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Dr. Márton László
RISSAC, Agrochemistry, Budapest, Hungary (laszlo.marton@gmail.com, +36 1 3558491)

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DR. MÁRTON L. PhD
RISSAC-HAS, Agrochemistry, Budapest, Hungary (marton@rissac.hu, +36 1 3558491)

Summary

Ecological quality has a well established dependence on climate-rainfall changes because the water problems are pressing. There is, therefore, growing concern about the potentially wide ranging risks that climate change would have on these key industries as the nature and extent of anticipated changes have become more evident. It also includes changes in land use and in plant production and their management. These changes are unprecedented in terms of both their rate and their spatial extent. Changes in land use (agrotechnics, soil, cultivation, fertility, quality, protection etc.) and in plant production (plant nutrition-, rotation-, protection-, etc.) are currently the main manifestations. As an interdisciplinary problem it is necessary to study such a complex matter in terms of agricultural production. Generally among natural catastrophes, droughts and floods cause the greatest problems in field crop production. The droughts and the floods that were experienced in Hungary in the early 1980's have drawn renewed attention to the analyses of these problems. New research on climate change-soil-plant systems are focused on yield and yield quality. This paper reports the climate change (rainfall) x soil (acidic sandy brown forest) x mineral N-fertilisation x plant interactions on triticale yields in a long term field experiment set up at Nyírlugos in north-eastern Hungary under temperate climate conditions in 1962. The agrochemical parameters of the soil were as follows: pH (H2O) 5.9, pH (KCl) 4.7, hydrolytic acidity 8.4, hy1 0.3, humus 0.7%, CEC 5-10 mgeq 100*g-1, total N 34 mg*kg-1, AL-P2O5 43 mg*kg-1, AL-K2O 60 mg*kg-1. From 1962 to 1980 the experiment consisted of 2x16x4x4=512 plots and from 1980 of 32x4=128 plots in split-split plot and factorial random block design. The gross plot size was 10x5=50 m2. The average fertiliser rates in kg*ha-1*year-1 were nitrogen 45, phosphorus 24 (P2O5), potassium 40 (K2O), magnesium 7.5 (MgO) until 1980 and nitrogen 75, phosphorus 90 (P2O5), potassium 90 (K2O), calcium 175 (Ca) and magnesium 40 (Mg) after 1980. Nitrogen results are summarised from 1990 to 2001. Main conclusions were as follows: 1. On the basis of „general" (Harnos 1993) and triticale-specific rainfall deficiency values (Márton 2003) the years could be classified as average (1991, 1995, 2000), dry (1993), droughty (1992, 1994, 1996), wet (1997, 1998, 2001) and over wet (1999). 2. In average years the yield of the control plots became stabilised at the 1.4 t*ha-1 level. In the fertilised treatments the highest yield (4.0 t*ha-1) was more than two times the lowest yield (1.9 t*ha-1). N fertilisation resulted in an increase of around 1.0 t*ha-1 in the main yield compared with the control. The triticale yields could only be enhanced economically by full treatment with NPK (3.3 t*ha-1) or NPKCa-, NPKMg-, NPKCaMg (3.9 t*ha-1). 3. Without fertilisation the yield in the dry and drought years was decreased 14% and 36% to that in the average year. In case of the nitrogen treatmets the yield was decreased 45% and 24%. 4. In the wet years on the unfertilised plots the yield declined 14% and in the case of the nitrogen fertilisation the yield no changed than in the average years. In the over wet year the plots yielded similar than in the average years. 5. The relationships between rainfall during the vegetation period, N, P, K, Ca and Mg fertilisation and yield were characterised by second-degree correlation depending on the level of nutrition (R: 0=0.3455**, N=0.2779+, NP=0.4722***, NK=0.3739***, NPK=0.6311***, NPKCa=0.6673***, NPKMg=0.6734***, NPKCaMg=0.6232***). The maximum yield (5.0-6.0 t*ha-1) was yielded at 550-600 mm growth period rainfall. This paper summarises quantified results of triticale research with regarding to interaction effects and relationships between climate (rainfall)-mineral nutrition-crop production changes in Hungary during a long term field experiment to agricultural sustainability.

## Introduction

“Climate Change” are recognized as a serious environmental issues (Johnston, 2000). Presently the build up of greenhouse gases in the atmosphere and the inertia in trends in emissions means that we can expect significant changes for at least the next few decades and probably for the 21th century as well (Márton, 2001a., b). It would badly need to understand what might be involved in adapting to the new climates. A decade ago, researchers asked the „what if” question. For example, what will be the impact if climate changes. Now, we must increasingly address the following question: how do we respond effectivelly to prevent damaging impacts and take advantage of new climatic opportunities. This question requires detailed in information regarding expected impacts and effectíve adaptive measures. Information on adaptation is required for governments, landscape planners, stakeholders, farmers, producers, processors, supermarkets and consumers. Not only the local effects and options, but also the spatial implications must be understood. Will yields be maintained on the present range of farms. Where will new crops be grown. Will new processing plants be required. Will there be competition for water. Most recent agricultural impact studies have concentrated on the effects of mean changes in climate on crop production, whilst only limited investigations into the effects of climate variability on agriculture have been undertaken. The paucity of studies in this area is not least due to the considerable uncertainty regarding how climate variability may change in the future in response to greenhouse gas induced warming but also as a result of the uncertainty in the response of agricultural crops to changes in climate variability, effected most probably through changes in the frequency of extreme climatic events. Showed that changes in variance have a greater effect on the frequency of extreme climatic events than do changes in the mean values. Hence, it is important to attempt to include changes in variability in scenarios of climate change. Weather change at Hungary was started about of 1850. Among the natural catastrophes, drought and flooding caused by over-abundant rainfall cause the greatest problem in plant nutrition and in field crop production nowadays too (José et al., 2001). It is why we found it necessary to revise and to analyse this problem. The triticale is most important crop of many World countries (Márton and Pekli, 2003) but little research in the field of climate change impact assessment has been undertaken. These plant is sensitive to the prevailing weather conditions (rainfall) and, hence, it is important to evaluate the effects of anthropogenic climate change on her production. The crop is demanding indicator of soil nutrient status also. Have a particularly high requirement for supply of soil nitrogen, phosphorus, potassium, calcium and magnesium. From 1990 to 2001 this paper describes climate-rainfall-change and N-mineral fertilisation effects on triticale yield on a acidic sandy brown forest soil at long term experiment scale under temperate climate conditions at Hungary.

## Material and Method

The effect of rainfall quantity and distribution on certain crop fertilisation factors (N, P, K, Ca, Mg and yield) were studied in a long- term field experiment on acidic sandy brown forest soil at North- Eastern Hungary set up in 1962 and 2003. The agrochemical parameters of the soil were as follows: pH ($H_2O$) 5.9, pH (KCl) 4.7, hydrolytic acidity 8.4, hy1 0.3, humus 0.7%, CEC 5-10 mgeq 100*g-1, total N 34 mg*kg-1, AL-$P_2O_5$ 43 mg*kg-1, AL-$K_2O$ 60 mg*kg-1. From 1962 to 1980 the experiment consisted of 2x16x4x4=512 plots and from 1980 of 32x4=128 plots in split-split plot and factorial random block design. The gross plot size was 10x5=50 $m^2$. The average fertiliser rates in kg*ha-1*year-1 were nitrogen 45, phosphorus 24 ($P_2O_5$), potassium 40 ($K_2O$), magnesium 7.5 (MgO) until 1980 and nitrogen 75, phosphorus 90 ($P_2O_5$), potassium 90 ($K_2O$), calcium 175 (Ca) and magnesium 40 (Mg) after 1980 in the form of 25 % calcium ammonium nitrate, 18 % superphosphate, 40 % potassium chloride, calcium carbonate and magnesium sulphate. The groundwater table was at a depth of 2 - 3 m. Ecological (rainfall) and experimental data bases were estimated by Hungarian traditional (Harnos, 1993) and

RISSAC-HAS (Márton, 2003) standards, MANOVA (SPSS) and regression analysis (SPSS).

## Results and Discussion

Nitrogen results are summarised from 1990 to 2001. 1. On the basis of „general" (Harnos, 1993) and triticale-specific rainfall deficiency values (Márton, 2003) the years could be classified as average (1991, 1995, 2000), dry (1993), droughty (1992, 1994, 1996), wet (1997, 1998, 2001) and over wet (1999). 2. In average years the yield of the control plots became stabilised at the 1.4 t*ha-1 level. In the fertilised treatments the highest yield (4.0 t*ha-1) was more than two times the lowest yield (1.9 t*ha-1). N fertilisation resulted in an increase of around 1.0 t*ha-1 in the main yield compared with the control. The triticale yields could only be enhanced economically by full treatment with NPK (3.3 t*ha-1) or NPKCa-, NPKMg-, NPKCaMg (3.9 t*ha-1). 3. Without fertilisation the yield in the dry and drought years was decreased 14% and 36% to that in the average year. In case of the nitrogen treatmets the yield was decreased 45% and 24%. 4. In the wet years on the unfertilised plots the yield declined 14% and in the case of the nitrogen fertilisation the yield no changed than in the average years. In the over wet year the plots yielded similar than in the average years. 5. The relationships between rainfall during the vegetation period, N, P, K, Ca and Mg fertilisation and yield were characterised by second-degree correlation depending on the level of nutrition (R: 0=0.3455**, N=0.2779+, NP=0.4722***, NK=0.3739***, NPK=0.6311***, NPKCa=0.6673***, NPKMg=0.6734***, NPKCaMg=0.6232***). The maximum yield (5.0-6.0 t*ha-1) was yielded at 550-600 mm growth period rainfall.

## References

Harnos, Zs. 1993. Időjárás és időjárás-termés összefüggéseinek idősoros elemzése. In: Aszály 1983 (Szerk.: Baráth, Cs-né., Győrffy, B., és Harnos, Zs.). KÉE. Budapest

Johnston, A. E. 2000. Some aspects of nitrogen use efficiency in arable agriculture. K. Scogs-o. Lantbr. Akad. Tidskr. 139: 8.

José, A. B., Estáquio, M. J., and Márton, L. 2001. Results of Crotalaria ssp. effects on soil conservation. In: Congress on Conservation Agriculture, (Eds Armando, M. V.), ECAF., Madrid, 5, pp 1-4.

Márton, L. 2001a. Climate change and N, P, K, Mg fertilization effect analysis at Tisza-river basin in a long term field experiment. Szent István University, Gödöllő, p. 9.

Márton, L. 2001b. Climate change, N-fertilisation effect on rye (Secale cereale L.) yield in a long term field experiment. In: Rural development-Ecologically farming-Agriculture, (Eds Palkovics, M.), University Veszprém, Keszthely, pp 924-929.

Márton, L. 2002a. Climate-Rainfall Change (CRC) and mineral fertilisation (MF) effects on different crop production. In: Challenges of the new millennium our joint responsibility. (Eds A. Borhidi). MTA ÖBKI. Budapest. 1, pp 110-111.

Márton, L. 2002b. Relationships between rainfall, nutrient supplies and the yield of winter wheat (Triticum aestivum L.). Plant Production 51: 529-542.

Márton, L. 2003. Relationships between rainfall, nutrient supplies and the yield of triticale. Plant Production. In press

Márton, L., and Pekli, J. 2003. Plant production under sub-arctical and temperate climate conditions. SZIU. Gödöllő

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## Adderss of the author

Dr. Márton László Ph.D
Research Institute for Soil Science and Agricultural Chemistry of the Hungarian Academy of Sciences, 1022

H-Budapest, Herman O. u. 15. E-mail:marton@rissac.hu