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Management of Sprinkler Irrigation System and Different Egyptian Wheat Varieties for Monitoring Quality Properties

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Abstract: This field research work was carried out during two successive seasons to study the response of four Egyptian wheat varieties (Giza 168, Sids 12, Misr 1, and Misr 2) at three water consumptive use levels (100, 75, and 50 %) from (ETc) on some technological quality properties. The design experiment was factorial in complete randomized blocks with three replications. The results could be summarized as follows: Wheat quality properties: % net flour, % of grain protein, % fat, and % total sugar in flour, Field capacities were increased under Sids 12 relative to Giza 168, Misr 1 and Misr 2 verities. Dough quality evaluation (Farinograph) parameters, the values for the water absorption increased from 58.97% at 50% ETc to 64.32% for 100% ETc, and maximum value with Misr1 variety. Mixing tolerance (B.U.) values reached (133.5, 137 and 139.5 B.U) for ETc levels at 50, 75 and 100%, respectively. Dough period (min) and dough stability (min) values of the wheat flour sample were (1.66 &2.08), (1.74 & 2.14) and (1.78 & 2.13 min) at 50, 75 and 100% of ETc levels respectively. It could conclude that: treatment of 50 % from ETc applied gave the highest values and it was high in the significant differences between results values, so that for best grain quality production purpose using applied water 50 and 75 % with a varieties of Giza 168 and Sids 12. For better flour we can recommend using 50 or 75 % applied water and verity of Sids 12 and Misr 1.

Keywords: *Sprinkler Irrigation System, Wheat, Egyptian Varieties, Production, Technological Quality Properties.*

1. Introduction

Grain yield of wheat quality is defined in terms of specific properties that determine suitability for milling and bread production [1]. Wheat crop (*Triticum spp.*) is the most important cereal crop in the world in terms of area and production; it is a stable food for more than one third of the world population. In Egypt, wheat is the main winter cereal crop; it is used as a stable food grain for urban and rural societies. The wheat area over the last 10 years (2004-2014) has been expanded from (0.18-0.25 million ha) and the average productivity per ha has been increased from 6.4 to 8.8 million tons during that period.
Protein is a primary quality component that influences the most of wheat grain baking quality characteristics. In hard wheat, the majority of the variation in loaf volume of bread can be attributed directly to differences in protein concentration [2]. Flour protein percentage is a good predictor of loaf volume, which itself is a function of the environmental conditions under which the crop is grown [3]. [4] Found that determination of grain protein is only one test of flour quality and additional information is needed. The physical properties of wheat-flour dough such as extensibility and resistance to extend influence its mixing behavior very strongly. These properties, called rheological properties, are highly heritable [3]. Rheological tests (farinorgam and extension-gram) are carried out on unfermented dough and can be subdivided into tests, which give information about water absorption, mixing requirements and dough behavior. Water absorption is an important quality factor in Agronomy Research 8 (Special Issue III),637–644, 2010 638 the baker as it is related to the amount of bread what can be produced from a given weight of flour. It also has a profound influence on crumb softness and bread keeping characteristics [5]. The baking test is therefore the most useful test available for determining the practical value of a particular flour sample. Traditionally, loaf volume has been considered as the most important criterion for the bread-making quality. Bread-making quality of a variety usually reacts like other quantitative

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characteristics to favorable or unfavorable environmental conditions and varies its performance. It is unrealistic to expect the same level of performance in all environments [6]. For the milling and baking industry, it is desirable that quality traits should be maintained as stable as possible through all environments. There exit different concepts of stability definite. According to static concept (called also as biological) stable genotypes possess unchanged or constant performances regardless of any variety of environmental conditions. A genotype is considered to be stable if its among-environment variance is small [7]. Parameter used to describe this type of stability is the coefficient of variation (CV) used by [8].This measure depends on the diversity of the environments in the experiments. In the terms of relative stability we compare genotype quality trait with other genotypes in certain environments for using PI (cultivar performance) value for example. [9] Defined PI of genotype as the mean square distance between genotype (i) and the genotype with the maximum response. The smaller the estimated value of Pi the less its distance to the genotype with maximum value, and thus the better the genotype [10]. The genotype response to the environment is multivariate, yet the parametric approach tries to transform it to invert the problem via stability characters. There is possible to cluster genotypes according to their response structure. This represents shifts from ranking stability by a quantitative measure to assigning genotypes into qualitatively homogeneous stability subset [7].

The Farinograph test is described by ISO 5530, the method is applied to winter wheat. The resistance of the dough is evaluated by the Farinograph test, which means the evaluation of behavior of dough against mixing at a specified constant speed with specified water addition (ISO 5530-1:2013). Parameters determined by 5530 are consistent, Farinograph unit (FU), water absorption capacity of flour, dough development time, stability, mixing tolerance index and Farinograph quality number (FQN) [11]. The different baking products require wheat flours with different quality.

Winter wheat (*Triticum aestivum L.*) and maize (*Zea mays L.*) are considered from the main crops in the region of Nubaria. Available irrigation water for crop yields has been pumped from the The Nile River or from Ground water, and average crop yield has substantially increased. However, recently there has been a rapid decline in available water resources from the Ground water, there is an urgent need for more efficient water use in order to sustain agriculture in the area or Nubaria region [12], [13] and [14]. Scheduling of irrigation times is then more complex because irrigation operations must be based on the relationships between climate conditions, crop growing stages, water requirements (ETc) and crop gross water applied. Alternative irrigation intervals must be assessed to determine which irrigation schedule highest crop yield and water productivity (WP) for a given amounts of irrigation water [15], [16] and [17].

Use of sprinkler irrigation, where smaller amounts of water can be uniformly applied to fields, further helps to achieve higher water use efficiencies [18]. Crops sprinkled with low quality water are exposed in two ways that salts can affect plant growth and yield: direct salt adsorption through the leaves as well as increased soil salinity [19]. The use of the line source sprinkler method has been advocated for obtaining salinity production functions under such conditions [20]. With this method, it is possible to determine the separate and interactive effects of the quantity and salinity of applied water on crop yields. Therefore, the double-line sprinkler source was used for two growing seasons to determine the water–yield relations of wheat (*Triticumaestivum L.*) for two different types of marginal quality waters i.e. saline and alkali waters.

The aim of this research is studying the effect of different water amounts, 100, 75, 50 % from crop water consumptive use (ETc) and four wheat varieties (Giza 168; Sids 12, Misr 1, and Misr 2) to on some quality properties.

2. Materials and Methods

The present investigation was conducted at the National Research Centre, El-Noubaria Research Station El-Behaira Governorate, during the two successive seasons of 2012/2013 and 2013/2014 to study the effect of the effect of different water amounts, 100, 75, 50 % from crop water consumptive use (ETc) and four wheat varieties (Giza 168; Sids 12, Misr 1, and Misr 2) to on monitringl some quality properties.

Some soil physical, chemical and water properties of the studied soil are carried out after [21] and moisture retention at field capacity and wilting point after [22]. Soils of both investigated sites were sandy loam in texture. Some soil chemical characteristics of the studied two sites were recorded in **Table 1**. Analysis farmyard manure used in the experiments was as follows: 4.85 dSm^{-1} (EC, 1:20), 7.77 (pH, 1:20), 11.2% (OM), 5.4, 0.85 and 1.12% total (N, P and K) and 1:16.5 (C:N ratio).

Technological Quality Properties:

Moisture, fat, protein and ash contents were determined according to the standard methods of the [23]. The total sugar was calculated by difference according to [24] as the following: Total sugar (%) = [100 – (moisture (%) + crude protein (%) + total lipids (%) + ash (%)].

Farinograph (Brabender GmbH and Co. Duisburg, Germany) was used to estimate dough quality parameters according to [25]. A 300 g sample at 14 % moisture content was weighed and placed into the corresponding Farinograph mixing bowl. Water was added to the flour and mixed to form dough, then the dough is mixed, the Farinograph records a curve on graph paper. The amount of added water (absorption) affects the position of the curve on the graph paper. Less water increases dough consistency and moves the curve upward. The curve is centered on the 500-Brabender unit (BU) line 20 BU by adding the appropriate amount of water and is run until the curve leaves the 500-BU line. Dough Period (min), Dough stability (min), mixing tolerance (B.U.) and Water absorption (%) were analyzed.

Main factors and treatments mean were compared using the technique of analysis of variance (ANOVA) and the least significant difference (LSD) between systems at 1 %, [26].

3. Results and Discussion

Effect of water applied amounts and wheat varieties on wheat quality:

The results in Table (2) and Figures (1) and (2) illustrates that the effect of three levels (50, 75 and 100 %) from ETc on quality parameters as follows: % net flour, % of grain protein, % of fat, and % total sugar in flour. Regarding ETc, means values of % net flour, % of grain protein, % of fat, % total sugar and % wet gluten in flour and % dry gluten in flour, It could arrange in the following ascending order: 50<75<100. Results in Tables (2) and Figures (1) and (2) illustrates that the effect of wheat varieties (Giza 168, Sids 12, Misr 1 and Misr 2) on quality parameters as follows % net flour, % of grain protein, % of fat, and % total sugar in flour. With respect to wheat varieties, % net flour% of fat and % total sugar could be arranged in the following descending order: Giza 168 >Sids 12 >Misr 1 and >Misr 2. While % grain protein, % wet gluten in flour and % dry gluten in flour could be arranged in the following ascending order: Giza 168 <Sids 12 <Misr 1 and <Misr 2. The maximum values in (% net flour, % of grain protein, % of fat, and % total sugar in flour) were recorded under interactions of (120 X Giza 168, 120 X Misr 2, 120 X Giza 168, 120 X Giza 168, 120 X Misr 2 and 120 X Misr 2), respectively. Whereas the minimum values were recorded under interactions in (60 X Misr 2, 60 X Giza 168, 60 X Misr 2, 60 X Misr 2, 60 X Giza 168 and 60 X Giza 168), respectively.

Concerning the effect of ETc and wheat varieties on % net flour, % of grain protein, % of fat, and % total sugar in flour, there were significant differences at the 5 % level of all interactions. According to LSD 0.05 values of % net flour, % of grain protein, % of fat, and % total sugar in flour, the effect of field capacities and wheat varieties at all, there are significant differences at the 5 % level between all values..

Data in Table (2) and Figures (1) and (2) shows that the effect of three levels 50, 75, 100 % from ETc on wheat quality parameters as follows: % net flour, % of grain protein, % of fat, and % total sugar in flour. Regarding main factor ETc, means values of % net flour, % of grain protein, % of fat, and % total sugar in flour, It could arrange in the following ascending order: 50 <75< 100.

Table 1: Effect of Evapotranspiration (ETc) levels and wheat varieties on grain quality properties.

Water use ETc (%)	Wheat cultivars	% of net flour	% of grain protein	% of fat	% of total sugar
100	**Giza 168**	69.82	8.59	2.20	1.10
	Sids 12	69.04	8.86	1.92	1.02
	Misr 1	70.48	11.64	1.75	0.81
	Misr 2	74.02	11.87	1.64	0.69
Mean		**73.00**	**10.24**	**1.88**	**0.91**
75	**Giza 168**	71.80	9.81	2.55	1.34
	Sids 12	70.99	10.05	2.35	1.21
	Misr 1	72.45	13.02	1.97	0.91
	Misr 2	76.14	13.27	1.79	0.79
Mean		**74.60**	**11.54**	**2.16**	**1.06**
50	**Giza 168**	73.65	10.66	3.51	1.56
	Sids 12	72.98	11.07	3.16	1.45
	Misr 1	74.35	13.75	2.79	1.33
	Misr 2	74.03	14.04	2.37	1.04
Mean		**72.91**	**12.38**	**2.96**	**1.34**
Mean	**Giza 168**	71.76	9.69	2.75	1.33
	Sids 12	71.01	9.99	2.48	1.23
	Misr 1	71.25	12.80	2.17	1.02
	Misr 2	71.01	13.06	1.93	0.89
$LSD_{0.05}$ for ETC Means		**1.24**	**0.70**	**0.27**	**0.13**
$LSD_{0.05}$ for Cultivars Means		**0.64**	**0.21**	**0.10**	**0.06**
$LSD_{0.05}$ for Interaction		**1.24**	**1.12**	**0.12**	**0.06**

The interaction between field capacities and wheat varieties had a significant effect on % net flour and the maximum values of % net flour (75.69 and 76.58 %) were obtained by Giza 168 wheat variety irrigated by ETc. In respect of % of grain protein, increases gradually were noticed by increasing ETc, where application of 50% ETc achieved the maximum % of grain protein. The high of % of grain protein, variety Giza 168 significantly exceeded the results of verities (Sids 12, Misr 1, and Misr 2) were produced the highest % of grain protein.

The interaction between ETc and wheat varieties had a significant effect on % of grain protein and the maximum values of % of grain protein were obtained by Giza 168 wheat variety irrigated by 50 %ETc. The increasing of protein with increasing nitrogen fertilizer levels may be due to nitrogen element in formations of amino acid structure.

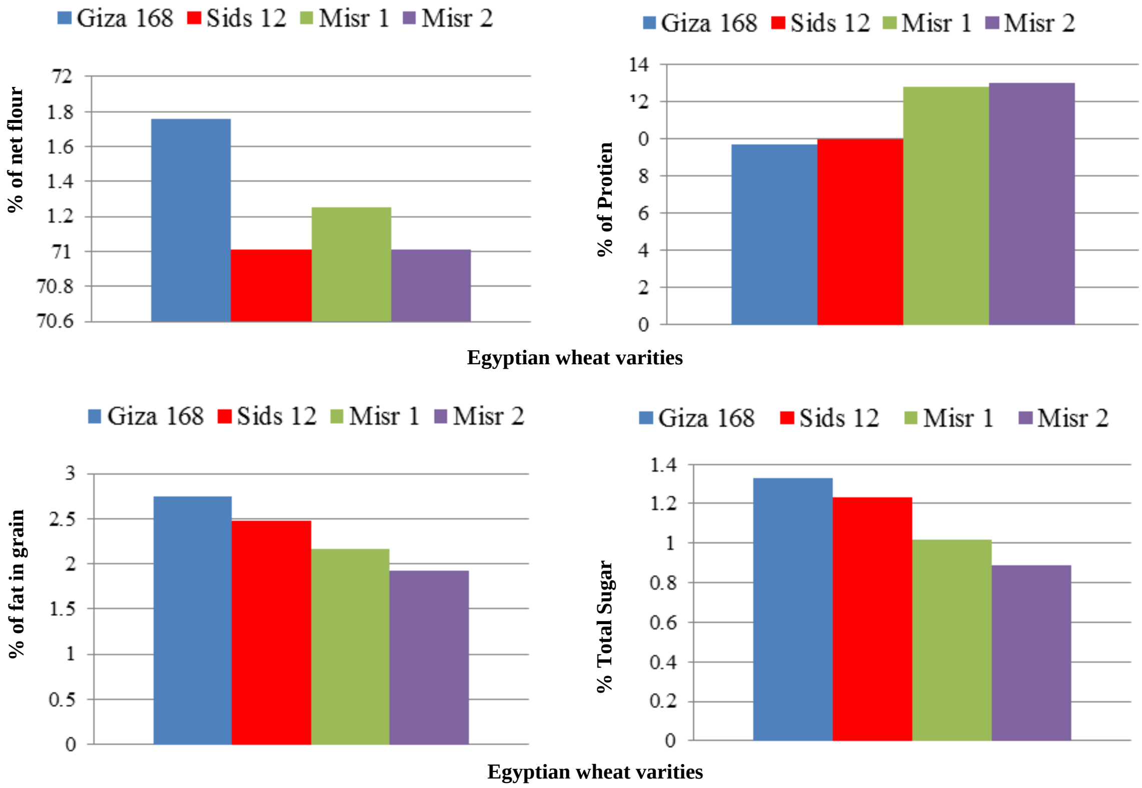

Figure 1: Effect of Egyptian varieties on grain quality properties

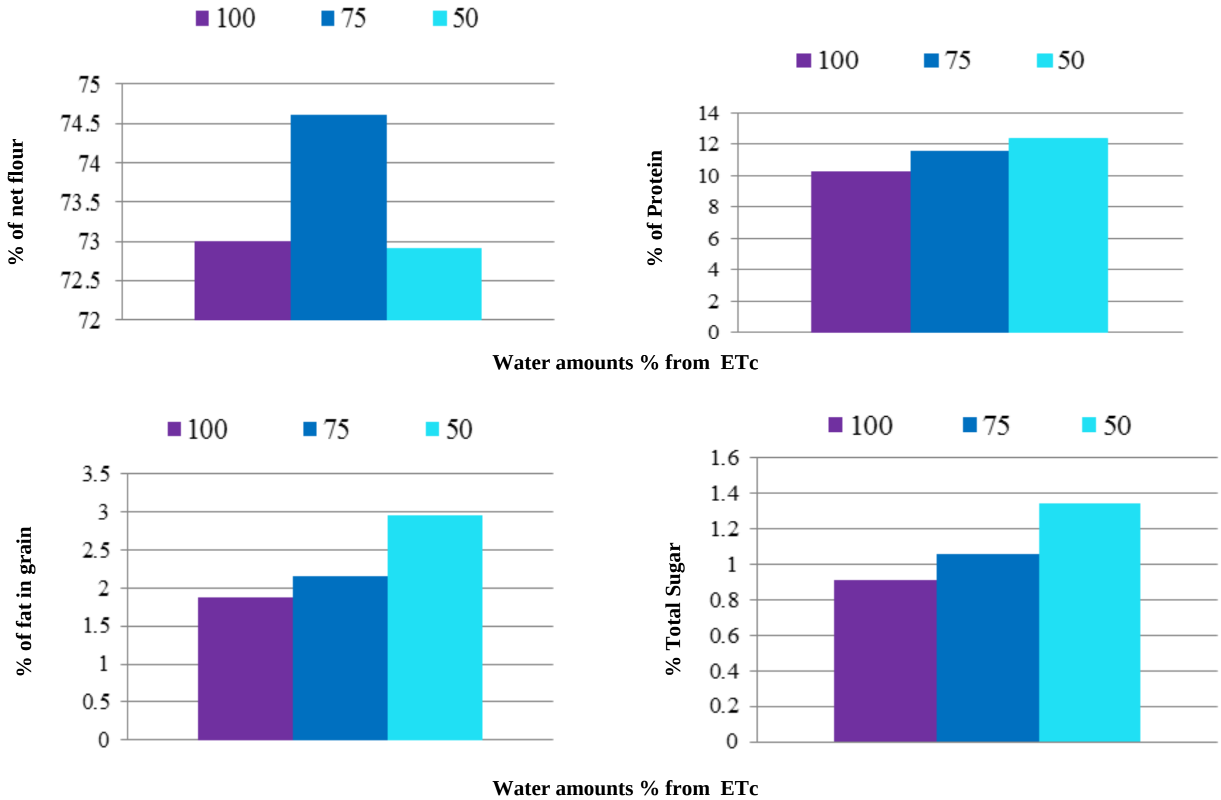

Figure 2: Effect of water amounts from ETc on grain quality properties

Table 2: Effect of Evapotranspiration (ETc) levels and wheat varieties on dough quality.

ETc (%)	Varieties	Dough Period (min)	Dough stability (min)	B.U. mixing tolerance	% of water absorption
100	**Giza 168**	2.6	2.2	147	59.92
	Sids 12	2.3	2.2	183.5	64.46
	Misr 1	1.7	2.1	118	69.92
	Misr 2	1.3	2.0	108.5	62.97
Mean		**1.78**	**2.13**	**139.5**	**64.32**
75	**Giza 168**	2.6	2.2	144	58.42
	Sids 12	2.3	2.1	179.5	61.01
	Misr 1	1.7	2.1	116	68.38
	Misr 2	1.3	2.0	108.5	61.17
Mean		**1.74**	**2.14**	**137**	**62.25**
50	**Giza 168**	2.4	2.2	139.5	54.15
	Sids 12	2.3	2.1	177	59.41
	Misr 1	1.7	2.1	112	65.42
	Misr 2	1.2	2.0	105	56.87
Mean		**1.66**	**2.08**	**133.5**	**58.97**
Mean	**Giza 168**	2.5	2.2	143.5	57.51
	Sids 12	2.3	2.1	180	61.65
	Misr 1	1.7	2.1	115	67.91
	Misr 2	1.3	2.1	108	60.33
$LSD_{0.05}$ for ETC Means		**0.03**	**0.008**	**2**	**0.73**
$LSD_{0.05}$ for Cultivars		**0.25**	**0.012**	**3.5**	**2.04**
$LSD_{0.05}$ for Interaction		**0.025**	**0.01**	**1.5**	**1.06**

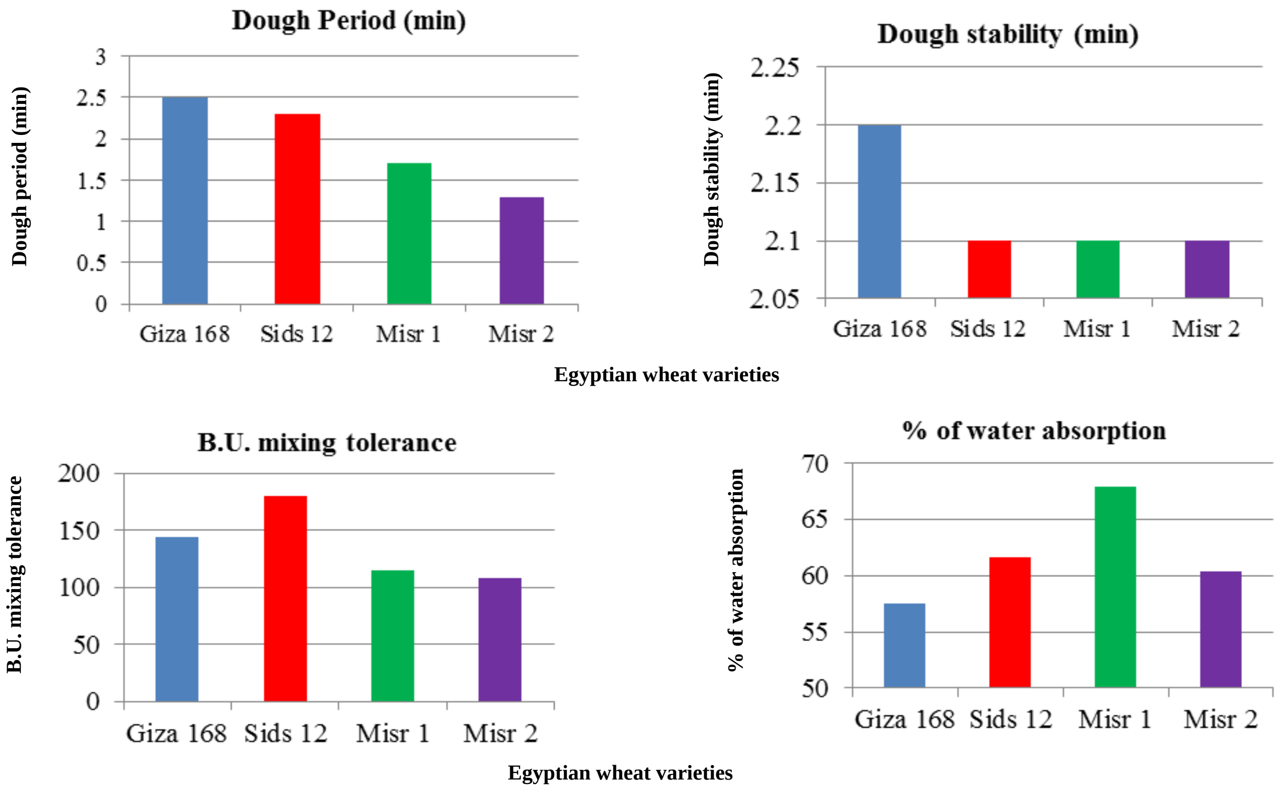

Figure 3: Effect of Egyptian wheat varieties of Farinograph properties

From Table (2) regarding LSD 0.05 of % net flour, % of grain protein, % of fat, and % total sugar, the effect of ETc and wheat varieties at all, there are significant differences at the 5 % level between all values. Concerning the effect of field capacities and wheat varieties on % net flour, % of grain protein, % of fat, and % total sugar in flour, there were significant differences at the 5 % level of all interactions. The increasing of quality parameters with increasing nitrogen fertilizer levels may be due to nitrogen element in formations of amino acid structure. The maximum values in (% net flour, % of grain protein, % of fat, and % total sugar in flour) had were recorded under interactions of (50% ETC X Giza 168, 50% ETc X Misr 2, 50% ETc X Giza 168, 50% ETc X Giza 168, 50% ETc X Misr 2 and 50% ETc X Misr 2), respectively. Whereas the minimum values were recorded (69.93, 9.15, 1.75 and 0.86 %) under interactions of (100% ETc X Misr 2, 100% ETc X Giza 168, 100% ETc X Misr 2, 100% ETc X Misr 2, 100% ETc XGiza 168 and 100% ETc X Giza 168), respectively.

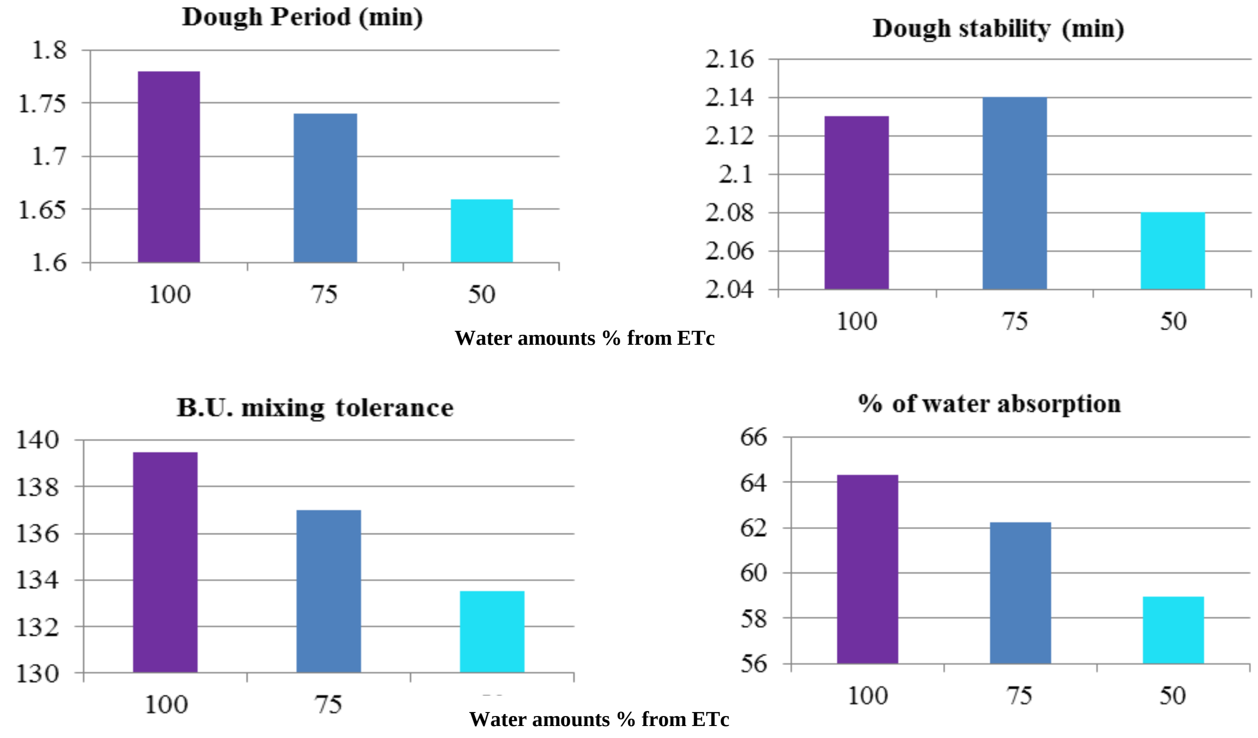

Figure 4: Effect of water amounts % from ETc on Farinograph properties

In Table (2), it is noticed that (% net flour, % of grain protein, % of fat, and % total sugar), the increasing of quality parameters with decreasing ETc levels may be due to concentrations of applied fertilizers of NPK and other elements in the sandy soils with lowest ETc and more leaching whenever increasing of levels ETc such as 75 and 100%. All measured values of dough quality evaluation (Farinograph) of wheat flour samples are shown in Table (3) and Figures (3) and (4) and as can be clearly seen, there were differences between ETc levels and wheat varieties. The values for the water absorption increased from 58.97% at 50% ETc to 64.32% for 100% ETc, and maximum value with Misr1 variety. The same phenomenon was also observed for mixing tolerance (B.U.) values, which reached (133.5, 137 and 139.5 B.U) for ETc levels at 50, 75 and 100%, respectively. On the other hand dough period (min) and dough stability (min) values of the wheat flour sample were (1.66 &2.08), (1.74 & 2.14) and (1.78 & 2.13) min at 50,75 and 100% of ETc levels respectively. The minimum values of dough period (min) and dough stability (min) recorded with Misr 2 variety and maximum values with Giza 168 variety.

4. Conclusion

Sprinkler irrigation system is one of the important irrigation systems in the desert of Egypt, and especially using in sandy soils and it must using with high density crops such as wheat crop it under current field condition. Wheat quality properties: % net flour, % of grain protein, % fat, and % total sugar in flour, Field capacities were increased under Sids 12 relative to Giza 168, Misr 1 and Misr 2 verities. Dough quality evaluation (Farinograph) parameters, The values for the water absorption increased from 58.97% at 50% ETc to 64.32% for 100% ETc, and maximum value with Misr1 variety. Mixing tolerance (B.U.) values reached (133.5, 137 and 139.5 B.U) for ETc levels at 50, 75 and 100%, respectively. Dough period (min) and dough stability (min) values of the wheat flour sample were (1.66 &2.08), (1.74 & 2.14) and (1.78 & 2.13) min at 50,75 and 100% of ETc levels respectively. It could conclude that: treatment of 50 % from ETc applied gave the highest values and it was high in the significant differences between results values, so that for best grain quality production purpose using applied water 50 and 75 % with a varieties of Giza 168 and 94. Also, for better flour we can recommend using 50 or 75 % applied water and verity of Sids 12 and Misr 1.

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