constituents, with maximal crystal-sizes of slightly more than 1 mm (anorthoclase) and 2 mm (quartz). The anorthoclase is generally in subhedral to anhedral crystals.

The crystals of plagioclase generally show large cores of bytownite and lime-rich labradorite with recurrent zones; there are rather narrow rims of andesine. The average anorthite content is clearly more than 50 %.

The augite and hypersthene are rather slightly altered. The augite is twinned on (100); a minute striation according to the basal plane combined with this orthopinacoidal twinning produces the characteristic "herringbone" appearance.

The anorthoclase has a well-developed murchisonite cleavage. The refractive indices are distinctly lower than that of the Canada balsam. This alkalifelspar shows decidedly oblique extinctions in sections perpendicular to $n\beta$ and $n\gamma$. For the optic axial angle $2V_\alpha$ of the anorthoclase in the rock H 123 values of $\pm$ 35° were obtained with the aid of the universal rotation stage. In the other rock (H 120) the anorthoclase shows a zonary variation of the optic axial angle $2V_\alpha$ from $\pm$ 40° in the cores to $\pm$ 30° in the rims.

Red-brown biotite is of subordinate importance. A very small amount of original light greenish amphibole may also be mentioned.

According to the quantitative mineralogical classification of JOHANNSEN these rocks could be named anorthoclase-granogabbro-porphyry to -granonorite-porphyry.

Bandoeng, Dienst van de Mijnbouw.

Botany. — *Researches on plant growth regulators.* XIII. *Leaf growth factors.* II. By W. KRUYT and H. VELDSTRA. (Communicated by Prof. V. J. KONINGSBERGER.)

(Communicated at the meeting of September 27, 1947.)

4. *Experiment with Cosmos bipinnatus Cav. "Sensation Innocence" at Boskoop.*

BONNER and HAAGEN-SMIT (5) had already pointed out that the effect of adenine as a leaf growth factor in Cosmos was greater under short than under long exposure to daylight. Therefore we thought it might be worth while to ascertain whether during the natural short day-length in winter-months the effect of adenine under our conditions would perhaps be greater than we had observed up to this time.

As our previous experiments had showed clearly how important it is with such an investigation to eliminate a possible influence of the position beforehand all the pots irrespective of their groups were randomized.

In this experiment, which lasted from Nov. 13th 1943 till Febr. 1st 1944, we examined the influence of adenine 0.1 and 0.5 mg/l and of α-naphthylamine in the concentrations 0.1, 0.5 and 1.0 mg/l. Alternately every two or three days 50 ml of solution or distilled water was administered to every pot.

After the experiment was finished the 8 best specimens were selected from the 12 plants. After the measuring the weight was determined before and after drying. Owing to the slight development which is considerably less than it is during the months of summer this time both leaves of the second real leaf-pair of each plant, counting from the bottom, were weighed fresh and dry. The results are to be found in table IV.

TABLE IV.

Group	Number of plants	Solution applied (Nov. 3rd 1943—Febr. 1st 1944)	Average length in mm	Number of plants with flower-bud	Fresh weight (g) of:			Dry weight (g) of:		
					second real leaf pair	shoots	roots	second real leaf pair	shoots	roots
1	8	Shive (= S)	153	5	0.85	5.85	0.91	0.055	0.368	0.085
2	8	S + adenine 0.1 mg/l	145	6	0.77	4.76	0.67	0.053	0.325	0.063
3	8	S + adenine 0.5 ,,	147	4	1.10	6.55	1.10	0.068	0.417	0.119
4	8	S + α-N.A. *) 0.1 ,,	145	4	0.88	5.78	0.96	0.057	0.370	0.082
5	8	S + α-N.A. 0.5 ,,	134	3	0.74	4.65	0.82	0.047	0.295	0.068
6	8	S + α-N.A. 1.0 ,,	147	6	0.80	5.18	0.73	0.050	0.321	0.064

*) N.A. = naphthylamine.

We may conclude that there is a slight influence of adenine noticeable, 0.5 mg/l not yet being toxic, as established by the American investigators. This effect of adenine, however, is not clearly visible in the plants. It is remarkable that in this experiment 0.5 mg/l α-naphthylamine does not have a favourable influence, whereas this was the case in our previous tests.

5. *Experiment with Cosmos bipinnatus Cav. "Sensation Innocence" at Boskoop.*

In this experiment an attempt was made to apply as much as possible the methods practised by BONNER and HAAGEN-SMIT (5), by watering the plants daily (excepting Sundays) alternately with nutrient-solution and distilled water; usually with 25 ml at a time. On Saturdays or when the weather was very hot 50 ml were administered, in which case care was taken that the next time again 50 ml were given so that the amount of nutrient solution and distilled water always remained equal.

Beside adenine in two concentrations (0.1 and 0.5 mg/l) we examined the influence of α-naphthylamine 0.1, 0.5, 1.0 mg/l added to Shive's solution so that in general the experiment corresponded with the preceding one. The p_H of the solutions was 4.3. The sowing was done on April 17th 1944 whilst on April 25th forty plants of each group were transferred into pots after the length of the shoot of all specimens had been determined (table V).

All the pots were dug into a layer of sand at random. The first real leaf-pair began to unfold on May 1st. On May 8th (1944) it was already noticeable that the plants in the most northern position were the largest. So evidently an influence of the southern side-wall could be noticed. Against this wall the hothouse shed, not covered with glass, was situated. This influence is comprehensible because in sunny weather a shadow continually fell on the southern part of the sand bed. This had already been stated in our first two experiments. Because this time all the pots were placed at random the unfavourable influence of the southern part of the bed was distributed equally over all the groups. The synoptical photo (Fig. 1) shows the position on May 15th 1944.

On May 22nd, 5 weeks after the sowing, the experiment was broken off. Flower-buds were then not yet visible. After determining the growth in length (table V) the fresh and dry weights of the different groups were determined for the aerial parts and the roots separately. This was done for the 10 best and the 25 next best specimens.

TABLE V.

Group	Solution applied (April 17th 1944—May 22nd 1944)	Length of the seedlings on April 25th 1944		Length of the shoot (mm) on May 22nd 1944			
		number	average length (mm)	number	average length of the 10 best specimens	average length of the 25 next specimens	average length of the whole group of 35 plants
1	Shive (= S)	58	22	35	177	143	153
2	S + adenine 0.1 mg/l	63	22	35	186	150	160
3	S + adenine 0.5 „	60	23	35	179	152	160
4	S + α–N.A. *) 0.1 „	61	24	35	187	147	159
5	S + α–N.A. 0.5 „	57	25	35	189	149	160
6	S + α–N.A. 1.0 „	50	22	35	184	140	153

*) N.A. = naphthylamine

The p_H of the sand was 7.2 at the start and after conclusion it was 6.8 in practically all groups; therefore as a result of the watering with nutrient-solution the medium has become slightly more acid. The results are summarized in table VI.

From this we may deduce the following. There is no clear influence of adenine or naphthylamine on the longitudinal growth of 4 days old seedlings (table V). The average length of 5 week old plants owing to the administration of adenine 0.1 mg/l and 0.5 mg/l and of α-naphthylamine

TABLE VI.

The first number in each column refers to the 10 best plants; the second number refers to the whole group of 35 plants.

Group	Solution applied (April 17th 1944—May 22nd 1944)	Fresh weight (g) of:					Dry weight (g) of:				
		the lowest leaf-pair	the second leaf-pair	shoots	roots	whole plants	the lowest leaf-pair	the second leaf-pair	shoots	roots	whole plants
1	Shive (= S)	1.90/6.30	3.90/13.95	33.20/104.9	13.60/43.12	46.80/148.02	0.15 /0.475	0.33/1.135	2.62 / 8.595	0.88 /3.005	3.50 /11.60
2	S + adenine 0.1 mg/l	1.80/6.05	4.35/13.80	39.95/115.25	15.87/46.02	55.82/161.27	0.14 /0.46	0.37/1.18	3.255/ 9.435	1.18 /3.365	4.435/12.80
3	S + adenine 0.5 „	1.90/7.05	4.15/16.10	34.65/123.3	13.32/48.62	47.97/171.92	0.14 /0.535	0.36/1.35	2.815/11.55	0.99 /3.625	3.805/15.175
4	S + α–N.A. *) 0.1 „	1.80/6.5	4.40/14.80	34.50/113.75	11.89/42.19	46.39/155.94	0.14 /0.49	0.38/1.225	2.79 / 8.88	0.89 /3.140	3.68 /12.02
5	S + α–N.A. 0.5 „	2.10/6.55	4.30/14.40	40.75/118.1	14.02/45.87	54.77/163.97	0.16 /0.51	0.38/1.24	3.33 / 9.61	1.055/3.450	4.385/13.06
6	S + α–N.A. 1.0 „	1.85/5.75	4.30/13.55	34.05/101.95	12.70/41.805	46.75/143.75	0.145/0.455	0.38/1.18	2.835/ 8.42	0.99 /3.310	3.825/11.73

*) N.A. = naphthylamine

TABLE VII.

The first number in each column refers to the 10 best plants; the second number refers to the whole group of 30 plants.

Group	Solution applied (May 30th 1944—July 14th 1944)	Average length (cm)	Fresh weight (g) of:				Dry weight (g) of:			
			the third leaf	shoots	roots	whole plants	shoots	roots	whole plants
1	Shive (= S)	44.5/43.1	3.7/ 9.7	76.0/194.5	15.5/37.5	91.5/232.0	5.5 /14.25	1.1 /2.6	6.6 /16.85
2	S + adenine 0.1 mg/l	45.9/43.8	5.0/11.6	92.1/226.1	17.9/41.5	110.0/267.6	6.7 /15.90	1.2 /2.9	7.9 /18.8
3	S + adenine 0.5 „	45.1/41.7	3.9/ 9.5	81.5/188.5	16.9/38.0	98.4/226.5	5.9 /13.05	1.1 /2.5	7.0 /15.55
4	S + α–N.A. *) 0.1 „	48.1/44.6	4.7/11.2	93.0/229.0	18.0/45.1	111.0/274.1	6.8 /16.90	1.35/3.25	8.15/20.15
5	S + „ 0.5 „	44.7/40.9	4.0/10.3	81.1/119.0	14.3/38.4	95.4/237.4	5.75/14.10	0.9 /2.5	6.65/16.6
6	S + „ 1.0 „	48.5/43.3	3.8/10.4	87.6/215.9	16.6/42.5	104.2/258.4	6.3 /15.75	1.0 /2.7	7.3 /18.45
7	S + β–N.A. 0.1 „	45.2/43.4	4.4/11.6	89.1/230.9	16.4/46.1	105.5/277.0	6.55/17.10	1.05/2.9	7.6 /20.0
8	S + „ 0.5 „	47.2/43.6	4.8/12.3	93.7/229.2	16.9/45.7	110.6/274.9	6.8 /16.85	1.1 /2.8	7.9 /19.65
9	S + „ 1.0 „	46.9/43.9	4.1/10.9	85.8/217.2	14.8/40.7	100.6/257.9	6.2 /15.85	1.0 /2.75	7.2 /18.6
10	S + α–A.M.N. **) 0.1 „	45.3/45.4	5.0/12.0	95.3/231.3	18.6/43.5	113.9/274.8	7.25/17.65	1.25/2.95	8.5 /20.6
11	S + „ 0.5 „	46.6/42.8	3.6/ 9.6	80.6/195.3	15.8/39.2	96.4/234.5	6.05/14.80	1.1 /2.8	7.15/17.6
12	S + „ 1.0 „	44.4/42.2	4.4/10.7	82.6/203.1	15.0/41.5	97.6/244.6	6.1 /15.10	1.05/2.7	7.15/17.8

*) N.A. = naphthylamine.
**) A.M.N. = (aminomethyl-)naphthalene.

0.5 mg/l is slightly more than that of the control plants. Considering the whole group the maximum of the fresh and dry weights of the aerial parts as well as those of the picked leaves (fig. 2 and 3) is observed with adenine 0.5 mg/l (group 3, table VI), after which α-naphthylamine 0.5 mg/l (group 5) usually follows. The increase of the dry weight of the aerial part is 34 %; of the leaves 12—18 %.

Also the fresh and dry weight of the roots was influenced most by adenine 0.5 mg/l. These results run practically parallel to those obtained with the aerial parts.

The increase of weight of the whole plant (aerial part and roots) is maximal in the group receiving adenine 0.5 mg/l and amounts to 31 %. α-Naphthylamine had the most favourable influence at a concentration of 0.5 mg/l; the effect lay between that of adenine 0.1 mg/l and 0.5 mg/l.

6. *Experiment with Cosmos bipinnatus Cav. "Sensation Innocence" at Lunteren.*

The rather extensive experiment made at Lunteren in 1943 (Nr: 3) gave results which on account of the big differences in position were not altogether trustworthy. Therefore this experiment was repeated in 1944 in the rebuilt hothouse equipped with glass walls on all sides. All pots of the 12 different groups were placed at random in a sand bedding in the centre of the hothouse, so that position influences were equally distributed. As was done in the previous experiment, the pots were watered daily, excluding Sundays, with alternately nutrient solution and distilled water. Beside adenine, we examined the influence of α- and β-naphthylamine and α-(aminomethyl-)naphthalene in three concentrations. The sowing was done on May 30th 1944 (the p_H of the sand being 6.3) and on June 5th the 40 best plants of each group were transferred into pots. On July 14th the experiment came to an end and of each group the 30 best plants were selected; of these the 10 very best specimens were always judged too. Table VII states the results.

As a result of cloudy weather during the last period of the experiment, combined with the fact that the hothouse was continually covered with hurdles, the plants considerably stretched in length. In comparing the dry weight figures of the aerial parts of all the 30 plants the lowest concentration (0.1 mg/l) here always proves to be optimal. In this case adenine gives an increase in weight of 12 %, α-naphthylamine 19 %, β-naphthylamine 20 % and α-(aminomethyl-)naphthalene 24 % in comparison with the control group. The influence of the added substances is also noticeable in the determination of the dry weights of the roots and again the lowest concentration is optimal. Adenine gives an increase in weight of 12 %, α-naphthylamine 25 %, β-naphthylamine 12 % and α-(aminomethyl-) naphthalene 13 % in comparison with the control plants. In this case α-naphthylamine evidently has the greatest effect.

On the total weight of the plants (sum of the aerial parts and roots) the influence of α-(aminomethyl-)naphthalene dominates. The concentration of 0.1 mg/l here gives an increase of weight of 22 %, adenine 12 %, α-naphthylamine 29 % and β-naphthylamine 19 %.

It is peculiar that in this experiment the lowest concentrations (0.1 mg/l) are always optimal, while in the previous ones it was usually the case with

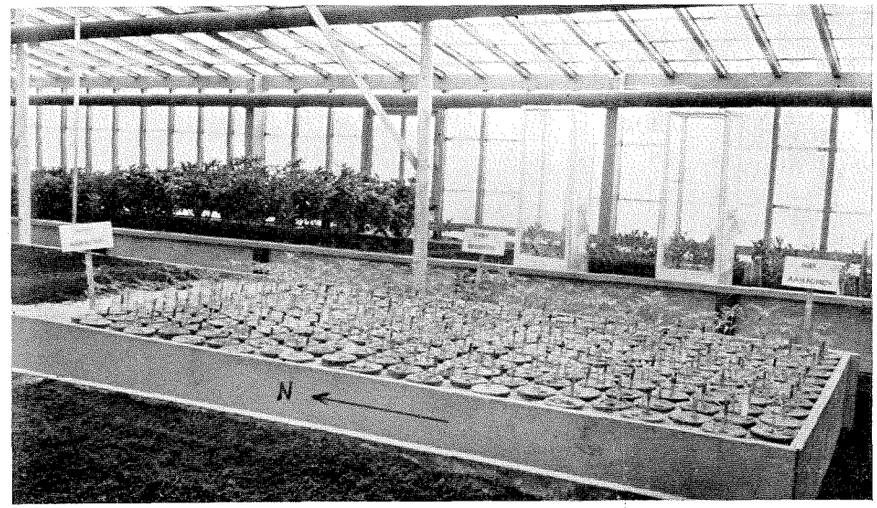

Fig. 1. Arrangement of the groups, mixed at random, of experiment 5 at Boskoop (April 17th 1944—May 22nd 1944). Look for the coloured sticks showing to which group the plant belongs.

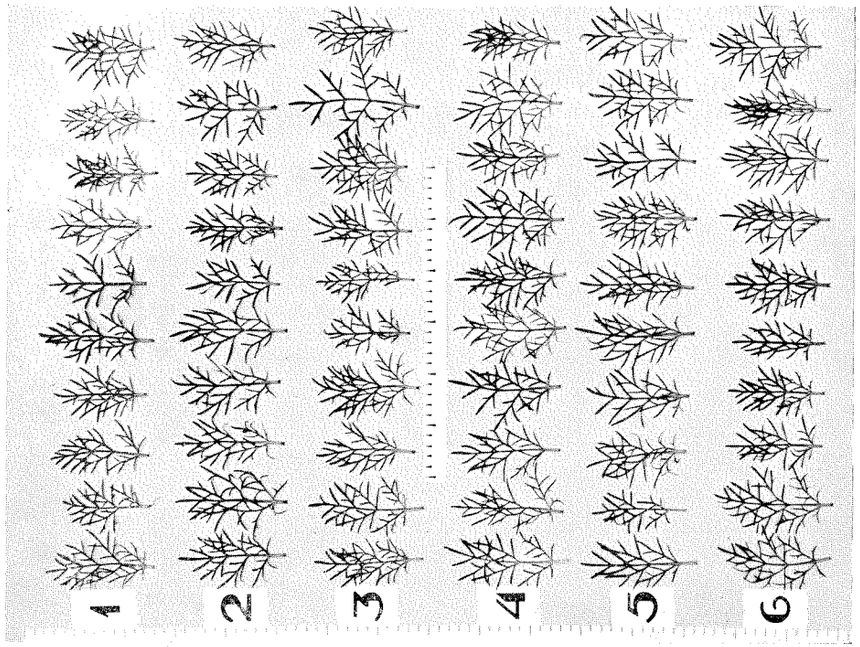

Fig. 3. *Cosmos bipinnatus* Cav. "Sensation Innocence" experiment 5 (April 17th 1944—May 22nd 1944). Leaves of the second real leaf-pair of the 10 best plants.
1 Shive (control); 2 and 3 Shive + adenine 0.1 and 0.5 mg/l; 4, 5 and 6 Shive + α-naphthylamine 0.1, 0.5 and 1.0 mg/l.

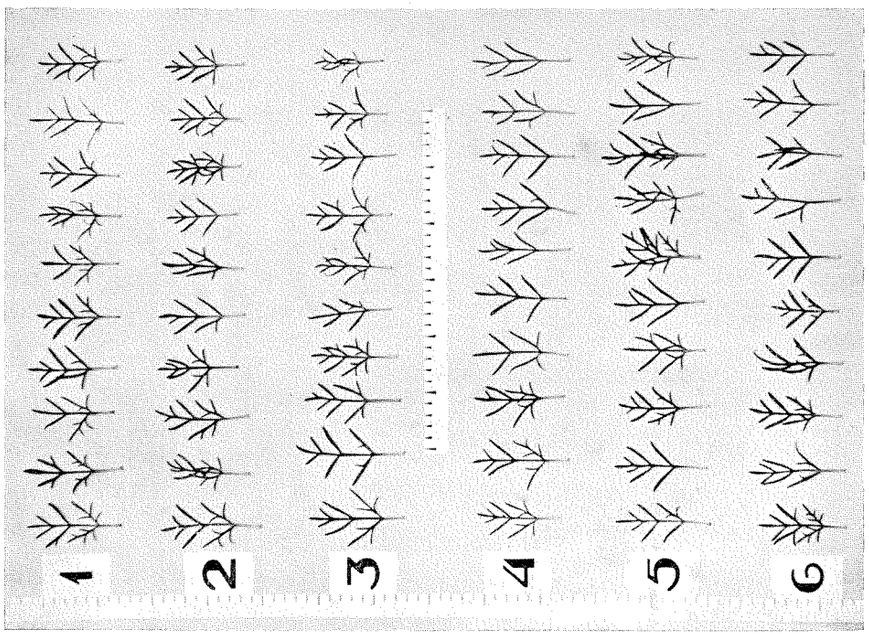

Fig. 2. *Cosmos bipinnatus* Cav. "Sensation Innocence", experiment 5 (April 17th 1944—May 22nd 1944). Leaves of the first real leaf-pair of the 10 best plants.
1. Shive (control); 2 and 3 Shive + adenine 0.1 and 0.5 mg/l; 4, 5 and 6 Shive + α-naphthylamine 0.1, 0.5 and 1.0 mg/l.

0.5 mg/l. There is a possibility that this shows a relation to the stage of development at the time the experiment is ended. The fact that in previous experiments adenine showed optimal activity, whilst here this is the case with α-naphthylamine or with α-(aminomethyl-)naphthalene, would indicate that the action of the substances examined is not a very specific one.

It has been clearly proved that the influence of the position in the hothouse on the development of the test plants in such experiments should not be underestimated. We would therefore only consider the results of our last 3 experiments (Nrs: 4, 5 and 6) as being quite trustworthy, as in these cases the plants of the whole experiment series were placed at random. (See the summary of the results in table VIII.)

As BONNER and HAAGEN–SMIT (5) did not mention any details as to the manner in which their plants were placed in the hothouse and as they probably worked with only a few pots (in which were several plants), that is to say, on a small scale (see p. 187 of their article), the possibility must be kept in mind that the great differences found are not trustworthy. In this connection it is worth noting that DE ROPP (11) in a study on the growth of stem-tips (isolated from rye-embryos) on a synthetic nutrient medium, observed that the purine derivatives adenine, guanine, uric acid and caffein had no influence whatever on the leaf growth.

Summary.

With reference to the investigations made by BONNER and HAAGEN–SMIT (5) and by D. M. BONNER and J. BONNER (6) concerning the influence of adenine on the leaf growth of Cosmos plants, with which, in certain cases an increase of dry weight up to three times that of the control was obtained, the influence of adenine was examined in an elaborate series of experiments on the growth of *Cosmos bipinnatus,* using more material for each group. Besides this the influence of the structurally somewhat related substances α-naphthylamine, its isomer β-naphthylamine and its homologue α-(aminomethyl-)naphthalene were examined on *Cosmos bipinnatus.*

The strong effects of adenine on the leaf growth observed by the above-mentioned investigators, could not be confirmed with this material. The differences of the best groups in this respect with the control had an average of + 15 %. As compared with this, the figures for α-naphthylamine are 13 %, β-naphthylamine 11 %, α-(aminomethyl-)naphthalene 11 %.

The effect of the three naphthalene derivatives, evidently of the same order of magnitude, and, similar to the effect of adenine, do not seem to be very specific.

Attention is drawn to the great influence which may be exerted by the arrangement of the experimental material if not all places are equivalent and the special measures that must be taken on this account.

We thank Messrs. H. Bosch and P. de Vogel, chief assistants of the "Tuinbouwvoorlichtingsdienst" at Boskoop for their cooperation in our experiments.

TABLE VIII.

Dry weight of all plants as compared with controls (= 100).
(Experiment 1—6).

Group	Treatment (concentration in mg/l)		Aerial part							Roots							Whole plants						
			1	2	3	4	5	6	Average of 4, 5 and 6	1	2	3	4	5	6	Average of 4, 5 and 6	1	2	3	4	5	6	Average of 4, 5 and 6
1	Shive (= S)		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
2	S + adenine	0.1	111	111	111	88	110	112	103	105	106	110	74	112	112	99	109	110	111	86	110	112	103
3	S + „	0.5	127	111	111	113	134	92	113	126	106	126	140	121	96	119	127	110	115	118	131	92	114
4	S + α–N.A. *)	0.1	116	119	100	101	103	119	108	124	119	83	97	105	125	109	119	119	96	100	104	120	108
5	S + „	0.5	136	129	109	80	112	99	97	156	119	90	80	115	96	97	143	127	104	80	113	99	97
6	S + „	1.0	129	157	94	87	98	111	99	124	150	83	75	110	104	96	127	155	91	85	101	110	99
7	S + β–N.A.	0.1			67			120	120			49			112	112			62			119	119
8	S + „	0.5			102			118	118			91			108	108			99			117	117
9	S + „	1.0			110			111	111			94			106	106			106			110	110
10	S + α–A.M.N. **)	0.1			98			124	124			86			113	113			94			122	122
11	S + „	0.5			91			104	104			78			108	108			87			104	104
12	S + „	1.0			68			106	106			51			104	104			63			106	106

*) N.A. = naphthylamine.
**) A.M.N. = (aminomethyl-)naphthalene.

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