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Influence of gibberellin and β-indole-acetic acid on plants of yellow and white lupine
Part II. The nitrogen and the alkaloid content

Wpływ gibereliny i kwasu β-indolooctowego na rośliny łubinu żółtego i białego

Cz. II. Wpływ na zawartość azotu oraz alkaloidów w roślinach

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The first part of this report (B i r e c k a 1962) dealt with the influence of gibberellin A_3 and β-indole-acetic acid on the growth and the development of plants in the autumn experiments of 1960 and the spring — summer experiments of 1961. Special attention was given to the response of lupine plants between the 28th and the 64th day of growth. The second part of the report deals with the influence of the same two substances on the content in nitrogen and in alkaloids of the experimental plants accounting also for the yields of the plants at a later stage of development; yellow lupine was harvested on the 105th day * of growth and the three populations of white lupine at the phase of full maturity. The alkaloids were extracted with methanol from the vegetative organs and with chloroform after previous alkalization from the hulls and seeds; after purifying the extracts the content of alkaloids was determined colorimetrically (R e i f e r and N i z i o ł e k 1957); the coefficient of extinction was accepted to be 0.145 for yellow lupine and 0.105 for white lupine. The chromatographic analysis carried out to check the error in the total content determinations did not show significant difference in the relations between the particular fractions of the alkaloids according to the examined factors.

RESULTS

Yellow Lupine

The 1960 Autumn Experiments

The weight increments of the organic matter in yellow lupine (fully discussed in Part I) are illustrated by Graph I.

* As was mentioned in Part I yellow lupine was attacked by *Rhizoctonia aderholdi* and had to be harvested before full maturity was reached.

Table 1 — Tabela 1

Nitrogen and alkaloid content in yellow lupine (per plant)
Zawartość azotu i alkaloidów u łubinu żółtego (w przeliczeniu na 1 roślinę) (doświadczenie 1960 r.)

Plant treated with Stosowane substancje	Concentration Stężenie g/l	Nitrogen content mg. N per plant Zawartość azotu			Alkaloid content mg. per plant Zawartość alkaloidów		
		leaves liście	stem łodyga	total razem	leaves liście	stem łodyga	total* razem
Control	0	71.7	10.5	82.2	6.9	0.9	7.8
		increase after 18 days przyrost po 18 daniach					
control	0	74.0	12.3	86.3	11.5	3.4	14.9
A_3*	10^{-2}	84.5	22.1	106.6	10.2	3.5	13.6
A_3	5×10^{-1}	93.0	21.3	114.3	11.3	3.3	14.6
IAA	10^{-5}	73.3	15.4	88.7	14.2	4.0	18.2
IAA	10^{-3}	75.0	12.8	87.8	13.8	3.3	17.1
A_3 + IAA	10^{-2} + 10^{-3}	68.4	10.2	78.6	11.2	3.7	14.9
A_3 + IAA	5×10^{-1} + 10^{-5}	67.0	20.1	87.1	11.5	4.4	15.9
decapit.	0	41.8	14.5	56.3	11.4	3.9	15.3

* A_3 — potassium salt of gibberellin acid, IAA — β-indole-acetic acid.
A_3 — sól potasowa kwasu giberelinowego, IAA — kwas β-indolooctowy.

** The increment of the content of alkaloids in roots after 18 days ranged 0.26—0.33 mg. in all treatments with the exception of decapitated plants where the alkaloid content in roots was 0.52 mg. (on the day the experiments began the alkaloid content of roots was 0.11 mg.).

Przyrost zawartości alkaloidów w korzeniach po 18 dniach wahał się w granicach 0.26—0.33 mg. we wszystkich kombinacjach z wyjątkiem roślin dekapitowanych — przyrost w ich korzeniach wynosił 0.52 mg. (w dniu rozpoczęcia doświadczenia zawartość alakaloidów w korzeniach — 0.11 mg.).

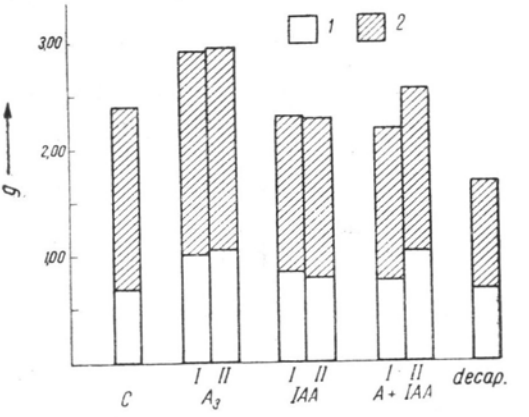
During the time the experiments lasted the nitrogen content* (Table 1) of the controls was doubled and so was their weight. The plants of lupine treated with IAA alone or jointly with A_3 showed no significant differences in their nitrogen content, whereas in plants sprayed with either concentration of A_3 alone the nitrogen increment was significantly higher.

The reaction of plants to the two substances was different with respect to the increase of alkaloid content (which was high in the controls). A significant increase in the amount of alkaloids occurred only in plants treated with IAA alone especially in their leaves, in

* The differences in the per cent content of nitrogen and of alkaloids between the particular replications of the various treatment were here, similarly as in the later experiments, very small: in the discussion of the results only the significant differences will be mentioned.

spite of the relatively small increase of their weight during the period under consideration. The other treatments did not differ from the controls.

Very remarkable were the decapitated plants; in spite of the much smaller increase of the weight of their leaves — and obviously the

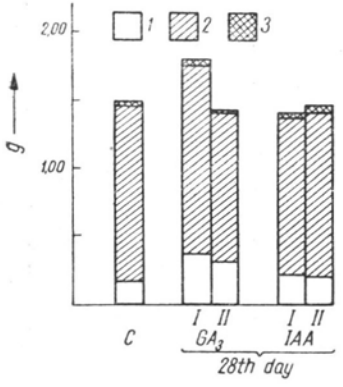


Graph. I. Yellow lupine. Exper. 1960, increase of plant weight after 18 days
Przyrost ciężaru po 18 dniach wegetacji, 1960
1 — stem (łodyga); *2* — leaves (liście)
A_3 I — 10^{-2}; II — $5 \cdot 10^{-1}$ g/l
IAA: I — 10^{-5}; II — 10^{-3} g/l
A_3 + IAA: I — $A_3 - 10^{-2}$ + IAA — 10^{-3}
II $A_3 - 5 \cdot 10^{-2}$ + IAA — 10^{-5} g/l

smaller number of leaves — and in spite of the lower, absolute nitrogen content (though the percentage was similar) the rise of the alkaloid content was analogous to that in the controls.

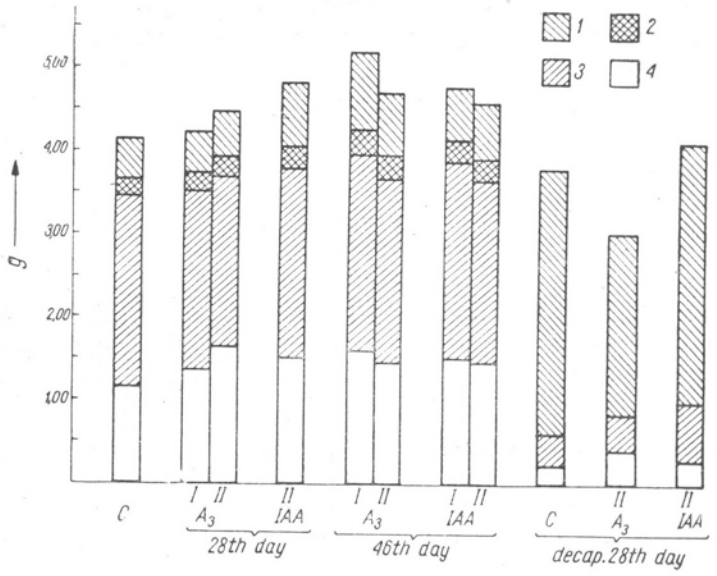
The 1961 Experiments.

The weights of plants at the age of 46 and 64 days are presented in Graphs II and III. Table 2 lists the yields of lupine on the 105th day of vegetation. In spite of the significant stimulation by A_3 of the



Graph. II. Yellow lupine. Exper. 1961, plant weight on the 46th day of growth
Ciężar roślin w 46 dniu wegetacji, 1961
1 — stem (łodyga); *2* — leaves (liście); *3* — lateral shoots (pędy boczne)

growth of the main stems and also, when the substance was applied on the 46th day, of the side shoots lasting to the stage of pod formation, the weight of the gibberellin treated plants did not differ in the final development period from the weight of the controls.



Graph. III. Yellow lupine. Exper. 1961, plant weight on the 64th day of growth
1 — lateral shoots (pędy boczne); *2* — flowers (kwiaty p. główn.); *3* — leaves (liście); *4* — stem (łodyga).

Table 2 — Tabela 2

Weight of yellow lupine on the 105th day of growth (experiment 1961)
Ciężar roślin łubinu żółtego w wieku 105 dni (doświadczenie 1961 r.)

Plants treated with Substancje wzrostowe	Concentration Stężenie g/l	Weight — g d.m. per plant Ciężar 1 rośliny — g s.m.				Total Razem
		leaves liście	stems łodygi	pods — strąki		
				hulls łupiny	seeds nasiona	
control		3.42	3.47	3.08	2.27	12.24
		plants treated on the 28th day of growth rośliny opryskane w 28 dniu wzrostu				
A_3	10^{-2}	3.79	3.35	3.47	2.77	13.36
A_3	5×10^{-1}	3.17	3.31	2.69	2.22	11.38
IAA	10^{-5}	2.66	3.00	3.13	2.65	11.44
IAA	10^{-3}	3.17	3.22	4.41	4.56	15.35
		plants treated on the 46th day of growth rośliny opryskane w 46 dniu wzrostu				
A_3	10^{-2}	3.00	3.03	2.86	2.18	11.08
A_3	5×10^{-1}	3.63	3.34	2.50	2.12	11.69
IAA	10^{-5}	3.78	3.79	4.08	3.88	15.53
IAA	10^{-3}	3.04	2.89	4.06	3.90	13.89

Table 3 — Tabela 3

Nitrogen and alkaloid content in yellow lupine till the 64th day of growth
Zawartość azotu i alkaloidów w łubinie żółtym do 64 dnia wzrostu

Plants treated with Substancje wzrostowe	Concentration Stężenie g/l	Time of treatment Czas stosowania	N content — mg. per plant Zawartość N — mg. w 1 roślinie			Alkaloid content — mg. per plant Zawartość alkaloidów — mg. w 1 roślinie		
			leaves liście	stems łodygi	total razem	leaves liście	stems łodygi	total razem
			on the 46th day of growth — w wieku 46 dni					
	control*	on the 28th	42.8	2.6	45.4	6.4	0.6	7.0
A_3	10^{-2}	day of growth	54.3	6.8	61.1	6.7	1.5	8.2
A_3	5×10^{-1}	w 28 dniu	35.1	4.8	39.9	5.7	1.3	7.0
IAA	10^{-5}	wzrostu	41.5	4.2	45.7	7.4	1.0	8.4
IAA	10^{-3}		43.7	4.0	47.7	8.5	0.8	9.3
			on the 64 th day of growth — w wieku 64 dni					
	control		114.5	19.8	134.3	20.1	3.3	23.4
A_3	10^{-2}	on the 28th	97.3	18.7	116.0	21.8	3.6	25.4
A_3	5×10^{-1}	da of growth	95.5	21.9	117.4	17.8	4.0	21.8
IAA	10^{-5}	w 28 dniu	[76.4	21.0	97.4	15.7	3.7	19.4]
IAA	10^{-3}	wzrostu	109.7	21.0	130.7	27.3	5.0	32.3
decapit**	0		87.8	18.4	106.2	17.4	6.0	23.4
decapit + A_3	5×10^{-1}		69.3	14.7	84.0	14.9	4.7	19.6
decapit + IAA	10^{-3}		102.6	18.0	120.6	22.8	4.8	27.6
GA_3	10^{-2}	on the 46th	119.7	25.3	145.0	19.7	4.5	24.2
GA_3	5×10^{-1}	day of growth	104.6	22.1	126.7	21.0	4.8	25.8
IAA	10^{-5}	w 46 dniu	117.7	20.9	138.6	19.6	3.6	23.2
IAA	10^{-3}	wzrostu	107.5	21.4	128.9	22.5	4.7	26.9

* The aerial part of one plant at the age of 28 days contained 8.2 mg. N and 1.4 mg. alkaloids.
Część nadziemna rośliny w wieku 28 dni zawierała 8.2 mg. N oraz 1.4 mg. alkaloidów.

** In the main stem of decapitated plants the N contents were 2.7, 4.8, and 4.0 mg. and the alkaloid contents 1.2, 1.4, and 0.5 mg. (the order of listing is the same as in the table).
Łodygi pędu głównego serii roślin dekapitowanych wg kolejności podanej w tabeli zawierały mg. N — 2,7; 4.8; 4.0; mg. alkaloidów — 1.2; 1.4; 0.5.

The response of lupine to IAA was different: although the lower concentration of this substance when applied in the early stage of growth, i.e. on the 28th day, had no influence on the yield on the 105th day, the higher concentration caused a significant increase of the weight of hulls and seeds.

The effect of IAA applied on the 46th day of vegetation was analogous. The increase of the weight of pods was in this case the same independently of the applied concentration.

Table 4 — Tabela 4

Nitrogen and alkaloid content in yellow lupine on the 105th day of growth
Zawartość azotu i alkaloidów w łubinie żółtym w 105 dniu wzrostu

Plant treated with Substancje wzrostowe	Concentration Stężenie	N content — mg. per plant Zawartość N — mg. w 1 roślinie					Alkaloids content — mg. per plant Zawartość alkaloidów — mg. w 1 roślinie				
		leaves liście	stems łodygi	pods — strąki hulls łupiny	pods — strąki seeds nasiona	Total Razem	leaves liście	stems łodygi	pods — strąki hulls łupiny	pods — strąki seeds nasiona	total razem
Control		62.9	22.9	25.7	148.0	259.5	14.7	1.8	6.3	13.1	35.9
		plants treated on the 28th day of growth rośliny opryskane w 28 dniu wzrostu									
A_3	10^{-2}	76.9	20.8	33.2	180.0	310.9	15.1	1.6	6.6	17.7	41.0
A_3	5×10^{-1}	60.2	21.8	29.7	158.6	270.3	13.0	2.3	5.4	15.7	36.4
IAA	10^{-5}	54.0	21.3	26.9	183.1	285.3	9.6	1.1	9.4	15.2	35.3
IAA	10^{-3}	58.3	21.3	21.2	305.9	406.7	10.3	1.2	2.5	26.9	40.9
		plants treated on the 46th day of growth rośliny opryskane w 46 dniu wzrostu									
A_3	10^{-2}	52.2	16.4	14.4	163.7	246.7	12.3	2.3	5.9	17.8	38.3
A_3	5×10^{-1}	75.5	23.0	31.3	163.5	292.3	15.9	2.3	4.8	13.0	36.0
IAA	10^{-5}	83.9	29.1	31.8	275.5	420.3	17.1	2.5	9.1	37.1	65.8
IAA	10^{-3}	55.4	19.1	19.5	276.1	370.1	14.6	1.8	16.1	21.0	53.5

Up to the 64th day of growth there were no significant differences in the nitrogen content among the intact plants (Table 3) with one exception: on the 46th day, the nitrogen content of lupine sprayed with the lower concentration of A_3 was, similary as in the earlier experiments, higher than in the controls; however, for the higher dose causing a certain depression of the growth of leaves the amount of nitrogen was somewhat lower.

Large differences appeared in the final period of vegetation (Table 4). Plants which after IAA treatment produced increased yields of seeds and hulls showed also a much higher nitrogen content than the controls. On the other hand, lupine plants sprayed with A_3 did not significantly differ from the controls, independently of the time of spraying and the dose.

In the decapitated plants, which on the 64th day of growth had a lower nitrogen content than the intact ones (Table 3), A_3 had a negative and IAA a positive effect on the accumulation of this element.

A_3 had no significant influence on the alkaloid content of the plants at any period or at any concentration; the only exception here was

a small drop in the amount of alkaloids in the leaves of decapitated plants.

The effect of IAA was different:

1. The higher concentration of this substance applied first on the 28th day of growth brought about on the 64th day a higher alkaloid content in plants, in particular in leaves; a similar effect was observed at the same time in the leaves of decapitated plants. However, on the 105th day the total of alkaloids no longer differed from their amount in control plants. Perhaps the only noteworthy observation was some difference in the distribution of these compounds in the particular parts of a plant after treatment with IAA; the accumulation of alkaloids in seeds was greater and in other parts lower as compared to the controls.

2. IAA first applied on the 46th day of vegetation did not cause during the following 18 days any significantly greater, as compared to the controls, increase of the alkaloid content. However, in the later period of growth its influence at both concentrations was high: in the final stage the IAA sprayed plants had a much higher alkaloid content than the controls.

White Lupine

In the 1960 autumn experiments the influence of A_3 and IAA during 18 days after spraying was only manifested by a greater increase of the weight of leaves (see Part I). A similar effect was observed in lupine sprayed with a solution of both these substances when the concentration was $A_3\,10^{-2} + IAA\,10^{-3}$ g/l. A somewhat higher weight increment of stems was observed only after treatment with A_3 alone at the higher concentration. The weight of leaves as well as of stems of the decapitated plants was much smaller than of the intact ones.

Table 5 lists the results of the analyses of the lupine plants. As is to be seen the magnitude of the increase of nitrogen and the alkaloids was strictly correlated with the magnitude of the increase of the weight of plants. Only the behaviour of the decapitated plants was different: in spite of the smaller weight, the smaller number of leaves, and the lower nitrogen content they had the same amount of alkaloids as the controls.

The three populations of white lupine studied in the 1960 experiments reacted to the two substances neither by their growth nor by their development; no influence whatever of the two substances was observed on the weight of the mature plants; for these reasons Table 6 lists only the yields of the controls. Although, so far as the number of leaves, the growth of stems and side shoots, and the rate of development vere concerned the fodder hybrid resembled the bitter Czech-

Table 5 — Tabela 5
Nitrogen and alkaloid content in bitter white lupine (per plant)
(Experiment 1960)
Zawartość azotu i alkaloidów u łubinu białego gorzkiego (w przeliczeniu na 1 roślinę)
(Doświadczenie 1960 r.)

Plant treated with Stosowane substancje*	Concentration Stężenie g/l	Nitrogen content mg. N per plant Zawartość azotu			Alkaloids content mg. per plant Zawartość alkaloidów		
		leaves liście	stem łodyga	total razem	leaves liście	stem łodyga	total razem
Control	0	22.4	2.7	25.1	3.6	0.4	4.0
increase after 18 days przyrost po 18 dniach							
Control	0	41.3	11.0	52.3	3.2	2.2	5.4
A_3	10^{-2}	46.3	10.5	56.8	4.4	2.4	6.8
A_3	5×10^{-1}	50.2	15.1	65.3	6.0	2.6	8.6
IAA	10^{-5}	50.5	12.4	62.9	5.2	2.0	7.2
IAA	10^{-3}	51.6	13.1	64.7	5.0	2.2	7.2
A_3 + IAA	10^{-2} + 10^{-3}	51.7	11.7	63.4	5.3	2.3	7.2
A_3 + IAA	5×10^{-1} + 10^{-5}	44.6	9.4	54.0	3.6	2.1	5.7
Decapit.	0	30.4	11.0	41.4	3.5	2.1	5.6

* A_3 — potassium salt of gibberellin acid, IAA — β-indole-acetic acid.
A_3 — sól potasowa kwasu giberelinowego, IAA — kwas β-indolooctowy.

Table 6 — Tabela 6
Weight of white lupine at the end of vegetation
(Experiment 1961)
Ciężar roślin łubinu białego gorzkiego w fazie pełnej dojrzałości
(doświadczenie 1961 r.)

Kind of population Populacje	eight g d.m. per plant ciężar 1 rośliny g. s.m.				
	leaves liście	stems łodygi	hulls łupiny	seeds nasiona	total razem
Bitter Czechn. v. Czechn. Gorzka	1.60	4.43	2.79	6.79	15.61
Bitter hybrid Ród gorzki 119—1—3	1.80	4.38	2.38	5.71	14.57
Fodder hybrid Ród past. E_7/DB_2	1.18	3.73	2.79	3.38	11.08

nicka variety and significantly differed from the bitter hybrid, its yield, in particular its seeds yield, was much lower than in the two

bitter populations. The average weight of seeds in the five treatments were 6.36 for the Czechnicka variety, 5.44 for the bitter hybrid, and 3.14 g for the fodder variety the differences in each case ranging 5—10 per cent.

The plants of the 1961 experiments were not analysed chemically because:

1) the preliminary experiments in the spring of 1960 did not show any significant differences in alkaloid content in white lupine after treatment with A_3 or IAA and simultaneously there were no differences in the weight of plants;

2) the development of the fodder and the bitter hybrids did not follow the same pattern, whereas one of the aims of the 1961 experiments was to compare two homologues differing, as little as possible.

DISCUSSION

The most significant results, from the point of view of the influence of the applied growth substances, were obtained in the experiments with yellow lupine. Unfortunately, the plants could not be kept till their complete maturity. However, considering that plants had to be harvested not long before their full maturity we may presume that the facts observed for the 105th day of growth would not be substantially changed during the next three or four weeks. All the more so as at this late stage the assimilation of nitrogen by *Rhizobium* and the accumulation of alkaloids are in general already weak, if indeed they still continue.

In the experiments with yellow lupine the influence of A_3 on the growth of plants between the 28th and the 64th day of vegetation varied; it was either stimulative or inhibitory. This was reflected by the greater or smaller increase of the weight of the particular plant organs, stimulation usually occuring in the main stems and inhibition in the leaves of main stems or in the whole side shoots. The differences in the influence of A_3 often depended on the dose and too on the age of plants at which the substance was applied. Nevertheless, in the later period of development all these differences disppeared and the yields of plants treated with A_3 did not differ from the control yield. Similar effects were also observed with other species (Humphries and French 1960, 1961, Morgan a. Mes 1957, Smith a. Sciuchetti 1959, Sciuchetti 1959). After higher doses of A_3 or when it is applied more often the development of plants could be significantly depressed also in the later stages. It is to be stressed that in the present experiments no positive or negative influence on the growth of roots was observed.

Thurber et all. (1958) pointed to the possibility of the negative

effect of gibberellin on the formation of nodules and the assimilation of nitrogen in pea inoculated with *Rhizobium*. A similar negative effect of gibberellin was observed by Mes (1959) in very young *Vicia villosa* plants after treatment with this substance. But Mes also reported that in vetch treated with gibberellin at a later stage — on the 30th day of growth when the nodules had already developed — the lower nitrogen content was not observed, and shortly after spraying the amount of this element could even be higher than in untreated plants in particular under short-day conditions.

In our experiments with lupine A_3 was applied at the stage when the nodules on the roots were already intensely developing. In these plants 18 days after the first spraying (the 1960 and 1961 experiments) we also observed a higher nitrogen content than in the controls; this effect seems to be indirect and to be associated with the more intense growth of the plants. In the later development stages the influence of A_3 on the nitrogen content was no longer noticeable, similarly as in other papilionaceous species (Flecher 1958, Mes 1959).

In experiments with *Nicotiana*, *Datura stramonium*, *Atropa belladonna*, and *Hyoscyamus niger* (Brummett and Sciuchetti 1960, Burk a. Tso 1958, Fish 1960, Masuda a. Hamur 1959, Smith a. Sciuchetti 1959, Sciuchetti 1959) a drop of the content of alkaloids was observed after treatment with gibberellin. This drop often, but not always, occurred even when the yields of the plants treated with this substance were either the same or appreciably higher than the control yields. In some of those experiments, when under the influence of gibberellin the alkaloid content was considerably reduced, a weak growth of roots was also observed; in all these species the roots were the organ mainly responsible for the synthesis of alkaloids. In lupine, however, the alkaloids are mostly, if not entirely, synthesized in the aerial organs (Birecka, Szklarek a. Mazan 1960, Birecka, Sebyła a. Nalborczyk 1960). In the investigated yellow lupine only one instance was observed when a small drop of the alkaloid content was caused by gibberellin (decapitated plants); most probably the drop was associated with the strong depression of the growth of side shoots. It is to be noted, however, that at no stage of the development of yellow lupine an increase of the alkaloid content was observed after treatment with A_3, even when this substance stimulated a more intense growth of the aerial parts and caused an increase of the nitrogen content (the 1960 and 1961 experiments).

The response of lupine to IAA both in the yields and in the content in nitrogen and in alkaloids was quite different. The more intense growth of the plants under the influence of this substance was not short-lasting, since it was also manifested by the greater weight of

the hulls and seeds in the final period of development. The changes of the nitrogen content in the course of the development of yellow lupine after IAA indicate that the much greater accumulation of nitrogen than in the other treatments occurred not within the period, during which the sprays were applier (a fact observed also in the 1960 experiments), but in later stages, when the assimilation of this element by *Rhizobium* was still very intense, not only in this population, but also in other varieties (Birecka and Włodkowski 1960). It does not seem probable that this effect was the result of the direct action of IAA on the nodule bacteria, all the more so as these bacteria are themselves capable of synthesizing auxins; the nodules constitute active centres of the synthesis of these compounds (Allen 1958). We may, therefore, suppose that the influence exerted by IAA on the nitrogen content was of an indirect character and that this substance acted through the stimulation of growth or through the influence on the translocation of organic compounds to roots.

The changes of the amount of alkaloids in lupine treated with IAA indicate that the greater alkaloid content was not always associated with a greater increase of the total amount of nitrogen. Supporting evidence in this regard was primarily supplied by the relatively young plants (the 1960 and 1961 experiments). These plants had a higher alkaloid content even when IAA did not stimulate a more intense growth of leaves. The above mentioned facts give rise to the supposition that this growth substance may be involved in the transformations of the organic nitrogen compounds in plants, transformations associated with the biosynthesis, or the decomposition of alkaloids*. Noteworthy from this point of view were the decapitated plants (decapitation in these plants must have had an influence on their "auxin economy"). The changes in the alkaloid content in the plants of yellow, and specially, of white lupine in which the side shoots were not yet developed (the autumn experiments), seem to indicate that the removing of the apex caused in the leaves a greater increase of alkaloids than in the analogous leaves of undecapitated plants**. It is of course

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* This supposition seems to be supported by that in plants sprayed with IAA when they were still young — between the 28th and the 46th day of growth — the greater accumulation of alkaloids was observed only to the 64th day of growth, whereas in the final stages of development these plants did not significantly differ in this regard from the controls.

** Although there is no direct supporting evidence for this statement, nevertheless many experiments at this laboratory have shown that in lupine the leaves from the higher nodes contain more alkaloids than those from the lower nodes, which is mainly the result of the more intense synthesis of these compounds.

difficult to decide whether the changes leading to greater accumulation of alkaloids in the decapitated plants were similar to or different from the changes caused by IAA in intact plants.

The above discussed differences between the influence of gibberellin and β-indole-acetic acid on the content in nitrogen and alkaloids of plants supply supplementary evidence that the nature of the action of these substances is different, a problem which was fully considered in Part I of this report.

In addition to what has been said above here are some marginal remarks about white lupine. In our experiments the yields of the two bitter populations of white lupine were, in spite of the significant differences in their development, very similar; on the other hand the yields of the fodder hybrid, which was derived from the same original parents as the bitter hybrid, were much lower, though the fodder hybrid greatly resembled in its development the Czechnicka bitter variety. May we assume that these facts are caused by the differences associated with the biosynthesis of alkaloids in these plants? In the case under consideration such a conclusion would be unwarrented: the two hybrids differed also in many other respects. But the question, in itself rather important not only from the physiological point of view, necessitates further investigations with hybrids which would resemble each other more closely than those used in the experiments reported here.

CONCLUSIONS

1. The influence of gibberellin on the development of yellow lupine was short lasted. The yields of the A_3 treated plants did not differ in the final period of development from the controls.

2. A_3 did not cause any significant changes in the nitrogen and alkaloid contents in the plants.

3. The positive influence of β-indole-acetic acid on yellow lupine was reflected by a higher yield in the final period of development and by a higher nitrogen content.

4. The plants sprayed with IAA had a higher alkaloid content. The greater increase of these compounds was manifested even when yellow lupine treated with IAA showed no increase of the total nitrogen content.

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STRESZCZENIE

W niniejszej II części badań nad łubinami omówiono wpływ gibereliny i kwasu β-indolooctowego na zawartość azotu oraz alkaloidów w roślinach, przy czym uwzględniono ich plony w końcowej fazie wegetacji.

Analizy na azot wykonano metodą Kjeldahla; alkaloidy ekstrahowano z organów wegetatywnych metanolem, z łupin i nasion (po uprzednim zalkalizowaniu) — chloroformem, Sumaryczną zawartość tych związków po oczyszczeniu ekstraktów oznaczano kolorymetrycznie.

Uzyskane wyniki można zreasumować następująco:

1. Wpływ gibereliny na wzrost łubinu żółtego był krótkotrwały. Plony roślin potraktowanych tą substancją nie różniły się w końcowej fazie rozwoju od plonów roślin kontrolnych.

2. Giberelina nie wywołała istotnych zmian w zawartości ani azotu, ani też alkaloidów w roślinach.

3. Dodatni wpływ kwasu β-indolooctowego przejawił się w większym plonie łubinu żółtego w końcowej fazie rozwoju oraz w większej zawartości w nim azotu.

4. Rośliny opryskane kwasem β-indolooctowym zawierały więcej alkaloidów. Większy przyrost ilości tych związków występował nawet wtedy, gdy łubin żółty potraktowany tą substancją nie wykazywał wyższej ogólnej zawartości azotu.

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