Bellido, 1991). The decrease in durum wheat area was even greater, since in the late 1970s and early 1980s, its area was reduced to just over 90,000 ha (with a historic low of 88,600 ha in 1978) due to the promotion of cereal species for feed and competition with bread wheat in a context of relatively high but decreasing prices (López Bellido, 1991). However, the entry of Spain into the then European Economic Community (EEC) in 1986 and the growing international demand for semolina and pasta of the 1980s pushed up the durum wheat area to 190,000 ha in 1990. In 1992, the EEC established a supplementary subsidy for durum wheat cultivation to curb imports of foreign grain (especially from Canada and the United States) to European semolina factories (Martínez-Moreno & Solís, 2017). The area greatly increased in the 1990s and 2000s, with a historical maximum in 2004 (949,000 ha), although not all grain was used for the manufacture of quality pasta, which was the initial objective (the low-quality grain was destined for feed). The subsidy disappeared in 2007, but two positive effects remained for future campaigns: one was, and is, the greater use of certified seed (between 70-80% of the area is currently planted with certified seed,

which is a high figure for a winter cereal), and the annual area has subsequently stabilized *circa* 300,000 ha (~15% of the national wheat area) (Martínez-Moreno & Solís, 2017).

Durum wheat is currently planted in Andalusia (Seville, Cordova, and Cadiz) and Saragossa (Table 1), a province where it was not a traditional crop. The cultivars are well adapted and have resistance to different diseases (such as leaf rust), high yield, and good semolina quality. In addition, the CRF collection of durum wheat landraces is publicly available. It is a collection with a huge patrimonial and historical value that has been characterized by older (Gadea, 1954; Sánchez-Monge, 1957) and more modern studies (Ruiz et al., 2012, Ruiz et al., 2013).

Conclusions

The durum wheat acreage in Spain was approximately 19% of the total wheat area at the end of the 19th century, which meant approximately 700,000 ha, a figure higher than previously thought. In addition, there were approximately 140,000 ha of rivet wheat. The rivet wheat area decreased from

the end of the 19th century, while durum wheat maintained its cultivated area up to approximately 1950. From that time, durum wheat decreased to 632,449 ha in 1957 and 256,100 ha in 1964. This decrease was due to the introduction of better bread wheat varieties of foreign origin that occupied much of the area previously devoted to durum wheat to increase grain production. Further studies in each province could give us a more complete picture of the importance and the area planted with durum wheat, especially in the period from 1940-1963.

Searching additional files of the National Wheat Service where durum wheat acreages are compiled (and perhaps also rivet wheat) by province in that period may help to refine this study.

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Resumen

Martínez-Moreno, F., y Solís, I. 2022. Descenso en la superficie de trigo duro y cambio varietal en España durante 1888-1963. Int. J. Agric. Nat. Resour. 123-129. El trigo duro es una especie de trigo que se sembraba principalmente en el sur y el este de España. Sin embargo, no se conoce la superficie sembrada de trigo duro antes de 1964. En este trabajo se hace una estimación de la superficie nacional de trigo duro durante 1888-1963 utilizando varias fuentes de información: estadística provincial, descripciones de las variedades más importantes en cada provincia y estimaciones del Servicio Nacional del Trigo. Se tomaron seis campañas de referencia (1888, 1898, 1920, 1935, 1950 y 1957). En 1888-1950, el trigo duro suponía una superficie estimada de 16-19% del trigo sembrado en España (unas 700,000 ha), y después de 1950 empezó a disminuir. Ese descenso fue debido a la introducción de nuevas variedades de trigo harinero y a la eliminación de variedades de trigo duro de menor calidad. Además, se sembraba una especie parecida, el redondillo (que a veces aparecía mezclado con el trigo duro), del que existían unas 140.000 ha a finales del siglo XIX, que disminuyeron paulatinamente hasta desaparecer en la década de 1970.

Palabras clave: Servicio Nacional del Trigo, *Triticum*, *Triticum turgidum*, variedad local.

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