Biological Forum – An International Journal **7**(2): 773-778(2015)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

The effect of yield and yield components of durum wheat varieties and lines in the Kabootarabad area

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(Received 12 September, 2015, Accepted 13 November, 2015)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: In order to investigate the different characteristics of durum wheat, 16 lines with 2 control cultivars (Parsi and Dena) in the farming year 2013-2014 in a randomized complete block design with three replications at the Agricultural Research Station of Kabootarabad were evaluated for a one year. The variance analysis results showed that the seed thousand weight between the different lines at five percent probable has a significant difference that presents the existence of genetic variation between the lines and cultivars to the mentioned traits. Based on the mean comparison results, line 8 has the most seed thousand weight and line 7 and 11 has the lowest amount of it. Also the most plant height is related to the line 6 and the lowest amount of it is related to the line 4.

Keywords: Durum wheat, seed yield, yield components, genetic variation

INTRODUCTION

Wheat is the most important food crops in Iran and the world and about 20 percent of the world's food is supplied by it. The major area under wheat cultivation in the world is consisted by common wheat or bread wheat so that nearly 95 percent of total global production is allocated to itself and the remaining five percent is dedicated to the durum wheat in order to produce pasta production (Oleson, 1994). This wheat is extraordinary from the physiological characteristics that is consistent this wheat to product in a wide range of climatic environments and chemical and physical characteristics of gluten, which makes seed wheat suitable for many different food products diverse (Arzani, 2004). Iran as one of the origins of durum wheat, which has a wide diversity of desirable characteristics and also relatively the existence of favorable climatic conditions for growing this crop in many parts of it and the growing need of it in the country, is likely to produce a successful product in the widely range (Irani,1993).

Durum wheat during its growth from seed germination to maturity passed the different stages. The most vegetative growth of it and the most dry matter production of it in the third and fourth week after flowering are observed and then dry matter of it up to maturity is remained constant (Kirigwi *et al.*, 2004). Durum vegetative stages can be divided to four parts, germination and tillering, stem length growth flowering and maturity (Lupton, 1987). Farmers familiarizing with new varieties of crops and the efficient using of them increase incomes and its products. Basically, new varieties production as a package of prepared technologies is considered that are easily accepted by farmers (Usherwood, 1985). Morphological and agronomic characteristics effect of the wheat in order to determine the importance of each of them in the increasing of yield and using in the breeding programs is important. The optimal choice of it ultimately leads to improve yield and presentation of commercial cultivars (Golparvar *et al.*, 2006). Yield and seed quality increasing, resistance to lodging, resistance to diseases and pests, tolerance to heat, cold, salinity and acidity, tolerance imbalance of micronutrients, photoperiod sensitivity, discoloration of the seed, pre-harvest germination resistance, the increasing of nitrogen efficiency using rate of seed filling are examples of modified wheat achievements in the past decade (Feil, 1992, Heisey *et al.*, 2002, Slafer and Peltonen-Sainio, 2001, Soufizadeh *et al.*, 2006). As well as changes in the plant morphological characteristics, such as diameter increasing and stem strength, the length spike increasing, the number of spikelet and florets increasing, leaf area increasing in order to increase seed production are created (Rajaram and Borlaug 1997). The increasing of global wheat production is attributed to increasing of area under cultivation, plant management improvement and development of more production varieties (Feil, 1992).

Several studies have been showed the importance of wheat improvement in yield, quality and apparent characteristics increasing (Byerlee and Moya 1993, McCaig and Depauw 1995, Van Lill and Purchase 1995).

In general, although present modern varieties have more yields in comparing with their ancestors but the quality of their cooking was decreased if the desire is that this protein percent reduction is lead to increase great seed biomass is attributed with a small increase in nitrogen accumulation (Acuna *et al.,* 2005). In a study that was conducted on the 3 populations of durum wheat in three separate regions was reported that despite the interaction effect existence of environment and genotype, cultivars selection with high performance is lead to select stable genotypes with high protein content (Verma *et al.,* 1998). Researchers (Peccitti and Annicchiari 1998) by examining the Italian durum wheat, seed thousands weight and spike fertility in grain yield was useful.

According to the important role of genetic diversity inbreeding promotion purpose of important agronomic crops such as wheat as well as the key role of native mass, the evaluation of existence durum wheat in the country is very important. The important of existence characters such as wide adaptability, disease resistance, quality, etc. in some native varieties, this gene pool as valuable sources of genetic variation in wheat is considered (Akar and Özgen 2007, Dreisigacker *et al.,* 2005).

Although these evaluations are performed of ten but a pure lines survey in this volume and for agronomic characteristics in itself is done less. And due to changes in the seed yield resulting from changes in yield components was included the number of seeds per spike, the seed thousands weight and number of spikes per m^2. Undoubtedly, morphological and physiological characteristics effects that determined the yield, is one of appropriate methods to achieve the criteria selection in order to improve yield and modifying and the introduction of commercial varieties of durum wheat. Morphological characteristics can be measured easily and with high precision and have high heritability, so the selection according to these characteristics may be a safe and rapid way for screening plant communities and improve function (Ames *et al.,* 1999, Yildrim *et al.,* 1993). Durum wheat is the main material for spaghetti industry and superiority of protein and high starch, relatively cheap price and easy cooking cause pasta to enter the community food culture and day to day be added on demand. Considering the fact that about half a million tons of semol in a is needed for past a making and there is possibility of its production in the country, production of desirable durum wheat, and meet the needs of the mentioned industry is important. The purpose of this study was to assess the quantitative and qualitative characteristics of durum wheat varieties that is exist in the durum wheat collection.

MATERIALS AND METHODS

This experiment in the framing year 2013-2014at the Kabootarabad Agricultural Research Station in the 30kilometers of Esfehan southeast that is exist at 32 degrees of latitude and 31 minutes of north and51 degrees of longitude and 51 minutes of east and its height from sea level is 1545 meters was conducted. This station is classified as a coupon with a very dry and hot climate with hot and dry summers. Before cultivation soil samples prepared and sent to the laboratory to determine a soil characteristic that is shown in Table 1.

Table 1: Some physical and chemical characteristics of experiment soil.

Texture	TN (%)	O.C (%)	Sand (%)	Silt (%)	Clay (%)	EC (ds/m)	pH	K (mg/kg)	P (mg/kg)
C.L	0.076	0.072	33	38	29	1.61	8.2	115	6.76

Parsi wheat cultivar is suitable for cultivation in the country temperate regions, has a spring growth habit, plant height average is 97 cm, preterm, the seed thousands weight average is 41 gr, the color of seed is yellow amber, the average of seed protein content is 12 percent, resistant to the lodging and seeds falling, with the average of 5.581 ton per ha in the yield seed, and response to the disease that are resistant to the stripe rust and stem rust (race ug99) and semi sensitive to the brown rust. Also Dena wheat cultivar is suitable for cultivation in the country temperate regions, has a spring growth habit, plant height average is 94 cm, preterm, the seed thousands weight average is 44 gr, the color of seed is yellow amber, the average of seed protein content is 13.2 percent, resistant to the lodging and seeds falling, with the average of 6.8 ton per ha in the yield seed, and response to the disease that are resistant to the stripe rust and partial and bunt.

Before entering the machines to the ground, irrigation was done and land preparation operations include disk and plow, cross leveler in two turns and furrow creation was conducted and after it cultivation was done.

Plots size in all experiments was fixed and planting area was 1.2 × 6 = 7.2 m^2 and the harvest area was observed 1.2 × 5 = 6 m^2. Also the number of planting rows 6 lines on the 2 stacks and line spacing 20 cm were considered. Seeds content of each variety depending on seed thousands weight and based on400 seeds per m^2 were prepared. The first irrigation was performed on 3/12/2013. Also two irrigations in the fall, irrigation in March and 4 irrigations after fertilization were conducted. To control heat plant weeds in conventional experiment of Granstar and Puma Super weeds in amounts of 30 gr and 1 liter per ha was used, respectively. The using of chemical fertilizers amount ($kg.ha^{-1}$) is shown in table 3.

Harvesting was done in July. To determine the number of days to heading emergence of the first irrigation to 50percent heading emergence per plots, the number of days was noted. Also to determine of days to maturity, physiological maturity days to 50 percent physiological maturity per plots was noted. To calculate the plant height, 20 plants number was choice from each plot, the length of each plant was measured from the ground floor to the tip of the spike and the average of their height was considered as plant height. In order to determine seed thousands weight among the related seeds of the harvested samples, by using seeds counter device, seed thousands weight is counted then by using an accurate scale is weighed. To measure the wheat production yield four random samples from each plot by a one m^2 quadrat (size 1×1 m) were determined and harvested. After sifting and cleaning seeds, obtained seeds were weighed and yield per ha of area was calculated. To ensure the accuracy of the results, after elimination of each plot production was harvested by research combine (with a width of 120 cm). After weighting, the obtained yield with the previous method of calculation was compared and consistent with the obtained values were confirmed. After sampling and data collection, by using of SAS software, the experimented data statistically were analyzed and also the mean comparison by Duncan test at 5 percent probable was conducted.

Table 2: The number of genotypes and pedigrees of wheat genotypes.

Genotype	Pedigree
DM-92-1	Dena
DM-92-2	Parsi
DM-92-3	
DM-92-4	
DM-92-5	UPARE O 2001/3/SOVAT_3/PHAX_1//TILO_1/LOTUS_4/4SOMAT_3/PHAX_1//TILO_1/LOTUS_4
DM-92-6	NUS/SULA//5XUS/4/SULA/RBCE_2/3/HUI//CIT71/CII2/5/ARMENT//SRN_3/NIGRIS_4/3/CANELO_91
DM-92-7	CVH85.797//CADO/BOOMER-33/4/ARVENT//SRN-3/NIGRIS-4/3CANELO-9.1
DM-92-8	TOPDUR/TETRADUR/3/ARTIOO/AJAIA_3//HUALITA/5/TOPDUR/TETRADUR/4/ARMENT//SRN_3/NIG
DM-92-9	TARRO_1/2YUAN_1//AJAIA_13/YAZI/3/SOVAT_3/PHAX_1/TILO_1/LOTUS_4/4/CANELO_8//SORA/2PLATA_12
DM-92-10	SOMAT_3/3/STOT//ALTAR 84/ALD/4/FOCHA_1/MUSK_3/6/RANCO//CIT71/CII/3/COMDK/4/TCHO//SHWA/MALD/3/CREX/5/SNIT
DM-92-11	PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/RAFI97/9/MALMUK_1/SERRATOR_1/10/ARMENT//SRN_3/NIGRIS_4/3/
DM-92-12	PLATA_10/6/MQUE/4/USDA573//QFN/AA_7/3/ALBA-D/5/AVO/HUI/7/PLATA_13/8/RAFI97/9/MALMUK_1/SERRATOR_1/10/ARMENT//SRN_3/NIGRIS_4/3/
DM-92-13	JUPERE C 2001
DM-92-14	SNITAN/5/AJAIA-12/F3LOCAL(SEL.ETHIO.135.85)//PLATA-13/3/SOMAT-3/4/SOOTY-9/RASCON-3
DM-92-15	PLATA-7/ILBOR-1//SOMAT-3/3D95223/4/PATKA-4/PLATA-16
DM-92-16	LLARETA INIA/YEBAS-8/3/MINIMUS-6/PLATA-16//IMMER
DM-92-17	RASOON-37/2TARRO-2/3AJAIA-12/F3LOCAL(SEL.ETHIO.135.85)//PLATA-13/4/SORA/2PLATA_
DM-92-18	LD357E/2TC60//JO69/3/FGO/4/GTA/5/SRN_1/6/TOTUS/7/ENTE/MEXI_2//HUI/4/YAV_1/3/LD357E/2TC60//JO69/8/SOMBRA_20/9/JUPAREC

Table 3: The using of chemical fertilizers amount for wheat plant ($kg.ha^{-1}$).

Urea	Super Phosphate	*Potassium sulfate*
350	180	100

RESULTS AND DISCUSSION

Number of days to heading emergence: The variance analysis results (Table 4) showed that between the different lines was not observed a significant difference on the number of days to heading emergence. The mean comparison results on the number of days to heading emergence (Table 5) indicated that the variation range of it, was observed between 156 to 164 days and line 18 has the average days number to more heading emergence in comparing with the other lines, also the lowest number of days to heading emergence is related to the line 15. Almost all previous studies have shown that between the different wheat cultivars there was a significant difference on the number of days to heading emergence (Ames *et al.*, 1999, Bechere *et al.*, 2002, Mladenov *et al.*, 2001, Panozzo and Eagles 1998, Zhang *et al.*, 2006).

Number of days to physiological maturity: The variance analysis results (Table 4) showed that between the different lines was not observed a significant difference on the number of days to physiological maturity. The mean comparison results on the on the number of days to physiological maturity (Table 5) indicated that the variation range of it, was observed between 187 to 197 days but there is no statistically significant difference between the lines. According to results of other researchers between the different lines of wheat, there was a significant difference on the number of days to physiological maturity (Ames *et al.*, 1999, Bechere *et al.*, 2002, Mladenov *et al.*, 2001, Panozzo and Eagles 1998, Zhang *et al.*, 2006).

Table 4: The variance analysis related to the yield and its components varieties and durum wheat lines in the Kabootarabad area.

S.O.V	df	Number of days to heading emergence	Number of days to physiological maturity	Plant height	Seed thousands weight	Seed yield
Block	2	20.06^{ns}	338^{**}	2.391^{ns}	14^{ns}	0.02^{ns}
Treatment	17	14.17^{ns}	28.59^{ns}	59.23^{ns}	28.51^{*}	0.41^{ns}
Error	34	8.76	34.94	62.15	14.67	2.53
CV%		1.85	3.09	9.53	9.22	17.67

**, * and ns are significantly at 1%, 5% and not significant, respectively

Table 5: The mean comparison results of different wheat lines related to the yield and its components varieties and durum wheat lines in the Kabootarabad area at 5 percent probable by using of Duncan test.

Line	Number of days to heading emergence	Number of days to physiological maturity	Plant height(cm)	Seed thousands weight (gr)	Seed yield (ton.ha^{-1})
DM-92-1	162^{ab}	188^{a}	80^{ab}	43.67^{abcd}	8.62^{a}
DM-92-2	157^{bc}	192^{a}	85^{ab}	41.67^{abcd}	9.44^{a}
DM-92-3	157^{bc}	187^{a}	83^{ab}	43.33^{abcd}	8.91^{a}
DM-92-4	160^{abc}	193^{a}	72^{b}	45^{abc}	8.48^{a}
DM-92-5	160^{abc}	192^{a}	83^{ab}	38.33^{abcd}	9.39^{a}
DM-92-6	159^{abc}	190^{a}	$\underline{90^{a}}$	45^{abc}	9.42^{a}
DM-92-7	157^{bc}	188^{a}	85^{ab}	37^{d}	9.4^{a}
DM-92-8	158^{bc}	189^{a}	82^{ab}	$\underline{45.67^{a}}$	9.35^{a}
DM-92-9	161^{abc}	191^{a}	$\underline{88^{a}}$	40^{abcd}	8.49^{a}
DM-92-10	162^{ab}	193^{a}	85^{ab}	45.33^{ab}	8.89^{a}
DM-92-11	158^{bc}	187^{a}	80^{ab}	37.33^{d}	8.68^{a}
DM-92-12	159^{abc}	188^{a}	82^{ab}	38^{bcd}	8.97^{a}
DM-92-13	160^{abc}	193^{a}	$\underline{89^{a}}$	44^{abcd}	8.36^{a}
DM-92-14	160^{abc}	191^{a}	75^{ab}	37.67^{cd}	9.24^{a}
DM-92-15	156^{c}	194^{a}	84^{ab}	41^{abcd}	8.76^{a}
DM-92-16	161^{abc}	196^{a}	84^{ab}	38.67^{abcd}	9.36^{a}
DM-92-17	162^{ab}	195^{a}	81^{ab}	43.33^{abcd}	9.12^{a}
DM-92-18	$\underline{164^{a}}$	197^{a}	81^{ab}	43^{abcd}	9.24^{a}

*The numbers underlined and italics indicates to the treatments that had the most amount in the desired character
*Common word in each column shows insignificant amount.

Plant height: The obtained information from variance analysis results show that between the different lines, there is no significant difference on the plant height (Table 4). The mean comparison results of plant height affected by different lines (Table 5) indicates that variation range of it between 72 to 90 cm were observed and 9, 13 and 6 lines respectively have the most plant height in amount of 88, 89 and 90 cm and line 4 was the lowest plant height in amount of 72 cm. The results of other researchers, clearly show that between the different lines of Durum wheat statistically there is a significant difference on the plant height, also stated that the figures will present in the future that have a height of about 95 cm, also it is believed that the presented figures have a suitable height for high-performance (Slafer and Araus 2007). Some researchers have suggested that an average height of 70 cm to obtain the most yield would be more appropriate (Borojevic, 1986, Fischer and Quail 1990).

However height less than it would be inappropriate because farmers usually uses from the remained stover to livestock feed (Law *et al.*, 1978).

Seed thousands weight: The obtained information from variance analysis results show that between the different lines, there is a significant difference on the seed thousands weight at five percent probable (Table 4). The mean comparison results of seed thousands weight affected by different lines (Table 5) indicates that variation range of it between 37 to 45.67 gr were observed and line 8 has the most plant height in amount of 45.67 gr and 7 and 11 lines was the lowest seed thousands weight in amount of 37 and 37.33 gr. Seed weight is considered as an important yield component, but this trait has the low heritability. The figures that have low numbers of spikelet per spike and seed per spike have more seed thousands weight. The researchers by studying on the Italian durum wheats find out that seed thousands weight in increasing of yield is effective (Peccitti and Annicchiari 1998). The researchers also noted the high heritability in the seed thousands weight and reported that between different lines, there are significant differences on the seed thousands weight (Subhashchandra *et al.*, 2009) which is corresponded with the obtained results.

Seed yield: Based on the variance analysis results (Table 4) between the different lines was not observed a significant difference on the seed yield. The mean comparison results on the seed yield (Table 5) indicated that the variation range of it, is between 8.36 to 9.44 $ton.ha^{-1}$ however, there is no statistically significant difference between the lines. According to results of other researchers between the different lines of wheat, there was significant difference on the seed yield (Kalantarzadeh 2000, Kirigwi *et al.*, 2004, Mansourfar 2008) that is not corresponded with the obtained results.

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