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# INFLUENCE OF CONDITIONS OF SUNFLOWER GROWING ON THE PROTEIN COMPLEX OF THE VEGETATIVE ORGANS OF PLANTS IN CONNECTION WITH THEIR STABILITY AND PRODUCTIVITY

The rate and speed of synthesizing protein or albuminous compounds in vegetative organs determines their growth and development and that of the generative organs, and in the ultimate analysis regulates the volume of harvest. In this connection it would be interesting to examine the effect of soil and air draughts of varied force and duration on the amount of protein and its qualitative composition in sunflower's vegetative organs.

The effect of the strong (35% TMC) and weak (55% TMC) draughts on the albuminous complex of sunflower vegetative organs was studied by building up water deficit from the seedling stage to the beginning of the differentiation of the growing point and from that period to the start of flowering, i.e. in the period of the highest level of synthetic processes (Tables 1 and 2).

Sunflower roots were most susceptible to the insufficient moistening of the soil. Even a weak draught brought about a sharp reduction in the amount of protein, both through a weakened synthesis of simple proteins (the fraction of water-soluble proteins was 95. 2% of the check) and through the stroma proteins (66. 5% of the check). Similar data were obtained in 1971-72 when the soil moisture was 55% of the total moisture capacity and the protein content in the roots decreased by 38. 5% and 26. 3% during the differentiation of the growing point and by 31.5% and 30.8%, respectively, during the budding phase, as compared to the check variant. The roots' weaker synthetic activity under slight draught is also demonstrated by a greater amount of am-

Table 1

Protein Content in Sunflower Vegetative Organs During the Differentiation of the Growing Point

VNIIMK, 1970

| Soil moisture, % of TMS | Leaves | | | | Roots | | | |
|---|---|---|---|---|---|---|---|---|
| | Protein | | | Total water, % of wet weight | Protein | | | Total water, % of wet weight |
| | mg/g of dry substance | mg/leaf | % of check | | mg/g of dry substance | mg/root | % of check | |
| 90 | 41.1 | 370.2 | 181.9 | 83.7 | 23.9 | 693.1 | 102.3 | 92.2 |
| 70 | 40.5 | 203.5 | 100.0 | 82.0 | 23.4 | 677.2 | 100.0 | 92.2 |
| 55 | 44.4 | 222.8 | 109.5 | 83.6 | 16.6 | 267.6 | 39.5 | 91.2 |
| 35 | 39.9 | 120.1 | 59.1 | 79.4 | - | - | - | 89.2 |

Table 2

Protein Content in Sunflower Leaves During Flower Budding

VNIIMK, 1970

| Soil moisture, % of TMC | 8th day of draught | | | | 15th day of draught | | | |
|---|---|---|---|---|---|---|---|---|
| | Protein | | | Total water, % of wet weight | Protein | | | Total water, % of dry weight |
| | mg/g of dry substance | mg/leaf | % of check | | mg/g of dry substance | mg/leaf | % of check | |
| 90 | 58.8 | 931.8 | 117.7 | 79.3 | 58.7 | 1,878.2 | 107.8 | 78.3 |
| 70 | 37.7 | 791.8 | 100.0 | 77.2 | 58.1 | 1,743.1 | 100.0 | 77.5 |
| 55 | 65.7 | 1,314.1 | 165.9 | 76.7 | 57.0 | 1,710.0 | 98.1 | 76.4 |
| 35 | 54.7 | 656.4 | 82.9 | 73.2 | 65.2 | 1,324.2 | 76.0 | 71.5 |

monia they accumulated, seven times as much as that in the roots of plants grown at the optimal soil moisture. It is interesting to note that when soil moisture decreases to 55% of TMC the roots have 200% as much asparatic acid which, together with the glutinic acid acts as acceptor of ammonia in non-photo-synthesising organs.

The protein content in leaves under weak draught either remains on the check level or goes up, as shown by analysis on the eighth day of the draught during budding. This is coupled with a decrease in the quantity of the aminoacids in the leaves and by an increase in the quantity of glutinic acid and its amide glutamine. All this can perhaps be attributed both to the changes in the outflow of nitrogenous substances, which can also be confirmed by the accumulation of glutamine, an active transporting agent, and to the activization of the defensive and adjusting reactions when plants are adapting themselves to weak draught (these are expressed in maintaining high water supply of vegetative organs). A high resistance to water drain that develops under weak draught shows that ties in the system "protein macromolecule - water molecule" become stronger and hence that the protein set changes. In our experiments water deficit decreased protein solvency as the plants concerned grew older.

Under intensive draught water holding is diminished though tissue watering is still maintained at a comparatively high level. The amount of protein in the leaves drops sharply and the "synthesis-disintegration" equilibrium seems to be established at a lower level.

A changed direction in metabolic processes affects growth processes, in particular those in the plants' generative organs. The reduction of soil moisture to 55% of TMC in the beginning of vegetation leads to the drop in the number of flowers by 600 and when soil moisture is reduced to 35% of TMC the number of flowers diminishes by 1,000 units. During flower budding draught has a somewhat weaker effect on the number of flowers in a head.

A short but quick and profound wilting and a combination of high temperatures and dry wind had a far stronger effect on the albuminous complex of sunflower leaves than even a long and intense draught, because these broke the secondary intermolecular ties (Tables 3 and 4).

When draught advances gradually secondary intermolecular ties in protein macromolecules grow stronger with increased water deficit, whereas an extremal factor exerting a quick and strong effect weaken these ties, probably resulting in the total decrease in the plants' resistance and stability.

Division of hardly soluble proteins into DZAZ-cellulose and their fractioning by molecular weight have revealed a more complex composition of proteins in conditions conducive to the development of strong protective forces. With a deap wilting 92.7% of all proteins have one peak with a molecular weight of 51,250 daltons.

Short but sharp changes in air temperature and humidity, even when soil moisture is maintained at an optimal level, change the synthesis of albuminous compounds in vegetative organs and considerably affects the seeds' yields and quality. Thus, a three-day dry wind blowing during the formation of flowers in a head decreased the seeds' yield by 2.9%, during seeds' growth by 31.0%, and during seeds' filling by 21.1% The oil content of check plants was 45.34%, while in experimental variants it was 44.29, 45.13 and 37.88%, respectively.

The work done gives grounds to affirm that the degree of sunflower resistance to the unfavourable conditions of the environment and hence the yield are predicted on the adjustive shifts in the albuminous complex of the vegetative organs. Moreover, the plants' resistance is linked with the character of the effect produced by the extremal factor.

Table 3

Protein in Sunflower Leaves Under Long Draught (mg/g of dry substance) 1974

| Soil moisture, % of TMC | Total protein, mg/g | Extracted by buffer PH 8.6 | | Extracted by buffer 8.6 with detergent | |
|---|---|---|---|---|---|
| | | mg/g | % of total | mg/g | % of total |
| 70 | 58.08 | 8.5 | 14.6 | 49.58 | 85.3 |
| 55 | 61.10 | 3.5 | 5.7 | 51.80 | 84.1 |
| 35 | 60.18 | 3.0 | 4.9 | 48.01 | 79.1 |

Table 4

Amount of Protein in Sunflower Leaves Under Dry Wind and Deep Withering VNIIMK, 1975

| Variants | Total protein, mg/g | Extracted by buffer PH 8.6 | |
|---|---|---|---|
| | | mg/g | % of total |
| High temperatures | 41.10 | 6.5 | 15.8 |
| High temperatures and dry wind | 40.13 | 8.5 | 21.2 |
| Deep withering | 38.91 | 11.9 | 38.9 |