
Some Effects of the Application of Urea on Amino Acid Composition of Johnson Grass

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The effect of urea and nitrogen fertilizers, when used as top dressing on hay crops, has been studied for several years by Ferguson (2). It was found that, when a top dressing of nitrogen fertilizer was applied 7 to 10 days before harvesting, it was possible to increase the protein equivalent of the hay by appreciable quantities. In all instances the studies were limited to the absorption of nitrogen by the roots.

Experiments have been conducted recently on the applicability of spraying nitrogen fertilizers directly to the leaves of plants. Since most nitrogen fertilizers are electrolytes, heavy applications will burn the leaves. Urea, a non-electrolyte, can be applied in limited quantities without injuring the plants. Fisher and Cook (4) have shown that urea becomes readily available when sprayed on the leaves of apple trees. Similar work has also been carried out on wheat (3) and cotton by Staten (6). The work described in this paper was designed to study the rate of absorption of urea and its effect on the amino acid content of Johnson grass leaves.

EXPERIMENTAL

The Johnson grass plants used in this experiment were grown in the greenhouse and were fertilized with ammonium nitrate three weeks before the application of urea to the leaves. The urea solution was applied to the leaves by means of an Alga micrometer syringe. The concentration of the urea solution was 100 milligrams per milliliter. It was found that

spreading the drops over the surface of the leaf increased the rate of absorption. It was difficult to spread the concentrated urea solution because of its high surface tension. This was overcome by wetting the leaf surface with a detergent before the application of urea. In this instance Dreft was the detergent used. The humidity in the greenhouse was kept high to reduce the rate of evaporation of the urea solution. When too rapid evaporation occurred, the rate and amount of absorption were reduced considerably.

When the leaves were harvested, the urea remaining on the leaf was removed by washing with distilled water. The leaves were composited and dried in the oven at 105° C. for 24 hours. Following this, they were allowed to equilibrate with the moisture in the air. The samples were weighed and ground to a fine powder in a mortar and pestle. After hydrolysis, they were analyzed for *l*-glutamic acid hydrochloride, *l*-threonine, *l*-valine, *l*-methionine, *l*-isoleucine, glycine, and *l*-leucine using the microbiological assay method of McCoy and Wender (5). For the determination of the amino acids, a 500-milligram sample was hydrolyzed by refluxing for 18 hours with 6 normal hydrochloric acid. After evaporating the largest part of the acid, the solution was filtered and neutralized with ammonium hydroxide. The urea content of the plant sample and wash water was determined by a modified procedure of the Association of Official Agricultural Chemists (1).

RESULTS

Two milligrams of urea per leaf were added to the Johnson grass. The leaves were harvested at the end of 1, 2, 3, 4, 5, and 21 hours, and the urea content of each individual leaf determined. As can be seen in Figure 1, the leaf began to absorb the urea at the end of 1 hour. During the first

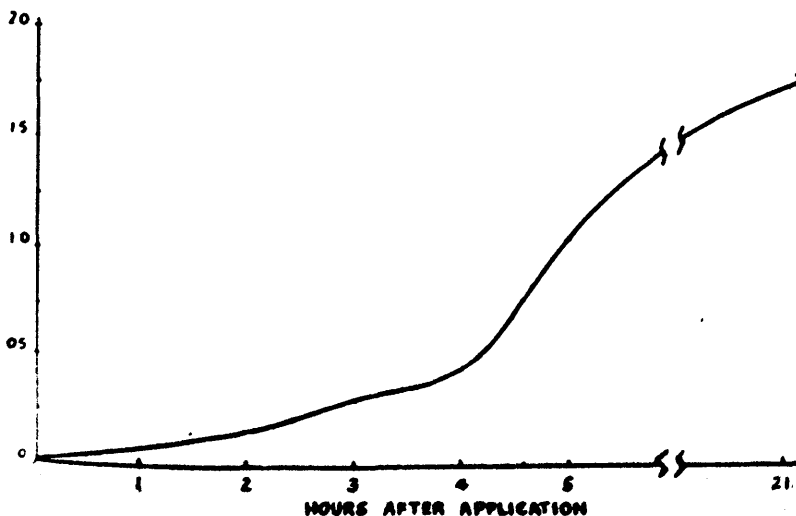


FIGURE 1. Rate of Urea Absorption in Johnson Grass Leaves.

4 hours, there was a gradual increase in the amount of absorption. After the fourth hour, there was a decided increase in the absorption of urea. During the time interval from 5 to 21 hours in which no leaves were harvested, the curve shows only a gradual increase. A comparison between the 24- and 96-hour treatment indicated that only a very small additional amount of urea was absorbed after 24 hours. The results are listed in Table I. It can be seen that 7.28 milligrams out of a total of 44.0 milligrams of urea applied was not absorbed at the end of 24 hours. After 48 hours 6.4 milligrams remained of the 38.0 milligrams applied, and after 96 hours 5.5 milligrams remained from 38.0 milligrams of urea added.

Most of the urea that was absorbed did not remain in the leaves. Only 18.4 per cent of the urea remained at the end of 24 hours, 13.0 per cent after 48 hours, and 1.4 per cent after 96 hours. At the end of 96 hours, 84.1 per cent of the urea added could not be accounted for.

The results of the amino acid analyses are listed in Table II. The only significant difference between samples was the glutamic acid content of the 24-hour treatment. The treated sample was definitely higher in glutamic acid than the untreated sample, while in the 48-hour and 96-hour

TABLE II

*The Effects of Applying Urea on the Amino Content
of Johnson Grass Leaves*

AMINO ACIDS/ TIME ¹ TREATMENT	L-GLUTAMIC ACID · HCl	L-VALINE	GLYCINE	L-THREONINE
24 hrs. Untreated	.385	.133	.112	.082
24 hrs. Treated	.515	.140	.105	.090
48 hrs. Untreated	.320	.116	.096	.068
48 hrs. Treated	.357	.132	.112	.082
96 hrs. Untreated	.375	.125	.108	.080
96 hrs. Treated	.380	.128	.112	.085

AMINO ACIDS/ TIME ¹ TREATMENT	L-ISOLEUCINE	L-LEUCINE	L-METHIONINE
24 hrs. Untreated	.159	.200	.041
24 hrs. Treated	.165	.212	.044
48 hrs. Untreated	.137	.180	.040
48 hrs. Treated	.140	.200	.042
96 hrs. Untreated	.141	.190	.040
96 hrs. Treated	.155	.204	.044

¹ Hours harvested after urea-treated.

² Amounts are expressed in milligrams per gram.

TABLE I
The Absorption of Urea by Johnson Grass Leaves

TREATMENT AND TIME	WEIGHTS IN GRAMS	AMOUNT ADDED TO TOTAL SAMPLE	AMOUNT NOT ABSORBED BY SAMPLE	RESIDUAL AMOUNT IN SAMPLE	UREA RETAINED IN SAMPLE	PER CENT IN SAMPLE	PER CENT UNACCOUNTED FOR	PER CENT NITROGEN
Untreated	Wet 8.32 Dry 1.87	0	—	2.87 mg.	—	—	—	3.02
Treated 24 hrs.	Wet 8.10 Dry 1.88	44 mg.	7.82 mg.	10.96 mg.	8.09 mg.	18.38	63.84	3.72
Untreated	Wet 5.00 Dry 1.32	0	—	2.03 mg.	—	—	—	2.96
Treated 48 hrs.	Wet 6.09 Dry 1.61	38 mg.	6.39 mg.	6.97 mg.	4.94 mg.	13.0	70.18	3.06
Untreated	Wet 5.53 Dry 1.36	0	—	2.79 mg.	—	—	—	2.95
Treated 96 hrs.	Wet 6.18 Dry 1.53	38 mg.	5.50 mg.	3.32 mg.	.53 mg.	1.39	84.13	3.06

1. These—Length of time urea was on leaf.

treatment there appeared to be no appreciable difference. There was some indication that the other amino acids in the treated sample ran somewhat higher than in the untreated sample, but since there were not sufficient samples to be treated statistically it could not be considered significant. It should be mentioned that the same sample which was high in glutamic acid was also high in nitrogen.

CONCLUSION

In a study on the rate of absorption of urea and its effect on the amino acid content of Johnson grass, it was found that the greatest percentage of urea was absorbed in the first 24-hour period after application to the leaves. After that time there was only a slight increase in absorption. It was impossible to account for all of the urea which was applied to the leaves. Apparently the urea was translocated rapidly into other portions of the plant. Except for glutamic acid, there was no appreciable difference in amino acid content of the leaves at the end of 24 hours. The glutamic acid content of the treated leaves was 33.0 per cent higher than that of the control. At the end of 48 hours there was some increase in glutamic acid content; however, this was very small at the end of 96 hours. Since most aminations occur in the roots of the plant, the urea would have to be translocated to the roots if the application of urea is to increase the protein content of the plant.

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