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Biochemical composition and germination capacity of *Ligustrum lucidum* ait. seeds in the process of biological invasion

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ABSTRACT. *Ligustrum lucidum* ait. is an exotic species and in the present study, contents of sugars, proteins, and germination were evaluated in seeds removed from not abscissed and abscissed fruits. The seeds were stored or not under shadow or sun. The higher contents of total and reducing sugars were observed in seeds removed from not abscissed fruit while the period of storage resulted in the loss of these compounds. The same result was observed in the content of total sugars of seeds from abscissed fruits. The content of reducing sugars in seeds from abscissed fruits and submitted to storage had its content increased. The contents of total proteins in seeds from abscissed and not abscissed submitted to shadow or sun were not significantly different, but the results suggested an increase in protein synthesis during the storage period, differently from those seeds that were not submitted to storage. When seeds from abscissed and not abscissed fruits were evaluated immediately after harvest, they presented greater percentages of germination, while after 28 days, seeds submitted to the storage treatments showed lower values. The invasive potential of *L. lucidum* seems to be more associated to the number of seeds produced, than to their germination potential.

Keywords: Oleaceae, sugar, protein, exotic species.

Introduction

Invasive plant species can disturb and cause several damages to different ecosystems, affecting them economically, environmentally and ecologically. These species compete with native plants and change drastically natural landscapes (DAVIS et al., 2001; PACHARD et al., 2004; ANDRADE et al., 2010). Nowadays, invasive plants have been considered the second most important threat to biodiversity, being just behind of the destruction by human action (ZILLER, 2001).

Exotic species are introduced by man for different purposes as food, windbreak, pasture, reforestation and as ornamental purposes. According to Ziller (2001), half of 491 exotic plants species found in South Africa were introduced as ornamentals.

Exotic invasive plants are organisms that interfere on growth and development of native species without direct human action. They can cause great environmental, social and/or economical changes (PYŠEK et al., 2012). Besides that, exotic invasive species have an enormous propagation and a
The fruits collected from plants (not abscisic fruits) or the fruits found under the canopy’s projection ray (abscisic fruits) were placed inside plastic trays and exposed to the sun or to the shadow (50% shade sail), at UTFPR - Pato Branco, during 20 days. The treatments evaluated were: seeds from not abscisic fruits exposed to the sun or to the shadow during twenty days or not (without storage), and seeds from abscisic fruits exposed to same conditions.

The seeds were removed from fruits, washed in water and then disinfected with ethanol at 70% during three min and sodium hypochlorite (0.2% of active sodium) during 15 minutes. Residues of chemical reagents were removed with sterilized water. After this process 50 seeds per treatment (five repetitions) were placed on a wet germination paper in Petri plates. They were maintained in darkness at a temperature of 25°C. The germination evaluations were carried out at the 7, 14, 21 and 28 days, when germinated seeds presented visible cotyledons.

Biochemistry analyses were performed at Laboratory of Biochemistry and Physiology of Plants (UTFPR). Total sugars were evaluated by phenol-sulphuric method (DUBOIS et al., 1956) and dinitrosalicylic acid reagent was used for determination of reducing sugars (MILLER, 1959), both with glucose as standard. Total proteins were quantified by Bradford method (BRADFORD, 1976) with bovine serum albumin as standard.

Data were submitted to analysis of variance and the averages were compared by Tukey’s test (p < 0.05) using the Assistat statistical software.

Results and discussion

The orthodox process of seeds development has four stages: the cellular division and expansion, food and energy storage and dehydration (MARÇOS FILHO, 2005). The fourth stage is the maturation, when soluble carbohydrates are important components that are involved in the dehydration tolerance (OBENDORF, 1997).

Higher concentration of total sugars (21.34 mg g⁻¹ of seeds) and reducing sugars (54.53 mg g⁻¹ of seeds) were observed in seeds removed from not abscisic fruits. This indicates that seeds still had food and energy storage and they were not at physiological mature stage (Figures 1 and 2). When these seeds were exposed to dehydration process under sunlight or shadow, both total and reducing sugars had decreased their contents (Figures 1 and 2). Content of total sugars was 11.97 and 15.41 mg g⁻¹ of seeds submitted to sunlight or shadow respectively. Reducing sugars also had their content...
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decreased by treatments, but without statistical difference (35.75 and 36.64 mg g$^{-1}$ of seeds, respectively).

![Figure 1](image1.png)

**Figure 1.** Total content of sugars in *L. lucidum* seeds from not abscisic or abscisic fruits under different conditions. Same letters indicate no statistical difference between treatments.

In spite of, there was no statistical difference in the sugar content in seeds maintained under the sun or shadow; it is possible that light and temperature contributed with the seeds to keep the higher sugar content and this numerical difference could be important for the maintenance of these seeds structures under stress conditions.

When abscisic fruits were exposed to the sun treatment, seeds presented the smaller content of total sugar, compared to the other treatments (about 9.97 mg g$^{-1}$ of seeds) (Figure 1) showing the mobilization of these compounds due to the maintenance of essential processes under stress conditions. Meanwhile the concentrations of reducing sugars in seeds increased when fruit were exposed to the sun or shadow (33.89 and 47.34 mg g$^{-1}$ of seeds, respectively), when compared to seeds from abscisic fruits without storage stage (22.90 mg g$^{-1}$ of seeds) (Figure 2).

The rise of reducing sugar in seeds proceeding from abscisic fruits could be related to consumption of storage during 20 days (NKANG, 2002).

This behavior also may explain the higher content of total proteins in these two treatments (under the sun or shadow) for both seeds from abscisic and not abscisic fruits (Figure 3), in which the synthesis of hydrolytic enzymes such as invertases and amylases and other important proteins must be involved in the maintenance process of embryo (viability), as well as, in induction of germination. Lower content of proteins were found in seeds from abscisic fruits (4.00 mg g$^{-1}$ of seeds) but without significant difference from those of not abscisic fruits (4.58 mg g$^{-1}$ of seeds) both without storage (Figure 3).

![Figure 2](image2.png)

**Figure 2.** Content of reducing sugars in *L. lucidum* seeds from not abscisic or abscisic fruits exposed to different conditions. Same letters indicate no statistical difference between treatments.

According to Binotti et al. (2008) the deterioration rate of seeds is considerably increased by the exposure to different levels of temperature and relative humidity of air. Furthermore, Delouche (2002, apud BINOTTI et al., 2008) argued that the duration of deterioration process is mainly determined by the interaction between genetic inheritance, degree of seed humidity and temperature. Consequently, the seeds removed from fruit, that were collected directly of the tree, had a higher content of water and possibly they were more susceptible to deterioration.

Buckeridge et al. (2004) stated that in order to accelerate the germination process, some seeds need to be removed from the fruit before physiological maturation. However, these seeds can die by dehydration. Low rates of germination observed in seeds from not abscisic of *L. lucidum* exposed to...
environmental conditions during 20 days (Figure 4) can be associated to a low potential of germination due to incomplete maturation and water loss, as the authors mentioned above.

Figure 4. Accumulated germination percentage during evaluation period.

Garcia et al. (2006), examining Caesalpinia echinata (Brazilwood), observed that the seeds lost viability when maintained under environmental temperature due to the loss of glucose and fructose compared to sucrose. Binotti et al. (2008) also observed a decrease in the vigor and germination of bean seeds (Phaseolus vulgaris) with loss of sugars and other compounds.

Seeds from not abscisic and abscisic fruits that were not stored showed relatively high germination percentage when compared to those treated by 20 days with sunlight or shadow (Figure 4). Low rates of germination were observed in all stored seeds indicating low vigor related to loss and possibly to consumption of reserve material for embryo support during the 20 days. Aragon and Groom (2003) studied germination of L. lucidum seed in Argentine forests below closed canopy and opened areas. They observed lower rates of germination for these seeds in the treatment below closed canopy. On the other hand, under second-growth forests and on the border of the forests they had better results for the seeds germination. These results agree with the present study suggesting that L. lucidum not have rustic seeds, and are able to germinate under stress conditions (storage under natural conditions) but this process is quite small than that verified for seeds from not abscisic fruits. It is possible that these seeds are immature, as supposed by Buckeridge et al. (2004) but the present study cannot confirm it.

Conclusion

L. lucidum produces a large quantity of fruit that are dispersed meters away from canopy projection, some of them under the sun or shadow. Aiming to understand the process of proliferation of this species, that besides being exotic, also became invasive in Paraná State, the studies pointed to a potential arising mainly from the production of a great number of seeds, rather than maintenance of high germination capacity, since under environmental conditions, the reserve material seems to be depleted before the complete embryo development and seedling establishment (growing).

Therefore, seeds that are released at short stage after fruit abscission seem to have more chances to produce a new plant than those that will remain for a long time onto the soil. This invasive potential of L. lucidum seems to be more associated to the great number of seeds produced by the species, than to their germination potential (rusticity).

References


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