Does nitrogen supply impact the cadmium fluxes to developing durum wheat (Triticum turgidum L. subsp. durum) grains?

Bofang Yan, Christophe Nguyen, Oleg Pokrovsky, Jean-Yves Cornu

To cite this version:

Bofang Yan, Christophe Nguyen, Oleg Pokrovsky, Jean-Yves Cornu. Does nitrogen supply impact the cadmium fluxes to developing durum wheat (Triticum turgidum L. subsp. durum) grains?. 18. International Conference on Heavy Metals in the Environment, Sep 2016, Ghent, Belgium. 2016, 10.13140/RG.2.2.36031.71843 . hal-02797874

HAL Id: hal-02797874
https://hal.inrae.fr/hal-02797874
Submitted on 5 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
Does Nitrogen Supply Impact the Cadmium Fluxes to Developing Durum Wheat (Triticum turgidum L. subsp. durum) Grains?

Bofang Yan1, Oleg S. Pokrovsky2, Christophe Nguyen1 and Jean-Yves Cornu1

1ISPA, INRA, Bordeaux Sciences Agro, Villenave d’Ornon, France
2GET, CNRS, Université de Toulouse, Toulouse, France
bofang.yan@bordeaux.inra.fr

Background

Cadmium is a toxic, non-essential element. It can be accumulated in durum wheat grain to levels exceeding the international trade standards, which is threatening human health. Cd imported into developing durum wheat grains originates from either direct uptake of Cd by roots or remobilization of Cd stored in vegetative organs. The remobilization of Cd has been shown to be quite limited when hydroponic plants are continuously well-supplied with nitrogen [1], while the availability of N is often low in field soils. N deficiency accelerates leaf senescence which often induces the remobilization processes [2]. So it is possible that, if Cd remobilization is a senescence-dependent process, the level of N supply might affect the fluxes of Cd to developing grains by its impact on plant senescence. Consequently, it is necessary to quantify the relative contribution of the two pathways for grain Cd loading and to assess how their relative contributions may be impacted by the levels of N supply.

Materials

- Durum wheat Cultivar: Sculptor;
- Plants were trained to develop 4 tillers from the start of elongation;
- Hydroponics: modified Hoagland’s nutrient solution at pH 6.0, refreshed automatically;
- Cd2+ was supplied after transplanting at low dose: non-toxic, fixed at 100 nM, pCd(CD) = 10.79 (to reproduce the level of exposure to Cd found in pore water of contaminated agricultural soils [3]);
- 114Cd-enriched isotope labeling after anthesis until maturity;
- Two treatments: continuous or interrupted N supply after anthesis until maturity;
- Harvest 2 times: at anthesis, at maturity;
- Five repetitions.

Results

Cd fluxes in plant under continuous N supply during grain filling

57% of the grain N derived from remobilization

Grains

<table>
<thead>
<tr>
<th>N (%)</th>
<th>Cd (μg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1a</td>
<td>1.3a</td>
</tr>
<tr>
<td>4.4a</td>
<td>1.2a</td>
</tr>
</tbody>
</table>

Cd derived from root uptake

Whole plant amount of Cd at Anthesis: 40.66 ± 3.53 μg
At Maturity: 41.81 ± 4.77 μg

The amount of Cd remobilized

Qe = Q_{tot} - Q_{ei}

Cd fluxes in plant under interrupted N supply during grain filling

100% of the grain N derived from remobilization

Grains

<table>
<thead>
<tr>
<th>N (%)</th>
<th>Cd (μg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.93</td>
<td>1.88</td>
</tr>
<tr>
<td>1.68</td>
<td>0.68</td>
</tr>
</tbody>
</table>

Cd derived from root uptake

Whole plant amount of Cd at Anthesis: 40.66 ± 3.53 μg
At Maturity: 38.27 ± 6.77 μg

The amount of Cd remobilized

Qe = 1 - \frac{1}{1+R_{ei}/Q_{ei}} × Q_{tot}

Conclusions

- The remobilization process accounts for about half (50-60%) of the Cd in durum wheat grains.
- The N supply after anthesis had no impact on the Cd fluxes into developing grains. Cd remobilization may thus be a senescence-independent process.
- The low availability of N during grain filling period in the field may not affect the accumulation of Cd in durum wheat grain.

References