Bangladesh J. Bot. **35**(1): 71-76, 2006 (June)

EVALUATION OF AGRONOMICAL AND BIOCHEMICAL CHARACTERISTICS OF NEW LINES OF *TRITICUM DURUM* DESF. IN TURKEY

RAMAZAN DOGAN*, MEVLUT TURK[1] AND HULYA GUL[2]

Department of Field and Crop Science, Faculty of Agriculture, Uludag University, 16200, Bursa-Turkey

Key words: Durum wheat, Crossing, Agronomy, New lines, Turkey

Abstract

Wheat (*Triticum durum* Desf.) lines obtained from F9 with special emphases to some agronomical and biochemical characters were selected as genotypes suitable for the production of food commodities. The new genotypes [Samples (a) and (h)] by crossing *T. durum* were found to be more productive (5283 and 4818 kg/ha) and more suitable for specific technological use than the older varieties.

Introduction

Wheat is one of the most important creal crops in the world. In Turkey, wheat accounts for the largest production of cereals, approximately 16 million tones in 1998. Turkey is one of the major wheat-producing countries and 2.6% of world wheat production is made in Turkey (Dendy and Dobraszczk 2001).

Approximately 70% of world wheat production is used as food, mainly as bread and other baked products such as cakes and cookies. Wheat is the main source of protein and dietary fiber for many people around the world, and especially in Turkey. Experts recommend cereals as the first food to be added to infant diets, and evidence from recent research upholds that a healthy diet for adults should have most of its calories in the form of complex carbohydrate such as cereal starch. A healthy human diet must also include 20 to 30 g/day of dietary fiber, which can be easily achieved by eating whole grain cereal products (Dendy and Dobraszczyk 2001).

As for the nutritional aspects, studies on the *in vitro* starch digestibility showed the presence of a good amount of resistant starch, which together with soluble fiber, made wheat an interesting source of prebiotics substrata for the tropism of intestinal bacteria (Galterio *et al.* 2003).

In this research, F_9 lines, obtained by crossing the *Triticum durum* Desf. were characterized from the agronomical and biochemical point of view in order to constitute genotypes suitable for the preparation of pasta, cakes, bread, macaroni etc.

Materials and Methods

The agronomical research was done at the Reserch and Application Centre of Agricultural Faculty of Bursa Uludag University in Southern Marmara Region, Turkey. The structure of the soil of the centre is clayey and neutral in reaction. It is poor in organic matter and rich in available P and K (Katkat *et al.* 1985).

In this study, F_9 lines of several combinations were formed by the hybridization of cvs. Ambral, Bintepe, Cakmak-79, Gediz-75, Japiga, Sham-1, Yavoras and control cv. Gediz-75 and these constituted the plant material. Genotypes considered in F_9 were selected using pedigree

*Corresponding author. E-mail: rdogan@uludag.edu.tr. [1]Department of Field and Crop Science, Faculty of Agriculture, Suleyman Demirel University, 32260, Isparta, Turkey. [2]Department of Food Engineering, Faculty of Agriculture, Cukurova University, 01100, Adana, Turkey.

method developed in the department of field crops, among the plant lines obtained highly productive and high-quality cultivars with high adaptability to Southern Marmara Region in 1990 (Ekingen 1988, Yagdi 1999). Genotypes were formed as: (a) Ambral × Cakmak-79, (b) Ambral × Cakmak-79 (26), (c) Ambral × Cakmak-79 (36), (d) Sham-1 × Santa (28), (e) Sham-1 × Yavoras (12), (f) Sham-1 × Japiga, (g) Bintepe × Gediz-75 (12), (h) Gediz-75 × Cakmak-79 (33), (i) Japiga × Gediz-75 (44) and (j) Gediz-75 (St.). Only nine lines from F_9 and control cv. Gediz-75 were analyzed for agronomical and biochemical traits.

The trial was established with three replicates in plots with the dimensions of 1.2 m × 10 m according to randomized block design. Before sowing, 50 kg N/ha and after sowing 100 kg N/ha were applied. Seeds were sown by Oyjord drill in plots, each consisting of eight rows. The agronomical characteristics such as plant height (cm), seed number/spike and weight/spike, harvest index and seed yield (kg/ha) were examined.

The per cent broken grains of durum wheat were determined by the method of Ozkaya and Kahveci (1990). Wheat hardness was determined using the Scott barley pearlier standard method, measuring the material eliminated after abrasion of 20 g sample for 1 min (AACC 1983). Thousand kernel weights were noted. The weight of 1 L (hectoliter) was determined using a standard hectoliter apparatus. Moisture content was calculated as dry basis by weight difference after drying grain samples at 110°C for 24 h (AOAC 1984). Whole wheat grains were blended and milled using a Cyclotec mill equipped with a 1 mm sieve. The following analyses were carried out on whole grains flour. Sodium dodecyl sulphate (SDS) sedimentation test was performed applying the method of Dick and Quick (1983). Wet gluten was measured according to the approved method (AOAC 1984) with the glutomatic 2200 system. The α-amylase activity was measured by using the Falling Number test (AACC 1983).

Analysis of variance was performed on data obtained at different stages of experiment. The experimental data for the durum wheats were subjected to analyses of variance using ANOVA (Turan 1995).

Results and Discussion

Climatic values of wheat vegetation period in 1999 and 2000 was almost equal to long-term temperature. Total rainfall of experimental period was somewhat below the total rainfall of long-term period (560.6 mm). The period of nutrient accumulation in wheat grain for Bursa vicinity in May indicated the importance of rainfall quantity in this month.

Plant height, seed number/spike, seed weight/spike, harvest index and seed yield (kg/ha) values belonging to lines and control varieties (Table 1).

According to mean years, statistically, the differences among plant height of the varieties were significant at $p < 0.05$. The plant heights of the lines ranged from 75.50 to 84.40 cm. The (b) and (j) samples had the maximum plant heights. The plant height is very important because of resistance to lodging and harvest index. Some researchers reported that ideal plant height was between 90 and 100 cm (Yurur 1998, Tosun 1987). The plant heights of the samples of the experiment were generally a little shorter than 90 - 100 cm, which are the ideal plant heights. Results obtained during this experiment were similar to the results of some others (Yaradat *et al.*1996, Yurur 1998 and Yagdi 1999).

The differences among seed numbers of the lines and control were statistically non significant. Seed number/spike levels of the lines ranged from 31.70 to 41.50. According to mean of two years, although there were some numerical differences among seed number of the varieties, the line gave the highest value as 41.50. Many researchers reported that seed number/spike is very closely and positively correlated with grain yield (Thorne 1966, Genc 1978, Yuru *et al.* 1983).

The differences between the lines related to seed weight/spike were found non-signfiicant. But there were some numerical differences among seed weight/spike of varieties. The seed weight/spike of the lines ranged from 1.57 to 1.76 g. The seed weight/spike was maximum in line (c). The differences between the lines could be due to genotypic differences. Similar results were obtained by some other researchers (Yilmaz and Dokuyucu 1994, Dokuyucu *et al.* 1977 and Sener *et al.* 1997).

There were statistically highly significant differences among values of harvest index of lines and varieties. Harvest index ranged from 30.70 to 35.50%. According to mean values of two years, the sample (a) and (c) had the highest value of harvest index (35.50%). Similar results were obtained by some other researchers (Donald 1968, Sing and Stoskof 1971, Tosun 1986 and Sener *et al.* 1997). Many researchers have reported that harvest index is related with seed numebr/spike and seed weight/spike (Donald 1968, Sing and Stoskopf 1971, Tosun 1986 and Sener *et al.* 1997). Some other researchers have reported that harvest index is correlated with seed yield and this correlation is desired by wheat breeders (Sharma and Smith 1986 and Sharma 1992).

Seed yield (kg/h) is one of the most important goals in these kinds of studies (Yagdi 1999). Results presented in Table 1 show that according to mean of two years, differences were found among seed yields of lines and control variety. Rainfall, in March and April of 1999 and 2000 were more than from long-term value. Especially rainfall in March, April and May 2000 was more from both long-term and from 1999 year. Thus, in 2000 seed yield of lines was highest than that in 1999. The seed yield of line (a) was the highest (5283 kg/h), while that of (e) was the lowest (3839 mg/ha). Two lines out-yielded from the control variety Gediz-75 in the trial year 1999. According to mean of two years, seed yields were 5283 and 4818 kg/ha, respectively and thereby exhibited superiority over Gediz-75. Based on the mean of two years and single year, line Cakmak-79 combinations appeared to be stable and consistent when seed yield is considered. Therefore, quality factors such as hectolitre weight and gluten level must be considered with the yield before selection.

There were important variation in seed yield. It is known that variation in the yield were due to annual precipitation and also specially, due to variation of precipitation in critical months. Frere *et al.* (1987) reported that precipitation is an important factor for seed yield.

The broken grains of the samples were lower than $\leq$ 0.7%. Grain harnesses of the genotypes were generally vitreous. The 1000-kernel weight of the durum wheat samples ranged from 37.30 to 44.60 g. In addition, hectolitre weight of sample (b) was the lowest as 80.20 kg/hl. According to Turkish standard (TS 2974), the durum wheat genotypes were the best quality wheat when broken grain, grain hardness, 1000-kernel weight and hectolitre weight were taken into consideration.

The results of 1000-kernel, weight of the samples were similar to the results of Ereifej *et al.* (2001). Vazquez *et al.* (2001) reported that hectolitre weights of wheat grains ranged from 63.2 to 81.4 kg/h. Our findings on hectolitre weight were higher than that of Vazquez *et al.* (2001).

The moisture, wet gluten levels, Zeleny sedimentation index (ml) and α-amylase activities of the durum wheat genotypes were also given in Table 1. The moisture contents of the samples were approximately 10%. Wet gluten levels of flour obtained from the investigated wheat samples ranged between 15.00 and 21.50%. Per cent gluten amount of sample (i) was the highest. These values are higher than those reported previously (Galterio *et al.* 2001). However, our findings for wet gluten were similar to findings of Ereifej *et al.* (2001). Zeleny sedimentation (ZS) index shows the amount and quality of wheat gluten (Ozkaya and Kahveci 1990). The ZS indexes of the durum wheat samples ranged from 30.00 to 39.00 ml. The ZS index of (d) was the highest. The falling number system measures the α-amylase activity in grains and flour to detect sprout damage, optimize flour enzyme activity and garantee soundness of traded grain. α-amylase activity is crucial for final product quality of bread and pasta. α-amylase activity value of flour should be higher than 250 ± 25 second (Dendy and Dobraszczyk 2001). Our findings of α-amylase activity range from 267.00 to 302.00 seconds.

The agronomic and biochemical properties varied significantly and they were influenced by genotypes and environment. Amongst the new genotypes (a) and (h) were found to be more productive and suitable for specific technological use than the older varieties. In particular, the gluten composition and the ZS index test values of whole flours revealed that among all new varieties this one could be suitable for high-quality pasta production with good sensory characteristics.

References

AACC. 1983. American Association of Cereal Chemists. Approved Methods of AACC. St. Paul, MN.

AOAC. 1984. Official Methods of Analysis. Association of Analytical Chemists, Washington DC.

Dendy, D.A.V. and B.J. Dobraszczyk. 2001. Cereals and Cereal Products, Chemistry and Technology. Aspen Publishers Inc., Gaitsburg, Maryland, USA.

Dick, J. and J. Quick. 1983. A modified screening test for rapid estimation of gluten strength in early-generation durum wheat breeding lines. Cereal Chem. **60**: 315-320.

Dukuyucu, T., A. Akkaya, A. Nacar and B. Ispir. 1997. Kahramanmaras Kosullarinda Bazi Ekmeklik Bugdaylarin Verim ve Verim Fenolojik Ozelliklerinin Incelenmesi. Turkiye 2. Taria Bitkileri Kongresi, S: 16-20, 22-25 Eylul, Samsun.

Donald, C.M. 1968. The design of wheat ideotypes. The Third International Wheat Genetics Systems. Aust. Acad. Sci. pp. 377-388.

Ekingen, H.R. 1988. Bitki Islahi. Courses Notebook of Uludag Univ. **31**: 68-72.

Ereifej, K.I., G.N. Al-Karaki, G.N. and M.K. Hammouri. 2001. Variability of some physico-chemical characteristics of wheat cultivars grown under arid and semiarid Mediterranean conditions. Internat. J. Food Properties **4**(1): 91-101.

Frere, M., G. Maracchi, F. Migliette and C. Canes. 1987. Agroclimatogical classification of the Mediterranean and southwest asian areas. pp. 3-13. *In:* Drought Tolerance in Winter Cereals. (Eds. J.P. Srivastava, E. Porceddu, E. Acevedo and S. Varma). Proc. Intern. Workshop. 27-31 October, Capri, Italy.

Galterio, G., D. Cardarill, P. Codianni and R. Acquistucci. 2001. Evaluation of chemical and technological characteristics of new lines of *Triticum turgidum* ssp. *dicoccum*. Nahrung **45**(4): 263-266.

Galterio, G., P. Codianni, A.M. Giusti, B. Pezzarossa and C. Cannella. 2003. Assessment of the agronomica and technological characteristics of *Triticum turgidum* ssp. *dicoccum*. Nahrung **47**(1): 54-59.

Genc. I. 1978. Cumhuriyet-75 buddaty cesidinin bitki basina kardes sayisinin verim ve verim unsuriarina etkileri uzerine bir arastirma. Bilimsel inceleme ve Arastirma Tezleri. Cukurova Univ. Agric. Faculty Press, No. **21**, Adana, Turkey.

Katkat, A.V., F. Ayla and I. Guzel. 1985. Uludag Univestitesi Ziraat Fakultesi Uygulama ve Arastirma Ciftligi arazisinin toprak etudu ve verimlilik durumu. J. Uludag Univ. Agric. Faculty **3**: 71-78.

Ozkaya, H. and B. Kahveci. 1990. Tahil ve urunleri analiz yontemleri. Gida Teknolojisi Demegi Yayinlari. **14**: 152.

Sharma, R.C. and E.Y. Smith. 1986. Selection for high and low harvest index in three winter wheat populations. Crop Sci. **26**: 1147-1150.

Sharma, R.C. 1992. Analysis of phytomass yield and wheat. Agron. J. **84**: 926-929.

Sener, OP., M. Kilinc, T. Yagbasanlar, H. Gozubenli and U. Karadut. 1997. Hatay kosullarinda bazi ekmeklik (*Triticum estivum* L.) ve makarnalik bugday (*Triticum durum* desf.) Cesit ve hatiarini saptanmasi. II. Field and Crops Congr. 22-25 September 1997, Samsun, Turkey.

Sing, I.D. and S.A. Stoskopf. 1971. Harvest index in Cereals. Agron. J. **63**: 224-226.

Thorne, G.N. 1966. Physiological aspects of grain yield in cereals. Growth of cereals and cereals and grasses. Butterworths. pp. 88-106.

Tosun, O. 1986. Turkiye Tariminda Bitki Islahini Onemi ve Tarimsal Uretime Katkisi. Plant Breeding Symp. 15-18 November 198. Izmir, Turkey.

Tosun, 1987. Turkiye'nin Tahil Yetistirme Sorunlari ve Bunlarin Cozum Yollari. Turkiye Tahil Simpozyumu (Tubitak), Bursa, Turkey.

TS 2974. 2001. Wheat Standard. Turkish Standard Institute. Ankara, Turkey.

Turan, Z.M. 1995. Arastirma ve Deneme Metodlari. Uludag Univ. Agric. Faculty Press, No. **62**: Bursa, Turkey.

Vazquez, L., M,. Vizcarra, A. Salazar, A. Castillo and I. Guerrero. 2001. Effect of heat treatment on the industrial quality of two varieties of Mexican wheat. Intern. J. Food Properties **4**(3): 419-430.

Yagdi, K. 1999. Bursa kosullarinda gelistirilen bazi ekmeklik (*Triticum aestivum* L.) hattarinin kimi ozelliklerinin arastirilmasi-I. Agronomik ozellikleri. III. Field and Crops congress. 15-18 November 1999. Adana, Turkey.

Yaradat, A.A., M.M. Ailuni and G. Karaki. 1996. Genetic structure of durum wheat landrace in a center of diversity. 5th Int. Wheat Conf. Abst.

Yilmaz, H.A. and T. Dokuyucu. 1994. Kahraman maras Kosullarinda Uygun ve Yuksek Verimli Ekmeklik Bugday Cesitierinin Belirlenmesi. Taria Bitkileri Kongresi. **1**: 303-306, Ege Univ. Ziraat Fak. 25-29 Nisan, Izmir, Turkey.

Yurur, N. 1998. Serin lklim Tahillari (Tahillar-I). Uldag Univ. Agric. Faculty Press, N0. **7**: 035-0295, Bursa, Turkey.

Yurur, N., O. Tosun, D. Eser and H. Gecit. 1983. Bugdayda anasap verimi ile bazi karakterier arasindaki iliskiler, bilimsel arastirmalar ve Incelemeler. Ankara Univ. Agric. Faculty Press, No. **755**, Ankara, Turkey.

(Manuscript received on 10 October, 2005; revised on 25 April, 2006)