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Responses of *Typha latifolia* subjected to metal stress

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Abstract

In order to preserve the quality of the waste water, we use the macrophyte plants, which go in the direction of the phyto-purification of an aquatic ecosystem. These purifying plants cleanse the water and transform the organic residues into nutritional elements from which they feed. They have a great ability to fix heavy metals. In our job, we orientated our study on the impact of metallic dusts rejected by the steel complex "Arcellor-Mittal" El Hadjar Annaba, on a macrophyte *Typha latifolia*. The sites of samples (S1, S2, S3, and S4) are located in the neighbourhood of the steel complex, and the least polluted site (St) is located far from the sources of pollution. We studied several parameters: of growth (medium number of roots), biochemical (content in protein at root level) and enzymatique (proportion of root catalase activity).We were also studying, the composition of metallic dusts rejected by the high stoves of complex Arcellor Mittal. Acquired results show an increase of parameters studied in the four sites of sample (S1, S2, S3, S4), compared with the site least polluted (St). Increase varies between significant ($p \leq 0.05$), and very highly significant ($p \leq 0.001$). These results explain the capacity of *Typha latifolia* to fit to the oxidative stress generated by metallic dusts, *Typha latifolia* proves to be a very good bioaccumulative of heavy metals; we recorded a stimulation in growth, in content in proline and in activity catalase.

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Introduction

The phyto-purification of water or use of vegetables for the treatment of wastewater and pluvial, is a recent technique which re-hangs the natural techniques of the phyto-purification. Effect cleaning up macrophytes is known in an empirical manner since for a long time however, it is only from 1950s that German researchers begin analysing this phenomenon in a scientific manner. They put in an obvious place that it is not plants themselves that have a cleaning activity, but rather microbes living around their rhizomes (underground stem in the form of roots). (Dabouineau *et al,* 2005).

Heavy metals are pollutants generated in most cases by human activity; they can be at the origin of several types of toxicity on the man, the animal and even vegetables. Their presence in environment and in most cases in water one of reason of the disturbance of the aquatic ecosystems. Certain plant kinds are known to be able to absorbe the battery of pollutants and heavy metals, among which they find *Typha latifolia* «Club hammer with broad leaves» very used in the field of the phyto-purification of wastewater.
Pollution attained a threshold alarming level in Annaba, particularly in the neighbouring localities of the steel complex Arcelor-Mittal which is classified as a major pollutant of the region.

The objective of our work is to demonstrate the changes observed at the level of a purifying macrophyte of the waste water, in the event of industrial metals pollution. We aim to assess the impact of metallic dusts rejected by complex Arcellor-Mital Annaba on *Typha latifolia*, on the one hand we will study several parameters of growth, biochemical and enzymatique. We will take a sample of samples from five sites (a site least polluted and four sites chosen according to the site of the source of pollution Arcellor-Mittal)

Materials and methods

The used plant equipment concerns a macrophyte *Typha latifolia* taken from five sites.

The sites of sample

S0: the least polluted site, located at El Battah region of El kala.

S1, S2, S3, S4 are located in the neighborhood of the complex.

Samples were performed during the second quarter of year 2015.

One of analysed metallic dusts took a sample from the rejections of the high stoves of the complex Arcellor-Mittal HFx.

Proportion of metallic dusts rejected by the high stoves of the complex

Methods followed for the proportion of the different metallic elements of the complex, are studied and broadcast by the French Association of Normalization AFNOR. By using a spectrophotomètre of nuclear absorption of type ASX-520 Auto Sampler (AFNOR, 2016).

Parameters studied to Typha latifolia

Medium Number of roots: This parameter is measured by the counting among roots of the plant after the collection of samples.

Content in proline at the level of the roots of *T.latifolia*: The technology of proportion of the used proline is that of Troll and Lindsley, (1955).
(Meksem, 2016)

Proportion of the activity of catalase at the level of the roots of *T. latifolia*: Proportion spectrophotometrique catalase activity (CAT)is accomplished according to the method of Cakmak and Horst (Boscoloa et *al.,* 2003).

We performed five repetitions for every studied parameter.

Statistical analysis

The statistical analysis of data is performed by the test T of Student which consists in comparing the averages of 2 sites with the aid of the data of two independent samples, it is accomplished with the aid of a software of analysis of data: Minitab (Version 16.0) (Dagnelie, 1999) Khaldi, 2014).

Results and discussion

Effects of metallic dusts on the medium number of the roots of Typha latifolia

The fig. 1 shows the variations of the medium number of the roots of *Typha latifolia* in the five sites of sample.

Table 1. The methods used for the proportion of metallic dusts.

Metallic dusts	Methods
Plomb/Zinc	NF ISO 8753
Cuivre	NF A20-427
Silice	Gravimetricdosage
Aluminum/Fer/Manganèse	Volumetricdosage

We determine a very highly significant increase (p=0.000) of the medium number of the roots of *T. latifolia*, between the least polluted site St and sites (S1, S2 and S4) with one. We also determine difference significant (p=0.02) in S3 compared with the St.

Content in proline at the level of the roots of Typha latifolia

The figure 02: illustrates the variations of content in proline at the level of the roots of *T. latifolia* in the five sites of sample (mg/g MF).

The results obtained, show that the content of proline racinaire, is higher in the four polluted sites, compared to the site less polluted. This difference is very highly significant (p=0.000) between St and the sites (S1, S2 and S3), and highly significant (p=0.003) between St and S4.

Table 2. Percentage of the rejections of the high stoves of complex Arcellor-Mittal.

Metallic dusts	mg/l	Algerian norms
Fe	18.53	3
Al	3.42	3
Mn	1.05	1
Cu	0.03	0.5
Zn	7	3
Pb	0.8	0.5

Proportion of activity Catalase at the level of the roots of Typha latifolia

The figure 03: shows the variations of catalase activity at the level of the roots of *Typha latifolia* (nmol/min/mg of protein) in the five sites of sample.

We recorded an increase CAT activity of roots, in the four polluted sites (S1, S2, S3 and S4), compared to the site less polluted St. This difference is very highly significant (p=0.000) between the sites (S1, S2et S3) and St And it is significant (p=0.027) between S3 and St.

The analysis of the composition of the metal dusts, rejected by the high stoves of the complex Arcellor-Mittal (table 2), has shown an increase in the concentration of elements analyzed by contribution to the Algerian standards of industrial discharges (JORA, 2006).

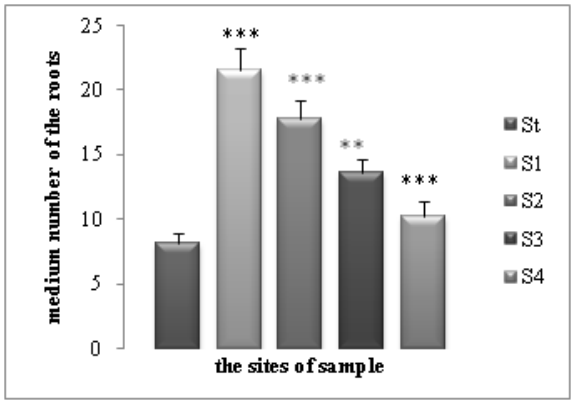

Fig. 1. The medium number of the roots of *Typha latifolia* in the five sites of sample.

The results obtained in our research, show that this pollution, stimulates the average number of roots, the proline content and root the catalase activity of roots of *T. latifolia* in neighboring regions. In our job, we put in evidence a root system more developed to taken *T. latifolia* polluted middle and particularly in S1 near complex Arcellor-Mittal compared with samples taken has leave the site least polluted.

These results are similar to those of (Esser,1999), which translates the increase among the roots of reeds due to the fact that reeds have a very active root system, and are able of resisting to the most dangerous xénobiotiques such as heavy metals, detergents and pesticides.(Moffat *et al.*, 2001) stipulate that plants used for the phytoepuration have a quick growth.

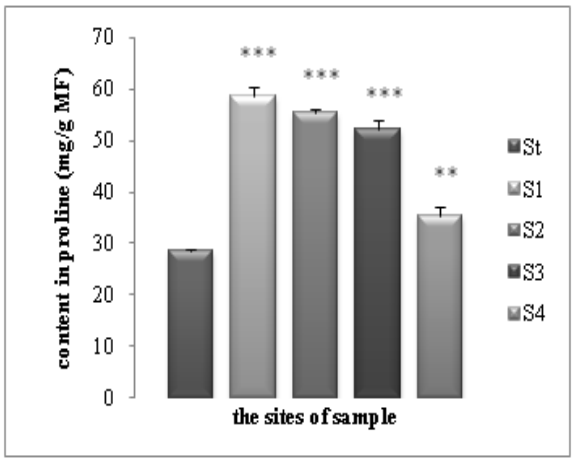

Fig. 2. Contentin proline at the level of the roots of *Typha latifolia* in the five sites of sample.

Sandermann (1994) adds that for the mechanisms of phyto-dépollution, in general, plants having a system broad and root dense are favored because they on tune bigger absorbency and they explore a vaster zone of soil.

The proline is an amino acid known for its accumulation in a big variety of organisms since baking yeast up to plants the upper, displayed in a stress abiotique (Pardha *et al.*,1993), such as stress leads by heavy metals (Alia and Pardha, 1991), (Trpathi *et al.*, 2006), by manures (Deruelle, 1983) and by a fungicide (Meksem, 2007).

Concerning the increase of content in proline leaf to *T. latifolia* in the four sites by provision to the witness, our results compound with those of (Bensoltane, 2006) which recorded an increase of the proline during a stress of in NH_4NO_3 to ship's apprentices and lichens.

Several researches mentioned that the increase of content in proline translates the stress of the plant procreated by the accumulation of a pollutant (Deruelle, 1983); (Legadic *et al.*, 1997); Hellmann *et al.*, 2010).

An increase of content in proline to *Lemna minor* and *Elodéa canadensis* in the presence of Calliofop 36 EC (Tlidjen, 2014), (Kleche, 2013) recorded also an increase of content in proline to *Phragmites australis*.

These results can confirm our results as regards adaptation of *T latifolia* on the conditions of stress. The proline can play an inhibitive role of heavy metals according to (Ferago and Mullen, 1979).

The catalase is one of the antioxidizing most efficient enzymes according to (Khaldi, 2014). They determined an increase of catalase activity in four sites by provision in the site witness. The most well brought up rate is recorded in S1 near complex Arcellor-Mittal,

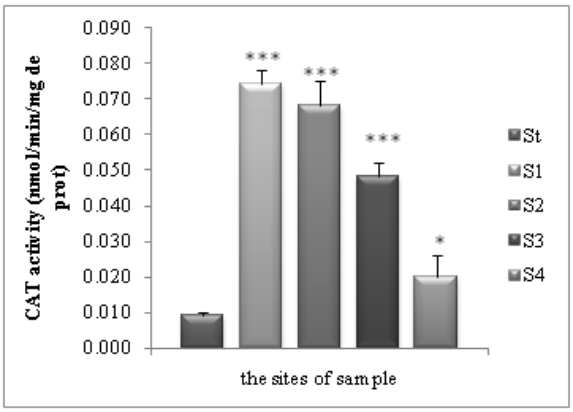

Fig. 3. Variations of catalase activity at the level of the roots of *Typha latifolia* (nmol/min/mg of protein).

These results compound with those of (Meksem, 2007) which worked on a variety of hard wheat *Triticum durum* subjected to two fungicides flamenco SC and Tilt 250 EC, and that put in an obvious place an increase of catalase activity. The entirety of enzymes implicated in the détoxication of ROS, introduces a net increase of activity.

Conclusion

Typha latifolia is a plant present in the littoral zone of lakes and other shallow waters in temperate climates. Our study can demonstrate its ability to grow in polluted environments without severe physiological disturbance.

The results obtained in our study, revealed that the steel complex Arcellor-Mittal exercises a very high pollution of waters, the surrounding regions. *T. latifolia* is very sensitive in the presence of pollutants (the metal dusts) in its environment. *T. latifolia* has proved to be a very good bio-accumulatrice metal dust.

There has been an increase in the average number of roots, in the proline content and root in the catalase activity at the level of the roots, in the four sites polluted by contribution to the site less polluted. The highest figures were recorded at the level of the site S1 near the complex Arcellor-Mittal

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