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## EFFECTS OF UREA NITROGEN ON THE METABOLISM OF PLANTS (IV)

On the Change of Simple Sugar Content in Plants  
Treated with Nitrogen

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金 俊 鎬 : 植物의 代謝에 미치는 尿素窒素의 影響(IV)  
窒素處理後의 炭水化合物含量의 變化에 對하여

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### ABSTRACT

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Change of the amount of carbohydrates in relations with nitrogen metabolism was studied under the different manners of supply and with different sources of nitrogen. In barley plant supplied with nitrogen through root, the depression periods of glucose and sucrose content occurred at 2 days after, but the amounts of both sugars were different with the different sources of nitrogen; there were in sequence diminished by treatment of  $\text{NO}_3$ ,  $\text{NH}_4$  and urea.

In sunflower leaves sprayed with urea both sugar contents were inversely related to the urea concentration sprayed, and depressing periods of the sugars appeared immediately in the N-deficient plant but late in the N-abundant one.

### INTRODUCTION

In previous papers <sup>(2, 3, 4)</sup> of these serial studies it has reported to effect of urea and other nitrogens on the metabolism of the plant under the different conditions. Urea-N absorbed through leaf surface was assimilated more swiftly than that through root to take part in the nitrogen metabolism of the plant. When urea was sprayed on the leaf surface, its utilization was meager in the old leaves and the nitrogen abundant ones compared with in the young leaves and the nitrogen deficient ones.

In the present paper, as nitrogen metabolism is directly connected with the amount of carbohydrate in leaves, it will clarify to effect of urea and other different sources of nitrogen on the carbohydrate content of plant supplying them through leaf surface or through root.

### MATERIALS AND METHODS

Materials, winter barley which was supplied with nitrogen, 120 mg N/1, through root, and sunflower leaves which sprayed with urea through leaf surface, were made by the same methods in the previous papers <sup>(2,3)</sup> during April-May. Killing of the material in alcohol, extraction of sugar from the material, conversion from it to reducing sugar and determination of the reducing sugar were carried out by Somogi-Shaffer method <sup>(6)</sup>.

## RESULTS

## 1. Change of sugar content in barley plant supplied with nitrogen through root

By supply with the different sources of nitrogen through the root, the amount of sugar in barley leaves grown in water culture appeared generally similar trend in all the treated plots except plot of lacking nitrogen. Fig. 1 shows the time course of glucose content in barley leaves; the glucose content decreased rapidly with minimum value at day 2, but increased from that time to day 6, and there after kept constant with minor variations. As shown in Fig. 1 two days after its content was 9.95, 5.45, 4.30, 2.25 mg/g. fresh weight for control, urea, ammonia and nitrate plot, respectively (100:55:43:23). Decreasing effect of nitrogen on glucose content was heaviest in nitrate plot, but lightest in urea plot.

Change of sucrose content was in harmony with that of glucose in showing that the content was smallest at day 2. As shown in Fig. 2 two days after, the leaves contained 16.7, 14.7, 13.6, 12.2 mg sucrose/g. fresh weight in control, urea, ammonia and nitrate plot, respectively (100:88:81:73). Decreasing effect of urea-N on both glucose and sucrose contents was lesser than those of two other nitrogens in corresponding concentrations.

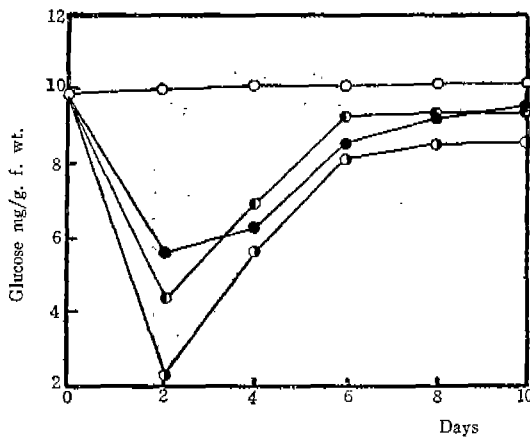


Fig. 1. Changes of glucose content in the leaves of barley plant supplied with the different sources of nitrogen through root. Note: (○); control(no nitrogen), (●); urea, (□) ammonium sulfate, (△); sodium nitrate.

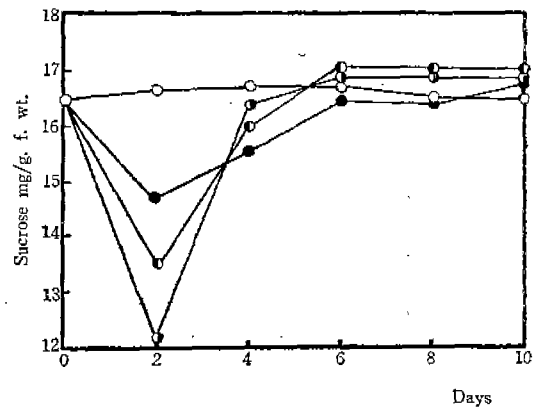


Fig. 2. Changes of sucrose content in the leaves of barley plant supplied with the different sources of nitrogen through root. See the note in Fig. 1.

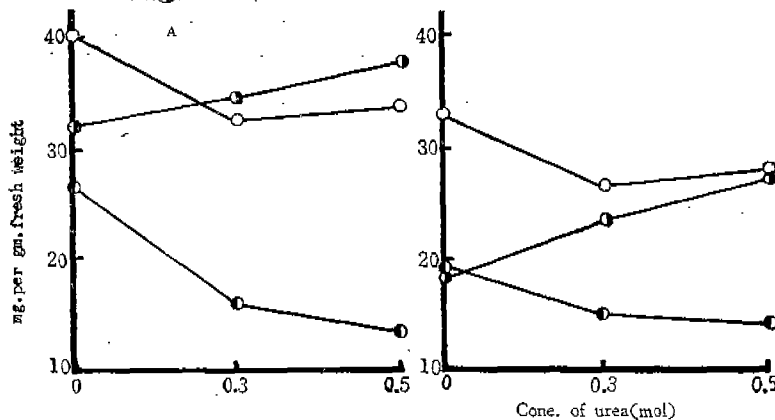


Fig. 3. Relations between urea concentration (mol) and glucose (A) or sucrose (B) content in sunflower leaves at 24 hours after spray with urea. Note: (○); N-deficient, (●); young leaves, (◐); mature ones.

## 2. Change of sugar content in sunflower leaves after urea foliar spray

24 hours after urea foliar spray, the amounts of glucose and sucrose related inversely to the urea concentration sprayed in the mature and the N-deficient leaves, but rather directly proportionated to its concentration in the young ones (Fig. 3).

Time course of sugar content in sunflower leaves sprayed with urea is shown in Fig. 4. In the N-abundant plant the glucose content decreased after 96 hrs. following spray though it somewhat increased between 24 hrs. and 48 hrs. but the sucrose content was almost kept constantly during this period. In the N-deficient plot both the amounts of glucose and sucrose decreased gradually by urea spray with time elapse; e.g. glucose content was in the ratio of 100:94:81:73:45, and sucrose was 100:97:80:77:59 at 0-, 12-, 24-, 48- and 96-hrs. after, respectively.

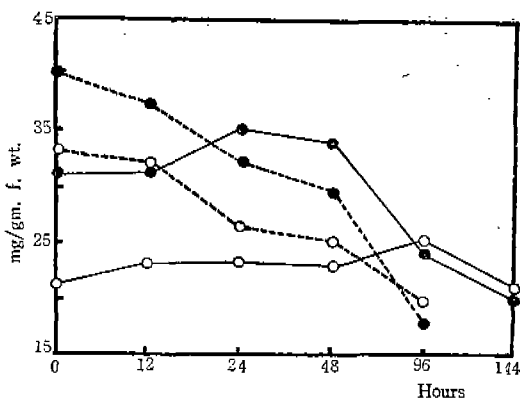


Fig. 4. Time trends of glucose and sucrose content in sunflower leaves sprayed with urea. Closed circles indicate glucose content, open circles sucrose, solid lines the N-abundant plots and broken lines the N-deficient ones.

## DISCUSSION

In the present study, it has been shown that decrease of sugar content occurs at different times according to the different manners of treatment with varying sources of nitrogen.

Eckerson<sup>(1)</sup> has found that in young tomato plant in water culture carbohydrate of the tissue was decreased and a high amino acid content was evident by treated with nitrate. Nightingale<sup>(2)</sup> and others<sup>(7-6)</sup> have also found that transformation of nitrogen compounds and disappearance of carbohydrate in plant occurred when nitrate were supplied, that is, it appears that steps in the reduction of nitrate during protein synthesis involved in sequence the formation of ammonia from nitrate and amino nitrogen from ammonia reacting with fatty acid produced from carbohydrate in the plant.

In the previous paper<sup>(3)</sup> dealing with barley plant grown in water culture, the speed of nitrogen assimilation was slower in the urea treated plant than in the  $\text{NO}_3$  or  $\text{NH}_4$  treated one. However, in the present study accomplished under the quite same condition as mentioned above, the decreasing period of carbohydrate appeared at the same time in all the different sources of nitrogen though at that time its amount was different among them.

In the urea foliar spray on sunflower, 24 hrs. after spray, the amounts of ammonia-N, amino-N and alcohol soluble-N in the leaves, which was mature, young and N-deficient condition, were linearly related to the urea concentration treated<sup>(2)</sup>. While in the same condition as stated above, both glucose and sucrose contents were inversely related to the urea concentration sprayed though in young leaves it was proportionated to its concentration. Decreasing effect of carbohydrates appeared immediately after the spray in the N-deficient plant but late in the N-abundant plant. It may conclude that, therefore, the N-deficient plants make use of the urea sprayed on the leaves more swiftly than the N-abundant one. In

comparison with barley plant supplied with urea through root and sunflower sprayed with urea, in the former, the depression period of carbohydrate begun to appear 2 days after, in the latter, that period begun at 12 hrs. after in the N-deficient plant but at 4 days after in the N-abundant one. Otherwise, unlike the former, the increase of carbohydrate was not shown in the latter so far as this experiment concerned.

## 摘 要

尿素 其他窒素를 根 및 葉面에서 吸收시킨後 葉内の 炭水化物量을 定量하였다. 根에서 吸收시킨 結果, 2日 後에 葡萄糖 및 蔗糖의 減少가 나타났고,  $\text{NO}_3 > \text{NH}_4$  尿素的 順位로 減量이 甚하였다.

尿素的 葉面散布한 結果는, 窒素缺乏植物에서는 糖의 減小는 일찍이 일어났으나(12時間後), 多窒素植物은 4日後에 減少되기 始作하였다. 이 境遇 어린잎을 除外하고는, 糖의 減少度는 尿素濃度에 逆比例하였다.

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