Differences in Fertilizer Response Due to Winter Wheat Varieties

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The production of cereals, especially wheat, is of essential importance in Hungarian agriculture. The volume of grain yield and the level of production are important factors in the national economy.

Wheat production is based on the use of up-to-date, high yielding varieties which meet current commercial requirements. The genetic advance in wheat breeding has shown a rapid development during the past twenty years. The efforts of wheat breeders have produced a wide range of varieties for today's agriculture. The genetically determined properties of these varieties /high yielding ability, winter hardiness, quality, resistance to lodging and to various diseases/ can only be manifested through appropriate advanced agronomic technologies.

Among the factors of development in agronomy, the most powerful is the practice of fertilization. Most authors writing on this subject have stated that 30-50% of the two to three-fold increase in wheat grain yields compared to those achieved twenty years ago is due to genetic advance and 50-70% to agronomic development. The major part of the latter can be considered as the result of a rapid growth in fertilizer use.

Several fertilizer application systems are utilized in Hungary, as in other parts of the world. In all these systems nutrient rates are calculated on the basis of soil and/or plant analysis data to meet the nutrient requirements of a certain crop. But there is one factor that fertilizer systems never take into consideration: every species consists of several varieties, and all varieties have different nutrient responses.

In the Agricultural Research Institute the effects of fertilizer use and irrigation were studied in a three-year polyfactorial experiment using 12 winter wheat varieties. Two levels of irrigation and eight levels of fertilization were introduced in a split-split-plot design. The effects of combinations and their interactions were evaluated on agronomic and economic characters.

The experimental results obtained /Fig. 1/ show that the yield averages of all the varieties examined increased parallel with ascending rates of nutrients to a certain level, which was 500 kg NPK/ha under dry conditions and 400 kg NPK/ha under irrigated conditions. Above these levels yield averages dropped. Under irrigated conditions the decrease was slight, while under dry conditions a stronger, well-defined decline could be observed. Irrigation resulted in an average 9% increase in yield compared to the non-irrigated variant.

When evaluating the yield data by means of cluster analysis the varieties examined could be divided into three distinct fertilizer response

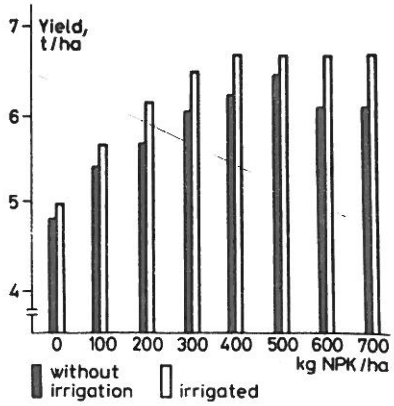

Fig. 1

Effects of irrigation and fertilization on yield /Martonvásár, 1979-1981/

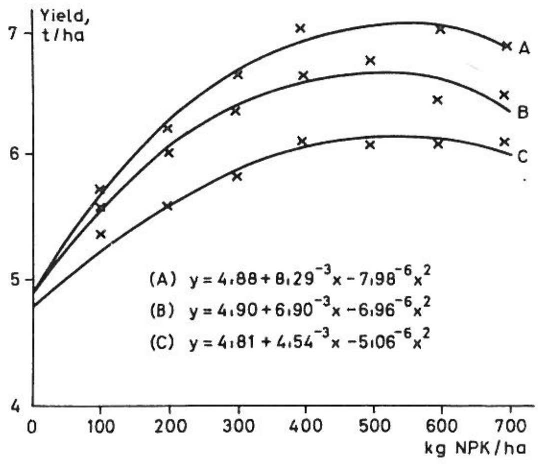

Fig. 2

Fertilizer response groups /Martonvásár, 1979-1981/

groups /Fig. 2/. Group "A" represents varieties with a good fertilizer response /Martonvásári 5 and 9/. The response curve shows a rapid rise until a nutrient level of 500 kg NPK/ha, but above this maximum value the yield decline. Group "B" represents varieties with a medium fertilizer response /Bezostaya 1, Sava, Martonvásári 1, 4, 6, 7 and 8/. The major characteristics of the curve are similar to that for the first group, but at a lower level. The third response group, "C", behaves quite differently. These varieties /NS Rana 2, Yubileinaya 50 and GK Tiszatáj/ show a poor response to nutrients, but yields remain at much the same level after reaching the maximum at 400 kg NPK/ha.

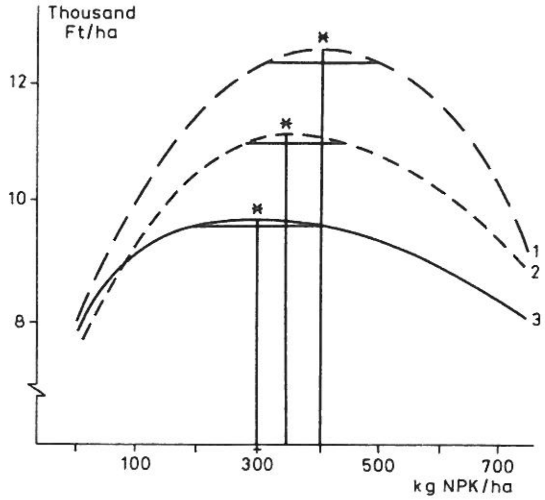

Fig. 3

The level and range of profitability /Martonvásár, 1979-1981/
Fertilizer response: 1. Good /MV 9/; 2. Medium /Mv 4/; 3. Poor /Yubileinaya 50/

The importance of variety differences in fertilizer response can only be judged truly by economic aspects. The diagrams in Fig. 3 show the levels and ranges of profitability in different fertilizer response groups. The data represent profit values calculated on the basis of the net costs of production. The three fertilizer response groups /A, B and C/ represent three well distinguishable levels of profitability. The peak of each curve occurs at a certain value of nutrient rates; however, the possible range of maximum profitability is in negative correlation with the amount of profit. This means that the production of varieties with a good fertilizer response can result in higher profit, but special care and appropriate fertilizer practice are needed. Failing this, the use of unsuitable nutrient rates in group "A" may lead to greater economic losses than would be incurred by using varieties with poorer fertilizer responses.

The three-year trials were conducted on 12 varieties under the ecological conditions of the given experimental location. Consequently, further experiments will be required with the inclusion of more varieties before any general conclusions can be drawn. However, it would appear that differences in fertilizer response due to winter wheat varieties have economic importance. Therefore, the present system of "species fertilizer practice" should be replaced by "variety fertilizing".