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RESPONSES OF SUNFLOWER GROWN IN POLISH CLIMATIC CONDITIONS TO INCREASING NITROGEN DOSES IN FERTILIZATION

Sunflower adapts itself to diverse climatic conditions much better than soybean. In Poland attempts are being made to introduce a large-scale cultivation of sunflower. Cultivation technology is being developed and fertilization requirements are being specified, particularly nitrogen requirements, since a vast majority of our soils are deficient in nitrogen /3/. To find out the response of sunflower to nitrogen fertilizers 10 field experiments were conducted between 1970 and 1973. Nitrogen fertilizer was applied within 0 to 150 kg N/ha range in doses graded by 30 kg/ha. The experiments were carried out under the climatic conditions of the Great Polish Valleys on podzol and brown and black soils of varied compaction and reaction.

The obtained results have shown that for pretty compact soils of neutral or slightly alkaline reaction /pH 6.3-7.2/ there was a curvilinear increase in achene yields as a result of nitrogen fertilization (Fig. 1); the yield was maximal after a nitrogen dose of 120 kg/ha. For lighter soils with a slightly acid reaction /pH 5.6-6.2/ nitrogen fertilization had no effect on the yield. On compact acidified soils /pH 5.0-5.4/ nitrogen fertilization accounted for a linear decrease in achene yields.

The significant effect of soil reaction on sunflower growth, development and yield was emphasized by Foy et al. /2/ and Stoyanov /4/. The authors found a strong inhibition of the plant growth and a decrease in the sunflower yield in their pot experiments when pH of the soil was less than 5.5. In field conditions

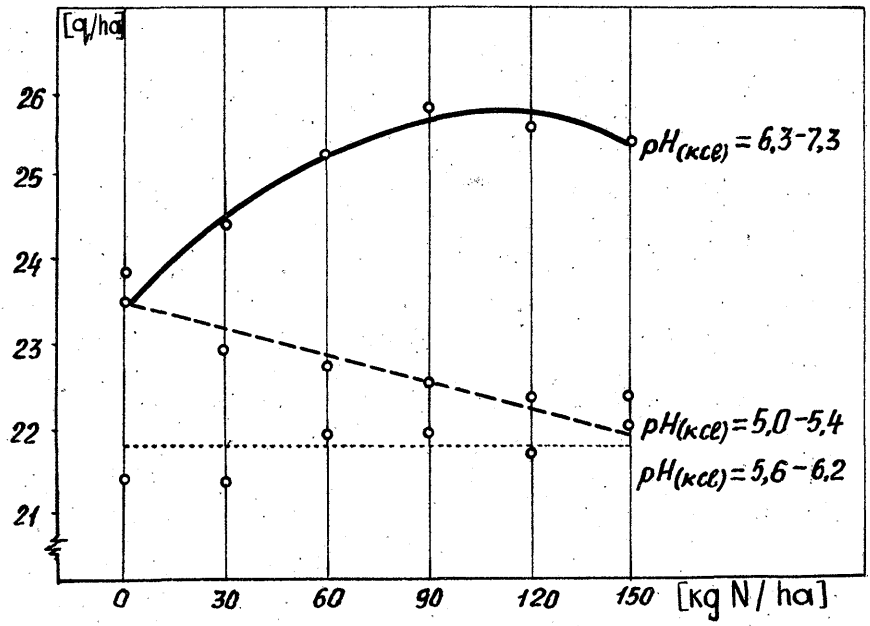

Fig. 1. Achene yield of sunflower grown on soils of various pH

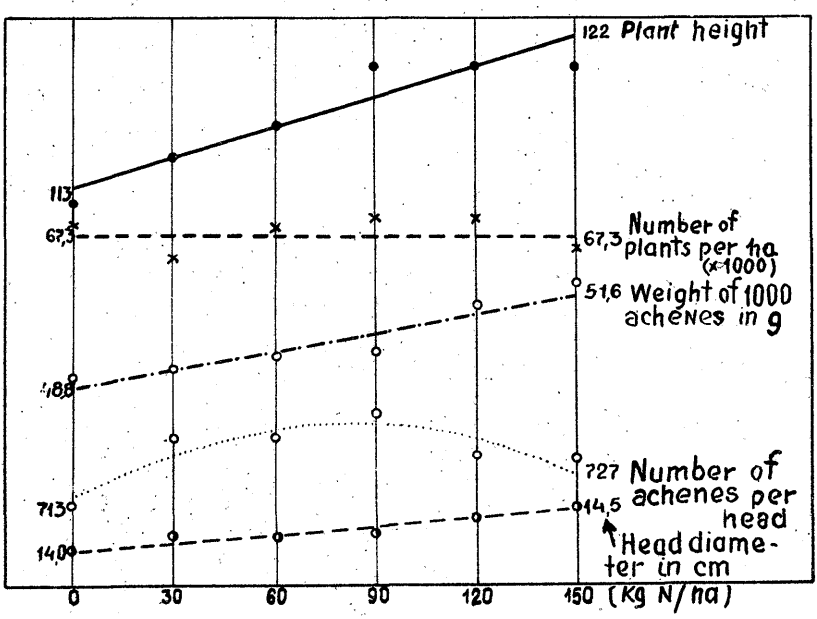

Fig. 2. Yield structure components of sunflower grown on neutral and slightly alkaline soils

physiological disorders in the plant growth manifested themselves, according to Stoyanov, as chloroses, yellowing and necroses commonly known as "sunflower yellowing". More intense nitrogen fertilization under conditions of a low pH brings about a two- or three-fold reduction of plant mass and may lead to a yield reduction of up to 30-50%.

In our own experiments no changes were observed in the plant density in the fields when nitrogen doses were increasing. However, during cold weather persisting in springtime the plants were inhibited in their growth and turned yellow at intensive nitrogen fertilization. When the cold weather was over, the plants were soon making up for their delayed growth and recovered their normal appearance. Foy et al. (1974) explain that although in the low sunflower varieties physiological disorders may not lead to plant necrosis or leaf chlorosis, they nevertheless have a negative effect on their productivity. In our own experiments two low varieties of sunflower, were used, namely Chernyanka 66 and Wielkopolski, the most adaptable under the local conditions. This may account for the absence of strongly marked symptoms of physiological disorders when acid soils are fertilized with high amounts of nitrogen. However, nitrogen fertilization under such conditions caused a gradual decrease in the achene yields. In case of slightly acid soil reaction the nitrogen fertilization proved equally ineffective. The effect was good only on neutral or slightly alkaline soils.

In our experiments the content of molybdenum, boron and aluminum in the soil and the plants was not defined. It is therefore not possible to explain whether sunflower response to nitrogen fertilization is due to a deficiency or an excess of those microelements. This has already been suggested by both authors mentioned above.

Nitrogen fertilizer applied in neutral or slightly alkaline soils had beneficial effect on the height of plants, their head diameters, the number of achenes in the heads, 1000 kernel weight, and consequently on the yield.

There were fewer seed filled achenes in sunflower heads in case of slightly acid soils fertilized with nitrogen. The achenes, however, were heavier.

In acid soils nitrogen fertilizer had no significant effect on the head diameters and the 1000 kernel weight; however, in case of stronger nitrogen fertilization plant heads contained also fewer filled achenes.

Stoyanov /4/ and Decau et al. /1/ paid attention to a weak activity of nitrate reductase in case of ample amount of nitrogen and small amount of molybdenum in the soil. Mineral nitrogen accumulated in plants cannot be then transformed into protein nitrogen of seeds.

Nitrogen fertilization did not effect the content of husk in achenes and irrespective of soil reaction it reduced the oil content linearly /Fig. 2/.

In our experiments the maximal oil yield was obtained from sunflower grown on neutral and slightly acid soils at a dose of 90 kg N/ha. Nitrogen fertilization on slightly acid and acid soils resulted in a small or marked linear drop in sunflower oil yield (Fig. 3).

Conclusions

1. The reaction of sunflower to nitrogen fertilization was dependent on soil compaction and soil reaction.

2. On pretty compact soils of neutral or slightly alkaline reaction the maximum achene and oil yields were obtained at 90–120 kg N/ha.

3. On lighter soils of slightly acid reaction the nitrogen fertilization did not affect the yield, and on compact acidified ones resulted

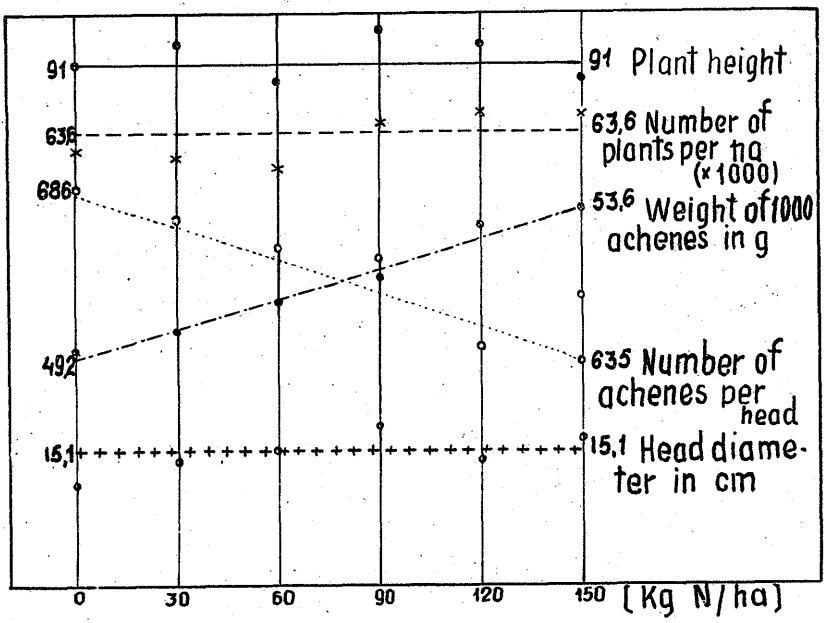

Fig. 3. Yield structure components of sunflower grown on slightly acidic soils

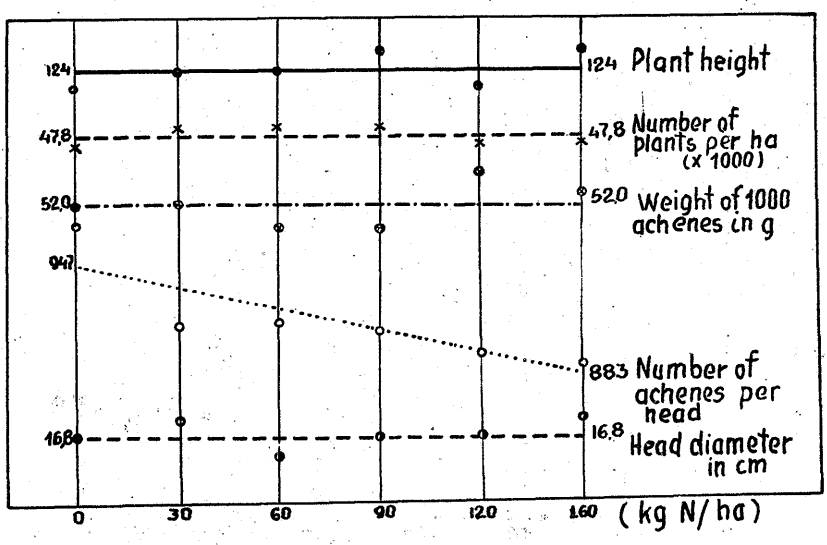

Fig. 4. Yield structure components of sunflower grown on acidic soils

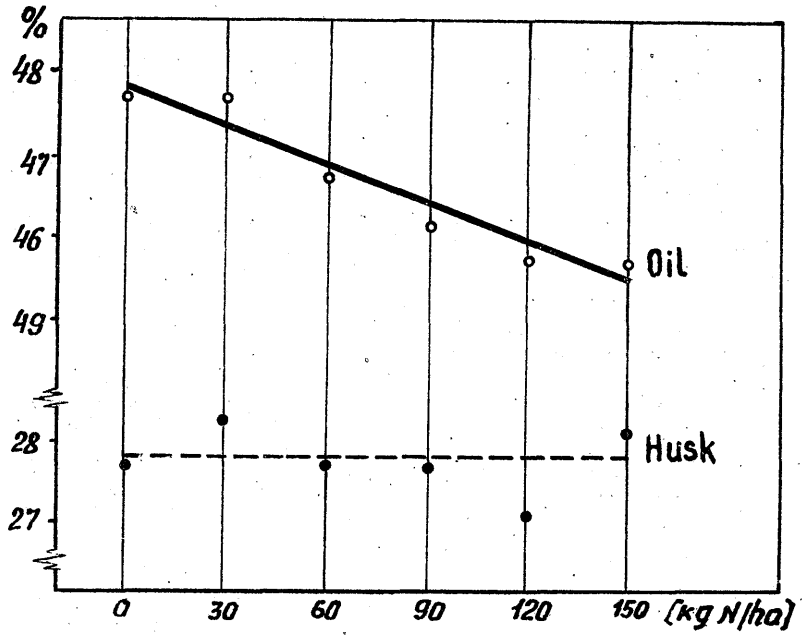

Fig. 5. Oil and husk contents in sunflower achenes irrespective of soil pH

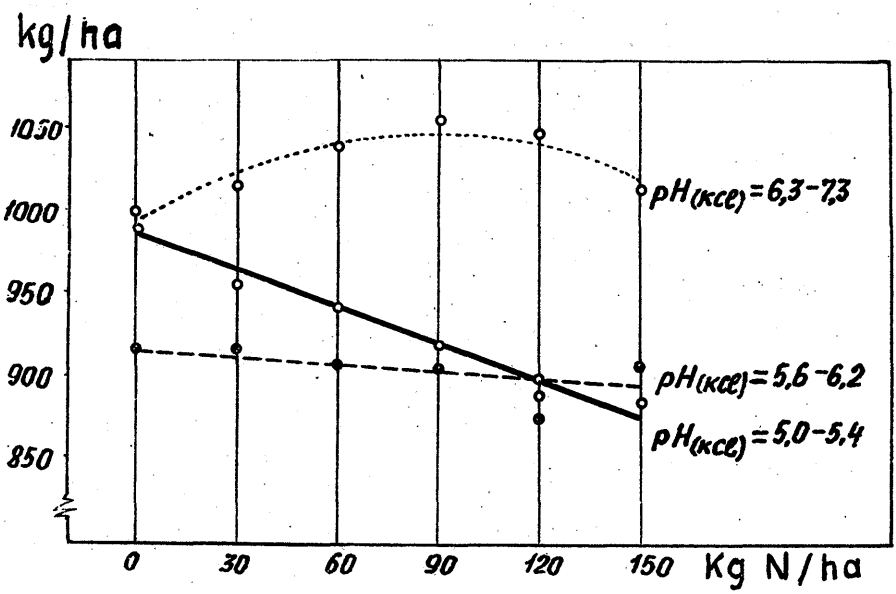

Fig. 6. Oil yields of sunflower grown on soils of various pH

in linear decline of achene and oil yields.

4. Irrespective of the soil conditions nitrogen fertilization did not affect husk content and decline of oil content in achenes.

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