Coumarin- and indole-3-acetic acid-induced growth and respiration in sunflower as affected by 2-chloroethyl trimethylammonium chloride, actinomycin C₁, puromycin and diazouracil*

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I. INTRODUCTION

Coumarin (250 mg/l) enhances the growth of excised sunflower hypocotyl sections by about two times (Neumann 1960, Knypl 1964 a) and increases oxygen uptake in this tissue by about 20—30 per cent; respiration of older, non-growing tissue is intensified about 200 per cent (Knypl 1961, 1964 a). The increased respiration was shown to be accompanied by a marked decrease in the rate of phosphorus uptake (Knypl 1964 b). On the basis of experiments with 2,4-dinitrophenol and other respiratory inhibitors, it was suggested that coumarin may be active as a potential uncoupling agent (Knypl 1964 b). This suggestion was directly supported by the fact that coumarin lowered the P/O ratio in cucumber and lettuce mitochondria (Stenlid and Saddik 1962, Ulitzur and Poljakoff-Mayber 1963).

With the aim of elucidating whether the enhanced respiration following application of coumarin to sunflower hypocotyl sections taken from the zone of maximal longitudinal extension has any physiological significance, i.e. whether or not the stimulated growth is dependent on the induced oxygen uptake, simultaneous analyses of the effects of several inhibitors on both processes were undertaken. The studies involved: actinomycin C₁ (AMC), also known as actinomycin D — a specific inhibitor of DNA-dependent RNA synthesis (Goldberg et al. 1962, Gellert et al. 1965); puromycin (PMC) — an inhibitor of protein synthesis (Nathans 1964); diazouracil (DAU) — an analogue of uracil; and a growth-retarding chemical (Cathey 1964), 2-chloroethyl trimethylammonium chloride (CCC). All these compounds reduce the coumarin- and IAA-induced growth in sunflower (Knypl 1965, 1966 a, b).

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II. MATERIAL AND METHODS

1. *Plant material.* Sunflower seedlings, 7—9 cm long, grown for 6—7 days in the dark at 23—25° C (Knypl 1964 a) were used. Two types of 100-mm segments were dissected out of the hypocotyl: (I) 6 mm below the cotyledonary node, and (II) 10 mm above the root zone. Sections I comprised the cells in a phase of longitudinal extension, responsive to IAA or coumarin but not to gibberellin or kinetin (Knypl 1966 b). Sections II comprised "old" cells which had finished growth.

The sections were floated for about 60 min. on 2.0 per cent sucrose in diffused daylight, then washed with tap water, quickly blotted, weighed on a torsion balance and used for tests.

2. *Incubation.* Batches of 10 sections I were weighed and floated on 8 ml of 2.0 per cent sucrose supplemented with growth stimulators and/or inhibitors, and poured into 5.5-cm Petri dishes. Control series were fed only with 2.0 per cent sucrose. Incubation was carried out under light at 23—25° C (Knypl 1964 a). Tests with AMC were conducted in the dark, and the sections handled under diffused incandescent light.

In the following paragraphs, growth will be expressed as the increment of fresh matter per one section (initial weight = 50 mg).

Respiration was measured on simultaneously arranged duplicate sets.

3. *Oxygen uptake.* Respiration was measured by the standard Warburg manometric technique. The sections of a given type (I or II) were placed in Warburg flasks containing 2.0 ml of 2.0 per cent sucrose (control) or sucrose supplemented with growth stimulators and/or inhibitors in a mine compartment and 0.2 ml of 15% KOH with a wick of filter paper in the centre cup. Since salts decrease the growth stimulating activity of coumarin (Knypl 1964 a), the solutions were not buffered.

Oxygen uptake was measured for 120 min. at 28° C, following a 120 min. period of equilibration; the experiments presented in Table 6 were performed at 25° C. Oxygen uptake will be further expressed as Q_{O_2} , meaning $\mu\text{l O}_2$ per 1000 mg of initial fresh matter per hour.

4. *Other details.* Each test was run in triplicate and repeated 3 or 4 times. Results were evaluated statistically by Student's *t*-test.

All solutions contained penicillin G (100 I. U. per ml).

The experiments were carried out in the spring of 1963 on *Helianthus annuus* L. var. 'Pastewny' (Tables 1—5) and in the spring of 1964 on *H. annuus* var. 'Pastewny' and var. 'Borowski Prązkowany' IHAR. (Table 6).

III. RESULTS

As seen from Table 1, coumarin in a 250 mg/l dose and 1.2×10^{-5} M IAA enhanced oxygen uptake in sunflower hypocotyl sections I by about 130 ($Q_{O_2} = 238$) and 212 per cent ($Q_{O_2} = 221$), respectively, in comparison with the control taken as 100 per cent ($Q_{O_2} = 182$). CCC alone (8×10^{-3} M) insignificantly ($P = 0.05$) increased respiration. It had no effect on IAA-stimulated respiration when applied simultaneously with auxin at the start of the test, and slightly decreased O_2 uptake when applied 4 hours before IAA.

Table 1

Effect of CCC on coumarin and IAA induced respiration and growth of sunflower hypocotyl sections I

Series*	Inhibitor**	Incubation hrs.	Growth stimulator**		
			None	Coumarin	IAA
			$\mu\text{l O}_2/1000 \text{ mg original fr. wt./60 min.}$		
A	None		181.7	238.0	220.7
	CCC		187.0	226.0	222.0
B	None, a		185.0	240.2	229.4
	CCC, b		188.7	224.3	216.4
			Increment of fresh wt., mg***		
	None	4	52.6	55.8	56.9
	CCC	4	51.7	52.5	54.2
	None	8	55.2	61.3	63.7
	CCC	8	53.2	55.0	58.9

* Series A: Oxygen uptake was measured immediately after addition of growth regulators. Series B: The sections were pre-incubated for 4 hrs. in 2.0% sucrose alone (a) or sucrose plus CCC (b) and then transferred into Warburg flasks containing growth stimulators without (a) or with (b) CCC.

** Concentrations in sole and combined solutions: CCC, 8×10^{-3} M; IAA, 1.2×10^{-5} M; Coumarin, 250 mg/l and 200 mg/l in respiration and growth tests, respectively.

*** Original fr. wt. of one section = 50.0 mg.

L. S. D. between any two values at $P = 0.05 = 13.1 \mu\text{l}$, and 0.6 mg.

CCC significantly decreased the coumarin-stimulated oxygen uptake (Table 1).

CCC in the concentration used decreased the growth rate in the control and IAA series by about 35 per cent (Table 1) and reduced considerably more growth in the series treated with coumarin (200 mg/l). It is evident, however, if comparison is made with the CCC alone series taken as 100 per cent, that both growth stimulators reverse the growth-retarding effect of CCC, IAA being more effective than coumarin.

Actinomycin alone (10 or 20 mg/l) slightly decreased respiration and markedly inhibited the growth of sunflower hypocotyl sections I (Table 2). It significantly decreased both IAA- and coumarin-induced O_2 uptake and growth. It is worth noting that IAA-induced growth and respiration, in comparison with these induced by coumarin, were more sensitive to the inhibitory influence of AMC.

Table 2

Effect of actinomycin C_1 on coumarin and IAA induced respiration and growth of sunflower hypocotyl sections I

Series*	Inhibitor	Incubation hrs.	Growth stimulator		
			None	Coumarin	IAA
			μ l O ₂ /1000 mg original fr. wt./60 min.		
A	None		180.0	238.5	219.6
	AMC		170.6	212.4	199.3
B	None, a		183.2	240.1	222.9
	AMC, b		175.7	214.1	197.1
C	None, a		182.0	239.0	222.5
	AMC, b		168.4	206.0	195.6
			Increment of fr. wt., mg		
A	None	4	53.4	55.9	57.3
	AMC	4	52.2	53.6	54.7
	None	8	57.1	62.3	64.7
	AMC	8	54.1	57.9	57.8
C	None, a	0(4)	53.4	53.4	53.4
	AMC, b	0(4)	51.2	51.2	51.2
	None, a	4(8)	57.3	59.5	60.7
	AMC, b	4(8)	54.9	54.1	54.9

L. S. D. ($P = 0.05$) = $12.5 \mu l$, and 0.7 mg.

* Series A: The sections were placed in solutions of growth regulators at 0 hr. Series B: The sections were pre-incubated for 4 hr. in 2.0% sucrose alone (a) or in sucrose supplemented with 10 mg/l AMC (b) and then transferred into Warburg flasks (respiration) or Petri dishes (growth) containing growth stimulators without (a) or with (b) AMC. Series C: Same as series B, but the sections were pre-incubated in 20 mg/l AMC. Other details as in Table 1.

Puromycin (60 mg/l) significantly increased respiration in sunflower hypocotyl sections I and relatively slightly reduced growth in the control during the first 4 hours of incubation (Table 3). When applied simultaneously with IAA or coumarin, PMC did not affect either the

induced growth or respiration in 4-hour experiments. However, the responsiveness to IAA or coumarin of the sections preincubated with PMC for 8 hours was markedly reduced.

Table 3

Effect of puromycin on coumarin and IAA induced respiration and growth of sunflower hypocotyl sections I

Series*	Inhibitor**	Incubation hrs.	Growth stimulator**		
			None	Coumarin	IAA
			μl O ₂ /1000 mg original fr. wt./60 min.		
A	None		179.0	234.8	216.8
	PMC		195.9	229.0	216.0
B	None, a		181.0	237.0	220.8
	PMC, b		206.3	221.3	203.2
			Increment of fr. wt., mg		
A	None	4	52.6	55.4	56.4
	PMC	4	52.0	55.3	55.9
B	None, a	0 (8)	55.0	55.0	55.0
	PMC, b	0 (8)	53.2	53.2	53.2
	None, a	4(12)	57.2	60.0	61.0
	PMC, b	4(12)	54.4	54.4	55.0

L. S. D. between any two values ($P = 0.05$) = 14.5 μl , and 0.6 mg.

* Series A: The sections were placed in solutions of growth regulators at 0 hr. Series B: The sections were pre-incubated for 8 hr. in 2.0% sucrose (a) or in sucrose plus PMC (b) and then transferred into Warburg flasks (respiration) or Petri dishes (growth) containing growth stimulators without (a) or with (b) PMC.

** Concentration of PMC, 60 mg/l. Other details as in Table 1.

Diazouracil inhibits IAA- and coumarin-induced growth (Knypl 1965, 1966 a), the latter being more sensitive than the former. Table 4 shows that DAU alone inhibits also oxygen uptake in the control, and prevents the stimulatory effect of IAA on respiration of sunflower hypocotyl sections I.

DAU (150 mg/l) completely abolished the stimulatory effect of coumarin on respiration of the growing sections I (Table 4). It is striking that after 4—5 hours of incubation, respiration in the series treated with DAU in combination with coumarin was markedly lower ($Q_{O_2} = 116$) than in the series subjected only to DAU ($Q_{O_2} = 155$). It is evident, therefore, that coumarin increases the inhibitory effect of DAU on respiration. This effect is partially reduced by uracil (Table 4).

DAU reduced also respiration of the coumarin-treated sunflower hypocotyl sections II (table 5), although it did not completely prevent the stimulation of O_2 uptake due to coumarin in this case.

Table 4

Inhibitory effect of diazouracil on IAA and coumarin induced respiration in sunflower hypocotyl sections I, and its partial reversal by uracil

Series*	Supplement***	$\mu\text{l O}_2/1000 \text{ mg original fr. wt./60 min.}$			
		Control	DAU, 50 mg/l	DAU, 100 mg/l	DAU, 150 mg/l
A	None	179.2	168.6	161.3	152.0
	IAA	219.0			171.0
B	IAA	233.0	201.0	181.7	163.0
Incubation** hrs.	Supplement	Control	Coumarin	Coumarin plus DAU, 150 mg/l	DAU, 150 mg/l
2	None	179.5	227.0	180.6	163.0
	Uracil		229.0	215.0	
3	None	180.3	230.2	158.0	159.4
4	None	181.0	233.7	140.0	156.3
5	None	180.1	235.1	115.8	155.0
5	Uracil		234.0	150.2	

L. S. D. between any two values ($P = 0.05$) = $15.0 \mu\text{l}$ in tests with IAA and $14.2 \mu\text{l}$ in tests with coumarin.

* Series A: O_2 uptake was measured immediately after addition of DAU (50–150 mg/l), IAA alone, or IAA plus DAU (150 mg/l). Series B: The sections were pre-incubated for 4 hrs. in 2.0% sucrose alone (control) or in sucrose supplemented with DAU (50, 100 or 150 mg/l) and then transferred into Warburg flasks containing IAA alone (control) or IAA plus DAU.

** Incubation was carried out in the Warburg apparatus.

*** Final concentrations: IAA, $1.2 \times 10^{-5} \text{ M}$; Coumarin, 250 mg/l; Uracil, 150 mg/l.

Chloramphenicol was without effect (Table 5).

Table 6 shows that IAA, in contrast to coumarin, only slightly stimulated respiration of the non-growing sunflower hypocotyl sections II.

Table 5

Inhibitory effect of diazouracil on coumarin induced respiration in non-growing sunflower hypocotyl sections II

$\mu\text{l O}_2/1000 \text{ mg original fr. wt./60 min.}$					
Control	DAU	Coumarin	Coumarin plus DAU	CHL	Coumarin plus CHL
94.3	83.1	180.8	140.5	97.3	180.1

L. S. D. between any two values at $P = 0.01 = 10.2 \mu\text{l}$.

Final concentrations: Coumarin, 500 mg/l, DAU, 100 mg/l; chloramphenicol (CHL), $5 \times 10^{-3} \text{ M}$.

Table 6

The stimulatory effect of IAA on respiration of sunflower hypocotyl sections II as compared with that induced by coumarin

Variety	$\mu\text{l O}_2/100 \text{ mg original fr. wt.}/60 \text{ min.}$		
	Control	Coumarin	IAA
Pastewny	94.9	164.1	110.2
Borowski Prądkowany, IHAR	94.1	160.4	104.5

L. S. D. between any two values at $P = 0.01 = 9.1 \mu\text{l}$.

Final concentrations: coumarin, 500 mg/l; IAA, $2.5 \times 10^{-5} \text{ M}$.

IV. DISCUSSION

It is well established that auxin-induced growth is respiration-dependent (Hackett and Thimann 1953) and is more or less intimately associated with the increased oxygen uptake in several tissues, viz. in etiolated pea-stem segments (Christiansen and Thimann 1960; Kelly and Avery 1951), in coleoptile segments (French and Beevers 1953) and other tissues (cf. Bonner and Bandurski 1952; Audus 1959). It has been suggested that the auxin-dependent intensified respiration is due to an increased turnover of ATP (French and Beevers 1953). However, the details of the relationship between IAA-induced growth and respiration are not definitively established (cf. Beevers 1960) because, for instance, Busse and Kandler (1956) did not note the immediate increase in respiration of *Avena* coleoptile tissue on adding IAA.

It has been found recently that "wound respiration" of potato tuber slices is inhibited by puromycin and actinomycin, and is dependent on the synthesis of new proteins (Click and Hackett 1963). Ap Rees (1966) also has shown that chloramphenicol and 5-fluorouracil markedly reduced or completely prevented the increase in respiration rate following slicing in pumpkin (*Cucurbita pepo* L.) fruit and celery (*Apium graveolans* L.) petioles. Chloral — an inhibitor of RNA and protein synthesis (Laties 1965), or lithium ion suppressed the respiratory changes which normally follow slicing in Jerusalem artichoke and potato tubers, and prevented the auxin-induced growth (Sperling and Laties 1963). On the basis of these findings it was suggested that auxin-mediated growth is dependent upon the induced respiration.

It has been demonstrated that auxin-induced growth is dependent on continuous, and probably de novo synthesis of RNA and proteins (Noodén and Thimann 1963, 1966; Hertogh et al. 1965; Hamilton et al. 1965; Key 1964; Masuda and Yenagishima

1964; Penny and Galston 1966); the same has been suggested for coumarin-induced growth (Knypl 1965, 1966 a). The data presented in this report are inconclusive as concerns the question whether or not the IAA- or coumarin- induced longitudinal extension in sunflower is dependent on induced respiration. It seems that there cannot be induction of growth without a concomitant enhancement of respiration. It is clear, however, that DAU, AMC and PMC reduce the respiratory increase following application of coumarin or IAA. These inhibitors reduce also the growth-stimulating effect of IAA and coumarin. It is possible, therefore, that the intensified respiration following IAA or coumarin application to the growing sections I of sunflower is dependent, at least partially, upon the synthesis of RNA and, in a final analysis, of proteins. It would seem that both induced growth and induced respiration have the same cause, i.e. the induced synthesis of uracil-rich RNA directing the synthesis of proteins.

It is also clear, on the basis of Table 6, that the primary mode of the respiration-stimulating action of coumarin is quite different from that of IAA, because IAA relatively slightly affects oxygen uptake in the non-growing tissue (sections II) of sunflower seedling; coumarin in this tissue possibly acts as an uncoupling agent (cf. Knypl 1964 b).

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SUMMARY

2-Chloroethyl trimethylammonium chloride, actinomycin C₁, puromycin and diazouracil decreased the stimulatory effect of IAA and coumarin on growth and respiration in sunflower hypocotyl sections, taken from a zone of the maximal longitudinal extension of etiolated seedlings. Diazouracil completely blocked the coumarin induced respiration; the inhibitory effect of diazouracil was partly reduced by uracil.

IAA slightly and coumarin markedly stimulated oxygen uptake in non-growing sunflower hypocotyle sections. The coumarin-induced respiration was markedly reduced by diazouracil.

It is suggested that both induced growth and induced respiration have the same cause, i.e. the synthesis of the uracil rich RNA, directing the synthesis of proteins.

REFERENCES

- Ap Rees T., 1966, Evidence for the widespread occurrence of induced respiration in slices of plant tissues, *Australian J. Biol. Sci.*, 19:981—990.
- Audus L. J., 1959, *Plant Growth Substances*, Leonard Hill Ltd., London pp. 88—114.
- Beevers H., 1961, *Respiratory Metabolism in Plants*, Row, Peterson and Co., Evanston, Ill.
- Bonner J., and R. S. Bandurski, 1952, Studies of the physiology, pharmacology and biochemistry of the auxins, *Ann. Rev. Plant Physiol.*, 3:59—86.
- Busse M., and O. Kandler, 1956, Über die Wirkung des β -Indolyllessigsäure auf den Stoffwechsel von *Avena coleoptilen*, *Planta* 46:619—642.
- Cathey H. M., 1964, Physiology of growth retarding chemicals, *Ann. Rev. Plant Physiol.* 15:271—302.
- Christiansen G. S., and K. V. Thimann, 1950, The metabolism of stem tissue during growth and its inhibition. II. Respiration and ether soluble materials. *Arch. Biochem.* 26:248—259.
- Click R. E., and D. P. Hackett, 1963, The role of protein and nucleic acid synthesis in the development of respiration in potato tuber slices, *Proc. Natl. Acad. Sci. U. S. S.* 50:243—250.
- French R. C., and H. Beevers, 1953, Respiratory and growth responses induced by growth regulators and allied compounds, *Amer. J. Bot.*, 40:660—666.
- Gellert M., C. E. Smith, D. Neville, and G. Felsenfeld, 1965, Actinomycin binding to DNA: Mechanism and specificity, *J. Mol. Biol.*, 11:445—457.
- Goldberg I. H., M. Rabinowitz, and E. Reich, 1962, Basis of actinomycin action. I. DNA binding and inhibition of RNA-polymerase synthetic reactions by actinomycin, *Proc. Natl. Acad. Sci. U. S.*, 48:2094—2101.
- Hackett D. P., and K. V. Thimann, 1953, The nature of the auxin induced water uptake by potato tissue. II. The relation between respiration and water absorption, *Amer. J. Bot.*, 40:183—188.
- Hamilton T. H., A. F. Rumsey, A. R. Means, and A. R. Schrank, 1965, Stimulation of synthesis of ribonucleic acid in sub-apical sections of *Avena coleoptile* by indolyl-3-acetic acid. *Nature* 208:1180—1183.
- Hertogh A. A. De, D. C. McCune, J. Brown, and D. Antoine, 1965, The effect of antagonists of RNA and protein biosynthesis on IAA and 2,4-D-induced growth of green pea stem sections. *Contrib. Boyce Thompson Inst.*, 23:23—32.
- Kelly S., and G. S. Avery, Jr., 1951, The age of pea tissue and other factors influencing the respiratory response to 2,4-dichlorophenoxyacetic acid and dinitro compounds, *Amer. J. Bot.*, 38:1—5.
- Key J. L., 1964, Ribonucleic acid and protein synthesis as essential processes for cell elongation, *Plant Physiol.*, 39:365—370.
- Knypl J. S., 1961, Coumarin vapours as the stimulator of oxygen uptake by sunflower hypocotyls, *Naturwissenschaften*, 48:530—531.
- Knypl J. S., 1964 a, Characteristic features of the coumarin induced growth, *Planta*, 51:352—360.
- Knypl J. S., 1964 b, Coumarin-induced respiration of sunflower, *Physiol. Plant.*, 17:771—778.
- Knypl J. S., 1965, Dependence of indolyl-3-acetic acid and coumarin induced growth on ribonucleic acid and protein synthesis, *Nature* 206:844—846.
- Knypl J. S., 1966 a, Specific inhibitors of RNA and protein synthesis as suppressors of the IAA- and coumarin-induced growth responses. *Acta Soc. Bot. Polon.*, 35:357—373.

- Knypl J. S., 1966 b, Action of (2-chloroethyl) trimethylammonium chloride, 2,4-dichlorobenzyl-tributylphosphonium chloride, and N-dimethylaminosuccinamic acid on IAA and coumarin induced growth of sunflower hypocotyl sections, *Acta Soc. Bot. Polon.*, 35:611—625.
- Laties, G. G., 1965, Inhibition of RNA and protein synthesis by chloral in potato sclices, *Plant Physiol.*, 40:1237—1241.
- Masuda Y., and N. Yanagishima, 1964, RNA functional in auxin action of expanding tuber tissue of Jerusalem artichoke, *Plant Cell Physiol.*, 5:365—368.
- Nathans D., 1964, Inhibition of protein synthesis by puromycin, *Fed. Proc.* 23:984—989.
- Neumann J., 1960, The nature of the growth-promoting action of coumarin, *Physiol. Plant.* 13:328—341.
- Noodén L. D., and K. V. Thimann, 1963, Evidence for a requirement for protein synthesis for auxin-induced cell enlargement, *Proc. Natl. Acad. Sci. U. S.* 50:194—200.
- Noodén L. D., and K. V. Thimann, 1966, Action of inhibitors of RNA and protein synthesis on cell enlargement. *Plant Physiol.* 41:157—164.
- Penny P., and G. A. Galston, 1966, The kinetics of inhibition of auxin-induced growth in green pea stem segments by actinomycin D and other substances, *Amer. J. Bot.* 53:1—7.
- Sperling E., and G. G. Laties, 1963, The dependence of auxin-induced growth on auxin-independent metabolic changes in slices of storage tissue, *Plant Physiol.* 38:546—550.
- Stenlid G., and K. Saddik, 1962, The effect of some growth regulators and uncoupling agents upon oxidative phosphorylation in mitochondria of cucumber hypocotyls, *Physiol. Plant* 15:369—379.
- Ulitzur S., and A. Poljakoff-Mayber, 1963, Oxidative phosphorylation in germinating lettuce seeds, *J. Exp. Bot.* 14:95—100.

Wpływ CCC, aktynomycyny, puromycyny i dwuazouracylu na wzrost i oddychanie wzbudzone przez IAA i kumarynę u słonecznika

Streszczenie

CCC, aktynomycyna, puromycyna i dwuazouracyl obniżają pobudzające działanie IAA i kumaryny na wzrost i pobieranie tlenu przez wycinki hypokotyli słonecznika, obejmujące strefę wzrostu wydłużeniowego. Dwuazouracyl całkowicie znosi oddychanie wzbudzone przez kumarynę; efekt ten częściowo obniża uracyl.

IAA nieznacznie, a kumaryna silnie pobudza oddychanie starszych, nierosnących tkanek słonecznika; dwuazouracyl obniża pobudzające działanie kumaryny na pobieranie tlenu.

Wysuwa się przypuszczenie, że zarówno wzbudzony wzrost, jak i oddychanie mają tę samą przyczynę, mianowicie wzbudzoną syntezę bogatego w uracyl RNA, kierującego z kolei syntezą białek.

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