

GENETIC PROGRESS OF DURUM WHEAT IN ITALY

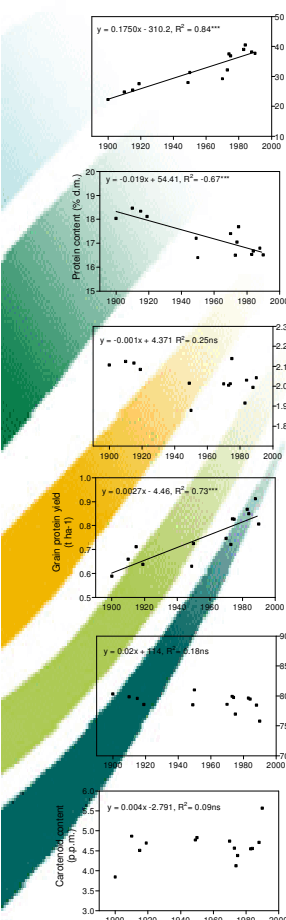
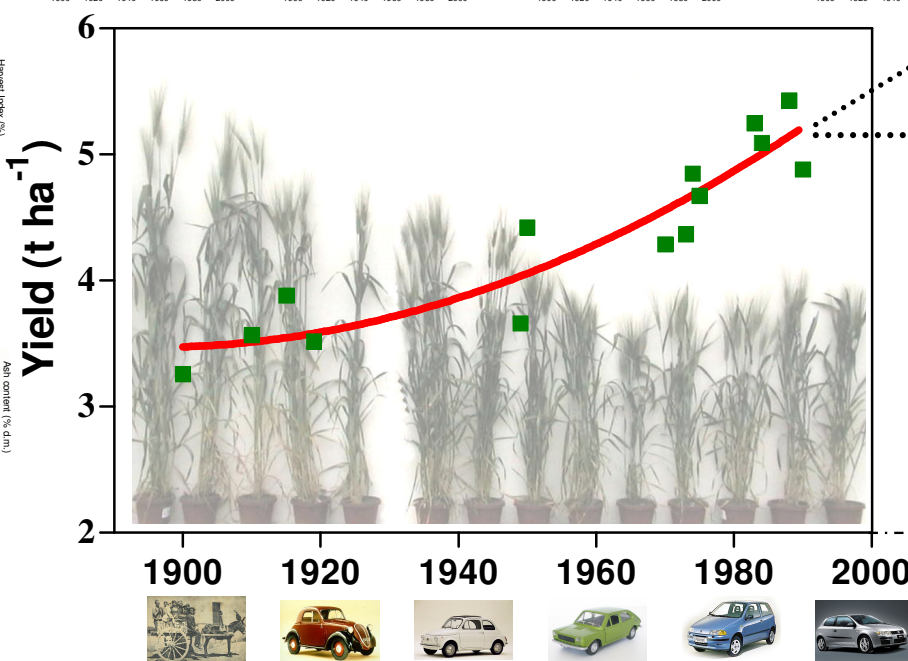
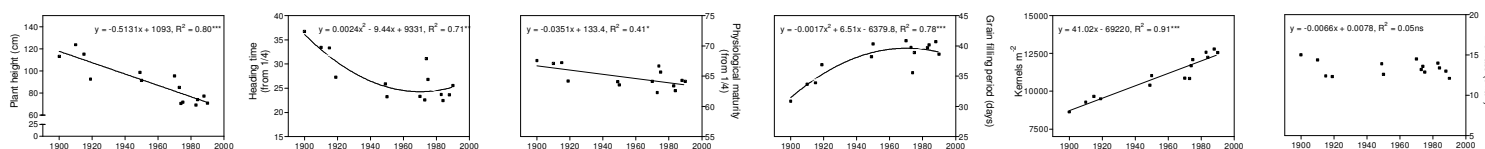
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Abstract

Fourteen durum wheat (*Triticum durum* Desf.) cultivars introduced in Italy between 1900 and 1990 were grown for two years (2001 and 2002) at Foggia (Italy) in field trials with three agronomic treatments in order to assess the genetic improvement in agronomic and qualitative parameters. The traits were measured in the field to describe the biomass production and its partitioning to the grain, the phenological behaviours and the photosynthetic properties. Grain protein content, alveograph's W-index, carotenoid pigments content, ash content and the glutenin and gliadin subunit compositions were then measured to assess grain quality. The results showed that differences in agronomic traits among durum wheat cultivars released in Italy in the last century are generally similar to differences observed in hexaploid wheat, with an annual genetic yield gain of 19.9 kg ha⁻¹ year⁻¹. The genetic gain was most clearly associated with a higher kernels number m⁻² indicating a larger grain-sink size and a higher number of spikes m⁻². The gradual reduction in plant height associated with an increased harvest index has represented the main breeding goal with an effect on the sink capacity and on the biomass partitioning. The progressive incorporation into recent cultivars, of favourable alleles (7+8 glutenin subunit composition) coding for superior quality subunits reflects the improvement in pasta making quality of the recent genotypes.



Cultivars	W-Alveograph Index	Glu-A1	Glu-B1	Gli-A1 α-gli	Gli-B1			LMW	Gli-A2 α-gli	Gli-B2 β-gli
					α-gli	γ-gli	β-gli			
Timilia (1900)	30	Null	20	20	23.35	45.46	-	LMW-2	76,78,80,82,85	59,60,62,65
Russello S.G.7 (1910)	40	Null	13+16	-	23.25; 35.38	45.46,51	-	LMW-1	76,78,80,82,85,94	59,60,62,65
Cappelli (1915)	80	Null	20	20	23.35	45.51	-	LMW-2	73,77,79,84,89	59,60,62,65
Azziah (1925)	99	Null	6+15	-	25,33,35,38	42	-	LMW-1	73,77,79,84,89	55,58,61,63
Grifoni 235 (1949)	104	Null	7+8	-	23,31,35	45,46	-	LMW-2	76,78,80,82,85,94	59,60,62,65
Capelli 8 (1950)	97	Null	20	-	35	45,46	-	LMW-2	73,77,79,84,89	59,60,62,65
Trinakria (1970)	75	Null	20	-	35	45,46	-	LMW-2	73,77,79,84,89	59,60,62,65
Appulo (1973)	58	Null	20	20	23.35	45,46	-	LMW-2	73,77,79,84,89	59,60,62,65
Creso (1974)	146	Null	6+8	20	23.35	45,51	-	LMW-2	73,77,79,84,89	59,60,62,65
Valnova (1975)	128	Null	7+8	20	23.35	45,51	-	LMW-2	73,77,79,84,89	59,60,62,65
Arcangelo (1983)	111	Null	20	20	23.35	45,51	-	LMW-2	73,77,79,84,89	59,60,62,65
Dulio (1984)	127	Null	7+8	20	23.35	45,51	-	LMW-2	76,78,80,82,85,94	59,60,62,65
Simeto (1988)	194	Null	7+8	20	23.35	45,51	-	LMW-2	73,77,79,84,89	59,60,62,65
Olfanto (1990)	49	Null	20	20	23.35	45,51	-	LMW-2	73,77,79,84,89	59,60,62,65

Conclusions

The results reported in this work suggest that over the 20th century the breeders selected cultivars that not only most of the times outyielded their predecessors in relatively poor environments, but also responded remarkably stronger to environmental improvements. These gains were attained by consistently boosting the number of grains per unit area, while the mean weight of the grains remained virtually unchanged. As suggested by Reynolds et al. (2005) this implies that durum wheat yield is more restricted by the size of the sink than by the strength of the source after anthesis. Such restriction may be interpreted as an indication that future breeding should continue to enlarge the size of the sink, although the genetic increases in wheat yields, based on harvest index, are becoming harder to achieve (Reynolds et al., 1996; Sayre 1996). Regarding the grain quality, modern cultivars reflect a relatively appreciable increase in the pasta-making quality of proteins. Compared with ten years ago, breeders now have new perspectives for plant improvement. Firstly, they have new tools such as markers for single loci and QTLs as well as genes for plant transformation that will provide an opportunity to move the selection from phenotype to genotype. Secondly, they will have a new role, to blend together all knowledge of the traits sustaining yield and quality and to accumulate randomly dispersed QTLs and/or transgenes into elite genotypes. This "breeding by design" strategy (Peleman and Van der Voort, 2003) is an important chance to face the future breeding challenges. Notably, it becomes more evident that successful breeding will only be possible when a true integration of traditional breeding with physiology and genomics is achieved. Thus, to ensure sufficient yield in the future requires a multidisciplinary approach based on plant genomics, physiology and modeling.

References

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