orientation mechanism, which until now has been proved only for a few arthropod species[19–23]. That mechanism may be switched off in favor of a tropotactic orientation towards the azimuth of the moon or a menotactic orientation towards the pattern of polarized light, which is already visible before sunrise and after sunset. The ants always decide alternatively between astromenotactic and anemomenotactic courses and never perform compromise directions. If one wants to state a hierarchy between the different orientation mechanisms used by the ants for night-time orientation, the mechanisms must be ordered in the following way: astromenotactic orientation towards the pattern of polarized light > anemomenotactic orientation > astrotropotactic orientation towards the azimuth of the moon (LI > 1 Lux). For LI < 1 Lux the two latter orientation performances occur simultaneously. SANTSCHI's early results[1,2] can be satisfactorily explained by these 3 types of orientation performances. A celestial orientation by means of some brighter stars could not be proved in *Cataglyphis bicolor*[24].

Zusammenfassung. Nachts orientiert sich die Wüstenameise *Cataglyphis bicolor* vorwiegend anemomenotaktisch. Einerseits kann jedoch in Mondnächten bei Lichtintensitäten < 1 Lux eine Astrotropotaxis nach dem Mondazimut (positive oder negative Phototaxis) die Windorientierung ausschalten. Andererseits dominiert bei Lichtintensitäten > 350 Lux (ca. 30 min vor Sonnenauf- und nach Sonnenuntergang) die astromenotaktische Orientierung nach dem Polarisationsmuster über die Anemomenotaxis. Wegen der Spiegelsymmetrie des Polarisationsmusters bei horizontnahem Stand der Sonne treten in diesem Zeitintervall bimodale Laufverteilungen auf, die jedoch bei Sonnensicht sofort in unimodale übergehen.

R. WEHNER and P. DUELLI

Zoologisches Institut der Universität, Künstlergasse 16, CH-8006 Zürich (Switzerland), 13 April 1971.

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Induction of Root-Coiling by 2-Chloroethane Phosphonic Acid and its Reversal by 2,3,5-Triiodobenzoic Acid

The role of ethylene in plant growth regulation is becoming increasingly important; and, on the basis of recent evidence, the gas may well be referred to as an endogenous bio-regulant[1]. The new chemical ethrel (2-chloroethanephosphonic acid, CEPA) releases ethylene directly to plant tissues and causes a variety of physiological responses[2]. We have observed that following treatment with CEPA the main roots of the *Ipomoea pentaphylla* indicate extensive coiling, much like that of the tendrils; and furthermore this effect of CEPA can be almost completely reversed by a simultaneous application of 2, 3, 5-triiodobenzoic acid (TIBA). The results are presented in this report.

Material and method. Seedlings of *Ipomoea pentaphylla* were raised in 9 cm petri dishes containing a single layer of filter paper moistened with 5 ml of distilled water or an equivalent amount of the test solution. During the experimental period the seedlings were grown at 28 °C and received cool flurescent light from 2 Philips 40 Watt lamps hanging at a distance of about 1 m. Data relating to seedling length, fresh weight, dry weight, synthesis of pigmentation in cotyledons, as well as development of anthocyanins, were recorded regularly commencing from 16th till the 6th day after germination. Pigments were analyzed according to the method of RÖBBELEN[3] ,while for antho-

Effect of CEPA and TIBA on seedling growth and pigmentation of *Ipomoea pentaphylla*

Treatment Concentration in ppm	Seedling growth after 5 days: Seedlings showing coiling (%)	Root (mm)	Hypocotyl (mm)	No. of laterals	Fresh wt. (mg)	Dry wt. (mg)	Total pigments µg/g fresh wt.	Anthocyanins/2 hypocotyls (O.D. at 525 mm)
Control	—	58	50	28	445	40	2365	0.42
$TIBA_1$	—	53	35	15	470	42	2360	0.40
$TIBA_{10}$	—	21	23	—	420	40	2345	0.41
$TIBA_{50}$	—	20	22	—	310	39	2325	0.48
$CEPA_{120}$	70–80	20	18	30	440	42	490	1.18
$CEPA_{120} + TIBA_1$	20–25	23	28	8	350	39	525	0.98
$CEPA_{120} + TIBA_{10}$	2– 4	24	25	—	300	38	705	0.88
$CEPA_{120} + TIBA_{50}$	—	20	22	—	280	38	690	0.82

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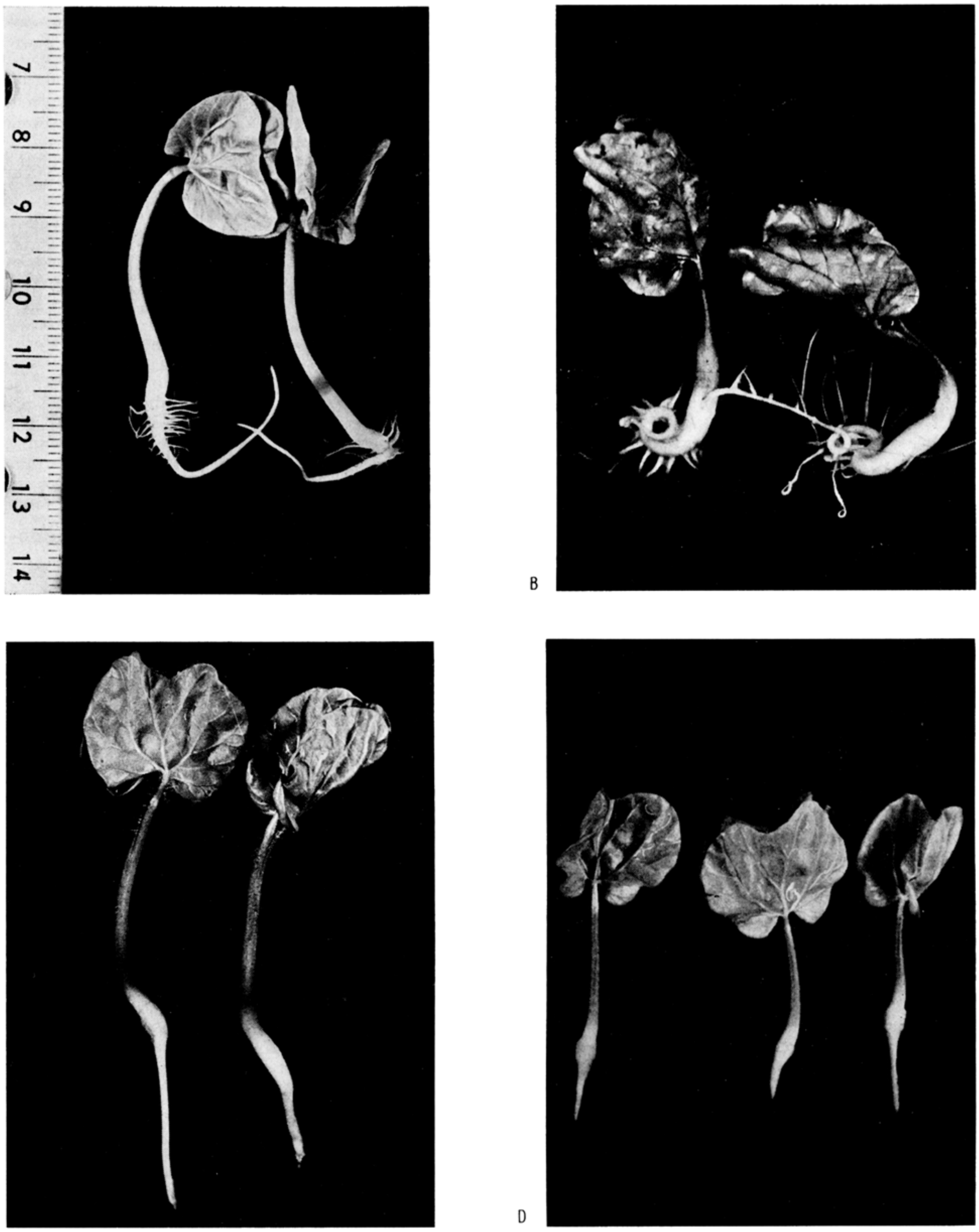
cyanins 2 hypocotyls were extracted in 5 ml of 1% acidulated methanol and O.D. read at 525 mm.

Results and discussion. Seedlings of *Ipomoea* normally produce a long main root (Figure A). However, those treated with CEPA (120 ppm, 240 ppm) indicated characteristic coiling of the main root (Figure B). It was interesting to note that the coiling appeared to be specific to the main root alone; the laterals almost always developed normally. The positive geotropism of roots has been attributed to a localized production of ethylene resulting from the asym-



A B C D

Seedlings growth after 5 days in A) Control; B) CEPA 120 ppm; C) TIBA 10 ppm and D) CEPA 120 ppm + TIBA 10 ppm.

metric distribution of auxin[4]. The present results appear to suggest that, following treatment with ethrel, an asymmetric distribution of auxin might occur which results in local surplus of auxin on one side of the root. This, in turn, causes inhibition of cell elongation on that side while the other side continues to elongate thereby causing the coiling of the root. As a matter of fact ethylene is known to inhibit lateral auxin movement and also to check the capacity of the polar auxin transport system[1]. In addition, the treated seedlings usually developed much greater anthocyanin in the hypocotyls. However, at the same time a reduction in the synthesis of chlorophylls in the cotyledons was also equally evident (Table). TIBA inhibited elongation of root as well as hypocotyl, and drastically affected the production of lateral roots (Figure C).

Since root curvatures arise by the differential expansion of the two sides through a lateral migration of auxin instead of the normal symmetical and strictly polar flow[5] it seemed of interest to study interaction between ethrel and 2, 3, 5-tri-iodobenzoic acid. The latter substance is an extremely active synthetic antiauxin and is known to interfere with normal auxin transport[6]. The results presented in the Table are indicative of the fact that TIBA strongly antagonizes the effect of ethrel at root level. Therefore, the seedlings reared in TIBA-ethrel combination did not indicate any coiling (Figure D). However, the possibility of TIBA acting as competitive inhibitor of ethylene is ruled out, because the former chemical did not reverse the effect of CEPA on chlorophyll synthesis in cotyledons and seedling growth. The exact mechanism by which TIBA affects decoiling of roots in ethrel treated seedlings remains to be explored. However, since root-coiling is associated with altered auxin metabolism, more specially the altered transverse transport, it would appear that TIBA brings about decoiling by influencing auxin transport. This, however, needs further confirmation.

Résumé. L'éthrel provoque l'enroulement des racines du jeune *Ipomoea pentaphylla*. Cet effet est complètement annulé par l'adjonction de TIBA.

N. SANKHLA

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STUDIORUM PROGRESSUS

Sequence Comparison of Human Pituitary Growth Hormone, Human Chorionic Somatomammotropin and Ovine Pituitary Lactogenic Hormone

Human growth hormone (HGH) and ovine lactogenic hormone (LTH), secreted by the pituary gland, and human chorionic somatomammotropin (HCS), secreted by the human trophoblast during pregnancy, are all potent lactogenetic hormones[1-3]. While LTH possesses no growth promoting activity, HCS has been shown in the rat tibia test, to be 10–15% as potent as HGH in this regard[3]. HCS has also been shown to closely resemble HGH in amino acid composition[4] and immunochemical behavior[2]. Limited sequence studies, cyrried out in conjunction with these early investigations on HCS, already showed similarities to HGH in both the amino[3,5] and carboxyl[3,6] terminal regions of the molecule.

The recent publication of the complete primary structure[7] of HCS and a revised structure[8] for HGH has prompted[9] us to reevaluate our earlier[11] comparision of the HGH structure with that of LTH, and to extend this to include the newly available HCS structure. In the following discussion, we shall use the term homology to refer to instances where equivalent positions in two or more sequences are occupied either by identical amino acids, or by two different amino acids which are judged to be acceptable replacements for each other. By statistical analysisis of a large number of sequences from several types of related proteins, DAYHOFF[12] has characterized the degree of homology between all possible amino acid pairs according to the relative rates of acceptance of either member of the pair into the same residue position in a given type of polypeptide chain. As might be expected, the highest degrees of homology are found between the amino acids showing the greatest degrees of chemical similarity, corresponding to the 'conservative replacements' described by PERUTZ et al.[13]. Other pairs, in which the chemical similarity is not immediately obvious, have also been considered as homologous or acceptable replacements[12]. We shall designate as 'highly acceptable' those replacements having acceptance rates[12] equal to or greater than 40 times that predicted by chance, and as 'acceptable' those with acceptance rates from 21 to 39. In our analysis, amino acid pairs representing replacements with acceptance rates from 0 to 20 will not be considered homologous.

To examine the structues for areas of homolgy, we have aligned the three sequences according to the best possible fit of certain reference residues. Cysteine, tryptophan, tyrosine, histidine and proline were used as references because

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