Short communications

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The influence of abscisin II and gibberellic acid on the sprouting of excised potato buds

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Summary

It was shown that abscisin II at low concentration (0.5×10^{-5} M) has a significant growth inhibiting effect on the sprouting of excised potato buds.
The growth accelerating effect of GA is partly suppressed by abscisin II. No effect could be observed on the length of the dormant period.
GA seems to have a negative influence on the root formation.
Combined treatment with GA and abscisin II nearly completely inhibited root formation.

Introduction

It was discovered some years ago, that potato tubers contain certain metabolic products during the period of natural dormancy, that prevent germination of seeds (Schippers, 1961). It also appeared that these compounds inhibit the cell elongation in the avena coleoptile test (Hemberg, 1947).
Except a very recent indication (Walker, 1968), earlier attempts to inhibit sprouting of potatoes with extracts containing these compounds, which showed significant resemblance to the so-called 'inhibitor β complex' (Bennet-Clark and Kefford, 1953; Blumenthal-Goldschmidt and Rappaport, 1965) were unsuccessful (Burton, 1956; Buch and Smith, 1959; Hemberg and Larsen, 1961).
Abscisin II discovered some years ago by Eagles and Wareing (1964) followed by establishment of the chemical structure (Okhuma et al., 1965) and synthesis by Cornforth et al. (1965) has been shown to influence the dormancy and growth of a wide variety of plants, and is possibly identical with the inhibitor β complex. It was shown that abscisin II prolongs the dormant period of whole potato tubers and that sprout growth of excised buds was retarded (El-Antably et al., 1967). It was also found that abscisin II acted as a gibberellic acid antagonist.

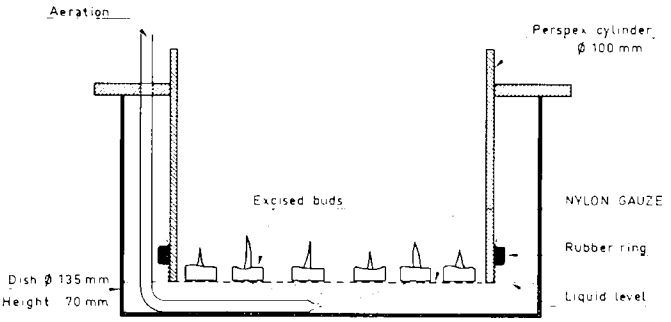

Fig. 1. Apparatus for the biotest.

Material and methods

The experiments were carried out with potatoes of the variety *Bintje* which had been previously stored at 2°–5°C.
By means of measurement of the volume and weighing, the specific weight of each tuber was determined. Measurement of the volume was done with a modified pycnometer.
In this way, the most frequently occuring specific gravity fraction with a class interval of sp. gr. 1.086–1.095 was selected.
From these tubers the two buds near the apical bud were excised with a cork borer (diameter 14 mm). The plugs were cut at a height of 8 mm (Rappaport et al., 1965).
The excised buds were treated as follows:

a. untreated control
b. gibberellic acid[1] 0.5 · 10^{-5} M soln. in dist. water
c. abscisin II 0.5 · 10^{-5} M soln. in dist. water
d. gibberellic acid 0.5 · 10^{-5} M + abscisin II 0.5 · 10^{-5} M soln. in dist. water

The abscisin II and the GA were dissolved in 1 ml ethanol and diluted with distilled water to the desired concentrations. The pH of the solutions was adjusted to pH 6.0 by adding 10^{-3} M ammonia. The controls were grown on distilled water to which ethanol was added and adjusted to the same pH value. The initial concentration of ethanol in the experimental solutions and the controls was thus 0.1 %.
The biotests were carried out in the following way:
Nylon gauze was attached to a perspex cylinder by means of a rubber ring (Fig. 1) and the potato plugs were placed on it. The cylinder was placed in a dish in such a way that the nylon gauze just made contact with the surface of the respective solutions. Each dish contained 100 ml of solution which was aerated continuously. The experiments were carried out in the dark at room temperature. Every treatment consisted of

[1] GA = 90 % GA_{A_3} + 10 % GA_{A_1/A_7}

Table 1. Number of sprouted buds as percentages of the total number.

Days of treatment	*Control*	*Abscisin II*	*GA*	*Abscisin II + GA*
1	35	45	58	47
2	79	87	87	83
3	94	88	95	91
4	96	96	100	96

5 dishes, each with twenty buds. Every two days representative samples of twenty buds were taken out and the sprout length was measured.

Results and discussion

The results are presented in Table 1 and Fig. 2.

The data presented in Table 1 show that treatment with abscisin II did not prolong the dormancy period. It is also not shown that under the given circumstances GA has a dormancy breaking effect.

However the graphical representation Fig. 2 shows that treatment with abscisin II has a significant growth inhibiting effect. Treatment of the buds with GA in combination with abscisin II showed that the latter compound acts as an antagonist of GA. These results correspond to those of El Antably et al. (1967).

In the investigations of El Antably et al. 5 µl of a 50 ppm solution of abscisin II was applied daily directly onto the buds during a period of 3 weeks.

In similar experiments carried out by us using the method of daily application onto the buds, but with a concentration of 25 ppm abscisin II, no difference in sprouting could be observed. However using the method, as described here with aeration, with a lower concentration of $0.5 \cdot 10^{-5}$ M abscisin II, the results show a noticeable effect. The latter concentration is more in agreement with physiologically possible circumstances. In contradiction to the method in which the excised potato buds were placed on filter paper, no microbial rotting occured with the aerated method. Moreover the excised buds were in continuous contact with the solutions.

The results show that the different treatments have no effect on the moment of the beginning of sprouting. This may well be because of the well known wound effect. In addition to the above effects it was noticeable that there was a great difference in root formation.

The untreated buds showed the greatest number of roots. Moreover these roots were better developed than in the case of the other treatments. Treatment with GA as well as with abscisin II caused a decrease in the number of roots by about 20%. In the case of abscisin II this possibly was caused by the fact that the sprouts were less developed. Treatment with GA also showed very thin roots, this in contrast to the treatment with abscisin II that showed a more normal root formation. However the combined treatment with GA and abscisin II caused a decrease of the number of roots by more than 75%. Moreover these roots were very poorly developed.

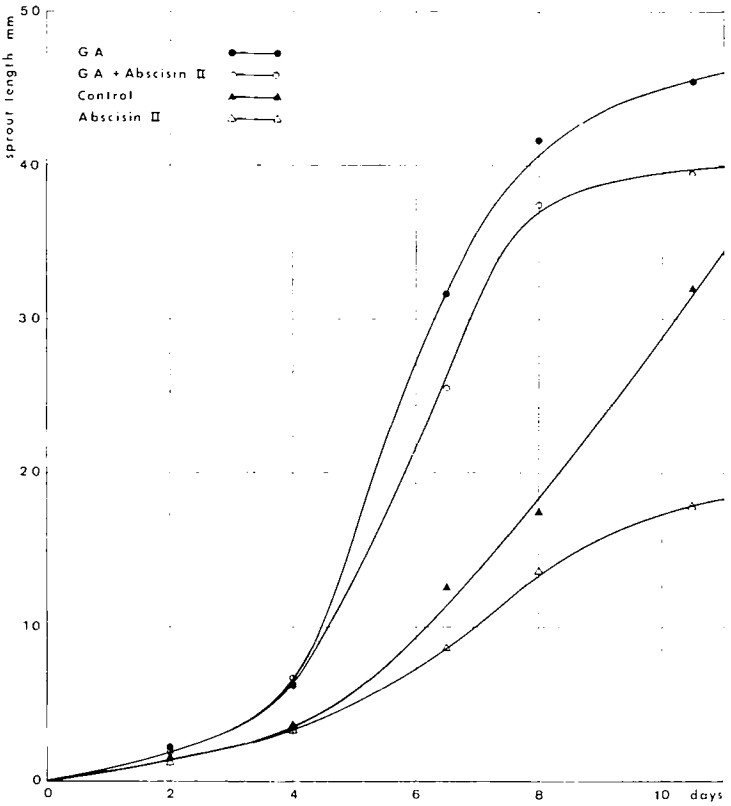

Fig. 2. Effects of GA and abscisin II on the sprouting of excised potato buds.

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