Assessing diversity in *Triticum durum* cultivars and breeding lines for high versus low cadmium content in seeds using the CAPS marker *usw47*

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RESULTS AND DISCUSSION

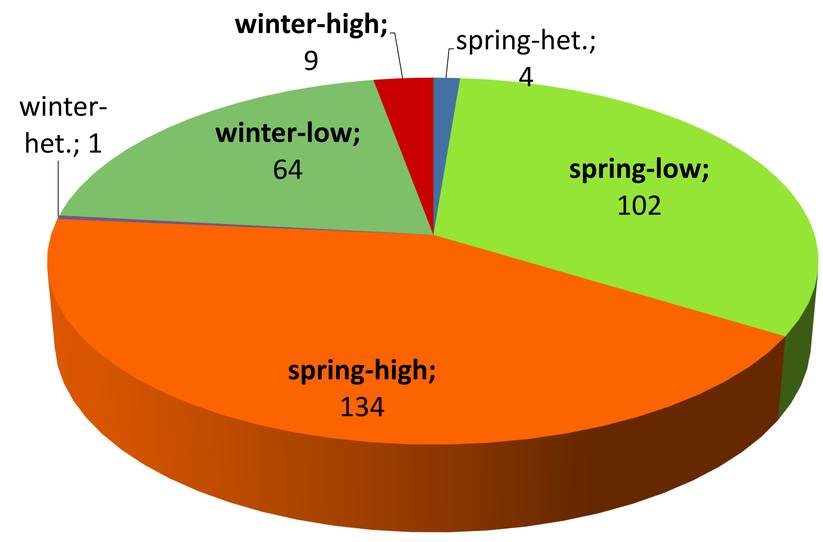

Fig. 2: Allele distribution for marker *usw47* among 314 durum lines, split in spring types and winter types.

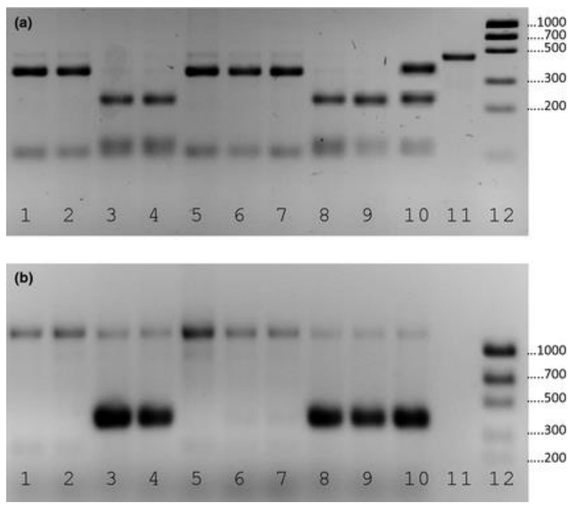

Fig. 1: Electropherograms of markers ***usw47* (a)** and ***ScOPC20* (b)** on 9 *T. durum* cultivars: Floradur (1), Rosadur (2), Malvadur (3), Nicodur (4), CDC Verona (5), Auradur (6), Lunadur (7), Elsadur (8), IS Pentadur (9), a heterogeneous DNA sample (10), one not Hpy188I digested PCR product (11 a) or a water control (11 b) and a DNA size ruler (12).

In a nutshell we conclude:

- Both markers are useful to assess the *Cdu1* locus
- *Usw47* is co-dominant therefore more informative (Fig.1)
- In European spring durum the *high-Cd* allele is more frequent than the *low-Cd* allele (Fig. 2)
- Lines with the *high-Cd* allele accumulated 2.4 times more Cd in the grains than lines with the *low-Cd* allele (Table 1)
- Lines with the *low-Cd* allele surpassed the critical level of 0.2 mg/kg Cd only rarely, lines with the *high-Cd* allele frequently
- For details see Zimmerl et al. (2014)

Table 1: Mean Cd content (mg/kg) in durum wheat seed samples evaluated at 6 experiments with critical Cd load in the soil in Germany (3 environments during 2 years) (*Cd data from Anders 2012*)

	Experiment							
Culitvar	EKW-*08*	PE15-*08*	PE30-*08*	EKW-*09*	PE15-*09*	PE30-*09*	**Mean**	***usw47*- Allele**
ACS-54720	0.07	0.07	0.06	0.07	0.07	0.05	0.07	*low*
Floradur	0.07	0.06	0.08	0.07	0.06	0.07	0.07	*low*
Rosadur	0.09	0.06	0.06	0.08	0.08	0.06	0.07	*low*
Calladur	0.09	0.06	0.08	0.08	0.08	0.07	0.08	*low*
ACS-55711	0.09	0.09	0.07	0.07	0.08	0.09	0.08	*low*
Strongfield	0.16	0.09	0.1	0.14	0.1	0.08	0.11	*low*
Duroflavus	0.11	0.09	0.1	**0.21**	**0.21**	0.17	0.15	*low*
Wimadur	**0.23**	0.16	**0.22**	0.19	0.19	0.17	0.19	*high*
Duramar	**0.27**	0.14	0.16	0.19	0.15	**0.24**	0.19	*high*
Durabon	0.18	0.19	**0.22**	0.19	**0.2**	0.16	0.19	*high*
Orjaune	0.19	0.16	0.18	0.17	**0.21**	0.17	0.18	*high*
Joyau	**0.35**	0.17	0.17	**0.22**	0.19	0.14	**0.21**	*high*
Kombo	**0.25**	**0.2**	**0.23**	**0.25**	**0.24**	0.17	**0.22**	*high*
Hallmark	**0.29**	**0.21**	**0.32**	**0.22**	**0.25**	0.19	**0.25**	*high*
Karur	**0.42**	0.18	**0.22**	**0.25**	**0.21**	**0.2**	**0.25**	*high*
Navigator	**0.41**	**0.29**	**0.27**	**0.26**	**0.23**	**0.21**	**0.28**	*high*

INTRODUCTION

Cadmium (Cd) is a toxic heavy metal that occurs in soils and plants. Cereals are a major source of Cd uptake for humans. Durum wheat accumulates more Cd than other cereals. Because of its toxic effects, maximum allowed levels were set by several authorities, such as the EC (Commission Regulation (EC) No 466/2001), allowing a maximum 0.2 mg/kg Cd in wheat grain. Anders (2012) reported durum wheat seed contaminated by up to 0.42 mg/kg Cd from field trials in Germany. Genetic variation for Cd content in durum wheat has been reported and was found modulated by the gene *Cdu1* on 5BL, which is linked with several DNA markers, such as the co-dominant CAPS marker *usw47* (Wiebe et al. 2010) and the dominant SCAR marker *ScOPC20* (Knox et al. 2009). We therefore evaluated variation at the *Cdu1* locus using DNA markers in a set of mainly European durum wheats: cultivars, breeding lines and genebank accessions.

MATERIALS AND METHODS

Plant material: 314 *T. turgidum* (125 cultivars, 160 breeding lines and 26 genebank accessions, 3 *T. dicoccoides*) lines originating from 16 countries (240 spring and 74 winter types). Marker analysis: PCR detection was performed for CAPS marker *usw47* (MAS-wheat 2013) and SCAR marker *ScOPC20* (Knox et al. 2009). PCR products were separated on 2 % agarose gels and scored by comparison with the *low*-Cd cultivar 'CDC Verona' (Pozniak et al. 2009), for details see Zimmerl et al. (2014). The Cd content data of 16 *T. durum* cultivars tested in multiple environments in Germany at Cd loaded locations by Anders (2012) and genotyped with *usw47* and *ScOPC20* in our study were used to quantify the association of alternative marker alleles with Cd content in the grains (Table 1).

References

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