



# BREEDING FOR YIELD AND GRAIN QUALITY OF DURUM WHEAT IN CHILE



Iván Matus<sup>1</sup>, Ricardo Madariaga<sup>1</sup>, Claudio Jobet<sup>2</sup>

<sup>1</sup>CRI-Quilmapu, Casilla 426, Chillán, Chile. [imatus@inia.cl](mailto:imatus@inia.cl)

<sup>2</sup>CRI-Carillanca, Camino Cajon Vilcun Km 10, Temuco, Chile.

## Introduction

Durum wheat, is known in Chile as “Candeal wheat”, and it is used for pasta production. The maximum planted area of 50,000 hectares was reached in the sixties, with a yield average of 1,9 t ha<sup>-1</sup>. In 2007 the total planted area was approximately 14,000 hectares, with a yield average of 5.1 t ha<sup>-1</sup>. Ninety percent of the area cultivated with durum wheat is under full irrigated condition, which allows to reach up to 10 t ha<sup>-1</sup> under farmer field conditions. Fifteen varieties has been released since 1956. Since 1988 the breeding of durum wheat has have financial support from Lucchetti Chile S.A., which is one of the main pasta industry in Chile. Plant breeding of spring durum wheat in Chile is looking for wide adapted cultivars with high yield and grain quality, and resistance to foliar diseases. From 1956 the main durum production area was concentrate between Santiago (33°34'S; 70°38'W) and Talca (35°27'S; 71°30'W), but from the year 2004 the area of durum wheat was moved south up to Los Angeles (37°26'S; 72°14'W). Almost 95% of the land planted with durum wheat in Chile is sowing with the two varieties Llaretta-INIA and Corcolen-INIA. The first one is a variety selected from CIMMYT germplasm and the second one is a selection obtained from a cross made in the breeding project in Chile.

## Materials and Methods

Twenty five spring durum wheat cultivars and advanced lines were tested in six environments along central-south of Chile: Santiago (irrigated) (33°34'S; 70°38'W), Cauquenes (rainfed) (35°68'S; 72°17'W), Chillán (irrigated) (36°31'S; 71°54'W), Yungay (irrigated and rainfed) (37°08'S; 72°01'W), and Los Angeles (irrigated) (37°26'S; 72°14'W), for two growing seasons (2006-2007 and 2007-2008). These locations covers most of the area planted with durum wheat. The experimental design was an (5x5) alfa-lattice. The management of the experimental plots was similar in all sites. Traits evaluated were: yield (t ha<sup>-1</sup>), test weigh (kg hL<sup>-1</sup>), protein content (%), virtuousness (%), black point (%) and diseases resistance to *Puccinia triticina* and *Puccinia striiformis*. In this work we only shows data of yield (t ha<sup>-1</sup>), test weigh (kg hL<sup>-1</sup>) and protein content (%).

## Results and Discussion

**Table 1.** Grain yield (t ha<sup>-1</sup>) of cultivars and selected advanced lines of durum wheat planted in four irrigated (I) and two rainfed (RF) locations. Average of season 2006-2007 and 2007-2008.

CULTIVARS/LINES	LOCATIONS					
	SANTIAGO (I)	CAUQUENES (RF)	CHILLAN (I)	YUNGAY (I)	YUNGAY (RF)	LOS ANGELES (I)
LLARETA-INIA	7,1	4,4	8,0	8,1	6,7	10,0
CORCOLEN-INIA	6,8	3,7	7,8	8,0	6,5	9,3
QUC 5080	6,8	4,1	7,0	7,7	6,7	8,9
QUC 5002	7,1	4,1	7,9	8,6	6,9	9,4
QUC 5015	7,6	3,5	7,8	8,2	6,6	9,4
QUC 5019	8,6	3,8	8,3	8,6	6,7	10,1
QUC 116	7,0	3,7	8,8	9,5	7,6	10,7
QUC 5031	6,6	3,7	7,4	8,8	7,2	10,4
QUC 3103	6,8	4,6	8,1	8,8	7,1	9,3
QUC 3104	7,2	3,5	8,7	9,4	6,6	10,4
QUC 3114	6,7	3,1	6,5	7,5	6,2	9,5
QUC 3122	7,1	3,4	7,4	7,3	7,1	8,6
QUC 3214	6,6	3,5	7,6	7,0	6,2	8,6
QUC 3322	6,2	3,8	6,3	6,5	5,7	8,4
QUC 3224	6,8	3,8	7,1	7,8	5,4	8,9

**Table 2.** Test weight (kg hL<sup>-1</sup>) of cultivars and selected advanced lines of durum wheat planted in four irrigated (I) and two rainfed (RF) locations. Average of season 2006-2007 and 2007-2008.

CULTIVARS/LINES	LOCATIONS					
	SANTIAGO (I)	CAUQUENES (RF)	CHILLAN (I)	YUNGAY (I)	YUNGAY (RF)	LOS ANGELES (I)
LLARETA-INIA	83,8	84,6	86,2	84,8	84,3	86,3
CORCOLEN-INIA	83,8	85,3	86,0	84,9	83,9	86,3
QUC 5080	81,0	84,1	82,6	83,2	83,1	85,1
QUC 5002	83,4	80,6	85,1	84,2	83,0	85,8
QUC 5015	83,7	83,7	84,9	84,0	83,3	85,9
QUC 5019	84,5	84,2	85,0	84,4	83,6	86,0
QUC 116	82,4	84,7	84,7	83,8	84,0	85,8
QUC 5031	82,9	83,0	85,0	84,6	84,2	86,1
QUC 3103	82,4	85,4	85,2	84,3	84,1	86,2
QUC 3104	80,9	82,2	83,3	83,6	82,3	85,8
QUC 3114	82,9	83,9	84,0	83,7	83,8	85,9
QUC 3122	84,8	85,9	86,8	85,6	85,3	86,6
QUC 3214	84,0	84,0	85,8	85,0	84,0	86,1
QUC 3322	84,5	85,2	85,4	84,7	84,1	86,1
QUC 3224	82,6	84,2	84,5	84,7	82,9	85,7

**Table 3.** Protein content (14% M) of cultivars and selected advanced lines of durum wheat planted in four irrigated (I) and two rainfed (RF) locations. Average of season 2006-2007 and 2007-2008.

CULTIVARS/LINES	LOCATIONS					
	SANTIAGO (I)	CAUQUENES (RF)	CHILLAN (I)	YUNGAY (I)	YUNGAY (RF)	LOS ANGELES (I)
LLARETA-INIA	11,9	11,8	11,4	11,9	11,6	13,3
CORCOLEN-INIA	11,5	11,4	11,8	12,4	11,8	13,3
QUC 5080	11,8	12,1	11,7	12,4	11,6	13,5
QUC 5002	11,0	12,0	10,8	11,4	11,1	12,6
QUC 5015	11,7	11,8	11,5	11,9	11,6	13,2
QUC 5019	11,5	11,9	11,3	11,9	11,2	12,8
QUC 116	11,9	11,4	10,9	11,7	11,0	12,6
QUC 5031	12,6	11,4	11,5	12,1	11,1	12,9
QUC 3103	11,8	11,7	11,7	12,1	11,5	13,7
QUC 3104	11,5	11,0	11,1	11,7	11,1	12,5
QUC 3114	12,4	11,5	12,0	12,4	11,5	13,2
QUC 3122	12,1	12,1	11,9	12,1	11,4	13,0
QUC 3214	12,0	12,2	11,4	12,1	11,0	12,9
QUC 3322	12,8	11,6	12,5	12,9	12,2	13,2
QUC 3224	11,7	11,9	11,8	11,8	11,5	13,2

Table 1 shows the yield obtained under irrigated (I) and under rainfed (RF) condition. Under irrigated condition cultivars Llaretta-INIA and Corcolen-INIA show high yield potential, however, under rainfed the yield is lower especially in the location of Cauquenes, which is a location with an average rainfall of 500 mm; and with very poor soils. Yungay (RF) is different because it has more rainfall (700 mm) and more fertile soils. In both locations rainfall is concentrated during winter, being determinant for the yield potential spring rainfall. Under irrigated the selected lines showed high yield potential. It is important to note that the entire breeding has been carried out under irrigation and only two years ago, durum wheat started to be assessed in rainfed areas.

Test weight (TW) is one of the important quality traits in durum wheat in Chile, both for the industry and for the farmers. The industry pay and over price to the farmer when the TW is over 81(kg hL<sup>-1</sup>). For the industry is important because of the industrial semolina extraction. Table 2, shows that the cultivars and all the advanced lines have TW over 81 (kg hL<sup>-1</sup>). The other important trait for the industry is the virtuousness. When the values of this trait are over 85,01% the farmers can have an extra pay. In general the farmers can easily get virtuousness over 90,0 %.

The protein content (%) was determined, using NIR, and was measured in ground whole grain. As shown in table 3, values fluctuate between 10.8% and 13.7%. There is a variation according to the location, with the highest values reached in Los Angeles. The highest grain yield were also obtained in this location. This place is associated with high fertility and very deep soils. According to data supplied by the industry the average grain protein content increased from 9.1% in the year 2004 to 10.9% in 2006. The content of protein is a character highly influenced by the environment in which the agronomic management practices are very important, especially the handling of nitrogen. In Chile, the nitrogen, is recommended to split it in at least three times, in order to achieve high yield and high protein content.