

Screening of soil herbicides under *in vitro* conditions

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Abstract: It is known that the *in vitro* methods can be used for a rapid preliminary screening about the effect of soil herbicides.

The aim of the present study was to investigate the effect of terbacil, pendimethalin and napropamide on the growth habits of the vegetative rootstock GF 677 under *in vitro* conditions.

In vitro rooted plants have been treated. The herbicide solution was laid on the surface of the agar nutrient medium.

No visual characteristics of phytotoxicity were detected in the leaves and stems of the treated plants. No effect on rooting and stem growth was reported. The phytotoxicity observed referred to the suppression of root growth. The most strongly expressed phytotoxicity was observed after treatment with napropamide.

Key words: GF 677, *in vitro*, phytotoxicity, soil herbicides, vegetative rootstock

Introduction

The production of top quality certified fruit planting material requires the application of high agricultural technique in the fruit-growing nursery. In that aspect an efficient weed control is needed, based on selective herbicides. It is well known that the herbicides affect the growth habits of the fruit species and they can provoke phytotoxicity expressed in chlorosis, necrosis, growth suppression, etc. (Mitchell, 1987; Porterfield, Odell, Huffman, 1993; Wazbinska, 1997; Abdul, Mohammad, Tasleem, 1998; Kaufman, Libek, 2000). That makes it necessary to study the effect of different soil herbicides on the vegetative habits of the fruit species used as rootstocks.

In our previous studies it was established that the *in vitro* methods could be used for a rapid preliminary screening about the effect of the soil herbicides in fruit plants (Gercheva, Rankova, Ivanova, 2002). The advantage of the method is all the year round investigation on a limited area under controlled conditions.

The aim of the present study was to investigate the effect of the soil herbicides terbacil, pendimethalin and napropamide on the growth habits of the vegetative rootstock GF 677 under *in vitro* conditions.

Material and Methods

The study on the effect of some soil herbicides on the development of micropropagated and *in vitro* rooted rootstocks GF 677 was conducted in the period 2002-2003 at the Laboratory of Biotechnologies, Fruit-Growing Institute – Plovdiv. The tested plants were propagated and rooted *in vitro* following the adopted technology (Ivanova, 1988). The soil herbicides terbacil, pendimethalin and napropamide were included in the experiment.

The following variants were set in three repetitions by 10 plants per repetition:

- Control – untreated
- Terbacil – Sinbar 80 WP – 100 g/da
- Terbacil – Sinbar 80 WP – 150 g/da
- Pendimethalin – Stomp 33 EC – 400 ml/da
- Pendimethalin – Stomp 33 EC – 600 ml/da
- Napropamide – Devrinol 4 F – 400 ml/da
- Napropamide – Devrinol 4 F – 500 ml/da

The doses were calculated according to the surface of the *in vitro* used cultivation plates. The treatment was applied immediately after plant rooting in the *in vitro* jars. The herbicide solution (5 ml/cultivation plate) was laid on the surface of the agar nutrient medium. The plants were cultivated for 14 days in a growth chamber at a temperature of 22°C - 24°C, 30 μ mol.m⁻².s⁻¹ PAR and a photoperiod of 16/8 hours.

Visual observations on the development of the plants were carried out for studying the effect of the herbicides. The biometric characteristics height of the stem, mean number of roots and mean length of the roots were followed up in dynamics (at the moment of treatment, on 7th and on 14th day).

Results and Discussion

Outer characteristics of phytotoxicity in the stem and leaves of the *in vitro* plants were not observed after the treatment with the soil herbicides at the applied rates under *in vitro* conditions (Fig. 1).

An inhibiting effect of the herbicides on the height of the stem was not detected (Fig. 2). The growth of the control, as well as of the treated plants was within the range of 4 – 6 mm for the 14-day period. That was a normal growth at the stage of rooting when the major nutrient substances were directed to the growth of the root meristems induced by the auxin in the rooting medium. Variant 4 – pendimethalin 400 ml/da – was an exception with 100-mm growth of the studied plants.



Fig.1. *In vitro* plants of the vegetative rootstock GF 677 treated with soil herbicides

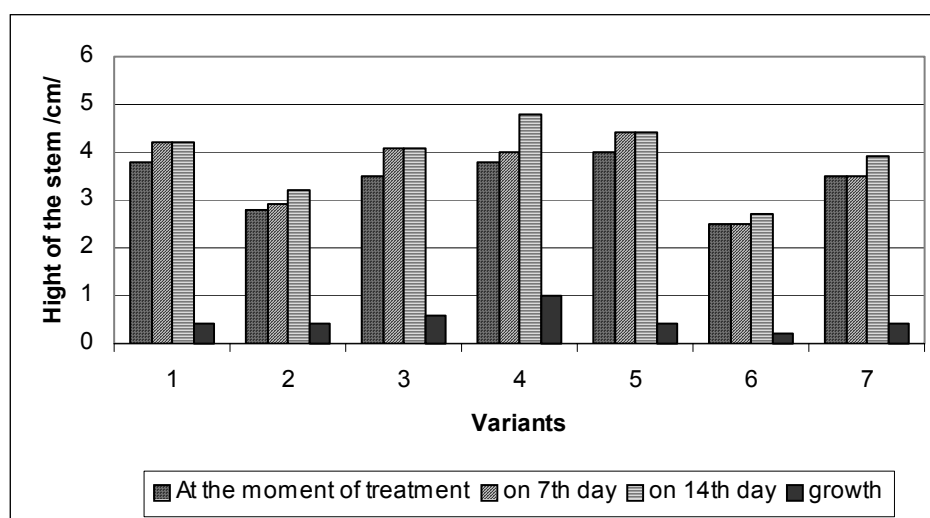


Fig. 2. Effect of the soil herbicides on the stem height /cm/

No significant effect of the herbicide treatment at the rates applied was established on rooting (mean number of roots/plant) of *in vitro* GF 677 plants (Fig. 3). That characteristic was comparatively constant in the control as well as

in the treated plants. The number of roots on the 7th and on the 14th day was the same for the control and it slightly increased in variants 2, 6 and 7.

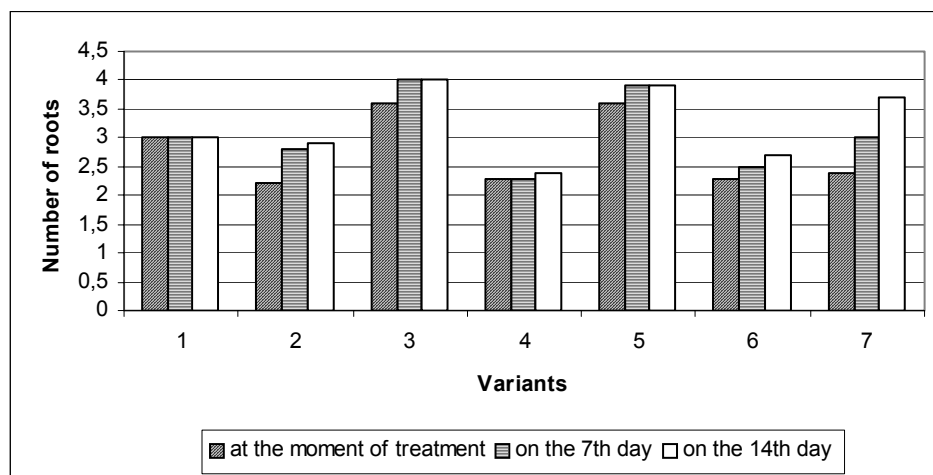


Fig. 3. Effect of the soil herbicides on the mean number of roots per plant

Taking into account the mechanism of action of the herbicides included in the experiment, their effect on the root growth was of special interest (Fig. 4).

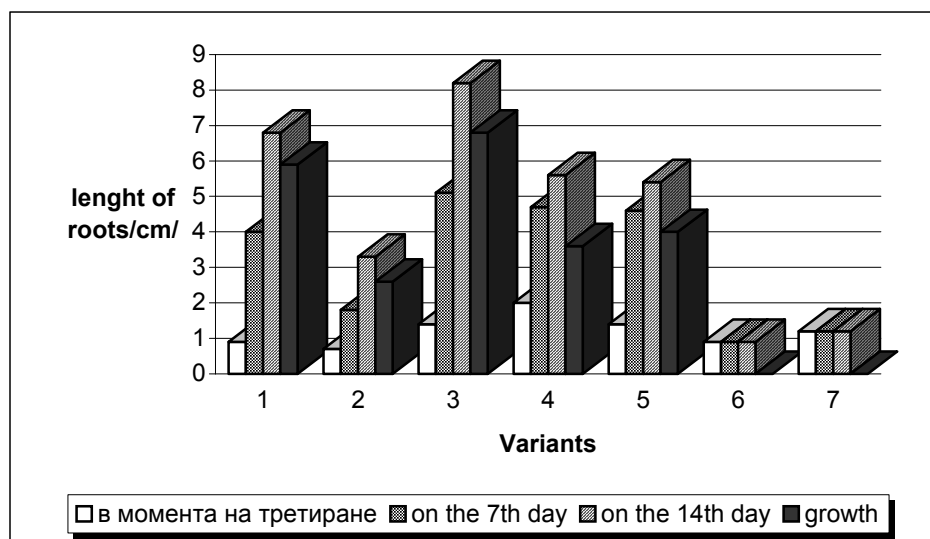


Fig. 4. Effect of the soil herbicides on the root length /cm/

When treated with terbacil – Sinbar 80 WP – 100 g/da (Variant 2) the root growth was significantly weaker compared to the control. Similar phytotoxic effect was not observed at the rate of 150 g/da (Variant 3) when the growth slightly surpassed that of the control plants. The slight stimulating effect observed corresponded also to the data about the stem growth. A probable reason for the observed habits was the root length at the moment of treatment, which was about 7 mm in Variant 2 and 14 mm in Variant 3. Our similar studies showed that the embryo root of the *in vitro* plants reacted in a different way depending on its length when treated with soil herbicides (Gercheva, Rankova, Ivanova, 2002). For the full explanation of the observed habits additional studies are necessary with reporting the effect of the root length at the moment of treatment at a broader range of tested rates.

The inhibiting effect on the root growth of the *in vitro* plants was detected when applying treatment with pendimethalin. In both rates used (Variants 4 and 5) the root growth was significantly weaker compared to the control, however visual characteristics of phytotoxicity were not observed. That corresponded to the mechanism of action of pendimethalin. It blocked seed germination as well as the growth of the embryo root (Fetvadjeva et al., 1994; Tonev, 2000).



Fig. 5. Inhibiting effect of the soil herbicide napropamid on the root length

Clearly expressed inhibiting effect was established when treating with napropamid (Variant 6 and 7), (Fig. 5). At both rates applied the roots of the experimental plants did not grow. Visual characteristics of phytotoxicity were observed. As early as the 7th day after treatment slight necrosis was established on the root surface and the root tips became brownish. Again the mechanism of

action of napropamid can be the explanation about the reported habits. It is known that as a soil herbicide it reduced the lateral roots and stopped their growth (Fetvadjeva et al., 1994; Tonev, 2000).

Conclusions

Visual characteristics of phytotoxicity in the leaves and stems of rooted plants of GF 677 under *in vitro* conditions were not established after treatment with the soil herbicides terbacil, pendimethalin and napropamid.

The soil herbicides included in the study did not exert an effect on rooting and stem growth of the vegetative rootstock GF 677 under *in vitro* conditions.

The soil herbicides terbacil, pendimethalin and napropamid caused phytotoxicity expressed in suppression of the root growth. It was most strongly expressed after treatment with napropamid at the two applied rates.

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PRAĆENJE AKTIVNOSTI ZEMLJIŠNIH HERBICIDA U VEŠTAČKIM USLOVIMA

- originalni naučni rad -

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Rezime

Poznato je da metode veštačkog izazivanja pojava mogu doprineti veoma efikasnom i brzom početnom praćenju dejstva zemljišnih herbicida.

Cilj ispitivanja je da se utvrdi uticaj terbacila, pendimetalina i napropamida na razvojne osobine vegetativne podloge GF67 u veštački izazvanim uslovima.

Okorenjene biljke su tretirane veštačkim putem, a zemljišni rastvor je stavljen na površinu agarizovane hranljive podloge.

Nisu nađene indikacije fitotoksičnosti na listu ni stablu tretiranih biljaka, niti je identifikovan uticaj na okorenjavanje i rast stabla. Uočena fitotoksičnost odnosila se samo na smanjenje razvoja korena. Najveća toksičnost ustanovljena je nakon tretiranja sa napropamidom.