Durum wheat (T. durum Desf.) vs. bread wheat (T. aestivum L. em.Thell.) in South-East Anatolia, Turkey

Ozberk I., Rajaram S., Ilkhan A., Ozberk F.

in

Porceddu E. (ed.), Damania A.B. (ed.), Qualset C.O. (ed.).
Proceedings of the International Symposium on Genetics and breeding of durum wheat

Bari : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 110

2014
pages 283-290

Durum wheat (*T. durum* Desf.) vs. bread wheat (*T. aestivum* L. em.Thell.) in South-East Anatolia, Turkey

Irfan Ozberk[1], Sanjara Rajaram[2], Ali Ilkhan[3], Fethiye Ozberk[3]

[1] Dept. of Field Crops, Fac. of Agriculture, the Univ. of Harran,Ş.Urfa, Turkey
[2] International Center for Agriculture in Dry Areas (ICARDA), Aleppo, Syria
[3] GAP Training and Research Center, Ş. Urfa, Turkey

Abstract. This study aimed to compare grain yield, marketing price and net return per unit area of durum wheat vs. bread wheat in the South-East Anatolia.16 bread wheat + 9 durum wheat advanced lines were tested employing randomized complete block design with 3 replications in 2010-11 and 2011-12 cropping seasons in 2 locations (Ş.urfa and Adıyaman) in each year. Mean separations for grain yields of combined analysis of variance (ANOVA) indicated that bread wheat in average over yielded durum wheat with 7.14%. Rank stability analysis further indicated that bread wheat entries fell into high stable area more than durum wheat. Marketing prices of entries was estimated in Ş.Urfa commodity market. Durum wheat entries in average received higher marketing price offers than bread wheat with 4.97%. A visual characteristic of 1000 kernel weight affected marketing prices for both durum and bread wheat significantly (r= 0.699**). Average net return of bread wheat in average was higher than that of durum wheat with 2.6%. Additional premium (as much as 2 times of Std. deviation of marketing prices) given to highest income generating durum wheat entry did not change the profitability rank. It was concluded that higher yielding bread wheat entries generated higher net returns. Unless purchasers give adequate premium to durum wheat, farmer preference for durum wheat cannot be achieved under supplementary irrigation in SE. Anatolia.

Keywords. Grain yield – Marketing price – Visual quality – Stability – Net return.

Blé dur (Triticum durum Desf.) vs blé tendre (T. aestivum L. em.Thell.) dans le Sud-Est de l'Anatolie, Turquie

Résumé. *Cette étude visait à comparer le rendement en grain, le prix de vente et le rendement net par unité de surface du blé dur et du blé tendre dans le Sud-Est de l'Anatolie. Seize lignées avancées de blé tendre et neuf de blé dur ont été testées en utilisant un dispositif expérimental en blocs aléatoires complets avec 3 répétitions, au cours de la saison de culture 2010-11 et 2011-12 et chaque année, dans deux endroits différents (Ş.urfa et Adıyaman). L'écart moyen des rendements en grain de l'analyse combinée de la variance (ANOVA) a mis en évidence que le blé tendre, en moyenne, a un rendement de 7,14% plus élevé que celui du blé dur. En outre, l'analyse de la stabilité des rangs a montré que les données d'entrée du blé tendre se situent davantage dans la zone de plus grande stabilité par rapport au blé dur. Le prix de vente des produits a été estimé au marché de Ş.Urfa. En moyenne, pour le blé dur, les offres de prix de marché dépassaient de 4,97% celles du blé tendre. Une caractéristique visuelle du poids de 1000 grains influait sur le prix de vente du blé dur et du blé tendre de manière significative (r = 0,699 **). Le rendement net moyen du blé tendre était plus élevé en moyenne de 2,6% par rapport à celui du blé dur. Le supplément de prix (jusqu'à 2 fois l'écart-type des prix de vente) payé pour le blé dur générant un revenu plus élevé n'a pas changé le rang de la rentabilité. Il a été conclu que les entrées de blé tendre à rendement supérieur ont généré des rendements nets plus élevés. A moins que les acheteurs ne soient disposés à payer un supplément de prix pour le blé dur, les agriculteurs continueront à lui préférer le blé tendre dans le Sud-Est de l'Anatolie où ils ont recours à l'irrigation d'appoint pour cette culture.*

Mots-clés*. Rendement en grain – Prix de vente – Qualité visuelle – Stabilité – Rendement net.*

I – Introduction

Durum wheat (*T. durum* Desf) comprises approximately 8-10 % of World wheat production (Ozberk et.al., 2005a; Oztahtacı,2000; Sardana, 2000; Nachit,1998; Abeye *et al.*,1997). The average annual durum wheat production between 2003-04 and 2009-10 was as 33,620 mil. tons from a harvested area of 14-16 mil. ha (Anonymous, 2012). More than 85% of the World durum wheat production area is located in the Mediterranean basin. It occupies about 11. mil. ha in this region. Manufacturing and marketing of durum products are also concentrated in the region (Nachit *et al*., 1998). Turkey is one of major durum wheat producer with an average 3,057 mil. tons between 2003-04 and 2009-10 (Anonymous, 2012) with an average 1.658 mil.ha area during the same period (Ozberk *et al*., 2005c). Wheat origins from the area called 'Fertile Crescent'. Wild relatives of wheat are widespread in Turkey, especially in South East Anatolia (Karagoz and Ozberk, 2010).SE. Anatolia is known to be the durum wheat belt of the country (Ozberk *et al*., 2005c). This area is the most favourable for durum wheat production (Kun *et al*.,2005).There are no significant yield differences in favour of bread wheat in this area (Bagcı and Ekiz, 1993). Average grain yield under rain fed condition is about 2 ton ha^{-1} whereas, a 6 ton ha^{-1} grain yield can be achieved under supplementary irrigation (Ozberk *et al*., 2011). Twenty-five percent of the national durum wheat production is met by this region (Ozberk *et al*.,2011).

Production capacity of macaroni industry in Turkey exceeded 1,2 mil. ton $year^{-1}$in 2009 (Bozkurt, 2010). But the capacity use was 67% (Bayram, 2010). Thirty-five % of this capacity is located in one of SE Anatolian city of Gaziantep. Bulgur a second important durum product is also produced over one mil. ton $year^{-1}$(Bayram ,2010). Only 218,000 tons of bulgur is produced by 242 bulgur plants. The rest comes from homemade production (Bayram, 2010). Another SE Anatolia city of Ş. Urfa is one of leading bulgur producer with 28 running plants. Macaroni consumption is about 6 kg $year^{-1}$ per head (Koksel *et al*, 2010). Whereas, bulgur consumption is about 12 kg $year^{-1}$per head (Bayram, 2010). Macaroni export figures changes year by year with an average of 189,000 tons $year^{-1}$.Wheras, bulgur and semolina export figures reach an average of 115,600 tons $year^{-1}$ between 2007-2009 (Bayram, 2010).

Durum wheat varieties Fırat-93, Sarıcanak-98, Ege-88, Fuat bey-2000, Svevo, Zenit, Burgos are the major dominating varieties in acreage in the region. Last three possessing high yellow pigmentation characteristic were introduced by private companies (Ozberk *et al*., 2011). Ceyhan-99, Dariel, Meta-2002, Adana-99, Pehlivan, Sagitario are leading bread wheat cultivars in the region. Yield potentials of durum wheat cultivars grown in the region varies from 4,925 ton ha^{-1} to 5,809 ton ha^{-1}(Ozberk *et al*.,2011). In a regional bread wheat trials with 20 entries, yield potential of standards varied from 4,491 to 5,282 ton ha^{-1} (Ozberk *et al*, 2006). In variety release and registration trials carried out in 2009, recently developed bread wheat and durum wheat candidates with highest yielding standards were tested at same location side by side. Bread wheat standards at combined ANOVA mean separation for 4 locations (Nurkent, Adana-99, Sagitario, Pehlivan, Ziya Bey-98, Basri Bey-05, Ceyhan-99, Pamukova-97) performed varying from 4,439 ton ha^{-1} to 4,991 ton ha^{-1} . Average yield of standards was 4,723 ton ha^{-1}.Whereas; durum wheat standards (Fırat-93, Sarıcanak-98, Svevo, Solen-2002, Ege-88, Zenit, Fuat Bey-2000, Amanos-97) performed from 4,654 ton ha^{-1} to 5,476 ton ha^{-1}. Average grain yield of standards was 5,048 ton ha^{-1} (Anonymous, 2010).

Ş.Urfa commodity market is the third largest market in Turkey with over 500,000 tons of summer season marketing capacity (Ozberk *et al*., 2005 a). Although there are many other quality requirements for durum wheat in the international marketing, some physical characteristics such as 1000 kernel weights and hectolitre weights determine the marketing price (Ozberk *et al*., 2006). Moreover, if the grain belongs to a highly reputed variety it attracts even higher market price. Portable protein analysers have been introduced to the purchasers in Ş.Urfa commodity market since 2006. Purchasers also refer to protein content (%) in marketing price offers.

The criterion of farmers is productivity and his concept of quality is closely linked to the need to obtain high yield in order to maximize profit (Troccoli *et al*., 2000; Inglis, 1992). Similar results were achieved by Ozberk *et al*., 2011. In which high quality cultivars were not given adequate premiums and high yielding cultivars were found to be high income generating in durum wheat.

II Material and methods

25 wheat entries (16 bread wheat + 9 durum wheat) consist of recently developed advanced lines (Table 1) were tested employing randomized complete block design with 3 replications in 2 locations (Ş. Urfa, Adıyaman) in 2010-11 and 2011-12 cropping seasons. Except 2011-12 Adıyaman experiment, the rest were grown under supplementary irrigated conditions. Annual rainfall in Ş.Urfa was 351,4 mm in 2010-11 and 296,5.mm in 2011-12 season. These turned out to be 679,6. mm in 2010-11 and 812,3.mm in 2011-12 in Adıyaman.

Table 1. Names and pedigrees of entries

Pedigree/Cross No:	
1.MILAN/KAUZ//HD29/2*WEAVER/3/KAUZ	RSM(BW)124-2002T-54CJ-010T-010CJ-010T-0CJ
2.CHIBIA//PRL/CM65531/3FISICAL	INDIA-0CJ
3.WAXWING*2/KIRATATI	INDIA-0CJ
4.PRL/2*PASTOR//SERI	RSM(BW)043-2002T-52CJ-010T-010CJ-010T-0CJ
5.BLANCA FUERTE	USA-0CJ
6.04W44509	USA-0CJ
7.02W50274_1	USA-0CJ
8.06W31187	USA-1T-0CJ
9.06W31455	USA-4T-0CJ
10.06W31455	USA-5T-0CJ
11.06W31582	USA-2T-0CJ
12.BERKUT	CMSS96M05638T-040Y-26M-010SY-010M-010SY-4M-0Y-05T-03CJ-03T-0CJ
13.PRL/2*PASTOR	CGSS97Y00034M-099TOBP-027Y-099M-099Y-099M-25Y-0B-05T-03CJ-03T-0CJ
14.VAR1/4/MILAN/KAUZ//PASTOR/3/CROC1/AE.SQUARROSA(224)//OPATASI85-03-040T-040CJ-4T-03CJ-5T-0CJ	
15.VAR1/F4SR S-2013	SI88-03-040T-040CJ-8T-03CJ-4T-0CJ
16.CROC/AE.SQUARROSA(205)/BOURLOG95/3/2*MILAN	
17.JUPARE(2001)/3/SOMAT/TILO//LOTUS	SI57-04-11T-03CJ-6T-0CJ
18.JUPARE(2001)/3/SOOTY_9/RASCON_37//SITE/3*MUSK_4	
	SI63-04-9T-03CJ-2T-0CJ
19.RIO COLORADO/ICARDA 94-MK3	SI74-04-8T-03CJ-4T-0CJ
20. RIO COLORADO/ICARDA 94-MK3	SI74-04-8T-03CJ-6T-0CJ
21. RIO COLORADO/ICARDA 94-MK3	SI74-04-8T-03CJ-8T-0CJ
22.RIO COLORADO/4/YAZI1/AKAKI 4…..	SI80-03-040T-040CJ-2T-05CJ-4T-0CJ
23.RIO COLORADO/6/ CHEN1/TEZ/3/GUILT….	SI84-03-040T-040CJ-4T-05CJ-10T-0CJ
24.ICASYR 2	SYRIA-010CJ-7T-0CJ
25.ICASYR 2 (SYRIA)	SYRIA -03CJ-03T-0CJ

Field trials were sown in mid-November under cotton-wheat crop rotation system in Ş. Urfa and wheat-food legumes rotation in Adıyaman. Sowing rate was 500 grain m^{-2} and 60 kg ha^{-1} pure P_2O_5 and 140 kg ha^{-1}(split) nitrogen were applied. Plot size was 6 m and 6 rows (1.2m) at planting and 5 m and 6 rows at harvest. All other necessary agronomic measures were taken to obtain healthy data. Two irrigations were practiced in grain filling period and the amount of water delivered was not measured.

Individual and combined analysis of variance was performed. Statistical prerequisites were taken into consideration prior to combine ANOVA. Data obtained from field trial carried out under rain fed condition in Adıyaman in 2011-12 seasons was also included for combined ANOVA. Therefore the performances of all entries under both conditions were assessed. Duncan multiple range test was employed for mean separations. Yield stabilities of all entries were assessed through 'Rank Stability Analysis' (Huhn, 1990).

Grain samples of all entries obtained from 2011-12 Ş. Urfa field trials were joined and cleaned by dockage cleaner. Subsequently, Hl (Anonymous, 1990) and 1000 kernel weights (Uluöz, 1965) were scored.

The grain samples (1kg) were presented to 6 randomly selected grain purchasers in Ş.Urfa commodity market in April, 2013. Relationship between hl and 1000 kernel weights vs. marketing prices was investigated through correlation analysis. Marketing price estimates were analysed by randomized complete block design with 6 replications (purchasers). Duncan multiple range test was employed for mean separation.

Production income (US$ ha^{-1}) was calculated by multiplying grain yield (ton ha^{-1}) x marketing price (US$ ton^{-1}) for each entry. Profitability estimates (average, min, and max.) of bread wheat vs. durum wheat were compared and promising entries were offered for release. SPSS statistical software was used for statistical analyses.

III – Results

Grain yield data obtained from the locations and two years were subjected to individual and combined analysis of variance (data not shown) results from all years and locations indicated that entries were found to be significant ($F_{Ş.Urfa\ ,2010\text{-}11}$ = 2.569**, $F_{Ş.Urfa,\ 2011\text{-}12}$ = 2.547**, $F_{Adıyaman,\ 2010\text{-}11}$ = 3.491**, $F_{Adıyaman,\ 2011\text{-}12}$ = 1.940*). Replications were also found to be significant for all experiments. Coefficients of variations (CV%) for Ş. Urfa- 2010-11, Ş. Urfa 2011-12, Adıyaman 2010-11 and Adıyaman 2011-12 were found to be 12.85%, 11.52%, 10.74% and 21.05% respectively.

Combined ANOVA was performed to test the presence of GxE interactions. Results revealed that locations (F= 665,97**), years(F= 246,59**), years x locations (F= 19.19**) and varieties x locations x years (F= 1,91**) were found to be significant. CV% was 16.26. Ş. Urfa location gave a 6.292 ton ha^{-1} grain yield whereas; Adıyaman gave 3.939 ton ha^{-1} in average.

Duncan multiple range test was performed for mean separations and the results showed that (Table 2) first 8 top ranking entries were 3, 7, 8, 6, 4, 3 and 9 giving 5.946, 5.788, 5.647, 5.571, 5.455, 5.421, 5.391 and 5.306 ton ha^{-1} respectively. Durum wheat entry no 19 took place at 9^{th} at rank giving 5.223 ton ha^{-1}. Rank stability analysis also indicated that bread wheat entries 2,6,7,8 and 13 were found to be stable for grain yield. Many of durum wheat entries fell into average rank and rank standard deviation area.

Marketing price data for grain samples of all entries for Ş. Urfa (2011-12) location were subjected to analysis of variance. Entries turned out to be significant (F= 45,12**). Purchasers (replications) were found to be non-significant (F= 2.16^{ns}).CV% was 3.25. Duncan mean separation test showed that (Table 2) durum wheat entries 17, 19, 25, 21,18, 20, 22, 23 and 24 took place at first 9 top ranking entries giving 459.76, 458.82, 457.44, 457.11, 456 05, 454 67, 454 23, 452 65 and

451 9 US $ ton^{-1} respectively. Bread wheat entry no 16 ranked at 10th place giving 441 06 US$ ton^{-1} marketing price.

Average Hl weight of bread wheat was 81 68 kg. Whereas; this was 81 84 kg for durum wheat. Average thousand kernel weights for bread wheat was 40 53 g. this was 45 79 g for that of durum wheat. The coefficient of correlations between hl weights vs. market price was not significant (r= 0.086 ^{ns}). Whereas, that for 1000 kernel weights vs. market price turned out to be highly significant (r= 0.699**).

Net returns (US$ ha^{-1}) (Table 2) showed that top five ranking entries were 13, 2, 7, 19 and 6 giving 2608.0, 2551.84, 2424.3, 2396.46 and 2382.23 US $ ha^{-1} respectively. Durum wheat entry no 19 was alone taking into top 5 ranking entries for net returns.

Table 2. Duncan's mean separations for combined grain yield, marketing prices and net returns

Entry No.	Grain yield/groups ton ha^{-1}		Marketing price/groups US$ ton^{-1}		Net return/groups US$ha^{-1}	Income rank
13	5.946	a	438.57	ef	2608,08	1
2	5.788	ab	440.84	e	2551,84	2
7	5.647	a-c	429.33	h	2424,3	3
8	5.571	a-d	427.0	hi	2378,85	7
6	5.455	a-d	436.69	ef	2382,23	5
4	5.421	a-d	439.01	ef	2379,96	6
3	5.391	a-d	434.86	fg	2344,59	8
9	5.306	b-d	434.86	fg	2307,41	11
19	5.223	b-e	458.82	ab	2396,46	4
18	5.138	c-f	456.05	a-d	2343,18	9
23	5.069	c-f	452.85	cd	2295,67	13
10	5.069	c-f	426.12	hi	2160,13	21
21	5.049	c-f	457.11	a-d	2308,22	10
5	5.020	c-f	431.15	gh	2164,37	20
12	5.017	c-f	434.42	fg	2179,87	16
17	4.996	d-f	459.76	a	2297,23	12
14	4.996	d-f	434.86	fg	2172,77	18
20	4.996	d-f	454.67	a-d	2271,66	14
15	4.957	d-f	439.12	ef	2176,93	17
16	4.950	d-f	441.06	ef	2183,51	15
1	4.947	d-f	438.07	ef	2167,39	19
25	4.639	e-g	457.44	a-c	2122,20	22
24	4.548	f-g	451.9	d	2055,60	23
11	4.537	f-g	423.79	i	1922,90	24
22	4.223	g	454.23	b-d	1918,44	25
CV%	16.25		CV%	3,25		

IV – Discussion

The entries under this study were very competitive for grain yields as the yield performance of varieties grown in the region (Ozberk *et al*., 2011; Ozberk *et al*., 2006). Significant effects of replications in the individual ANOVA's for grain yield can be attributed to the heterogeneity of experimental fields and differences in irrigation water given to plots. Although adequate rainfall for Adıyaman was received the distribution of rainfall was not homogeneous and lack of grain filling period. This resulted in lower average yield inevitably. Except Adıyaman 2011-12 experiments, all other CV's (%) were quite reliable. Combined ANOVA indicated the presence of GXE interactions. The presence of GXE interactions were further investigated through 'Rank Stability Analysis' and the entries with lower ranking and lower standard deviations were determined. Grand mean of

durum wheat entries was 4,876 ton ha^{-1} whereas; that of bread wheat entries was 5251 ton ha^{-1}. There was a 7.14% yield differences in favour of bread wheat (Table 3).There was also 12.16% yield gap in favour of bread with between highest yielding bread wheat vs. durum wheat entries. This turned out to be 6.9% for the lowest yielding bread wheat vs. durum wheat entries. In the field trials carried out by 'Variety Release and Registration Institute in 2009 found similar grain yield advantages in favour of bread wheat with 6.88%.

Hl weights of both bread and durum wheat were almost same. But average 1000 kernel weights of durum wheat was higher than that of bread wheat with 5.26 g (12.93%). Highly significant correlation coefficient between 1000 kernel weights vs. marketing price as indicated earlier (Ozberk *et al*., 2011; 2006; 2005a; 2005b) visual characteristics of grains in commodity market are main criteria for high market price offers.

Grand mean of marketing price for durum wheat entries was 455,83 US$ ton^{-1}.Whereas;that of bread what was 434.25 US $ ton^{-1}.marketing price advantage for durum wheat was 4,97%. When the highest market price receiving entries compared, there was a 4.24% advantage in favour of durum wheat. This was 6.63% for the lowest marketing price receiving durum vs. bread wheat entries.

Table 3. grain yield, marketing price and net return comparisons for durum wheat vs. bread wheat.

Comparisons	D W	BW	Advantage		
	ton ha^{-1}	ton ha^{-1}	BW%	DW%	BW%
Grain yield					
Grand mean	4,876	5,251	7,14		
Highest mean	5,223	5,946	12,16		
Lowest mean	4,223	4,537	6,9		
Marketing price					
Grand mean	455,83	434,25		4,97	
Highest mean	459,76	441,06		4,24	
Lowest mean	451,90	423,79		6,63	
Net income					
Grand mean	2223,18	2281,57			2,6
Highest mean	2396,46	2080,8			8,83
Lowest mean	1918,44	1922,90			0,23

Figure 1. Rank stability analysis of bread wheat and durum wheat entries.

The criterion for farmers in variety preference is productivity and his concept of quality is closely linked to maximize profit (Ozberk *et al*., 2011; Ozberk *et al*.,2006; Troccoli *et al*., 2000; Inglis, 1992).

Grand mean of net return for durum wheat entries was 2238,18 US$ha^{-1} whereas; that of bread wheat was 2281,57 US$ ha^{-1}There was 2,6% net return advantage in favor of bread wheat. This was 8,83% for highest net return generating bread wheat vs. durum wheat entries. Net return advantage of bread wheat was 0,23% for the lowest net return generating bread wheat vs. durum wheat.

In a simulation study additional premium (as much as 2 times of std. deviation of marketing price) given to high income generating durum wheat entry (19) did not change income rank.

By this time of the year in Ş. Urfa commodity market, marketing price differences between durum wheat vs. bread wheat was 5-7% (in favour of durum wheat). This is normally 15-20% throughout the year. It means that durum wheat can be a rival for bread wheat for net return. But durum wheat still needs to have additional premium support for sustainable and profitable production in the SE Anatolia.

References

Abeye A.O., Brann D.E., Alleyand M.M., Griffey C.A., 1997. Winter Durum Wheat: Do we have all answers. *Crop and Soil, Environ Sci*., Virginia Politechnic Institute and State Univ.,USA, pp. 424-802.

Anonymous, 2012. Sektör raporu. (http://www.tmo.gov.tr).

Anonymous, 2010. The results of variety release and registration trials in 2009 in Turkey. (http://ttsm.gov.tr).

Anonymous, 1990. Test weight per bushel. Approved methods of the American Association of Cereal Chemists No. 55-10.

Bağcı S.A., Ekiz H., 1993. Makarnalık buğdayın verim potansiyeli ve problemleri. Makarnalık buğday ve mamulleri sempozyumu. 30 Kasım-3 Aralık, pp. 21-29.

Bayram M., Tiryakioğlu A., Kayabaş S., Duru I., Arslan H., Koçak E., Altınbaş S., Baharoğlu M., Dağyutan A., Kılınç I., Balcı F., 2010. Dünyada ve Türkiyede bulgur sanayinin durumu, **üretim** teknolojisindeki gelişmeler vet sorunları-çözüm **önerileri**. Makarnalık buğday ve mamullari konferansı. 17-18 Mayıs 2010, **Ş.Urfa**, pp. 33-41,.

Bozkurt M., 2010. Dünyada vet Türkiyede makarnalık buğday **üretimi** vet makarna sanay-geleceği. Makarnalık buğday ve mamulleri konferansı. 17-18 Mayıs 2010, **Ş.Urfa**, pp. 1-3.

Huehn M., 1990 Non parametric estimation and testing of g x e interactions by rank. In: *Genotype x Environment Interactions and Plant Breeding.* Kang M.S. (ed). Department of Agriculture, Louisiana State University, Baton Rouge, Louisiana, USA, pp. 69-93.

Inglis A., 1992. Producing a better product; a grain grower's perspective. In: *Proc Grain Research Symposium.* Ahmedi Esfahani F.Z., Copeland L. (ed.), University of Sydney, NSW, Australia, pp. 1-9.

Karagöz A., Özberk İ., 2010. Türkiye'deki makarnalık buğday genetik kaynakları ve bu kaynakların buğday **ıslahında** kullanılması. *Makarnalık Buğday ve Mamulleri Konferansı*,. 17-18 Mayıs, 2010, **Ş.Urfa**, pp. 67-74..

Köksel H., Dexter J., Carcea M., Özay S.D., Olanca B., Uygun Ü., Şanal T., Özderen T., Yeter S., Köroğlu D., 2010. Hammadde kaynaklı bazı faktörlerin makarnalık buğday **ürünlerinde** kalite vet gıda güvenliği **üzerine** etkileri. Makarnalık buğday ve mamulleri konferansı. 17-18 Mayıs, 2010, **Ş. Urfa**, pp. 168-180..

Kün E., Gür A., Pakyürek A.Y., Karlı B., Ak B.E., Çullu M.A., Kılınçer N., Öktem A., Birsin M., Alp A., Çopur O., Özberk İ., Gül İ., Özberk F., Karahan S., Kutlu U.B., Özcan Z., 2005. 2005-2015 GAP bölgesi bitkisel **üretiminde** olası gelişmeler. *GAP IV. Tarım Kongresi*, Cilt I.;27-108, Ş.Urfa (http://ziraat.harran. edu.tr/kongre/Bildiriler/27_Ekremkun1.pdf).

Nachit M.M., 1998. Durum wheat breeding research to improve dryland productivity in Mediterranean Region. *Proceeding of'SEWANA Durum Research Network Workshop*. Nachit M.M. *et al*. (eds), 20-23 March, 1995, ICARDA, Aleppo, Syria, pp. 1-15.

Ozberk I., Kılıç H., Özberk F., Atlı A., Karlı B., Coşkun Y., 2011. Variety selection based on net return per hectare in durum wheat (*T. durum* L.), *AJAR,* 6(4), pp. 1016-1024.

Ozberk I., Zencirci N., Özkan H., Özberk F., Eser V., 2010. Dünden bugüne makarnalık buğday **ıslahı** ve geleceğe bakış. *Makarnalık Buğday ve Mamulleri Konferansı*, 17-18 Mayıs, 2010, **Ş.urfa**, pp. 43-66.

Ozberk I., Kılıç H., Atlı A., Ozberk F., Karlı B., 2006. Selection of wheat based on economic returns per unit area. *Euphytica*, 152, pp. 235-245.

Ozberk I., Atlı A., Pfeiffer W., Ozberk F., Coşkun Y., 2005a. The effect of sunn pest (*Eurigaster integriceps)* damage on durum wheat: impact in the market place. *Crop Prot.,* 24(3), pp. 267-274.

Ozberk I., Atlı A., Yücel A., Özberk F., Çoşkun Y., 2005b. Wheat stem sawfly (*Cephus pygmaeus* L.) damage; impacts on grain yield, quality and marketing prices in Anatolia. *Crop Prot.,* 24(3), pp. 1054-1060.

Ozberk I., Özberk F., Atlı A., Cetin L., Aydemir T., Keklikci Z., Onal M.A., Braun H.J., 2005c. Durum wheat in Turkey; yesterday, today and tomorrow. *Durum Wheat Breeding: Current Aproaches and Future Strategies.* Royo C. *et al*., (eds). The Howard Press Inc., USA. pp. 981-1010.

Ozberk I., Ozberk F., Öktem A., 2002a. Harran ovası koşullarında ekmeklik buğday (*Triticum aestivum*) bölge verim denemelerinde bazı istatistik analizler. **Çukurova Üniv**. Zir. Fak. Dergisi,17(3), pp. 111-118.

Ozberk I., Ozberk F., Coşkun Y., 2002b. Harran ovası koşullarında ekmeklik buğdayda verim ve Bazı verim **öğeleri** arasındaki ilişkiler. Harran **Üniversitesi** Ziraat Fakültesi Dergisi., 6(1-2), pp. 39-45.

Oztahtacı A.H., 2000. Turkish macaroni sector and improvements In: *Turkish macaroni industry symp*. Olgun A., Uzmay A. (eds), Izmir, Turkey, pp:9-19.

Sardana V., 2000. Export potential of durum wheat. *Agriculture tribune*. Online edition, Monday, October 23, Chandigarh, India.

Troccoli A., Borelli G.M., Devita P., Fares C., Difonzo N., 2000. Durum wheat quality: A multidisciplinary concept. Mini review, *J. Cereal Sci*., pp. 99-113.

Uluöz M., 1965. Wheat, flour and bread analysis. *EUZF Public*. No. 57, İzmir, Turkey.