

YIELD PERFORMANCE QUALITY OF EIGHT WHEAT GENOTYPES UNDER ORGANIC AND CONVENTIONAL FARMING SYSTEMS IN SAUDI ARABIA

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Abstract

The excessive application of chemical fertilizer and pesticides in the wheat growers in Saudi Arabia causes a negative impact on agriculture production. Therefore, the production of wheat organically may finding a appropriate solution to reduce the irrational use of chemical fertilizer or pesticides. The objective of this study is to evaluated selected wheat genotype under organic and conventional farming systems. The experiment was conducted over 2010 and 2011 growing seasons in the central region of Saudi Arabia. The conventional trial was established at Qassim University Agricultural Research and Experimental Station, while organic trial was established at a certified organic farm. Eight bread wheat genotypes were used in this study. Parameters that collected were: Plants height (cm) grain yield straw yield (tons ha⁻¹), grain filling rate (GFR) (kg/h/d), days to heading (DTH) and days to maturity (DTM). Results showed there was a significant differences ($P < 0.05$) in straw yield between the two systems and among genotypes. No differences in grain yield between conventional and organic systems and among genotypes was found. High grain and straw yields during 2011 versus 2010 growing season was observed. There was a significant differences in plant height between 2010 conventional and organic systems only in local and P3 genotypes. This results confirmed that conventional system recorded a highest plant height during 2011 versus 2010 growing season. Data of grain filling rate (GFR) showed there is a significant differences ($P < 0.05$) between conventional and organic system. A variation between wheat genotypes was observed in E-line and YR had the grater GFR while the lowest was P5, P3 and local genotypes. 2001 growing season showed a greater GFR over 2010.

Key words: Wheat genotype, conventional system, Organic system, Yield performance, quality

INTRODUCTION

The continued use of chemical fertilizers causes environmental hazards. Organic agriculture, can be defined as a system that prohibits the use of synthetic fertilizers, chemical pesticides and genetically modified organisms. However, the major challenge of organic farming system is to maintain high yield and excellent quality utilizing farming practices that have acceptable environmental impacts. Several trials were conducted to compare organic and conventional farming systems. These studies were shown there is a significant lower yields for organic versus conventional system (Ryan et al.2004 and Stanhill 1990). In a long-term study in Sweden, Kirchmann et. Al (2007) compared organic and conventional agriculture in barley (*Hordeum Vulgare*), wheat (*Triticum aestivum*) and some other crops, the study proved that there is a disparity in productivity between crop and another and between organic and conventional systems. Other studies showed that there is a difference in wheat varieties response in crop performance and quality attributes under organic farming and traditional with varieties respond better under organic farming (Nass et al., 2003, Carr et al.2006 and Mason et al., 2007; Murphy et al.2007). In Saudi Arabia, organic system was introduced recently with emphasis in vegetable crops. However, there has been no research to evaluate in field crops under organic system in Saudi Arabia. Therefore, the aim of this study was to assess yield performance of eight wheat genotypes under organic and conventional farming systems under the environmental condition of the central region of Saudi Arabia.

MATERIALS AND METHODS

Organic and conventional trials were conducted over 2010 and 2011 growing seasons at two different locations. (1)- **Conventional Trial** established at Qassim University Agricultural Research Station (26° 18' 28" N, 43° 46' E). This trial was treated according to standard agriculture application, including the use chemicals and inorganic fertilizer. (2)- **Organic Trial** established at The Research Center for Organic Agriculture. Belongs to Ministry of Agriculture in the city of Unaizah at Qassim province (26° 18' 28" N, 44° 46' E), which is considered a certified organic farm. The organic trial treated according to an organic system regulations set by Ministry of Agriculture

in Saudi Arabia. In each location, eight bread genotypes were seeded in a randomized complete block design (RCBD) with four replications using 3 m² plot (1.5*2m). Seeding rate 45 seeds per plot. Measurements parameters that collected were: Plants height (cm) straw yield and grain filling rate (GFR) (kg/h/d), days to heading (DTH), days to maturity (DTM). Table 1 listed the eight wheat genotypes used in this study..Analysis of variance (ANOVA) was performed, and the eight wheat genotypes means were compared using the least significant differences (LSD) at $P<0.05$. Coefficient of variation (CV) was listed to measure the precision of the trial The collected data for all variables were statistically analyzed MSTATC microcomputer program (MSTATC, 1990). The maximum air temperature during 2011 growing season (Jan to April) were below 2010 growing season. In the same time 2011 season was above the 27-year average (Fig1).

Table 1.Description of the of the eight wheat genotypes used in this study

No	Genotype name	Genotype source
1	*Y R (Yocora Rojo)	USA
2	**Local	KSA
3	P3	Australia
4	P5	Australia
5	IC8	ICARDA
6	IC17	ICARDA
7	E. Line	Egypt
8	Sids 12	Egypt

* Yocora Rojo (YR): - commercial genotype grow commonly in Saudi Arabia. **: local genotype named Sama. KSA: Kingdom of Saudi Arabia. ICARDA: Center for Agricultural Research in the Dry Areas

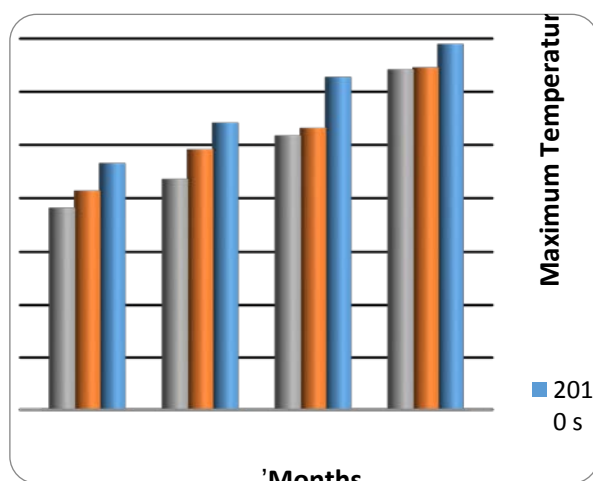


Fig 1 Monthly Maximum air Temperature during 2010 and 2011 growing seasons.

RESULTS AND DISCUSSION

Grain and Straw Yields.

Our finding results showed there was no differences between conventional and organic systems and among genotypes . In contrast, significant differences ($P<0.05$) was founded in straw yield between conventional and organic systems and among wheat genotypes. A high grain and straw yields during 2011 versus 2010 growing season was observed. This may due to suitable cold and dry weather condition during 2011 growing season that help to increase Grain Filling Rate (GFR),which reflected the total yields.(Table 2).

Table 2. Differences in grain yield and straw yield ($t\ h^{-1}$) between the two agriculture systems over two growing seasons

Genotype	grain yield ($tons\ ha^{-1}$)				straw yield ($tons\ ha^{-1}$)			
	C-2010	Or-2010	C- 2011	Or-2011	C-2010	Or-2010	C- 2011	Or-2011
Y R	4.8	4.1	9.6	8.5	7.0	4.7	11.4	10.7
Local	2.3	3.2	6.8	4.9	7.5	9.2	17.9	15.6
P3	3.7	3.3	8.6	6.3	8.2	6.4	13.4	11.7
P 5	3.3	3.2	8.6	6.1	7.8	6.3	14.4	12.8
IC 8	3.3	3.7	9.3	6.5	7.7	7.2	13.8	11.0
IC 17	3.6	4.0	9.7	5.8	8.2	5.9	14.9	11.5
E. Line	4.9	4.0	9.2	8.6	7.8	5.4	10.4	9.5
Sids 12	5.2	4.1	9.1	6.9	9.4	6.6	13.4	10.9
LSD	1.3				2.2			

C= conventional. Or= Organic

Plant height.

Plant height data showed there was a significant differences between 2010 conventional and organic systems only in local and P3 genotypes. In 2011 growing season, there was a significant differences in local, P5, IC 17 and Sids 12 genotypes. Local genotype recorded the highest plant height under conventional system over all genotypes. This results confirmed that conventional system recorded a highest plant height during 2011 versus 2010 season (Fig. 2).

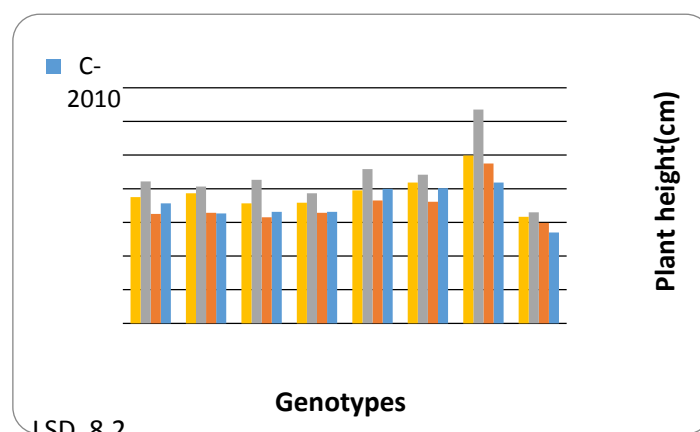


Fig. 2. Differences in plant height (cm) between the two agriculture systems over two growing seasons.

Grain Filling Rate (GFR) ($kg/h/d$).

Data of grain filling rate showed there is a significant differences ($P < 0.05$) between conventional and organic system. A variation between wheat genotypes was observed (Fig.3). E-line and YR had the greater GFR while the lowest was P5, P3 and local genotypes. 2001 growing season showed a greater GFR over 2010. As indicated, suitable cold and dry weather condition during 2011 growing season help to increase Grain Filling Rate (GFR).

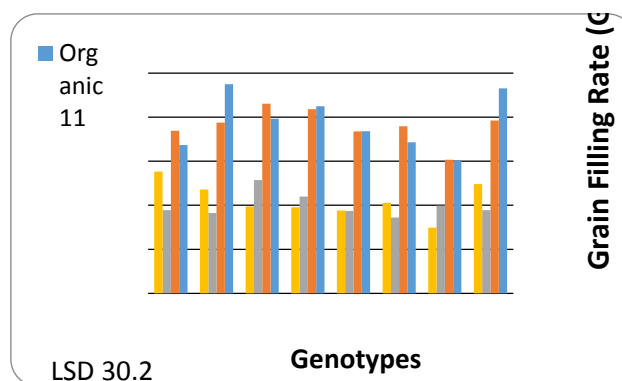


Fig.3 Differences in grain filling rate (GFR) (kg/h/d) between the two agriculture systems over two growing seasons

Days to heading (DTH) and Days to maturity (DTM).

Organic system had a long period to heading (DTH) than conventional system. DTH in Organic system were greater than in conventional by approximately 7 to 11% and 10 to 17% for 2010 and 2011 growing season, respectively. There is a significant differences ($P < 0.05$) between the two agriculture systems and among wheat genotypes (Table 3). Data from Days to maturity (DTM) showed a significant differences ($P < 0.05$) between the two agriculture system and among wheat genotypes (Table 3). Organic system had a long Days to maturity (DTM) than conventional system only in 2010 growing season. Unlike 2010, data of 2011 growing season showed that organic system had lowest DTM than conventional system in all wheat genotypes. This results provided a trend of lowest DTM in all genotypes for organic systems during 2011.

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Table 3. Differences in Days to heading (DTH) and Days to maturity (DTM) (days) the two agriculture systems over two years period

Genotype	DTH (days)				DTM (days)			
	C-2010	Or-2010	C- 2011	Or-2011	C-2010	Or-2010	C- 2011	Or-2011
Y R	64.0	71.3	73.0	76.3	104.0	114.3	122.0	112.7
Local	84.0	92.3	86.3	95.3	115.3	124.7	131.0	127.7
P3	73.0	79.7	80.0	86.7	109.0	118.0	125.3	123.3
P 5	75.3	83.3	80.0	90.0	110.3	118.0	127.0	123.0
IC 8	77.7	83.7	82.0	92.7	111.0	117.7	126.3	123.0
IC 17	77.0	87.0	81.7	95.7	113.3	117.7	126.7	125.3
E. Line	58.7	66.0	66.0	72.3	100.7	110.3	113.3	108.7
Sids 12	65.0	70.0	76.3	80.0	102.3	113.0	126.3	121.0
LSD	2.3				2.7			

C= conventional Or= Organic

CONCLUSIONS

This study demonstrated a variation between conventional versus organic systems in all parameters, which was included grain filling rate, plants height (cm) and grain yield, straw yield, days to heading (DTH) and days to maturity (DTM). A variation between wheat genotypes was observed in E-line and YR had the greater GFR while the lowest was P5, P3 and local genotypes. 2001 season showed a greater GFR over 2010. Cold and dry weather condition during 2011 growing season help to increase Grain Filling Rate (GFR). Finally different in DTH and DTM between organic and conventional systems.

REFERENCES

- Carr PM, Kandel HJ, Porter PM et al (2006) Wheat cultivar performance on certified organic fields in Minnesota and North Dakota. *Crop Sci* 46:1963-1971.
- Kirchmann, H., L. Bergström T Kätterer and S Gesslein. 2007. Comparison of Long-Term Organic and Conventional Crop–Livestock Systems on a Previously Nutrient-Depleted Soil in Sweden online. *Agron. J.* 99:960-972.
- Mason HE, Navabi A, Frick BL et al (2007d) The Weed-Competitive Ability of Canada Western Red Spring Wheat Cultivars Grown under Organic Management. *Crop Sci* 47:1167-1176.
- MSTATC (1990) A microcomputer program for the design, Management, and Analysis of Agronomic Research Experiments. Michigan State University East Lansing, MI, USA
- Murphy KM, Campbell KG, Lyon SR et al (2007) Evidence of varietal adaptation to organic farming systems. *Field Crops Res* 102:172-177.
- Nass HG, Ivany JA, MacLeod JA (2003) Agronomic performance and quality of spring wheat and soybean cultivars under organic culture. *Am J Altern Agric* 18:164-170
- Ryan, M.H., Derrick, J.W., Dann, P.R., 2004. Grain mineral concentrations and yield of wheat grown under organic and conventional management. *J. Sci. Food Agric.* 84, 207–216.
- Stanhill, G., 1990. The comparative productivity of organic agriculture. *Agric. Ecosyst. Environ.* 30, 1–26.