LIII. INVESTIGATIONS ON THE NITROGENOUS METABOLISM OF THE HIGHER PLANTS. PART VII.

LEAF PROTEIN METABOLISM IN NORMAL AND ABNORMAL RUNNER-BEAN PLANTS.

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(Received February 21st, 1914.)

THE experiments described in the earlier papers of this series extend over the seasons 1921, 1922 and 1923. During this period sufficient data have been collected to demonstrate certain abnormalities, which, though they cannot yet be explained, appear to be worthy of note.

These relate chiefly to experiments made during the season 1921. That year a prolonged drought was experienced during July, August and September. The roots of the plants were watered daily, but in spite of a normal inflorescence during July very few pods formed. During August and September no new pods were formed at all, the plant activity being confined solely to the production of an abnormally large number of new shoots and leaves. The seasons 1922 and 1923 were normal, and pod production was continuous during August and September.

An interesting difference between the leaf protein metabolism in the normal and abnormal plants has been noted. This relates to the leaf protein degradation products, which accumulate in leaves detached from the plant and left with their petioles in water for some days. The chemical composition of these products in four separate cases, two of them normal and two abnormal, is illustrated by Table I. In this table "amide N other than asparagine N" means the ammonia set free after prolonged hydrolysis, from which the free ammonia N and amide N (Sachsse) have been deducted.

Case 1. Leaves from normal plants, picked early in September, 1922, during the pod forming stage. The protein N decreased to the extent of 14.85 % of the total leaf N, with a corresponding increase in the non-protein N. About one-half of this increase was due to an increase in asparagine N. "Amide N other than asparagine N" showed a small increase, whilst free ammonia N remained unchanged. This result was typical of several similar experiments quoted in an earlier paper [Chibnall, 1924].

Table I. *Showing the increases in various forms of non-protein N due to protein metabolism in the leaves of normal and abnormal plants.**Phaseolus vulgaris* var. *multiflorus*.

(In percentages of total leaf N.)							
Case no.	Date picked	No. of days with petiole in water	I	II	III	IV	Total of III and IV
			Total non-protein N	Ammonia N	Amide N (Sachsse)	Amide N other than asparagine N	
1	11 Sept. 1922	0	16.75	0.46	1.06	1.44	2.50
		4	31.60	0.45	4.08	2.05	6.13
	7 "	Increases	14.85	—	3.02	0.61	3.63
2	12 July, 1923	0	14.05	0.30	0.75	n.d.	—
		4	37.74	1.01	5.63	"	—
	12 "	Increases	23.69	0.71	4.88	—	—
3	7 Aug. 1921	0	22.45	0.44	0.53	0.73	1.26
		4	34.14	0.44	0.49	5.69	6.18
	23 "	Increases	11.69	—	—0.04	4.96	4.92
4	11 Sept. 1922	0	16.75	0.46	1.06	1.44	2.50
		4	28.80	0.49	2.29	3.66	6.95
	13 "	Increases	12.05	—	1.23	2.22	3.45

Case 2. Leaves from normal plants, picked early in July, 1923, at the stage when flower-buds were about to form. As in Case 1, asparagine was the most prominent product of the protein metabolism. Free ammonia N showed a small increase: "amide N other than asparagine N" was not determined.

Case 3. Leaves from abnormal plants, picked 23rd August, 1921, during the drought. A more detailed description is given in an earlier paper [Chibnall, 1922]. The protein metabolism produced no increase in asparagine N, or in free ammonia N, but there was a large increase in "amide N other than asparagine N" equivalent to nearly one-half of the increase in total non-protein N. Such a result was totally different from that given by the normal leaves, for the products of the protein metabolism were clearly not simple amides such as asparagine or glutamine. This large production of ammonia on prolonged hydrolysis is very striking, and precludes the possibility of its being derived from soluble proteins or polypeptides, for these, like asparagine, yield practically all their ammonia during mild hydrolysis. It was at first thought that these unknown products might consist in part of urea or its derivatives, but a test for urea in similar material described in Case 4 showed it to be present only in traces. Lack of material has so far prevented any further study of this interesting observation being made.

Case 4. Leaves picked 13th September, 1922, from six abnormal plants. The seedlings had appeared above ground early in June, but, for reasons unknown, growth was stunted, and no flowers had formed. The protein metabolism produced a small increase in asparagine, but only about one-third of that given by the normal leaves. "Amide N other than asparagine N" showed a much larger increase than that given by the normal leaves, indicating the production

of the unknown products that were so pronounced in the protein metabolism of the abnormal leaves described in Case 3.

It seems probable, then, that under certain conditions, not yet known, the metabolism of the leaf proteins may vary, and it is interesting to note that in both cases when asparagine was not formed there was no production of pods.

In conclusion the author would like to thank Professors S. B. Schryver, V. H. Blackman and T. B. Osborne for their continued interest in the work described in this and the two preceding papers.

REFERENCES.

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