CRITICAL CROP MANAGEMENT FACTORS IN SUSTAINABLE MAIZE (Zea mays L.) PRODUCTION

Attila VAD – László ZSOMBIK – András SZABÓ – Péter PEPÓ

University of Debrecen, Agronomy Faculty, Institute of Crop Sciences

Introduction

Maize is a crop playing a decisive role in arable plant production of Hungary. The small grain cereals and maize have together 65-67 % of Hungarian arable land. Maize production has been dramatically changed during the last couple decades. Nowadays it is a basic requirement not only to obtain good agronomic and economic efficiencies but to built up sustainable, environmental friendly crop management based on scientific, experimental results.

According to GYŐRFFY's (1976) findings out of the production factors influencing corn crops the ones listed below had the following shares: fertilization 27 %, variety 26 %, cultivation 24 %, plant population 20 % and deep tillage 3 %.

The nutrient-supply, fertilization have decisive roles in sustainable crop production. The nitrogen is extremely important among macroelements (BERZSENYI and LAP 2005, NÉMETH 2006). The crop rotation can strongly modify the efficiency of fertilization (SÁRVÁRI 1995a). It is an important factor to use optimum plant density in maize production (NAGY 1989, SÁRVÁRI 1995b, BERZSENYI and LAP 2005). The efficiencies of agrotechnical factors on the yields of maize depended on the agrometeorological parameters of cropyears (HUZSVAI and NAGY 2005).

Material and methods

Our long-term experiment was set up in 1983 on a Chernozem soil in Hajdúság (East-Hungary) by prof. László Ruzsányi. From 2004 year the experiment is being supervised and managed by prof. Péter Pepó. The structure of polifactorial long-term experiment is the followings:

- crop rotation: monoculture (maize), biculture (wheat-maize), triculture (peas-wheat-maize)
- fertilization: control, basic dose: N = 60 kg ha^{-1}, P_2O_5 = 45 kg ha^{-1}, K_2O = 45 kg ha^{-1} and its two-, three- and fourhold
- plant density: 40-, 60-, 80 thousand ha^{-1}
- irrigation: $Ö_1$ = non-irrigated, $Ö_2$ = irrigation with half doses, $Ö_3$ = irrigation full doses (up to optimum)

PR 37M81 (Reseda) hybrid was used in our long-term experiment.

The test-experiments of plant density were carried out between 1998-2004 years using 10-15 hybrids every year.

The weed-control experiments were carried out between 1996-2006 years. In this paper we publish the yields of maize and weed-covering of 2004-2006 years.

Results and discussions

Maize is a sensitive field crop to agroecological and agrotechnical factors, too. We have to harmonize the ecological, biological and agrotechnical factors in the sustainable maize

 DOI: 10.1556/CRC.35.2007.2.272

production to obtain optimum yields and yield-stabilities. The key elements of sustainable maize production has been studied for more than twenty years in different mono- and multifactorial long-term experiments on Chernozem soil in Hajdúság. The scientific results of these experiments have proved that the most important, critical elements of sustainable maize production are the followings: crop rotation, fertilization, irrigation, plant density and weed control. The ecological factors (cropyear) can strongly modify the effects of the above mentioned agrotechnical elements.

The multifactorial long-term experiments started in 1983. The *Table 1*. contains the most important average yields between 1986-2006 years. Fairly extreme cropyears can be found during this 21 year long period: the proportion of drought years were 48 %, the average cropyears were 38 % and the rainy cropyears were only 14 %, respectively. The effects of cropyears were significant on the yields of maize in every crop rotation. The yields of control (no fertilizers) varied between 4800-8300 kg ha^{-1} in dry cropyears, 6600-9800 kg ha^{-1} in average cropyears and 8100-11300 kg ha^{-1} in rainy cropyears depending on crop rotation. The maize yields were in optimum fertilizer treatments in the same cropyear types between 5800-8700 kg ha^{-1}, 9600-11400 kg ha^{-1} and 12800-13100 kg ha^{-1}, respectively. We obtained the strongest effects of cropyears in monoculture of maize: the maximum yield was 8,7 t ha^{-1} in monoculture in dry cropyear, but in average cropyear it was 9,6 t ha^{-1}, in rainy cropyear it was 13,1 t ha^{-1} in optimum fertilizer treatments, respectively. The unfavourable effects of drought cropyear were the strongest on maize yields in monoculture and we obtained much more moderated effects on yields in bi- and triculture crop rotation.

The efficiency of fertilization was modified by the cropyear and the crop rotation, too. The yield surpluses of maize were low (400-1000 kg ha^{-1}) in dry cropyears and they were much bigger in average (1400-3000 kg ha^{-1}) and in rainy cropyears (1800-4700 kg ha^{-1}), respectively. The biggest fertilization effects were in monoculture and the lowest ones were in triculture in the average of years (*Table 1.*).

Table 1. The effects of crop rotation, cropyear and fertilization on the yields of maize (Debrecen, chernozem soil, non-irrigated, 1986-2006)

Crop rotation Fertilizer tr.	Yield (kg ha^{-1})					
	Dry cropyear (10 years)		Average cropyear (8 years)		Rainy cropyear (3 years)	
Monoculture						
Control	4 800	1000 *	6 600	3000 *	8 100	4700 *
Nopt+PK	5 800		9 600		12 800	
Biculture						
Control	8 300	400 *	9 100	2300 *	10 300	2100 *
Nopt+PK	8 700		11 400		12 400	
Triculture						
Control	6 700	500 *	9 800	2400 *	11 300	1800 *
Nopt+PK	7 200		11 200		13 100	

* yield-surpluses

According to our findings the following fertilizer doses may be considered as agronomically optimal on Chernozem soil in sustainable maize production:

triculture N = 60-120 kg ha^{-1} + PK
biculture N = 100-140 kg ha^{-1} + PK
monoculture N = 140-180 kg ha^{-1} + PK