PRODUCTIVITY AND QUALITY OF MAIZE AND SORGHUM CROPS IN CLIMATIC CONDITIONS OF IALOMITA COUNTY

PARTAL ELENA[1],PARASCHIVU MIRELA[2],OLTENACU CĂTĂLIN VIOREL[3],PARASCHIVU MARIUS[4]

[1]National Agricultural and Development Institute Fundulea
[2]Agricultural and Development Research Station Simnic
[3]University of Agricultural Science and Veterinary Medicine Bucuresti
[4]University of Craiova, Agriculture and Horticulture Faculty

Key words: maize, sorghum, yield, quality, tillage

ABSTRACT

Three conventional tillage methods combined with two fertilizing levels were compared using two different maize and sorghum hybrids in terms of yields and quality yields parameters (test weight and 1000-kernel weight). Autumn plow and N120P70 fertilizing treatment determined the higher yields and quality parameters values for both maize and sorghum. Fertilizing treatment with N120P70 lead to significant yield increases with 11-19 q/ha for maize and 8 q/ha for sorghum. On three years average the best yield results were recorded by Partizan (maize hybrid) and Fundulea 21 (sorghum).

INTRODUCTION

Knowledge of complex relationships between soils, crops and management practices is necessary to develop sustainable agricultural production systems. Different tillage systems can be applied in terms of increasing the level of mechanization and fertilization of crops without affecting yielding capacity. Thus, replacement of plowing by disking to a depth of 10-12 cm for two years didn`t significantly affect maize yield (Sin et al. 1986). There were previous finding which didn`t confirm direct relationships between tillage systems and fertilizing methods, although these measures are very important for crops management especially in areas frequently affected by drought (Tomoroga et al. 1980, Mupangwa et al., 2012). The ecological and technological resources aimed at increasing crops long-term productivity and quality underlying ensures sustainable agriculture (Draghici 2007). In the context of climate change the results obtained by Srivastava et al. (2010) and Byjesh et al. (2010) showed the importance of establishing proper cultural strategies by choosing the correct species that may be cultivated according with climatic conditions of the area concerned. Thus, in dry land areas replacement of maize crop with sorghum represents a viable option which can lead to profit due to sorghum ability to tolerate water and heat stress better than maize and other crops (Franzlubbers and Francis, 1995, Antohe 2007, Srivastava et al. 2010, Byjesh et al. 2010). Previous findings underline the significantly influence of nitrogen fertilization to maize (Ogola et al., 2002) and sorghum (Locke and Hons 1988, Mando et al., 2005) yield and yield components while little work has done about the influents of tillage especially to yield components of these crops. Thus, the aim of this study was to investigate the influence of tillage and nitrogen and phosphorus treatment on the yield and yield quality parameters of maize and sorghum crops in climatic conditions of Ialomita County.

MATERIAL AND METHODS

This study was design to asses maize and sorghum yield quality response to a combination of tillage methods and fertilizing treatments during 2008-2010. The experimental design was a split-plot randomized complete block with three replications. Three conventional tillage methods combined with two fertilizing levels were compared using two different maize and sorghum hybrids. For yield quality evaluation were used the following indicators: test weight (TW) and thousand kernel weight (TKW). Crops yield and quality parameters were determined across all tillage, fertilizing treatments and hybrids combinations in each year. The trail factors were: Factor A (tillage): a1- autumn plow, a2-spring plow, a3- disk

Factor B (fertilizing level): b1- unfertilized, b2- N120P70

Factor C (hybrid): maize hybrids c1-Partizan and c2-Opal;

sorghum hybrids c1-Fundulea 21 and c2- Fundulea 32.

The results were interpreted by analysis of variance.

Climatic considerations during 2008-2010

Of the three experimental years, 2008 was a droughty one characterized by an uneven distribution of rainfall amount (515 mm), 2009 year was a normal one and 2010 year could be considered as a rainy one due to rainfall amount of 740 mm (Fig. 1). In terms of air temperature there were recorded deviations from annual mean value which ranged between +0,1^{o}C and +1,6^{o}C, aspect that influenced the hybrids yielding capacity according with their tolerance to drought stress (Fig.2).

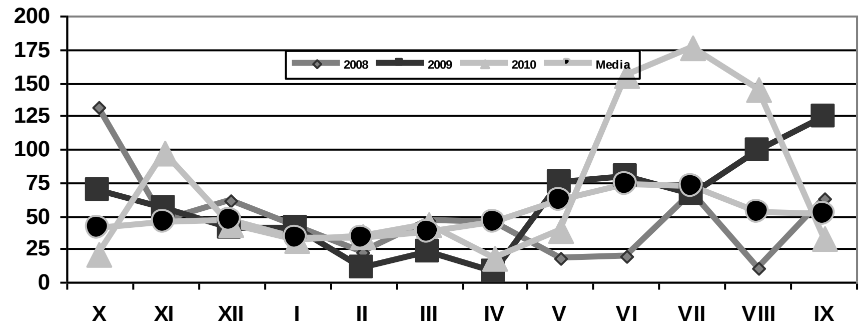

Fig.1 Rainfalls and annual means recorded to Marculesti Station during 2008-2010

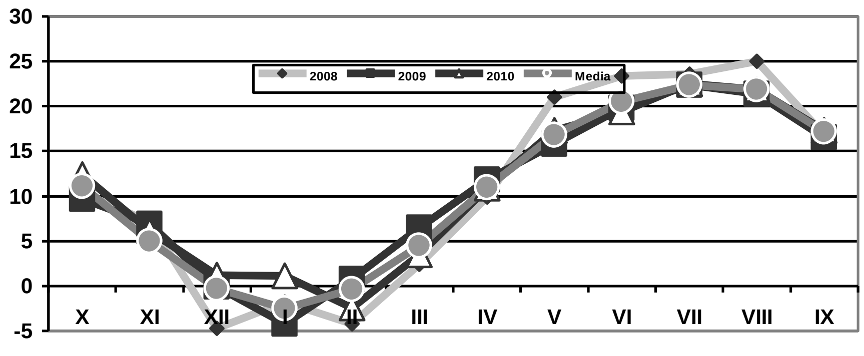

Fig.2. Air temperatures and annual means recorded to Marculesti Station during 2008-2010

RESULTS AND DISCUSSIONS

Tillage is considered the most effective farm activity, improves the physical conditions of soil, which lead to enhance nutrient uptake and better yield of crops (Zorita, 2000, Bahadar et al., 2007). Nitrogen and phosphorus fertilization play a significant role in improving soil fertility and increased crop productivity. The results regarding the influence of tillage, fertilizing treatment and hybrid to maize yield are presented in Table 1. The differences in yields between fertilized and no fertilized were larger for no fertilizing treatment for all tillage methods and maize hybrids. Thus, the highest yield (92 q/ha) was recorded when plowing was done in autumn, comparatively with spring plow (84 q/ha) and dick (67,5 q/ha). In terms of yielding capacity in dry land conditions of Ialomita County the maize hybrid Partizan competed better than Opal. Grain yield were strongly related especially with nitrogen rate and hybrid tolerance to drought stress which is in agreement with previous findings (Zorita, 2000, Costa et al., 2002, Betrán et al., 2003).

Table 1

The influence of tillage, fertilizing treatment and hybrid to maize yield (q/ha)

Variant		Hybrid Partizan Opal		Mean Yield
Autumn plow	unfertilized	76	75	75,5
	$N_{120}P_{70}$	94	90	92
Spring plow	unfertilized	65	61	63
	$N_{120}P_{70}$	86	80	84
Disk	unfertilized	58	53	55
	$N_{120}P_{70}$	70	65	67,5
Mean yield		75	70	72,5

The tillage and fertilizing treatment application significantly affect maize 1000-kernels weight. Thus, the highest TKW values were recorded for both maize hybrids in the conditions of autumn plow and N120P70 fertilizing treatment.

For spring plow and N120P70 fertilizing treatment TKW was 294,0 g for Partizan and 284,6 g for Opal. The lowest TKW values were recorded when were applied disk and N120P70 fertilizing treatment (262,6 g for Partizan and 265, 0 g for Opal) (Fig.3). Tillage and nitrogen and phosphorus application significantly decrease TKW for spring plow and disk variants.

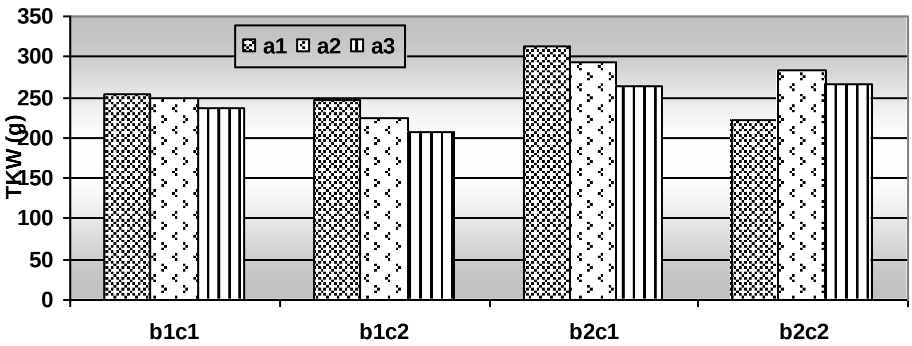

Fig.3 The influence of tillage, fertilizing treatment and hybrid to maize TKW (g)

Autumn plow and N120P70 fertilizing treatment determined also the highest test weight (TW) values for both maize hybrids tested. In the same fertilizing conditions (N120P70) tillage resulted in differences in TW values, 72 kg/hl for Partizan and 73 kg/hl for Opal (spring plow variant) and 70 kg/hl for Partizan and 73 kg/ha for Opal (disk variant) (Fig.4). The maize hybrid didn`t influence significantly test weight values.

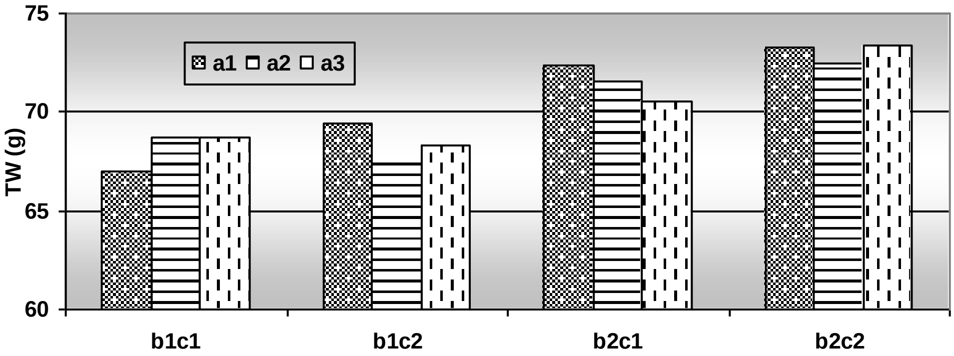

Fig. The influence of tillage, fertilizing treatment and hybrid to maize TW (kg/hl)

The results regarding the influence of tillage, fertilizing treatment and hybrid to sorghum yield are presented in Table 2.

Conventional tillage and fertilizing treatment significantly increased sorghum yield, which is according with previous findings (Locke and Hons, 1988, Mando et al., 2005). Grain yield tended to be higher when crop management included Fundulea 21 hybrid, N120P70 fertilizing treatment and tillage (plowing) realized in autumn (49 a/ha), than when tillage was done in spring (38 q/ha).

For disking and N120P70 fertilizing treatment the highest grain yield was recorded also by Fundulea 21 (36 q/ha) comparatively with Fundulea 32 (28 q/ha). (Fig.3).

Previous findings show that sorghum yields tended to be lower with no-tillage or reduced tillage comparatively with conventional system (Franzluebbers and Francis, 1995, Sainju et al., 2006).

Table 2

The influence of tillage, fertilizing treatment and hybrid to sorghum yield (q/ha)

Variant		Hybrid		Mean yield
		Fundulea 21	Fundulea 32	
Autumn plow	unfertilized	43,67	37,13	40,40
	$N_{120}P_{70}$	49	32	45,50
Spring plow	unfertilized	32	24	28
	N120P70	38	32	35
Disk	unfertilized	29,40	22,40	25,90
	$N_{120}P_{70}$	36	28	32
Mean yield		38	29	33,50

Tillage and fertilizing treatment determined the highest TKW values for the variant with autumn plow and N120P70 (Fig. 3). When spring plow and N120P70 were applied TKW was 23,47 g for Fundulea 21 and 22,4 g for Fundulea 32, while in the conditions of minimum tillage (disking) TKW values were lower respectively 23,2 g for Fundulea 21 and 22,7 g for Fundulea 32. For N120P70 fertilizing treatment and both hybrids TKW mean values were 27,4 g (autumn plow), 22,3 g (spring plow) and 22,5 g (disk).
Fertilizing treatment (N120P70) significantly increased 1000-kernel weight values.

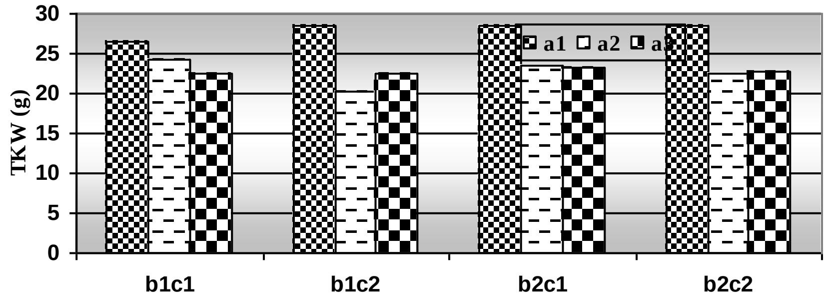

Fig.3 The influence of tillage, fertilizing treatment and hybrid to sorghum TKW (g)

The highest test weight (TW) values were recorded when plowing was done in autumn and sorghum was fertilized with N120P70 for both hybrids.

For the variant with spring plow and N120P70 fertilizing treatment TW values were 39,4 kg/hl (Fundulea 21) and 46,4 kg/hl (Fundulea 32) with significant differences depending on sorghum hybrid.

The hybrid Fundulea 32 performed also better in terms of this quality parameter when minimum tillage was applied together with N120P70 fertilizing treatment.

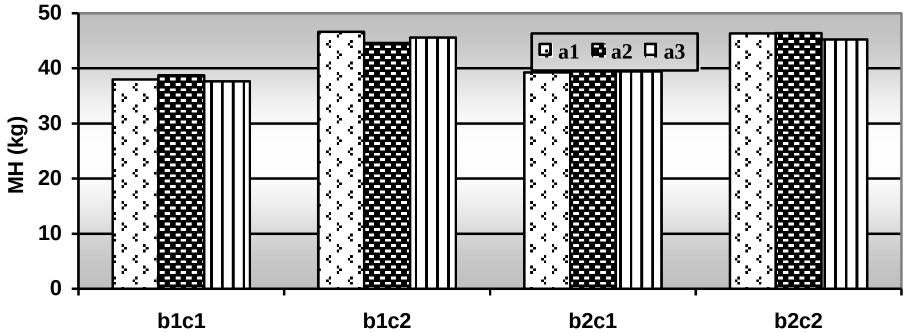

Fig.4. The influence of tillage, fertilizing treatment and hybrid to sorghum TW (kg/hl)

These results are in agreement with previous findings where tillage practices and various fertilizing treatments significantly affected yield and yield quality (Thiagalingam et al., 1991, Costa et al., 2002, Mundo et al., 2005, Khan et al., 2009). However, long-term studies under different soil, climatic conditions and socio-economic conditions still need to be conducted to substantiate the observations made in the reported study.

CONCLUSIONS

Tillage practices and fertilizing treatment (N120P70) had a significant influence to both maize and sorghum yield and yield quality. Autumn plow and N120P70 fertilizing treatment determined the higher yields for both maize and sorghum, while spring plowing and minimum tillage (disking) determined yield decreases with 9-30 q/ha for maize and 9-13 q/ha for sorghum. Fertilizing treatment with N120P70 lead to significant yield increases with 11-19 q/ha for maize and 8 q/ha for sorghum.

On three years average the best yield results were recorded by Partizan (maize hybrid) and Fundulea 21 (sorghum).

The highest values for quality parameters were recorded for both crops in the conditions of autumn plowing and N120P70 fertilizing treatment according with yearly climatic variation and hybrids tolerance to drought stress.

BIBLIOGRAPHY

Antohe, I., - 2007, *Realizări în ameliorarea sorgului la Fundulea*, Analele INCDA Fundulea, vol. LXXV:137-157.

Betrán, F.J., Beck, D., Bänziger, M., Edmeades, G.O. – 2003, *Genetic analysis of inbred and hybrid grain yield under stress and nonstress environments in tropical maize*. CropSci. 43, p.807-817.

Byjesh, K., Kumar, S. N. and Aggarwal, P. K. – 2010, *Simulating impacts, potential adaptation and vulnerability of maize to climate change in India.* Mitigation & Adaptation Strategies for Global Change: 15(5): 413-431.

Costa C., Dwyer L.M., Stewart D.W., Smith D.J. – 2002, *Nitrogen Effects on grain yield and yield components of leafy and nonleafy maize gentypes*. CropSci. 42, p.1556-1563.

Drăghici, I. – 2007, *Implicaţiile fertilizării cu fosfor şi azot asupra sorgului pentru boabe, cultivat pe soluri nisipoase.* In: Lucr. Simp.: Managementul nutrienţilor pentru îmbogăţirea calitaţii culturilor şi conservarea solului.

Franzluebbers, A.J. and Francis, A.J. – 1995, *Energy output: input ratio of maize and sorghum management systems in eastern Nebraska*. Agriculture, Ecosystems & Environment 53, p.271-278.

Khan, A., Jan, M.T., Marwat, K.B., Arif M. – 2009, *Organic and inorganic nitrogen treatments effects on plant and yield attributes of maize in a different tillage systems*. Pak. J. Bot. 41, p.99-108.

Locke, M. A. and Hons, A. – 1988, *Effect of N rate and tillage on yield, N accumulation and leaf N concentreation of grain sorghum*. Soil and Tillage Res. 12, p.223-233.

Mando, A., Bonzi, M., Wopereis, M.C.S., **Lompo, F., Stroosnijder, L.** – 2005, *Long-term effects of mineral and organic fertilization on soil organic matter fractions and sorghum yield under Sudano-Sahelian conditions*. Soiuse and Management 21, p.396-401.

Mupangwa, W., Twomlow, S., Walker, S. – 2012, *Reduced tillage, mulching and rotational effects on maize (Zea mays L.), cowpea (Vigna unguiculata L.) and sorghum (Sorghum bicolor L.) yields under semi-arid conditions*. Field Crop Res. 132, p.139-148.

Ogola, J.B.O., Wheeler, T.R., Harris, P.M., 2002- *Effects of nitrogen and irrigation on water use of maize crops*. Field Crop Res. 78, p.105-117.

Sainju, U.M., Whitehead, W.F., Singh, B.P., Wang, S. – 2006, *Tillage, cover crops and nitrogen fertilization effects on soil nitrogen and cotton and sorghum yields*. Eur. J.Agron. 4, p.372-382.

Sin, G., Ioniţă, S., Drăghicioiu, V., Bondarev, I., Nicolae, H., Boruga, I. – 1986, *Posibilităţi de reducere a lucrărilor solului pentru culturile de grâu, porumb şi floarea-soarelui.* Probleme de agrofitotehnie teoretică şi aplicată, nr.3:15-21.

Srivastava, A., Kumar, S.N., Aggawal, P.K. – 2010, *Assessment on vulnerability of sorghum to climate change in India.* Agric. Ecosyst & Environ. 138, p.160-169.

Thiagalinga, K., Gould, N., Watson, P. – 1991, *Effect of tillage on rainfed maize and soybean yield and the nitrogen fertilizer requirements for maize*. Soil and Tillage Res. 19, p.47-54.

Zorit, M.D. - 2000, *Effect of deep-tillage and nitrogen fertilization interactions on dryland corn (Zea mays L.) productivity*. Soil and Til