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Full Length Research Paper

Variety selection based on net return per hectare in durum wheat (*Triticum durum* L.)

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This study aimed to assess a variety selection and preference criteria based on net return ha^{-1} in durum wheat (*Triticum durum* L). Regional yield trials with 25 entries were planted in Diyarbakir, Hazro and Ceylanpinar locations in southeast Anatolia in 2004/05 and in Diyarbakir and Hazro in 2005/2006 growing season. A randomized complete block design with 4 replications was employed. Grain samples from each location were subjected to some quality analyses and then presented to randomly selected grain purchasers within the local commodity market for market price estimations. The results revealed that entries 13, 7, 3, 16 and 24 were found to be top 5 highest yielding. Regression analysis showed that the entry 13 and 24 were stable for grain yield. It was found that the most of high yielding entries were also high income generating in both years. Entries 13, 24, 16, 7 and 2 were always found to be first 5 highest incomes generating in both years. Except for 1000 kernel weights in first year, none of other quality parameters was found to be correlating market prices. There were 6.08 and 25 US$/tonne market price difference between entries with highest and lowest market prices in both years respectively. It was concluded that Şanliurfa commodity market does not offer adequate premiums for the quality characteristics of durum wheat under study. This may result in farmer preference for high yielding with relatively low quality varieties. Breeders and farmers must also give priority to develop select cultivars with high net return (US$/ ha) rather than high yielding or high quality (=high marketing prices) only.

Key words: Durum wheat, variety preference, net returns, quality, yield.

INTRODUCTION

The benefit of adopting improved wheat varieties were the genetic gains in yield, improve disease resistance, maintenance of disease resistance, changes in grain quality, yield stability and early maturity (CIMMYT, 1995). The participatory plant breeding approach (PPB) was proposed as a way to address adoption problems by using the basic principle that selection is conducted by the farmers in their own agronomic practices. Under these circumstances, adoption rates were higher and risks were minimized (Ceccarelli and Grando, 2005). Originally, high yielding ability and sustainability for farmers' own food needs were the only factor applying in PPB. Despite PPB meets farmer demands as food and high yielding it neglected specific end use quality for commercial production (Ozberk et al., 2006b). As known, nearly 5-8 % of total wheat production is durum (tetraploid) wheat which is used for pasta, bulgur and couscous (Abaye et al., 1997; Bushuk, 1998; Ozberk et al., 2005b).

World wheat's fall into relatively district categories of kernel hardness [durum wheat is extra hard with 35-42 particle size index (PSI)] which generally dictate end-use (Bushuk, 1998). Grain buyers sometimes blend the wheat to obtain a suitable balance for a specific end-use (Edwards, 1992). The need for specific end-use quality opened a new area in plant breeding called market oriented or market driven breeding (Storey, 1992). In this approach, it is imperative that the right signals reach

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breeders from marketers as to future market requirements. Various end-use quality characteristics such as test weights (kg/hl), 1000 kernel weights (g), protein content (%), amylase activity, pest damaged kernels (%) etc. determine marketing price.

High bushel weight has a positive effect on purchase probability and appear to be more important to buyers' purchasing decision than protein content, amylase activity or the choice between no.1 and no. 2 grade in USA (Lee et al., 2000). Durum wheat [*Triticum turgidum* L.ssp. *durum* (Desf)Husn.] is cultivated on approximately 10% of the world's wheat area. In Mediterranean basin, 60% of world production is produced on approximately 11 m.ha or 85% of world durum area. (Nachit, 1998) Turkey is one of the largest producer of durum wheat in the world with around 2-3 million hectares and 4 million tons of annual production (Özberk et al., 2003). Turkey with a consumption of 850 000 tons of bulgur, 360 000 tons of pasta and 750 000 tons of other products, is a leading durum wheat consumer in the Middle East (Eser, 1998). Wheat is the major cereal crop for southeast Anatolia with a weighted annual production averaging over 2 mt/ year from a harvested area of 1 m hectares (Anonymous, 2001). From 1980 through 1998 weighted grain yield averaged 1814 kg/ha under dry land conditions (Anonymous, 2001). On the other hand, average yield was 6000 kg/ha under supplementary irrigated conditions (Ozberk et al., 2006a). Southeast Anatolia is known as durum wheat belt of the country (Özberk et al., 2005b; Özberk et al., 2006a).The area is the most favourable environment for durum wheat production (Kün et al., 2005). Land races such as 'Bağacak', 'Sorgül', 'Beyaziye', 'Menceki' , 'İskenderi', 'Misri' were replaced by modern varieties such as 'Dicle-74', 'Diyarbakir-81', 'Firat-93', 'Aydin-93', ' Ceylan-95', 'Harran-95', ' Altintoprak-98', 'Sariçanak-98' and ' Akçakale-2000'. Most of them were selected from CIMMYT derived material by NARS (Özberk et al., 2005b). Some of varieties with high yellow pigmentation such as 'Zenith', 'Svevo', 'Spagetti', 'Duraking' were introduced by private companies. 'Zenith', 'Svevo', 'Spagetti', Sariçanak-98', 'Firat-93' and 'Ege-88' are leading varieties in acreage in the region (Özberk et al., 2003 ; Kün et al., 2005). Around 25% of total durum wheat production is provided by south eastAnatolia. 25% of macaroni production is located in the region (Öztahtaci, 2000). Şanliurfa is the major bulgur producer with a 25 000 tons of average annual production (Anonymous, 2002a). Farmers sell their own grain in commodity markets or through the Turkish Grain Board (TGB) which has a market price regulating role. Şanliurfa commodity market is the third largest market in Turkey with over a 500 000 tons of summer seasons marketing capacity (Özberk et al., 2005e). Some of grain purchasers in commodity market are in key position and control the demands of bulgur and pasta industry. Regional and some national grain users buy grain via local representatives (some of them are grain buyers in

commodity market) with required properties for a specific end-uses such as bulgur, semolina etc. Grading factors, mostly referred to by grain buyers are clean ness (absence of inert material, dirt and weed seeds), absence of other cereal grains (especially red bread wheat kernels), absence of sunn pest damage, kernel vitreous ness, high hectoliter and 1000 kernel weights (Özberk et al., 2006b; Özberk et al., 2006a). The quality criterion for farmers is productivity and his concept of quality is closely linked to the need to obtain high yield in order to maximize profit (Inglis, 1992; Troccoli et al., 2000). From the breeding point of view, the question is which of the following must be given priority; high grain yields, high marketing price or a combination of both (that is high grain yield x marketing price= high production income).

This study aimed to investigate the steps for final selection and release of advanced lines through multi location yield testing, basic quality analyses and marketing prices in south east Turkey.

MATERIALS AND METHODS

25 durum wheat entries (20 advanced lines + 5 standard variety) (names were not given were tested employing a randomized complete block design with 4 replications. Field trials were carried out in Diyarbakir, Hazro and Ceylanpinar locations of south east Anatolia in 2004/05 and in Diyarbakir and Hazro in 2005/06 growing season. Annual rainfalls were 329.8, 320 and 323.5mm in Diyarbakir, Hazro and Ceylanpinar respectively in 2004/05. This turned out to be 413.2 and 429 mm for Diyarbakir and Hazro respectively in 2005/2006. Field trials were sown in mid November as a part of supplementary irrigated cereals+ food legumes (or cotton) crop rotation. The drilled plot size was 6 m x 6 rows planted and 5 m x 6 rows harvested. The sowing rate was 450 grains/ m^2 and 60 kg/ha pure P_2O_5 and 140 kg/ha (split) nitrogen were applied. All other necessary measurements such as weed control, rodent control were taken in the field trials. Two irrigations were practiced during the grain filling period giving 100 mm in each prior to combine harvesting. All inputs were the same for all entries under testing.

Individual and year base combined analyses of variances were performed obeying some basic statistical rules such as testing homogeneity of error variances for each replication (F= highest variance/ lowest variance=ns) and experiments (F= highest error mean square/ lowest error mean square =ns) respectively. The means were grouped by Duncan's multiple range test (appropriate for the entries over 10) A regression analysis was performed for yield stability employing data for all environments. TARIST statistical software (Açikgöz et al., 1994) and TOTEMSTAT (Açikgöz et al., 2004) were employed for statistical analyses and generation of the reports. In 2004/05, after dockage cleaning (separating chaff and other light material by air flow and sieving), grain samples from each location (after joining each replication) were scored for some physical traits [hectoliter weights (Anonymous, 1990), 1000 kernel weights (Uluöz, 1965), vitreousness (%) (Anonymous 2002 b)] and sunn pest damage (g/100g) (Köksel et al., 2002) were scored via identifying the grains with partially pale region and crater like appearance with a black dot in center and weighting. Adequate amount of grain samples (joining replications) were grinded by Alfa Albara electronic mill (2850 rpm and protein (%) contents were scored by Dickey John (Instalab 600) according to ICC standard no.159 (Anonymous, 2002c). Except for above characteristics micro sedimentation (MSDS) (Dick,

1981) and grain colour (Minolta colour detection device) were further scored in 2005/2006. Marketing price estimates were based on Şanliurfa commodity market in summer and autumn months of 2005 and 2006 respectively. The grain samples were presented to 4 randomly selected grain buyers in Şanliurfa commodities market for market price estimations. Year base combined analyses of variances for market prices were performed using the same statistical software. The relationship between hectoliter weights (kg/hl), 1000 kernel weights (g), protein content (%), kernel vitreous ness (%) and sunn pest damage kernels (%) vs. grain yields and marketing prices were further investigated through correlation analysis in 2004/2005. Only 100 kernel weights and hectoliter weights were scored unanimously for two locations in 2005/2006. Therefore, correlations between those characteristics vs. market price estimates were investigated in 2005/2006.

Production income (US$/ ha) was calculated by multiplying grain yields (kg/ha) x marketing prices (US$/ tonne) for each entry in both years. A rank stability analysis for 2004/2005 was performed to detect low ranking cultivars for high production income/ha with relatively low standard deviations (Heuhn 1990). A rank stability graph was generated using Excel statistical software. Entries were assigned into four distinct zones in the graph. The first zone showed the entries falling into a 'low rank value and low standard deviation group' for production income.

The second zone indicated entries grouped as 'low rank and high standard deviation group'.

The third and fourth zones show entries falling into the 'high rank and high standard deviation' and 'high rank and low standard deviation' groups. Rank stability analysis was not performed due to the presence of only two locations in 2005/2006.

RESULTS

2004/2005

Grain yield data, obtained from Diyarbakir, Hazro and Ceylanpinar locations were subjected to combined analysis of variance (Table 1). Replications ($p<0.05$), locations ($p<0.01$), entries ($p<0.01$) turned out to be significant. Significant entries x locations interaction indicated the absence of genotype x environment (GxE) interaction. Diyarbakir was the highest yielding location (6201.4 kg /ha), with Hazro and Ceylanpinar placed in second and third ranks at 5933.0 kg /ha and 2786.7 kg /ha.

Entries were grouped by Duncan's multiple range test and results are given in Table 3. This shows that the entries 7,17,13,16 and 24 took place in top five ranks, giving 5586.8, 5229.8, 5208.3, 5174.3 and 5172.9 kg /ha respectively.

The coefficients of correlation between above characteristics vs. grain yield turned out to be non significant giving positive relations with hectoliter weights (kg/ hl), protein content (%) and kernel vitreous ness (%) and negative for 1000 kernel weights (g) and sunn pest damage (%) (Table 2a).

Marketing price data for grain samples of all entries for each location were analyzed on both individual location and combined basis. Entries were grouped by Duncan's multiple range test (Table 4). This shows that entries 2, 1, 22, 7 and 4 filled at top five ranks, giving 266.05, 266.04, 265.81, 264.53 and 264.41 US$/ tonne respectively. The coefficients of correlation for a number of characteristics vs. marketing price estimates are given in Table 2. Only correlation between 1000 kernel weights vs. marketing price estimates was found to be significant (r= 0.707**). Net economical returns (US$/ ha) are given in Table 4. This demonstrated that entries 7, 17, 1, 16 and 13 2 took top positions for production incomes with the values of 1477.66 1381.97, 1373.03, 1365.57 and 1355.17 US$ /ha respectively. Rank stability analysis was performed for further investigation for production income. Figure 1 shows that entries 7, 1, 16 and 13 were found to be stable for production income, giving high production incomes with low standard deviations.

2005/2006

Grain yield data obtained from Diyarbakir, and Hazro locations were subjected to individual and combined analyses of variance (Table 1). Entries turned out to be significant ($p<0.01$) statistically. The entries were grouped by Duncan's test and entries 13,3,16,24 and 18 placed at top five ranks giving 6710.5, 6485.8, 6368.5, 6311.8 and 6260.8 kg/ha respectively(Table 3). The coefficients of correlation for a number of characteristics vs. marketing price estimates are given in Table 2b. The coefficient of correlation between 1000 kernel weights and hectoliter weights vs. marketing price estimates and grain yield were not found to be significant. Some other characteristics such as grain color, MSDS and kernel vitreousness (%) did not result in significant correlations vs. market price estimates and grain yield. Net economical returns (US$/ha) are given in Table 4. This demonstrated that entries 13, 3, 16, 24 and 22 were the first five ranking entries with 3346.47, 3264.28, 3182.59, 3167.42 and 3128.28 US$/ha respectively.

Combined analysis of variance for all environments

Combined analysis of variance for 5 environments (3+2) showed the presence of statistical significance for replications, varieties and environments ($p<0.01$) but not for varieties x environments interactions. Top 5 ranking entries were 13, 7,3,16 and 24 giving 5809.3, 5804.5, 5657.25, 5652.08 and 5628.5 kg/ha respectively. Regression analysis also indicated that entries 13 and 24 out of these five top ranking entries were found to be most stable for grain yield with significant 'F' and high R^2 % values (Table 4).

DISCUSSIONS

Significant effects of entries and locations in the combined ANOVA for grain yield in both years indicated the presence of genuine differences among genotypes

Table 1. The Combined analysis of variances (that is, A: five environment, B: three locations in 2004/05, C: two locations in 2005/2006).

A				B				C			
Sources of variation	**DF**	**MS**	**F**	**Sources of variation**	**DF**	**MS**	**F**	**Sources of variation**	**DF**	**MS**	**F**
Replication	3	94022.55	6.865**	Replication	3	413837.07	3.830*	Replication	3	762594.79	4.272*
Variety	24	508188.50	3.712**	Variety	24	236514.64	2.189**	Variety	24	454787.46	2.548**
Environment	4	90926343.02	604.083**	Location	2	129788924.60	1201.295**	Location	1	68222880.5	382.194**
Var. x Env.	96	172184.49	1.258^{ns}	Var. x Loc.	48	124375.90	1.151^{ns}	Var. x Loc.	24	256872.34	1.439^{ns}
Error	372	136920.19		Error	222	108040.87		Error	147	178503.47	
Total	499	894160.28		Total	299	991474.34		Total	199	572012.62	
CV%: 11.55				CV%: 13.2				CV%: 11.96			

* : P≤0.05, ** : P≤0.01, ^{ns} : P>0.05.

Table 2a. Coefficients of correlation between some quality characteristics vs. grain yield and market prices in 2004/2005.

Characteristics	Yield (kg /ha)	Market prices (US$ /tonne)
1000 Kernel weights	-0.370^{ns}	0.707**
Hectoliter weights	0.0048^{ns}	0.052^{ns}
Protein %	0.108^{ns}	-0.228^{ns}
Vitreousness %	0.148^{ns}	0.261^{ns}
Sunn pest damage %	-0.120^{ns}	-0.022^{ns}

**:P≤0.01 Ns: non significant.

and locations respectively. Absence of genotype x environment interaction seems to be facilitating cultivar development and selection (Weber and Wricle 1990). First five top ranking entries for grain yield (13, 7, 3, 16 and 24) are CIMMYT derived entries. This confirmed the research findings (CIMMYT 1995; 1997) that CIMMYT germ plasm continues to be competitive in grain yield in the post green revolution period. All of entries ranking as top five yielded over 5000 kg/ ha in both years and there was no gap in favour of bread wheat in the region (Özberk et al., 2006b). Significant effects of entries in both locations for 2005/2006 season revealed the presence of genuine genetic variation among genotypes for grain yield. Entries 13, 24, 12, 18 and 9 were the top five ranking for grain yield. Entries 13, 24 and 12 were the high yielding for both years.

The presence of non significant correlations between protein content (%), Kernel vitreous ness (%) and sunn pest damage (%) in 2004/2005 and 1000 kernel weights, hectoliter weights, protein (%), kernel vitreous ness (%), grain colour and MSDS in 2005/2006 vs. grain yield were argued by several researchers such as Özkan et al. (1999) and Köksel et al. (2002) in some other studies. They found that sunn pest might result in direct yield reductions as much as 100% in central Anatolia. Alçin, (2004) and Özberk et al. (2005c) showed that there was no significant correlation between protein content (%) vs. grain yield in durum wheat. Furthermore, the inverse relationship between wheat yield and grain protein

Table 2b. Coefficients of correlation between some quality characteristics vs. grain yield and market prices in 2005/2006.

Characteristics	Yield (kg /ha)	Market prices (US$ /tonne)
1000 Kernel weights	(-0.222^{ns})	(0.056^{ns})
Hectoliter weights	(-0.072^{ns})	(-0.248^{ns})
Protein %	-0.115^{ns}	na
Vitreousness %	0.208^{ns}	na
Grain Colour	-0.031^{ns}	na
MSDS	0.100^{ns}	na

Ns:non significant; Na: not available.

Table 3. Yields and stability parameters.

Var. no.	Average yield 2004/05 (kg ha^{-1})	Average yield 2005/06 (kg ha^{-1})	Average yield (kg ha^{-1})	First five rank	a	b	Std b	R^2 %	F
1	5161.8 ab	6163.3 a-e	5562.6 a-c		224.16	0.972**	0.057	98.90	290.20**
2	5014.5 b	5752.5 b-g	5304.8 b-d		-408.26	1.122**	0.126	96.30	78.20**
3	5104.8 ab	6485.8 ab	5657.3 ab	3	-209.90	1.125**	0.113	97.02	97.76**
4	5107.0 ab	6148.8 a-e	5523.8 a-c		-154.14	1.082**	0.089	97.97	145.27**
5	5013.2 b	5508.8 c-g	5211.4 b-d		284.56	0.887**	0.110	95.57	64.84**
6	5011.1 b	5612.0 c-g	5251.5 b-d		-0.248	0.983**	0.095	97.24	106.04**
7	5586.8 a	6130.0 a-e	5804.5 a	2	-149.69	1.134**	0.125	96.45	81.50**
8	5162.5 ab	5690.6 b-g	5373.8 a-d		0.00	1.009**	0.040	90.48	38.05**
9	4841.6 bc	5937.7 a-g	5280.0 b-d		223.65	0.919**	0.112	95.79	68.31**
10	4755.5 bc	5244.5 fg	4951.2 d		409.09	0.799**	0.097	95.77	67.96**
11	4881.2 bc	5670.6 b-g	5197.0 b-d		-44.26	0.987**	0.083	97.87	138.43**
12	4786.1 bc	6076.0 a-f	5302.1 b-d		98.44	0.962**	0.119	95.58	65.01**
13	5208.3 ab	6710.8 a	5809.3 a	1	118.71	1.051**	0.129	95.63	65.74**
14	4461.8 c	5633.9 b-g	4930.6 d		-182.99	0.980**	0.099	96.99	96.96**
15	4700.0 bc	5447.8 d-g	4998.8 d		332.22	0.832**	0.076	97.53	118.49**
16	5174.3 ab	6368.7 a-c	5652.1 ab	4	-312.7	1.156**	0.076	98.69	226.31**
17	5229.8 ab	6001.6 a-g	5538.5 a-c		64.69	1.017**	0.116	96.21	76.33**
18	4772.9 bc	6260.8 a-d	5368.1 a-d		-458.06	1.148**	0.154	94.84	55.21**
19	4769.4 bc	5350.8 e-g	5002.0 d		-12.10	0.940**	0.061	98.72	232.61**
20	4749.3 bc	5189.5 g	4925.4 d		223.32	0.852**	0.073	97.79	132.87**
21	4788.8 bc	5711.4 b-g	5157.9 cd		122.31	0.927**	0.122	95.06	57.81**
22	5047.2 ab	6220.0 a-d	5516.3 a-c		-188.13	1.092**	0.070	98.77	242.73**

Table 3. Contd.

23	4878.5 bc	5763.5 b-g	5232.5 b-d		141.80	0.935**	0.020	99.84	1378.12**
24	5172.9 ab	6311.8 a-c	5628.5 a-c	5	-81.93	1.079**	0.112	96.82	91.44**
25	4963.8 bc	5742.5 b-g	5275.3 b		115.57	0.952**	0.136	94.21	48.85**
Average	4137.6	5885.4	5338.4						
MS of error	108040.87	178503.47	136920.19						
CV%	13.2	11.96	11.55						

Table 4. Net returns for 2004/05 (3 loc.) and 2005/06 (2 loc.).

Var. no.	Average market price2004/05 ($ Ton)		Net return 2004/05 ($ ha)	First ten rank	Average market price2005/06 ($ Ton)		Net return 2005/06 ($ ha)	First ten rank
1	266.04	a	1373.03	3	478.74	i	2950.47	
2	266.05	a	1333.97		502.94	ab	2892.91	
3	263.68	c-e	1345.82	9	503.36	a	3264.28	2
4	264.41	bc	1350.34	8	495.58	c-f	3046.82	7
5	262.77	d-f	1317.26		480.85	hi	2648.52	
6	261.25	h-j	1309.12		494.52	d-f	2775.24	
7	264.53	bc	1477.66	1	494.94	d-f	3033.98	8
8	261.92	f-h	1352.03	7	503.78	a	2866.50	
9	260.27	ij	1259.96		496.63	b-e	2948.49	
10	263.25	c-e	1251.75		499.78	a-d	2620.84	
11	263.92	c-e	1288.19		494.94	d-f	2806.30	
12	261.98	f-h	1253.83		495.58	c-f	3011.14	9
13	260.21	ij	1355.17	5	498.73	a-e	3346.47	1
14	261.33	g-i	1165.79		487.16	gh	2744.17	
15	263.25	c-e	1237.17		503.36	a	2741.80	
16	263.93	c-e	1365.57	4	499.78	a-e	3182.59	3
17	264.29	c	1381.97	2	492.42	e-g	2955.01	10
18	264.11	cd	1260.33		489.26	fg	3062.76	6
19	260.15	ij	1240.65		499.36	a-e	2671.57	
20	264.41	bc	1255.68		501.89	a-c	2604.30	
21	262.65	e-f	1257.56		497.68	a-e	2842.25	
22	265.81	ab	1341.54	10	502.94	ab	3128.28	5
23	263.25	c-e	1284.13		494.52	d-f	2849.91	
24	261.92	f-h	1354.65	6	501.89	a-c	3167.42	4
25	259.97	j	1290.23		498.31	a-e	2861.29	

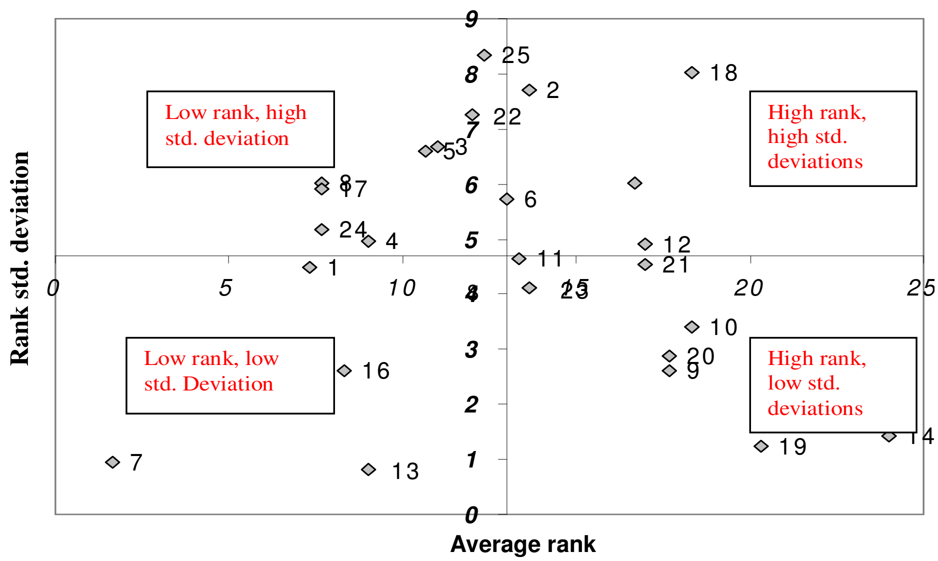

Figure 1. Production income stability graphic of entries by rank analysis over three locations in 2004/2005.

content (%) is well known (Terman et al., 1969; Entz and Fowler, 1989). High grain yields can be achieved possessing high number of kernel spike^{-1}, high kernel weight spike^{-1} and high number of spike lets spike^{-1} under supplementary irrigation in the south east Anatolia (Korkut et al., 1993; Akkaya et al., 1996; Alçin 2004; Özberk and Özberk, 2004; Özberk et al., 2005c). In the ANOVA's of market prices, the significant effect of grain buyers indicated differences in price estimations among grain purchasers in both years. This might be due to the presence of different purchasing criteria of purchasers and the World prices in the commodity market. Similar results were found by Özberk et al. (2005). Grain samples of entry 2, 1, 22, 7 and 4 for all three in 2004/2005 received high market price offers. While entries 8, 3, 15, 2 and 22 received the top five high market prices offer respectively. This might be due to possessing good visual characteristics such as high 100 kernel weights, good grain colour. Correlation analysis made this clear that 1000 kernel weight was the most important physical trait for high market price by selected grain purchasers in 2004/2005.

Non significant effects of hectoliter weights, protein content (%) kernel vitreous ness (%) and sunn pest damage (%) on to market price can be concluded having narrow variation among entries for these characteristics in 2004/2005. This confirmed that grain quality affects the market price slightly. In fact, there were significant correlations between sunn pest damage and kernel vitreous ness vs. market price (r= -0.608** and r=0.313* respectively) in durum wheat (Özberk et al., 2005e; Özberk et al., 2006a).

Although associated with kernel vitreous ness (Abeye et al., 1997), protein (%) levels seemed to be not affecting buyers' decision as did in the USA (lee et al., 2000). Despite being non significant in this study, hectoliter weight is only attribute that consistently influences the price in Iraq and Iran (Ahmedi Esfahani and Stanmore, 1997; Lee et al., 2000) even in Kansas, USA (Porter and Barkley, 1995).

After the above mentioned discussion, the key question is 'which of the following must be given priority; high grain yield, high market prices or combination of both (that is, high grain yields x market prices= high net return per ha)?' Four out of 5 top ranking entries for grain yield and net return matched with various orders. Therefore, as we did for bread wheat (Özberk et al., 2006b) we must propose a new approach for variety selection in breeding programs and farmer preference. It seemed that high grain yielding entries were also high income generating entries. It was evident that market prices, offered for good quality grains were not sufficient to change order of profitability. Correlation between grain yield rank vs. net return rank was 0.97** in first year of study. It is clear that the market price range between the highest and the lowest was too narrow and insufficient to compensate yield advantages in both years. Little premium offers for high quality grains in south east Anatolia might be due to relatively low international market prices for high quality durum wheat. Production costs such as fertilizer, fuel, chemical in Turkey are too high comparing major grain growers around the world and this result in high base market price building up inevitably in commodity market. Grain using industry does not desire to raise market prices paying further additional premiums for high quality grains. When only annual crop production is low, they may increase market prices a little up. Farmer demands for further increases in market prices may result in grain industry to import high quality grains with relatively low market price. Low rewards for quality might lead us in developing high yielding cultivars rather than high quality as the Australian breeders (Ahmedi Esfahani and Stanmore, 1997).

It was concluded that high grain yielding entries were also high income generating entries and the narrow range of market prices based on quality may result in farmers to avoid planting cultivars with good quality in south east Turkey. Breeders must also consider this result before offering an advanced line for release. Unless the grain industry offers additional premiums for high quality or suppliers decline the production inputs, neither specific end-use quality nor acceptable industrial quality demands will be met by growers in Turkey and all other countries with the same economical phenomena.

REFERENCES

Abaye AO, Brann DE, Alley MM, Griffey CA (1997). Winter durum wheat: do we have all the answers? Crop and Soil Environmental Sciences. Publication 424-802. Virginia cooperative extension, USA.

Açikgöz N, İlker E, Gökçöl A (2004). TOTEMSTAT. Biyolojik araştirmalarin bilgisayarda değerlendirilmesi. E.Ü. Tohum Teknolojisi ve Araştirma Merkezi Yayin no: 2, İzmir.

Açikgöz N, Akkaş ME, Moghaddom A, Özcan K (1994). TARIST: PC'ler için Veri Tabani Esasli Türkçe İstatistik Paketi. Tarla Bitkileri Kongresi Bitki Islah Bildirileri. 25-29 Nisan 1994, S: 264-267. Bornova

Ahmedi Esfahani FZ, Stanmore RG (1997). Export demand for attributes of Australian wheat in Asia and Middle East. Food Policy, 22: 145-154.

Akkaya A, Dokuyucu T, Kaya AR, Ispir B (1996). Determination of yield and yield components of some durum wheat varieties in K.maraş conditions. Proceedings of 5th International Wheat Congress. June 10-14,1996 Ankara, Turkey.

Alçin A (2004). Makarnalik Buğday Melez Bahçesinde Bazi Agronomik Karakterlerde Genetik Varyasyonun Saptanmasi, Harran Üniversitesi Fen Bilimleri Enstitüsü (Yüksek lisans tezi).

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

Anonymous (2001). GAP İl İstatistikleri. http:// www. tarim.gov.tr/istatistikler/gap/tahil/.

Anonymous (2002a). Sanayi rehberi. Şanliurfa Ticaret ve Sanayi Odasi, Şanliurfa, Turkey.

Anonymous (2002b) Method for determination of the vitreous ness of durum wheat. ICC standard no: 129.

Anonymous (2002c). Determination of protein by Near Infra Red (NIR) Spectroscopy. ICC standard No: 159.

Bushuk W (1998) Wheat breeding for end product use. *Euphytica*, 100(1-3): 137-145

Ceccarelli S, Grando S (2005). Participatory plant breeding: a fast track to variety development. The ASA-CSSA-SSSA International Annual Meeting.Nov.6-10, http://crops.confex.com/crops/2005am/techprogram/P7050.htm

CIMMYT (1997). Adoption of improved wheat varieties in developing countries. Chapter 4. http://www.cimmyt.org/research/economics /map/impact_studies/wheat1966_97/w6chapter4.pdf.

CIMMYT (1995). Impacts of international wheat breeding research in the developing world, 1960-1990. Executive Summary. http:// www. cimmyt.org/research/Economics/Revisar/htm/whesumma.htm

Dick W (1981). Micro sedimentation test for use in the quality testing program for durum wheat . Department of Cereal Science and Food Technology.North Dakota State University. Fargo. N.D. 58105.

Edwards IB (1997) A global approach to wheat quality. Wheat Quality Conference, Manhattan, Kansas, USA. Opening session keynote address, May, 1997. http://stars. kansas.net/iwqe/keyedwa.htm.

Entz MH, Fowler DB (1989). Response of winter wheat to N and water: Growth, water use, yield and grain protein. Can. J. Plant Sci., 69: 1135-1147.

Eser V (1998). Durum breeding in Turkey. In: M.M. Nachit, M.Baum, E.Porceddu, P.Monneveux, E.Picard (Ed.) SEWANA Durum research network workshop, 20-23 March,1995,ICARDA, Aleppo,Syria, pp. 43-55.

Huehn M (1990). Non parametric estimation and testing of g x e interactions by rank. In: Kang M.S. (Ed.) Genotype x Environment Interactions and Plant Breeding. 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: Ahmedi Esfahani F.Z.& L.Copeland (Ed.), Proc Grain Research Symposium., University of Sydney, N.S.W., Australia, pp. 1-9.

Korkut K, Başer I, Bilir S (1993). Makarnalik buğdayda korelasyon ve path katsayilari üzerinde çalişmalar. *Mak. Buğday ve Mamül. Simpoz.* 30 Kasim-3 Aralik 1993. Ankara

Köksel H, Atli A, Dağ A, Sivri D (2002). Commercial milling of sunn pest (Eurygaster spp.) damaged wheat. Nahrung/Food Int. J. Food Res. Dev., 46(1).

Kün E, Gür A, Pakyürek AY, Karli B, Ak BE, Çullu MA, Kilinçer N, Öktem A, Birsin M, Alp A, Çopur O, Özberk İ, Gül İ, Özberk F, Karahan S, Kutlu UB, Özcan Z (2005). 2005-2015 GAP bölgesi bitkisel üretiminde olasi gelişmeler. GAP IV. Tarim Kongresi, Cilt I, pp. 27-108 (http://ziraat.harran.edu.tr/kongre/Bildiriler/27_Ekremkun1.pdf).

Lee M, Lerohl M, Unterschultz J (2000) Buyer preference for durum wheat: a stated preference approach. Int. Food Agribus. Manage. Rev., 3: 353-366.

Nachit MM (1998). Durum wheat breeding research to improve dryland productivity in Mediterranean Region. Proceeding of 'SEWANA Durum Research Network Workshop'in 'SEWANA Durum Research Network' eds. M.M.Nachit, M.Boum, E. Poceddu, P Moneveux, E Picard. 20-23 March, 1995, ICARDA, Aleppo, Syria.

Ozberk İ, Ozberk F, Braun HJ (2003). Performance and stability of CIMMYT-derived durum wheat cultivars in the Souteastern Anatolia region., in the proceedings Arnel R. Halleuer International Symposium on Plant Breeding, 17-22 August, Mexico city, pp. 58-60 (Poster)

Özberk İ, Özberk F (2004). Harran ovasi koşullarinda makarnalik buğdayda bölge verim denemelerinde bazi istatistik analizler. Harran Ü. Zir. Fak. Dergisi, 8(2): 1-10.

Özberk İ, Ozberk F,Braun HJ (2005a) AMMI stability of some of internationally derived durum wheat varieties in the South-east of Anatolia. Pak. J. Biol. Sci., 8(1): 118-122.

Özberk İ, Özberk F, Atli A, Cetin L, Aydemir T, Keklikci Z, Onal MA, Braun HJ (2005b). Durum wheat in Turkey; yesterday, today and tomorrow. Durum Wheat Breeding:Current Aproaches and Future Strategies. Edit by:Royo,C; Nachit, M.N., Difonzo,N.,Araus,J.L. Pfeiffer,W.H. and Slafer, G.A. The Howard Press İnc., USA, 33: 1049.

Özberk İ, Alçin A, Coşkun Y, Özberk F (2005c) Yerli makarnalik buğdaylarda (*T.durum* Desf) tane verimi üzerine etkili bazi karakterlerin incelenmesi. GAP IV. Tarim Kongresi , 21-23 Eylül, Cilt, 1: 815-820

Özberk İ, Atli A, Yücel A, Özberk F, Çoşkun Y (2005d) Wheat stem sawfly (*Cephus pygmaeus* L.) damage; impacts on grain yield, quality and marketing prices in Anatolia. Crop Prot., 24: 1054-1060.

Özberk İ, Atli A, Pfeiffer W, Özberk F,Coşkun Y (2005e). The effect of sunn pest *(E.integriceps*)damage on durum wheat: Impact in the market place. Crop Prot., 24: 267-274.

Özberk İ, Atli A, Özberk F, Braun HJ (2006a). The effect of some grading factors on marketing prices in durum wheat. PJBS, 9(6): 1132-1138.

Özberk İ, Kiliç H, Atli A, Özberk F, Karli B (2006b). Selection of wheat based on economic returns per unit area. Euphytica, 152: 235-245.

Özkan M, Koçak E, Babaroğlu NE, Gökdoğan A, Atun V (1999) Problems caused by sunn pest and cereal bug in cereal fields and their solutions in central Anatolia region. In: Ekiz, H (Ed.),Cerelas 1999 Symposium. Konya, Turkey, pp. 462-476

Porter LL, Barkley A (1995). Selection of wheat varieties in Kansas:Does quality matter? Report of Progress 730. Kansas State University, Manhattan, USA.

Storey RJ (1992). From marketplace to breeder:getting the message through. In the proceeding of the Grain Reseach Symposium, Univ. Sydney, pp. 17-22.

Terman GL, Ramig RE, Dreier AF, Olson RA (1969). Yield–protein relationships in wheat grain, as affected by N and water. Agron. J., 61: 755-759.

Traccoli AG, Borelli M, De Vita P, Fares C,Di Fonzo N (2000). Durum wheat quality: A multidisciplinary concept. J. Cereal Sci., 32: 99-113.

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

Weber WE, Wricle G (1990). In: Manjif, S.K. (ed) Genotype x environment interactions and plant breeding. Dept. Agr. Lousiana State Univ., USA, pp. 1-9.