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Short communication

Synergistic effect of ribose and 2-deoxy-ribose with nutrition and auxin in rooting hypocotyl cuttings of *Phaseolus mungo*

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Exogenously supplied ribose and deoxyribose in a medium containing sucrose+IAA considerably enhanced the formation of roots on hypocotyl cuttings of *Phaseolus mungo* with intact apex and leaves. The effect increased with increasing concentration of pentose sugars and was more pronounced with deoxyribose than with ribose sugar.

Sucrose is more effective than glucose or ribose in the formation of adventitious roots on etiolated stem segments of *Populus nigra* (*3*), although roots form on these segments even when they are cultured in starch and more so in combination with IAA (*4*). As ribose and 2-deoxyribose serve as sugar moieties of nucleic acids, we considered it of interest to study their effect on rooting in the presence of sucrose as a carbon source and IAA as a trigger in transcription (*5*). The results are interesting and shed some light on the mechanism of their action in adventitious root formation.

Uniform seeds of *Phaseolus mungo* were sown on cotton pads in Petri dishes (15 cm dia.) under diffused light (3200 lux) in an air-conditioned growth chamber maintained at 28 ± 3°C. The cuttings, which consisted of 3.0 cm of hypocotyl, about 6.0 cm of epicotyl, a pair of primary leaves and a small apical bud, were taken from 6-day-old uniform seedlings of *Phaseolus mungo*. These cuttings were cultured in grade tubes (7.5×2.5 cm) with the hypocotyl portion of each dipping in 20 ml of the requisite test solution and kept under diffused light for 7 days. The test solutions were prepared in 30 μM chloramphenicol to prevent microbial infection. An equivalent amount of chloramphenicol was added to water to serve as the control. Observations of the number of rooted cuttings and protruded roots together with small rootlets that could be detected hidden under the epidermis were recorded periodically for 7 days. The rooting trials were repeated three times with similar results. No root primordia were detected in the hypocotyls of cuttings when the experiment was started.

Table 1 shows that while only 4–7 out of 10 cuttings rooted in water, ribose and deoxyribose, almost all rooted in sucrose and sucrose+IAA with or without the presence of ribose or deoxyribose in the medium. Both IAA and sucrose increased

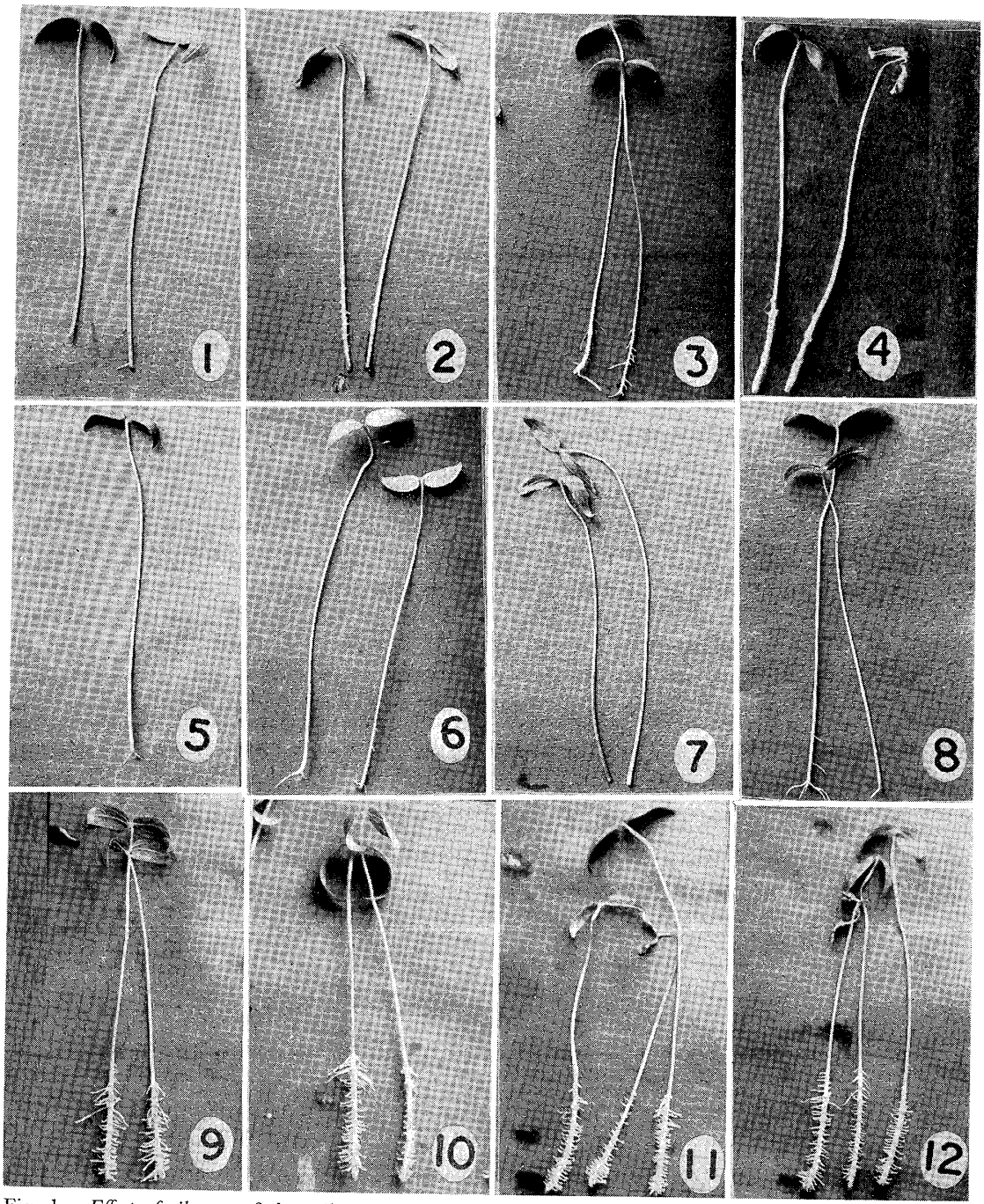

Fig. 1. *Effect of ribose or 2-deoxyribose alone and in combination with IAA and sucrose on hypocotyl cuttings of P. mungo treated with (1) water (control); (2) IAA, 5 mg/liter; (3) sucrose, 1%; (4) IAA, 5 mg/liter+sucrose 1%; (5) and (6) with 1 and 100 mg/liter ribose; (7) and (8) with 1 and 100 mg/liter deoxyribose; (9) and (10) with 1 and 100 mg/liter ribose+IAA, 5.0+sucrose 1%; and (11) and (12) with 1 and 100 mg/liter deoxyribose+IAA 5.0+sucrose 1%, respectively.*

Table 1 *Number of hypocotyl cuttings of* Phaseolus mungo *that rooted out of 10 samples and the number of roots produced after 7 days (figures within parentheses) as affected by varying concentrations of ribose and 2-deoxyribose each alone as well as in combination with IAA, sucrose and IAA+sucrose*

Treatment (mg/liter)	Control (water)	IAA, 5 mg/liter	Sucrose, 1%	IAA, 5 mg/liter +sucrose, 1%
Water	6 (3.8±0.20)	7 (15.0±0.36)	10 (12.5±0.38)	10 (43.0±2.33)
Ribose, 1	6 (5.0±0.27)	5 (15.2±0.32)	10 (13.0±0.40)	10 (63.0±1.94)
Ribose, 5	7 (5.0±0.30)	6 (15.0±0.45)	10 (13.2±0.47)	10 (63.5±2.40)
Ribose, 10	7 (4.8±0.25)	5 (14.9±0.37)	10 (13.8±0.29)	10 (67.0±3.20)
Ribose, 50	4 (3.5±0.18)	4 (14.0±0.44)	9 (13.8±0.22)	10 (75.0±2.22)
Ribose, 100	4 (3.5±0.20)	4 (12.5±0.73)	9 (14.0±0.52)	10 (98.4±2.50)
Deoxyribose, 1	5 (4.0±0.17)	6 (20.5±0.92)	10 (13.0±0.20)	10 (94.0±1.92)
Deoxyribose, 5	6 (4.0±0.18)	5 (18.2±0.42)	10 (13.0±0.17)	10 (98.4±2.22)
Deoxyribose, 10	5 (4.2±0.16)	5 (15.6±0.84)	10 (13.2±0.24)	10 (102.0±3.17)
Deoxyribose, 100	5 (4.5±0.20)	6 (12.5±0.42)	10 (13.6±0.17)	10 (107.4±2.15)

± Standard error.

the number of roots and the effect was more marked when the cuttings were cultured in medium containing both. Ribose or deoxyribose even in combination with either sucrose or IAA did not affect rooting but in combination with sucrose+IAA enhanced the number of roots considerably; the effect increased with the concentration of pentose sugar and was more pronounced with deoxyribose than with ribose sugar (Fig. 1).

The appreciably higher magnitude of rooting for hypocotyl cuttings cultured in IAA+sucrose as compared to that in each alone, lends support to the postulate already put forth that a proper balance between auxin and nutrition is necessary for optimal production of adventitious roots (*3*, *4*). The most significant point that emerges from this investigation is the pronounced stimulation caused by ribose as well as 2-deoxyribose when they are added to the medium containing IAA+sucrose. The fact that the enhancement of root production by these pentose sugars is caused only in the presence of IAA and sugar, clearly indicates that the effect of pentose sugars is through the multiplication of DNA, RNA and proteins (unpublished work). The stimulation of rooting by exogenous application of 2-deoxyribose is novel and as far as we are aware, is being reported here for the first time. This is particularly intriguing as the pathway concerned in the synthesis of deoxyribose is not established yet. Even the existence of an analogous compound, deoxy PRPP, has not been reported except by Kornberg (*1*) who recently proposed a scheme 'salvage pathway' for the biosynthesis of DNA through utilization of the free pool of precursors.

Our results show that IAA probably acts as a trigger at the transcriptional level (*5*), ribose and deoxyribose as moieties needed for the synthesis of RNA and DNA, respectively, and sucrose as a source of nutrition, specific amino acids and phenolic precursors through glycolysis and the TCA cycle 2 (unpublished work) for the synthesis of proteins.

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References

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