Specific adaptation: The key to overcoming the effects of terminal drought on durum wheat in Chile

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INTRODUCTION

In Chile, the wheat area reached 190,000 ha, about 12% of production is durum wheat(*Triticum turgidum*) produce in irrigated condition opposite to the rest of the world where the great proportion is of dry land environments. The agroclimatic conditions of central Chile are characterized by a concentration of rainfall between May-September, with a marked increase in temperature during the grain filling phase, which, together with the scarcity of water, strongly limits the potential yield that can be obtained. One of the greatest challenges for plant breeders is to obtain genotypes that are adapted to future environmental conditions. A genotype is considered adapted to a condition when its performance is superior under either broad or specific environmental conditions.

MATERIAL AND METHODS

During three years 2017-2019, twenty five genotypes are being evaluated in 3 locations throughout Chile: Los Tilos (Irrigated) (33° 42’ 26’’ S 70° 42’ 56’’ O 500 m.a.l.s.) Hidango (rainfed) (36º 06’ 48’’S; 71º 47’ 52’’ West; 269 m.a.l.s) and Santa Rosa (Irrigated) (36° 31'34 "S, 71 ° 54'40”). Lleuque-INIA, Queule-INIA and Llareta-INIA were used as check. Of the genotypes seventeen were selected from the durum breeding project of INIA, 1 from ICARDA and 3 from CIMMYT. The genotypes were planted in plots of 2 m long and 1 m wide (5 rows) (Figure 2). An alpha lattice design (3 X 5) with four replications was used in all locations.

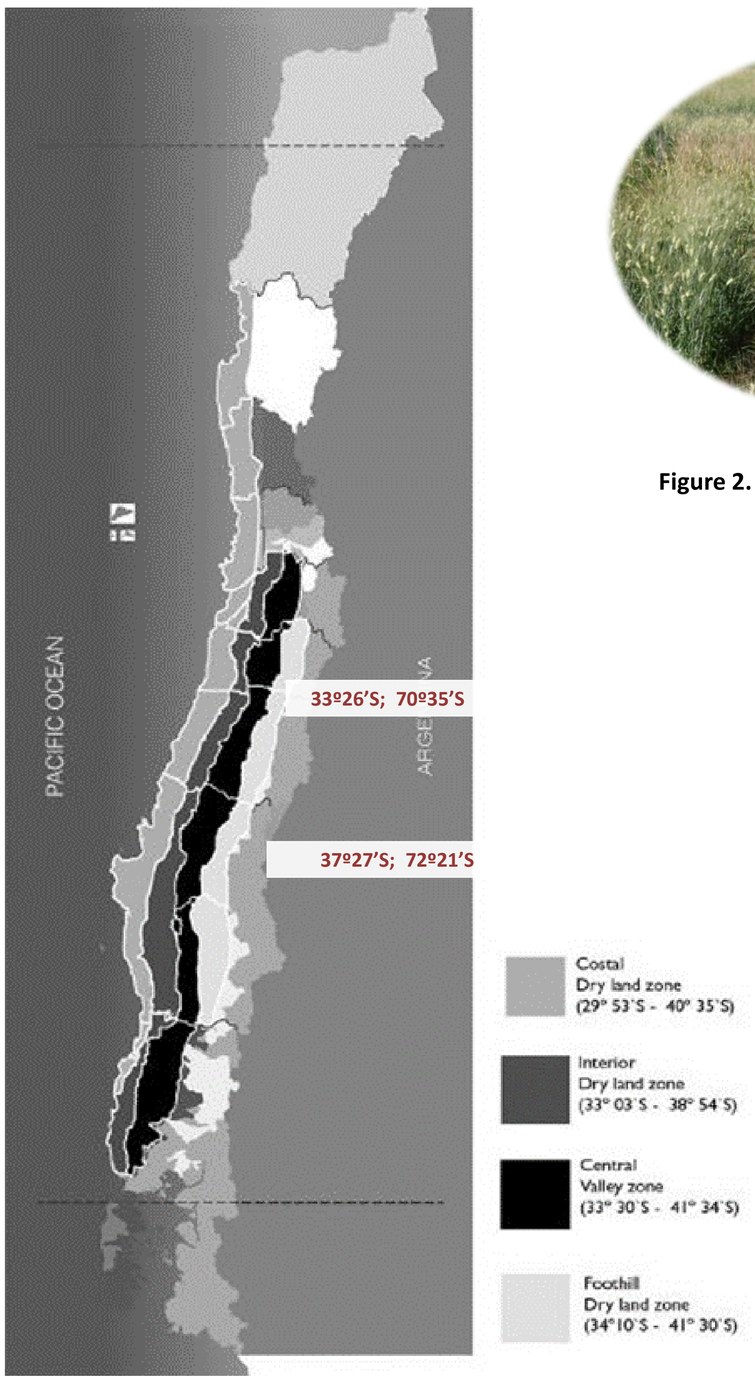

Figure 1. Area of setting up de experiments.

Figure 2. Rainfed trials

Table 1. Grain yield (ton/ha) of the five genotypes evaluated in 3 locations. Years 2017-2019.

Genotype/Location	*Los Tilos (Irrigated) 33 °S 70 W*			*Hidango (Rainfed) 34 °S 71 W*			*Santa Rosa (Irrigated) 36 °S 54 W*			Grain yield (Ton/ha)
	2017	*2018*	*2019*	*2017*	*2018*	*2019*	*2017*	*2018*	*2019*	
CIMMYT line (7107)	6.9	7.1	8.2	**6.5**	**10.6**	**7.1**	7.3	5.7	8.5	7.5
Lleuque-INIA (7110)	6.1	7.9	8.5	6.6	8.7	6.7	10.3	9.5	8.3	8.1
Llareta-INIA (7101)	4.7	8.3	7.4	5.1	7.7	5.4	7.1	8.1	8.3	6.9
Queule-INIA (7115)	**6.5**	**7.9**	**9.8**	6.6	8.7	6.5	**10.8**	**8.5**	**10.1**	**8.4**
Comercial variety (7120)	3.8	7.9	7.6	4.8	7.6	5.2	9.8	8.1	11.3	7.3
Coefficient of variation (%)	14.3	13.2	10.3	16.1	10.9	13.2	19	18.1	9.8	

Bold: Best genotype in each environment

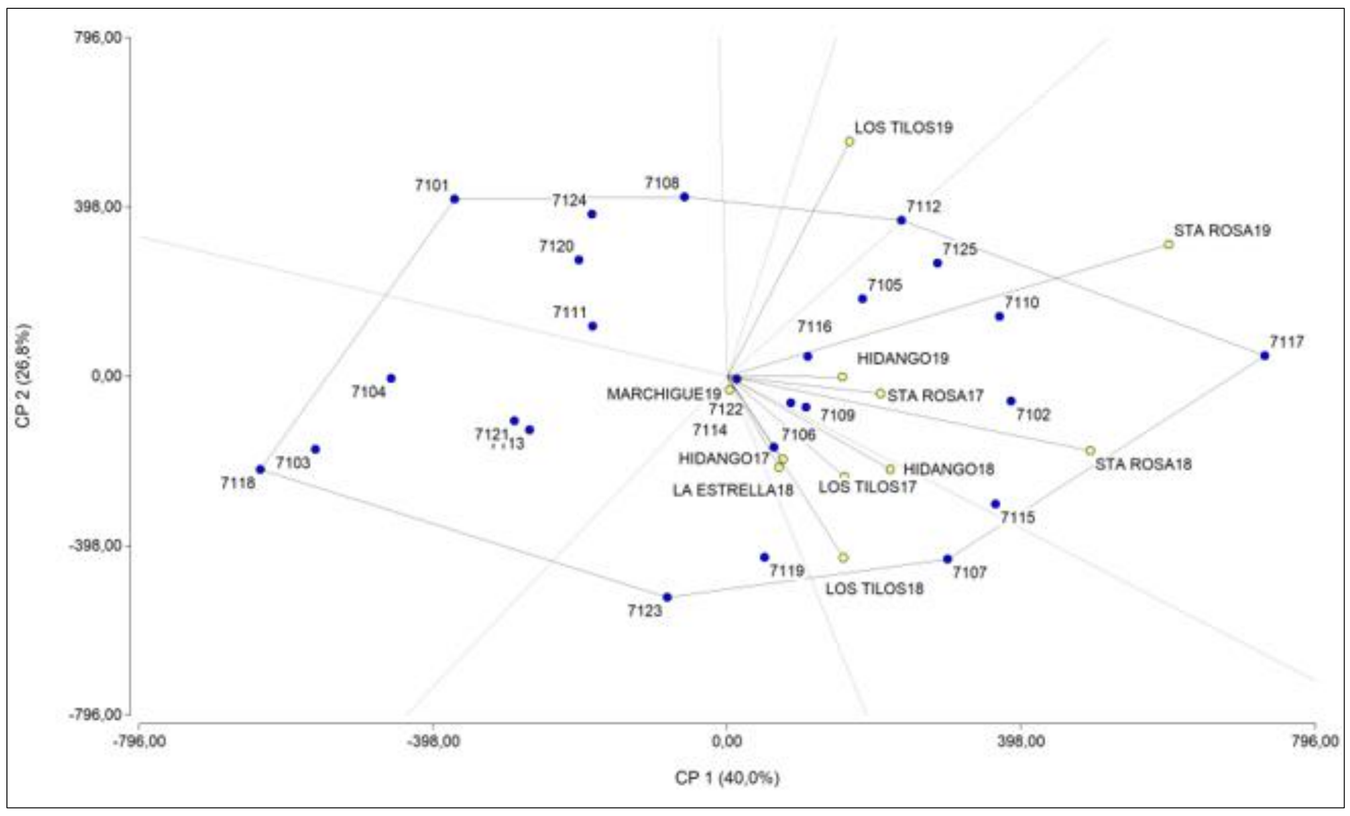

Figure 3. SREG Biplot, grain yield of the twenty five durum wheat genotypes evaluated in 11 environments. Years 2017-2019.

RESULTS AND DISCUSSION

The results presented describe best the adaptation of the germplasm in different environments. In the year 2017-2019 the grain yield ranges was of 4.8 to 10.6 ton/ha for rainfed location and 6.5 to 10.8 ton/ha for irrigated locations(Table 1). In 2018, these ranges were higher under rainfed location reaching from 7,6 to 10,6 ton due to better distribution of rainfall and adequate temperature during cycle. The opposite situation occurred in 2019, where precipitation did not exceed 320 mm (Hidango) and with at least 4 temperature events above 32°C in grain filling (terminal drought). The best performance (Figure 3) was CIMMYT line: **SORA/2*PLATA_12/3/SORA/2*PLATA_12//SOMAT_3/4/AJAIA_13/YAZI//DIPPER_2/BUSHE N_3**, selected in (F_6-2009) Cd. Obregon, México and evaluate in Chile in contrast environment previously described. Broad adaptation is generally considered to be mainly due to genotype effect (G) while specific adaptation can be associated with genotype by environment interaction (G x E) or with combined effect of G and G x E. G x E interaction has a negative impact on the success of breeding programs when broad adaptation is sought, which is the best strategy in favorable environments; however, **for environments under stress breeders can consider G x E and improve for specific adaptation.**

NATIONAL WHEAT BREEDING PROGRAM INIA

Ministerio de Agricultura
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