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ARTICLE

# 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
Phalaenopsis
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Oncidium
acclimatization

Sprouting of orchids depends on the micorrhizal connection between plants and some fungi under natural conditions (Fast et al. 1980). The essencial 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 | Ooccystis 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 |
|---|---|---|
| Phalaenopsis sp. | Leaf number | MACC-367 |
| | Leaf area | MACC-612 |
| | Fresh weight | MACC-389 |
| Paphiopedilum sp. | Leaf number | MACC-401; 430 |
| | Leaf area | MACC-401 |
| | Fresh weight | MACC-612 |

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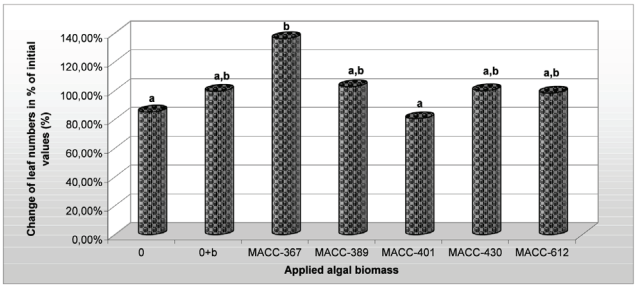


**Figure 1.** Change of leaf numbers in % of initial values (Phalaenopsis sp.) in the in vitro experiment.

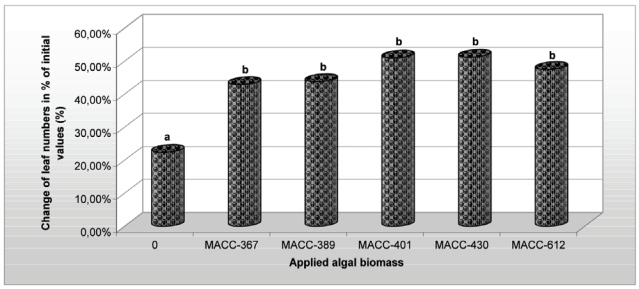


**Figure 2.** Change of leaf numbers in % of initial values (Paphiopedilum sp.) in the in vitro experiment.

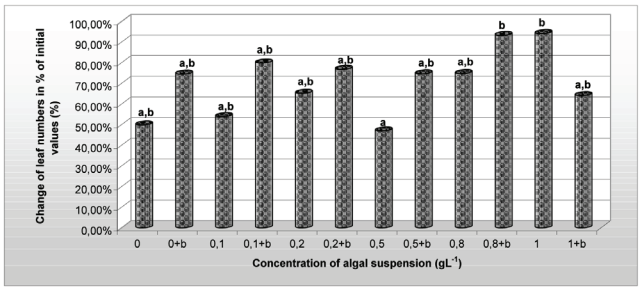


**Figure 3.** Change of leaf numbers in % of initial values (Oncidium sp.) in the in vitro experiment.

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 differen t 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

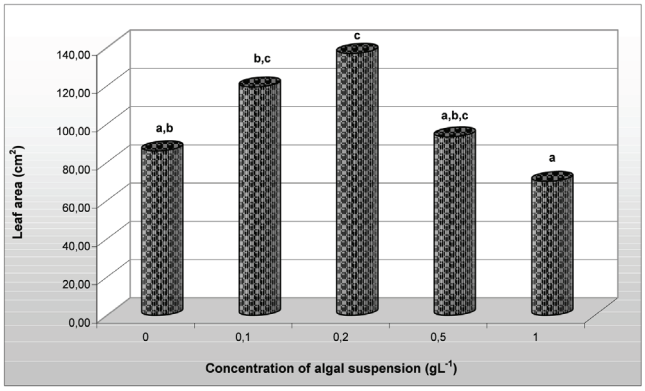


**Figure 4.** Phalaenopsis sp. leaf area at the end of the ex vitro experiment ($cm^2$).

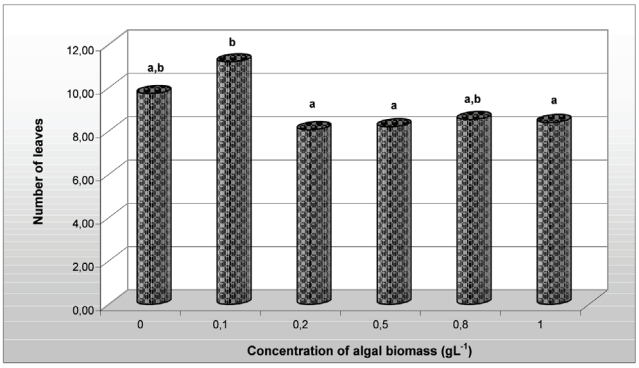


**Figure 5.** Oncidium sp. leaf number at the end of the ex vitro experiment.

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 |
| Paphiopedilum sp. | Shoot number | 0.2 |
| | Leaf number | 0.2 |
| | Leaf area | 0.2 |
| Oncidium sp. | Shoot number | 0.1 |
| | 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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