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Application of algal biomass for enhanced acclimatization of orchids

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ABSTRACT Algae produce plant growth regulators (PGRs), similar to higher plants. To study this feature, freeze-dried and ultrasonicated algal biomass was applied to support the development of certain orchids. An *in vitro* and an *ex vitro* experiment were carried out. In case of *Phalaenopsis* and *Paphiopedilum*, the nutrition medium was supplemented with the biomass of five algal strains at a concentration of 0.5 gL⁻¹ in the *in vitro* experiment. This treatment enhanced the development of plants, but different strains depending on orchid species proved to be efficient. In *Oncidium* cultures different concentrations of MACC-612 were applied as a supplementation of nutrition media. Results showed, that higher concentrations (0.5 – 1 gL⁻¹) evolved a salutary effect on the plant growth. In the *ex vitro* experiment orchids were grown on algal free media under sterile conditions. After that they were potted into the greenhouse and treated eleven times with different concentrations of algal suspension. After three months of acclimatization the lower concentrations (0.1 – 0.2 gL⁻¹) of algal biomass applied in the cultures of *Phalaenopsis*, *Paphiopedilum* and *Oncidium* exerted a positive effect.

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KEY WORDS

algal biomass
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acclimatization

Sprouting of orchids depends on the micorrhizal connection between plants and some fungi under natural conditions (Fast et al. 1980). The essential substances supplied by fungi in the nature are assured through the nutrition media due to *in vitro* propagation (Knudson 1922, 1946). Plantlets grown in sterile flasks with high humidity, available energy source, optimal lighting and temperature are not able to adjust to the changed circumstances entirely (Preece and Sutter 1991).

Similar to higher plants, algae produce plant growth regulators (PGRs) (Evans and Trewavas 1991), that can evolve beneficial effect on initial development and acclimatization of certain plants (Stirk and Van Staden 1997a, b).

We used freeze-dried and ultrasonicated biomass of algal strains derived from the Mosonmagyaróvár Algal Culture Collection (MACC) as supplementation of orchid nutrition media in our study. The hormone-like effects of these strains were confirmed through bioassays earlier (Ördög and Molnár, 1995; Molnár and Ördög 1996; Stirk et al. 2002; Ördög et al. 2004).

Materials and Methods

In the *in vitro* experiment we added the biomass of 5 algal strains (Table 1) to the nutrition media of *Phalaenopsis* and *Paphiopedilum* orchids at the concentration of 0.5 gL⁻¹. We

supplemented the media of *Oncidium* plantlets with the biomass of MACC-612 at different concentrations (0, 0.1, 0.2, 0.5, 0.8, 1 gL⁻¹). The plantlets were grown on these media for 3 months *in vitro*, then they were potted into the greenhouse. At the beginning of acclimatization fresh mass, shoot number, leaf number, leaf length, leaf width, leaf area, root number and root length were measured individually.

Table 1. Applied algal strains in the *in vitro* experiment.

Entitle in Collection	Generic name
MACC-367	Oocystis sp.
MACC-389	Scotiella sp.
MACC-401	Scenedesmus sp.
MACC-430	Tetracystis sp.
MACC-612	Nostoc

Table 2. Algal strains proved to be efficient *in vitro*.

Species	Influenced parameter	Algal strain
<i>Phalaenopsis</i> sp.	Leaf number	MACC-367
	Leaf area	MACC-612
	Fresh weight	MACC-389
<i>Paphiopedilum</i> sp.	Leaf number	MACC-401; 430
	Leaf area	MACC-401
	Fresh weight	MACC-612

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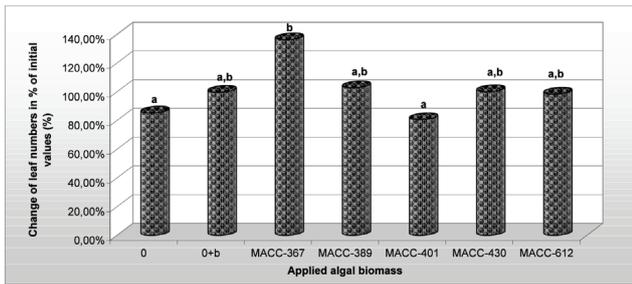


Figure 1. Change of leaf numbers in % of initial values (Phalaenopsis sp.) in the in vitro experiment.

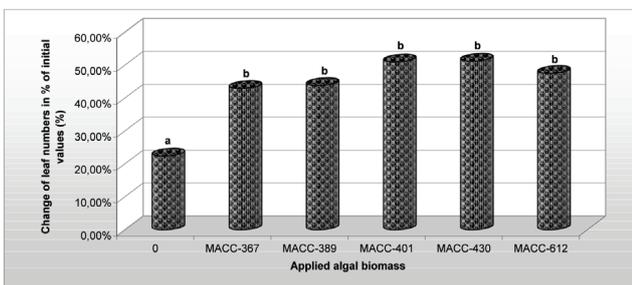


Figure 2. Change of leaf numbers in % of initial values (Paphiopedilum sp.) in the in vitro experiment.

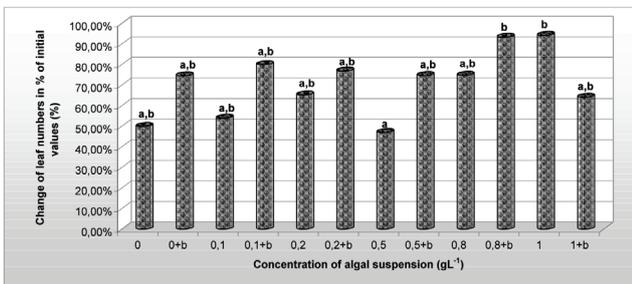


Figure 3. Change of leaf numbers in % of initial values (Oncidium sp.) in the in vitro experiment.

Before the ex vitro experiment Phalaenopsis, Paphiopedilum and Oncidium plantlets were grown *in vitro* on identical, algal-free control medium. The plantlets were treated with the suspension of MACC-612 at different concentrations (0, 0.1, 0.2, 0.5, 0.8, 1 gL⁻¹) after potting them into the greenhouse. Eleven treatments were used totally, the frequency of handlings were reduced gradually. The above mentioned parameters were measured after 3 months of acclimatization.

Results

In the course of *in vitro* experiment the application of some

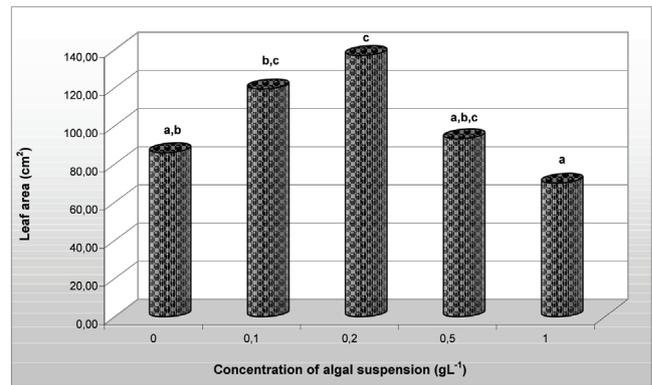


Figure 4. Phalaenopsis sp. leaf area at the end of the ex vitro experiment (cm²).

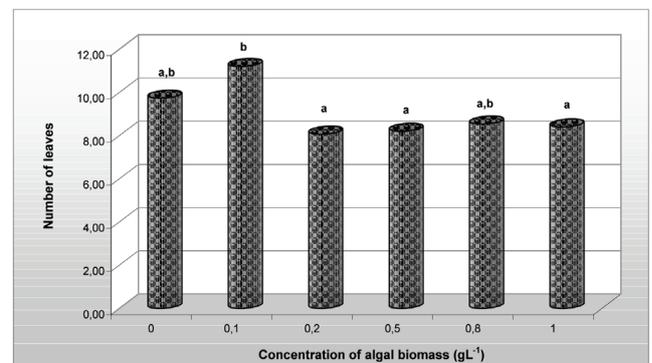


Figure 5. Oncidium sp. leaf number at the end of the ex vitro experiment.

algal strains enhanced the development of orchid plants, but different strains depending on orchid species proved to be efficient in Phalaenopsis (Fig. 1) and Paphiopedilum (Fig. 2) cultures (Table 2) at 0.5 gL⁻¹ concentration. In the case of different concentrations of MACC-612 in the nutrition medium of Oncidium, the higher concentrations (0.5 – 1 gL⁻¹) evolved a salutary effect on the plant growth (Fig. 3, Table 3).

In the ex vitro experiment the lower concentrations (0.1 – 0.2 gL⁻¹) of algal biomass applied at the beginning of the acclimatization in the cultures of Phalaenopsis (Fig. 4) and Oncidium (Fig. 5) exerted a positive effect, while in case of Paphiopedilum, there was no significant difference among the results (Table 4).

Discussion

We can state, that freeze-dried and ultrasonicated algal biomass, as a supplementation of nutrition media, can enhance the development of some orchid species. Studying the effect of different concentrations of MACC-612 in Oncidium

Table 3. MACC-612 concentrations proved to be efficient *in vitro*.

Species	Influenced parameter	Concentration of MACC-612 (gL ⁻¹)
Oncidium sp.	Leaf number	0.8
	Leaf area	0; 0.5
	Fresh weight	0.5

Table 4. MACC-612 concentrations proved to be efficient *ex vitro*.

Species	Influenced parameter	Concentration of MACC-612 (gL ⁻¹)
Phalaenopsis sp.	Root number	0.2
	Leaf number	0.2
	Leaf area	0.2
	Shoot number	0.2
Paphiopedilum sp.	Leaf number	0.2
	Leaf area	0.2
	Shoot number	0.1
Oncidium sp.	Leaf number	0.1
	Leaf area	0.1

cultures, we can declare, that the higher concentrations in nutrition media induced the best results. The cause could be that the algal biomass dispersed uniformly in the nutrition medium and the root system of orchids was not able to take up the favourable components completely. In case of higher amounts, plants could take up feasible quantity of algal extract for the improved development.

Through the greenhouse treatments the whole amount of algal biomass suspension touched with the leaf surface directly. The water could evaporate, but the algal biomass

remained on the leaf. As the plants could take up the beneficial compounds through their leaves, the higher amounts proved to be detrimental, while the lower concentrations supported the development of these plants.

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