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Agronomic Performance of Some Corn Cultivars (*Zea mays* L.) in Middle Anatolia

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Abstract: This study was conducted to determine some yield characters of corn cultivar in Konya province which is located in Middle Anatolian region in 2003 and 2004 years. Eight corn cultivars (Monton, Monzon, Ranchero, Ada, Montel, Progen, 35P12 and TTM 8119) were tested in randomized complete block design with four replicates. Corn yield changed from 10397 kg ha^{-1} (cv Ranchero) to 12725 kg ha^{-1} (cv Monton). Corn yield level in Konya was comperatible to other region in Turkey. Therefore, it can be new and large corn production area in coming years.

Key words: Corn cultivars, corn cultivation, region, replicates, Konya, Turkey

INSTRUCTION

Corn which can be used food, feed and industry has a remarkable place among cereals. Corn has a great adaptation ability and it can grow between 58°N and 35-40°S lattitudes. Corn acreage production and yield in Turkey 560,000 ha, 2,800,000 ton and 4958 kg ha^{-1}, respectively. It ranks 3rd following wheat and barley in Turkey's among cereals. Corn production of Turkey is insufficient. Therefore, considerable amount of corn is imported. Turkey's corn production is used 30% as human food, 45% animal feeding and 25% fodder industry. Middle Anatolia region products 108,326 ton and 3.87% total Turkeys corn production. As area, Konya is the largest province of Turkey and Middle Anatolia region. Even though, climatic conditions of Konya region are most favorable for corn production. But the soil has organic matter content (1.0-1.15%). Because of this reason, growth of maize is limited by it. Konya products are 0.09% of total Turkey's corn production. Moreover, Turkey's government encourages corn producers for corn production. For this reason, we did the experiment in Konya region.

In the Middle Anatolian region where maize is becoming increasengly important, inorganic fertilizer use is limited due to high cost. One approach to reducing the impact of N deficiency on maize production may be to select cultivars that are superior in the utilization of available N either due to enhanced uptake capasity or because of more efficient use of the observed N in grain production (Lafitte and Edmeades, 1994). Early proliferation of root in the topsoil allows the maize plant to make efficient use of the soil inorganic N while deep, dense root systems allows it to extract nitrate leached to deeper soil layers (Oikeh *et al*., 1999). Root system has been found to be important for nutrient acquisition and uptake from the soil (Kamara *et al*., 2003). Earlier studies showed no significant correlation of root density with grain yield and N uptake (Hauberger, 1998; Oikeh *et al*., 1999). In this study, we aimed to determine grain yield and good agronomic characters of maize cultivars.

MATERIALS AND METHODS

This research was conducted in 2003-2004 in Konya that it is the largest province in Central Anatolia region. In growing season of corn, average temperature was 18.2 and 17.7°C, rainfall and humidity were 15.6, 20.0 mm and 50.2, 49.1% in 2003 and 2004, respectively. Soils of research area have clay-loam texture, alkali (pH: 8.2), calcerously and slightly salt. Also, soils have low organic matter (1.04%) and lime levels (7.4%) and high potassium (1.812 ppm) and phosphorous (27.1 ppm).

In the research, eight corn cultivars (Monton, Monzon, Ranchero, Ada 89-24, Montel, Progen 1550, 35 P 12 and TTM 81-19) were tested in completely randomized blocks design with four replication. Each plot was 3.0×5.0 m = 15 m^2. Planting distance was 0.75 m between rows and 0.25 m between plants to give a plant population of 53,333 plants ha^{-1}. At planting P in the form of single superphoaphate was applied at 80 kg ha^{-1} each; N was applied at 150 kg ha^{-1} in the form urea. The

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N fertilizer was applied in two equal splits; 75 kg N ha^{-1} with planting and the other half 10 weeks after planting. Weed control were practiced two times by hand when plants reached to 15-20 and 35-40 cm.

Aboveground biomass was recorded at mid-silking, 2 weeks after anthesis from one end of the two middle rows and at harvest. At each biomass harvest, samples were divided into leaves, stems and ears. The components were oven dried at 72°C for 48 h. Ears were harvested from the two middle rows at physiological maturity. Grain yield was adjusted to 15% moisture. The grains and the aboveground biomass at physiological maturity were dried, milled and analysed for total N content. N uptake was determined by multiplying dry weight of plants parts by N concentration then summing over parts for total plant uptake (Kamara *et al*., 2003).

First of all, plant length was determined in harvested plants, later ear removed from plants. Grain yield, 1st ear height, ear length, ear diameter, weight, number and weight of kernel per ear, number of ear per plant and 1000 kernel weight were measurement. The obtained data were analyzed by using SAS statistic program correlation and regression procedures and means were compared with multiple comparisons Duncan test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Analysis of variace of the 2 years data showed significant differances among cultivars for all traits studies. According year interaction, cultivar was significant only for grain yield. The variation between cultivars is represented by the mean (Table 1). The ranges for grain yield, total dry matter at harvest and N-use efficiency were extremly wide. Grain yield for example ranged from 12724-10937 kg ha^{-1}. The range was also very wide for total nitrogen content and plant height.

Average yield of cultivars changed between 1039.7 kg day^{-1} and 1272.5 kg day^{-1} (Table 1). Monton (1272.5 kg day^{-1}), Progen (1270.2 kg day^{-1}) and 35P12 (1263.5 kg day^{-1}) cultivars had greatest grain yield. But also, Ranchero cultivar had the lowest (1039.7 kg day^{-1}) grain yield. Grain yield of different corn cultivars in Turkey changes depend on region. Some researchers (Ergin *et al*., 1989; Koycu and Kurt, 1997) reported grain yield of corn is >1000 kg day^{-1} grain yield but the other researchers reported <1000 kg day^{-1} grain yield (Gozubenli *et al*., 1997; Keskin *et al*., 2005). However, average corn grain yield in Turkey as 421.6 kg day^{-1}. Yield is affected strongly by climatically conditions. Present results indicate that Konya region can be important corn cultivation area future. Average plant height of cultivars was found between 252.4 and 273.3 cm (Table 1). Monzon (273.3 cm), Progen (271.9 cm) cultivars had highest plant height while Ranchero (252.4 cm) and Ada (253.8 cm) cultivars had the lowest plant height. Plant height values of corn cultivars were pretty similar to reports of many other researchers (Ergin *et al*., 1989; Gozubenli *et al*., 1997; Oktem, 1997; Keskin *et al*., 2005).

As ear characteristics, average 1st ear height of cultivars were found between 126.3 and 100.3 cm. Monzon (126.3 cm) cultivar had highest ear height while Ada

Table 1: Some characteristics of maize cultivars

			Ear				
Cultivars	Plant height	First ear height	Length	Dimension	Weight	No. of seed corn per ear	Weight of seed corn per ear
Monton	270.1^{ab}	126.3^{a}	20.7^{bc}	50.8^{b}	333.7^{bc}	701.8^{b}	268.0^{bcd}
Monzon	273.3^{a}	113.1^{bc}	21.8^{a}	51.2^{b}	357.0^{ab}	676.9^{b}	298.0^{ab}
Rsanchero	252.4^{c}	112.3^{bc}	21.8^{ab}	48.1(	300.0^{cd}	591.6^{c}	247.3^{cde}
Ada	253.8^{c}	100.3^{d}	20.3^{c}	47.9^{c}	278.7^{d}	723.9^{ab}	228.3^{e}
Montel	268.1^{ab}	110.4^{bc}	22.5^{a}	53.1$_{ab}$	382.3^{a}	773.7^{a}	300.4^{ab}
Progen	271.9^{a}	118.2^{ab}	21.5^{abc}	55.3$_{a}$	397.3^{a}	684.9^{b}	324.3^{a}
35 P 12	253.6^{c}	105.6^{cd}	22.1^{ab}	51.5$_{b}$	359.0^{ab}	720.9^{a}	285.3^{abc}
TTM-8119	259.0^{bc}	114.8^{b}	21.7^{abc}	51.0$_{b}$	358.0^{ab}	766.3$_{a}$	275.7^{bcd}
Means	262.8	112.6	21.6	51.1	345.8	705.0	278.4

			Total dry matter (g plant^{-1})					
Cultivar	No. of ear per plant	1000 seed weight	Mid-silking	Grain-filling	At maturity	Total N (g plant^{-1})	N-uptake efficincy	Grain yield
Monton	0.89^{a}	212.4^{c}	105.10^{a}	175.60^{a}	196.20^{a}	1.98^{a}	1.86^{a}	1272.5^{a}
Monzon	0.87^{ab}	198.5^{d}	86.70^{bc}	138.80^{b}	156.50^{b}	1.80^{b}	1.60^{b}	1146.0^{abc}
Rsanchero	0.83^{b}	231.6^{ab}	91.60^{b}	145.60^{b}	163.80^{b}	1.60^{c}	1.56^{bc}	1039.7^{c}
Ada	0.83^{b}	205.3^{cd}	85.20^{bc}	140.00^{b}	165.40^{b}	1.72^{bc}	1.50^{bcd}	1194.6^{ab}
Montel	0.79^{c}	235.1^{a}	86.60^{bc}	141.50^{b}	160.30^{b}	1.60^{c}	1.44^{d}	1097.3^{bc}
Progen	0.86^{ab}	222.8^{bc}	80.40^{c}	138.00^{b}	156.90^{b}	1.69^{bc}	1.41^{d}	1270.2^{a}
35 P 12	0.83^{bc}	235.9^{a}	88.60^{b}	142.60^{b}	158.30^{b}	1.65^{c}	1.43^{d}	1263.5^{a}
TTM-8119	0.81^{c}	198.7^{d}	91.40^{b}	148.50^{b}	160.00^{b}	1.70^{bc}	1.48^{cd}	1137.7^{bc}
Means	0.84	217.5	89.45	146.33	164.68	1.72	1.54	1177.7

Table 2: The results of regression analysis

Parameters	Monton	Monzon	Ranchero	Ada 89-24	Montel	Progen1550	35 P 12	TTM 8119
Constant	3070.00	6563.00	1489.00	-2565.000	-629.000	-7630.000	-35308.000	2636.000
Plant height	-17.50	4.74	1.50	0,24.000	0.250	-4.500	-8.700	2.070
First corn ear height	8.14	-12.70	-3.83	-3.830	-2.210	-6.100	8.700	-3.640
Corn ear length	-40.40	-83.20	51.00	-98.800	-6.900	46.000	196.000	-6.000
Corn ear dimension	-55.70	-25.30	-37.00	-29.900	-3.200	-63.800	252.000	-13.600
Corn ear weight	10.80	3.87	-2.69	-1.440	2.280	4.210	3.300	-1.020
No. of seed per ear	0.64	0.48	2.11	1.410	0.137	-0,40.000	2.650	-0.041
Weight of seed per ear	-9.10	-1.22	5.38	5.450	-2.280	-3.710	-12.600	2.830
No. of ear per plant	5362.00	1428.00	-465.00	1370.000	-285.000	3941.000	4047.000	-2058.000
1000 seed weight	-3.80	-23.70	-4.92	22.500	10.000	44.400	74.100	4.460
Total dry matter mid-silking (g plant^{-1})	3.65	-9.56	-4.45	-0.569	-0.250	0.458	0.588	-2.475
Total dry matter grain-filling (g plant^{-1})	21.05	1.25	3.68	1.560	-3.560	-1.550	-2.470	2.360
Total dry matter at maturity (g plant^{-1})	15.40	-3.59	-7.94	-2.360	-7.990	2.680	3.058	0.298
Total N (g plant^{-1})	36.12	7.54	5.51	5.120	1.060	0.350	0.480	1.560
N-uptake efficinecy	6.35	2.01	4.52	6.020	2.580	0.140	1.150	3.270
R^2	93.20	8.30	94.60	95.900	85.600	84.000	93.900	75.900

(100.3 cm) cultivars had the lowest ear height. Montel (22.5 cm) and Monzon (21.8 cm) had the greatest ear length. Ada (20.3 cm) cultivar had the lowest ear length. Many researchers reported that ear length changes depend on cultivars (Gozubenli *et al*., 1997; Oktem, 1997). Average ear dimensions of cultivars were found between 55.3 mm (Progen) and 47.9 mm (Ada). Ear dimensions were affected strongly by agronomic factors. Montel and Progen cultivars had the greatest ear weight and the other hand, Ada had the lowest ear weight. Ear weight of corn cultivars were found higher compared to findings of some other researchers (Ergin *et al*., 1989; Gozubenli *et al*., 1997; Oktem, 1997; Keskin *et al*., 2005). Monton cultivar had the greatest number of ear per plant (0.89 ear plant^{-1}). Therefore, Monton cultivar also had the greatest average grain yield per decar (1272.5 kg day^{-1}). On the other hand, ear numbers of the other cultivars were similar except Montel. Saglamtimur reported that ear number decreases with increasing plant density. Montel (773.7), TTM 8119 (766.3) and 35 P 12 (720.9) cultivars had the highest number seed of ear.

On the other hand, Progen (324.3 g) had the highest weight seed of ear while Ada (228.3 g) had the lowest weight seed of ear. Some researchers reported weight seed of ear is lower than mean of the results (Baytekin *et al*., 1997; Gozubenli, 1997) but some researchers reported highest than the results (Colkesen *et al*., 1997; Cesurer and Ulger, 1997). These differences may be causes from ecological and climatically conditions.

The 1000 seed weight of corn cultivars changes between 235.9 and 198.5 g. About 35 P 12 cultivar had the highest 1000 seed weight and Monzon cultivar had the lowest 1000 seed yield. The 1000 seed weight of cultivars were similar to finding of some researchers (Ergin *et al*., 1989; Koycu and Kurt, 1997; Gozubenli *et al*., 1997; Keskin *et al*., 2005). According to correlation analysis, relationships between yield and ear dimension (r = 0.751**), ear weight (r = 0.548**), number of seed per ear (r = 0.646**), seed weight ear (r = 0.426**), number of ear per plant (r = 0.442**) and 1000 seed weight (r = 0.552**) were significant while plant height (r = -0.067), 1st ear height (r = 0.008) and ear length (r = -0.128) insignificant. Ear characteristics had significant relationships yield and other characteristics.

Plant height and 1st ear had height (r = 0.581**) and significant relationships while 1000 seed weight (r = -0.136) insignificant. Some researchers reported similar results (Xu, 1986; Torun, 1994; Dash *et al*., 1992; Gozubenli, 1997; Torun and Koycu, 1999). According to regression analysis to be made for cultivars, Ada 89-24 cultivar had the highest R^2 (95.9) while TTM 8119 had the lowest R^2 (39.3) (Table 2). In this study, maize cultivars having high vertical root-pulling resistance showed good agronomic performance and recorded yield high. The correlation among the variables showed many significant values. Vetrical root-pulling resistance correlated positively with grain yield, total N content of the aboveground biomass. It correlated regularly, however with root lodging. The correlation among the variables suggested that vertical root-pulling resistance may be used to select cultivars resistance to root lodging with high N uptake efficiently and having high grain yield (Kamara *et al*., 2003).

Total dry matter (the total aboveground biomass of the plant at 0% moisture) is product of growth rate and growth duration (Takeda and Frey, 1979). Total dry matter provides a good estimation of the degree of adaptation of a geotype to the environment in which it is being grown. Differences in total dry matter accumulation in mazie cultivars have been showndifferences in photosyntehtic production (Kamprath *et al*., 1982).

The maize cultivation evaluated in the present study showed marked variation in the accumulation of dry matter at all growth stages. This may be due to differences in photosyntetic production. If moisture and other growth factors are adequate, the initial effect of applied N is to increase total dry matter propduction (Terman, 1979). In this study, maize cultivar was evaluated under irrigated conditions with sufficient moisture available throuh out the growing season.

The level (150-200 kg N ha^{-1}) used is generally recommended for root studies in Central Anatolian region. Total N content is an indication of the plant capacity to accumulate N (Desai and Bhatia, 1978). Total N and plant dry matter played major roles in the classification of maize cultivars.

CONCLUSION

The study concludes that Monton, Progen and 35 P 12 cultivars had height yield potential in Middle Anatolian region. But Ranchero cultivar had the worst yield. In suitable conditions, corn may provide higher yield than our obtained yield in Middle Anatolian region. The effect of different plants and nitrogen application in seed yield, yield components and some morphological chracters of TTM 813 hybrid corn cultivars (*Zea mays* L. *indentata*).

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