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Evaluation of Some Agronomic and Grain Quality Traits in Maize (*Zea mays* l.) Genotypes

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Abstract

The research was conducted Kano University of Science and Technology teaching and research field and National Institute for Horticultural Research Bagauda both in Kano State, Nigeria. Population development was carried out in Wudil while evaluation of six parents, fifteen hybrids and four checks were carried out in both Wudil and Bagauda during 2022 raining season. The data collected were analysed using Statistical Tool for Agricultural Research System (STAR, 2018) for combined analysis across the two locations. The result significant difference between the entries for most traits measured days to 50% Flowering (24.4days), days to 50% silking (25.02days), Anthesis Silking Interval (3.55), Plant Height (450.87cm), Ear Height (372.41cm), Days to Maturity (26.72days), Ear Length (20.32cm), Moisture (5.96%), Crude Protein (3.28%), Crude fat (14.0%), Ether (8.50%) and Nitrogen free extract (5.15) indicating substantial variability among the entries for the affected traits.The means ranged from the highest entry P6 (57.33, 57.33, 95.67 and 9.73) for days to 50% flowering, for days to 50% Silking, days to maturity, crude protein, to the lowest entry TZEI 124, TZEI 125, P5, P1x P2, P4 X P5, (49.00, 51.33, 144.13 and 87.00) for days to 50% flowering, Plant height and days to maturity with a CV (4.67, 8.89 and 12.97) respectively. P1 shows highest mean for Ear length (20.33cm) and ear diameter (38.53cm) with CV of 11.1 and 76.65 respectively. TZEI 25 shows highest mean for percentage Ash (24.4%) followed by P1 x P2 (17.2%), P3 shows highest mean for moisture (18.63%) while check TZEI 124 has the lowest mean (12.90%) with CV of 2.98%. P6 shows highest mean for crude protein (97.3%) while P4 X P6 and P2 x P3 shows highest mean for Ether (50.6) and Nitrogen Free extract (87.13) respectively**.** The data indicate that seeds of the studied genotypes vary greatly in term of days to 50% flowering, days to 50% silking, anthesis silking interval, plant height, ear height, days to maturity, ear length, ash, crude protein, fats, crude fiber contents, ether and nitrogen free extract. The variability observed is both genetic and environmental which may influence the individual chemical composition. These results will be useful to know about the physicochemical properties of the studied maize genotypes and may guide us in designing strategies that maximize the utility of maize genotypes.

Keywords: Agronomic, Grain, Genotypes, Maize, Traits and Quality

1. Introduction

Maize or corn (*Zea mays* L.), belong to the grass family Poaceae and tribe Maydeae, originated 5000 to 10,000years ago (Hallauer, 1997; Paliwal and Smith, 2002). The origin of maize is controversial; however, it is believed to have originated in the mid-altitude regions of Mexico and Guatemala or Mesoamerica (Paliwal and Smith, 2002). It is one of the three most important cereal crops in the world together with wheat and rice. In industrialized countries, it is largely used as livestock feed and as a raw material for industrial products, while in developing countries, it is mainly used for human consumption. Africans consume maize as a starchy base in a wide variety of porridges, pastes, grits, and beer. In sub-Saharan Africa, it is a staple food for an estimated 50% of the population. It is an important source of carbohydrate, protein, iron, vitamin B, and minerals. It is fast becoming a very important commodity in animal feed, food and beverage industries (USAID, 2010) [14]. Worldwide maize is cultivated in an area of 159 million hectares with a production of 796.46 million metric tons (USDA, 2010). Maize production in Africa in 2004 was estimated to be 41.6 million metric tons of which 27.7 million metric tons was produced in sub-Saharan Africa. The United States is the world's largest producer and exporter of maize in 2003-2004, maize production in the U.S was 256 million metric tons (USDA-FAS, 2005).Other top producing countries include China, Brazil, Mexico, Argentina, India and France. Nigeria is the 10th largest producer of maize in the world, and the main producing country in tropical Africa (USAID, 2010) [14]. It is cultivated both as rain fed and under irrigation on more than 5 million hectares, spread through the six agroecological zones and maize production is put at about 26 million tons from 3,845,000 hectares (FAO, 2009). In Africa, maize is grown by small- and medium-scale farmers who cultivate 10 ha or less (DeVries and Toenniessen, 2001) under extremely low-input systems where average yields are 1.3 tons ha-1 (Bänziger and Diallo, 2004).

The primary objective of most maize breeding programs is the evolution of high yielding and well adapted cultivars. Breeding for improving varieties is a continuous process and requires primarily a thorough knowledge of the genetic mechanism governing yield and yield components. Diallel cross technique developed by Hayman (1954) provides information on the inheritance mechanism in the early generations and help the breeder to make effective selection. There are few publications on white maize breeding because it is mainly performed by private companies. White maize breeding programs generally use well established white maize populations and inbred as base germplasm because the development of new varieties is complicated because of the strict quality requirement and the complex genetic regulation of endosperm. By exploiting variation, the composition of the grain was altered for both the quantity and quality of starch, proteins, and oil throughout seed development. Furthermore, the ability of maize breeders to use existing genetic variation and to identify and manipulate economically important genes will open new avenues for the design of novel variation in grain composition, thus providing the basis for the development of the next generation of specialty in maize and of new products to meet future needs. (Leford and Russel, 1985) [11].

Maize being nutritionally an important crop has multiple functions in the traditional farming system, being used as food and fuel for human and feed for livestock. It is a source of industrial raw material for the production of oil, starch, syrup, gluten, alcohol, glucose, custard powder, dextrose, flour, flakes, ethanol and many more products. The primary objective of most maize breeding programs is the evolution of high yielding and well adapted cultivars. Breeding for improving varieties is a continuous process and requires primarily a thorough knowledge of the genetic mechanism governing yield and yield components.

In the United States, maize is classified into five different grades, based on grain density, proportion of whole grain, damaged kernels, and grain colour (FAO, 1992). Breakage susceptibility is affected by hardness, but also by harvest and heat treatments, and is commonly estimated by dye techniques (Pomeranz *et al*. 1984; 1986).There are few publications on maize breeding because it is mainly performed by private companies. Food composition data is important in nutritional planning and provides data for epidemiological studies (Bruce and Bergstrom, 1983; Ali *et al*., 2008). However, there is limited information about the grain quality of the different maize genotypes growing in Nigeria. By exploiting genetic variation, the composition of the grain was altered for both the quantity and quality of starch, proteins, and oil throughout grain development. Furthermore, the ability of maize breeders to use existing genetic variation and to identify and manipulate economically important genes will open new avenues for the design of novel variation in grain composition, thus providing the basis for the development of the next generation of specialty in maize and of new products to meet future needs. 1985).

The aims and objectives of this study are as follows:
The present study aims to investigate physicochemical characteristics, proximate composition and mineral composition of the different maize genotypes grown in Nigeria.

1. To evaluate the maize genotypes for agronomic and grain quality traits in multiple location.
2. To determine the variation that exist between maize genotypes for agronomic and grain quality traits

2. Materials and methods

2.1 Description of Experimental Site

The research was conducted Kano University of Science and Technology teaching and research field and National Institute for Horticultural Research Bagauda both in Kano State, Nigeria. Population development was carried out in Wudil while evaluation of six parents, fifteen hybrids and four checks was carried out in both Wudil and Bagauda. Kano University of Science and Technology, Wudil is (10° 33S 7˚34N- 9˚ 24E). Mean temperature of the area from 29 – 32 ^{0}c and an average annual rainfall of area is 762 – 850 mm with abundant sunshine. The soil is sandy loam, low organic matter content, porous and medium texture soil and pH is 6.5 – 7.5.

Bagauda is located at an altitude of 496 m above sea level, $11^{0}36^{1}$N, $0.8^{0}26^{1}$E both in the Sudan savannah zone of Nigeria, with a mean annual rainfall of 830 mm distributed within five months, the soil type is sandy loam. (Singh and Balasubramanium, 1983).The mean daily temperature ranges from 29^{0}C to 38^{0}C (Kowal and Knabe, 1972) [10].

2.2 Description of Plant Materials

The materials consist of six genotypes of maize inbred lines. Brief descriptions of the genotypes are given in Table 1.

Table 1: Origin and Descriptions of the Genotypes

S. No	Name	Pedigree	Source
1	SMLY-6	SAMMAZ 18 6-3-2-1-2-1-1	IAR, Zaria
2	SMLY-9	SAMMAZ 18 6-5-2-3-2-1-3	IAR, Zaria
3	SMLY-10	TZEE-W 6-10-2-2-2-1-3	IAR, Zaria
4	SMLY-13	TZEE-W 6-3-2-2-2-2-3	IAR, Zaria
5	SMLY-14	SAMMAZ 18 6-3-2-2-2-1-5	IAR, Zaria
6	SMLY-23	SAMMAZ 26 6-16-3-2-1-1-3	IAR, Zaria
7	TZEI 13		IAR, Zaria
8	TZEI 25		IAR, Zaria
9	TZEI 124		IAR, Zaria
10	TZEI 125		IAR, Zaria

2.3 Generation of crosses

The six maize inbred lines selected on the basis of good performance were crossed in a half diallel mating scheme model 1, method 2 giving a total of 15 hybrids at Wudil in Kano State.

Table 2: Half diallel crosses among the parents

♂ / ♀	1	2	3	4	5	6
1		1×2	1×3	1×4	1×5	1×6
2			2×3	2×4	2×5	2×6
3				3×4	3×5	3×6
4					4×5	4×6
5						5×6
6						

2.4 Field Evaluation

The 25 genotypes parents, hybrids and checks were evaluated in two (2) locations; Wudil and Bagauda.

2.4.1 Experimental Design

The 25 genotypes were arranged in a 5×5 lattice design with three replications at each location. Each plot consists of two rows 4 m long, with inter and intra row spacing of 75 cm x 25 cm respectively. Sowing was be done manually; two seeds per hill were sown and later thinned to one plant per hill.

2.4.2 Fertilizer Application

Fertilizer was applied at the recommended rate of compound fertilizer (NPK 20:10:10) as basal dressing and urea (46 % N) as top dressing, giving a total plant nutrient of 120 kg N, 60 kg P_2O_5 and 60 kg K_2O per hectare.

2.4.3 Weeding

Three hoe weeding were done; the first one at two weeks after sowing the second at four weeks after sowing and third weeding was at six weeks after sowing.

2.5 Data Collection and Observation

Assessments of plant characters started two weeks after planting and continued fortnightly. Parameters from which the data were collected include the following:

-Days to 50% tasseling (pollen shed): number of days after sowing (das) to when 50% of the plants in a plot shed pollen.

Days to 50% silking: the number of days after sowing (das) to when 50% of the plants in a plot produced silk.

Anthesis silking interval: the difference between Days to 50% silking and Days to 50% tasseling

Plant height (cm): the height from soil level to the top node bearing the flag leaf

Days to maturity: the number of days from sowing to physiological maturity.

Ear height (cm): height from the soil level to the node bearing the top most ear.

Ear length (cm): The average length of the ear from the end of the peduncle to the end of the cob.

Ear diameter (cm): The average diameter of the ear taken from central part of the uppermost ear.

100 grain weight: weight of 100 grains in gram randomly taken from each plot after shelling.

Grain yield per hectare ($kgha^{-1}$):10,000 x kernels weight in a plot/Area of a plot

Proximate Analysis

The materials were analyzed for proximate composition using procedures described by AOAC (2000) [1]. Ash of the kernels, Crude protein, Crude fat, Nitrogen Free Extra as well as Moisture as described by Van Soest*et al.*, (1991).

2.6 Data Analysis

Statistical Analysis was computed using Statistical Tool for Agricultural Research System (STAR, 2018) for individual and combined analysis across the two locations. The ANOVA computed on plot mean values for all characters across the two locations. The following model (Bohren *et al.*, 1963) [2] will be used for one location in one year:

$$x_{ijk} = \mu + r_i + g_j + \rho_{k(j)} + e_{ijk}$$

Where

x_{ijk} = Observation of the i^{th} line and j^{th} line in the k^{th} replication

μ = The population mean

r_i = Effect of the i^{th} line due to replication

g_j =Effect of thej^{th} line due to genotype

$\rho_{k(j)}$ = Block within replicate effect

e_{ijk} = Experimental error

The statistical model to be used for the combined analysis of variance (ANOVA) across the two locations in one year is presented as:

$$x_{ijk} = \mu + l_t + r_{ij} + g_k + (rl)_{ij} + (gl)_{ik} + \rho_{l(kj)} + e_{ijk}$$

Where

x_{ijk}=Observation of the i^{th} line and j^{th} line in k^{th} replication

μ = Overall mean

l_t = The average effect of the t^{th} location

r_{ij} = The effect of the j^{th} replication in the i^{th} location

g_k = The effect of the k^{th} replication

$(rl)_{ij}$ = Replication × Location interaction

$(gl)_{ik}$ = The interaction effect between k^{th} genotype in the i^{th} location

$\rho_{l(jit)}$ = Block within replicate effect in i^{th} and t^{th} locations

e_{ijk}=Experimental error, where i = Location, j = Replications and k = Genotype

Table 3: Format of Analysis of Variance (ANOVA) combined across location in one year

Source of variation	Df	MS	EMS
Location	$(l-1)$		
Replication	$(r-1)$		
Replication in location	$l\,(r-1)$	m_l	
Block(loc$\times rep$)	$b(l-1)(r-1)$	m_{blr}	$\sigma_e^2 + r\sigma_{gl}^2 + rg\sigma_l^2$
Genotype	$(g-1)$	m_g	$\sigma_e^2 + r\sigma_{gl}^2 + rl\sigma_g^2$
Genotype×location	$(g-1)\,(l-1)$	m_{gl}	$\sigma^2_e + r\sigma^2_{gl}$
Error	$l\,(r-1)\,(g-1)$	m_e	σ_e^2
Total	$lgr-1$		

Where: l = location, g = genotype, σ_{gl}^2 = genotype × location interaction variance

σ_g^2 = variance due to genotype, σ_e^2 = error variance respectively, (Obi, 1986) [13].

3. Results and discussions

Table 1 Shows significant difference between the entries for most traits measured days to 50% Flowering (24.4 days), days to 50% silking (25.02 days), Anthesis Silking Interval (3.55), Plant Height (450.87 cm), Ear Height (372.41 cm), Days to Maturity (26.72 days), Ear Length (20.32 cm), Moisture (5.96%), Crude Protein (3.28%), Crude fat (14.0%), Ether (8.50%) and Nitrogen free extract (5.15) indicating substantial variability among the entries for the affected traits. The result of this study corroborates with the result of Ikram *et al.*, (2010) [8] who stated that Proximate composition shows moisture content in the range of 9.201-10.908%, ash (0.7-1.3%), fats (3.21-7.71%), protein (7.71-

14.60%), crude fiber (0.80-2.32%) and carbohydrates (69.659- 74.549%). The data indicate that seeds of these entries vary greatly in term of days to 50% Flowering, days to 50% silking, Anthesis Silking Interval, Plant Height, Ear Height, Days to Maturity, Ear Length, Moisture, protein, fats and crude fiber content, Crude fat and Nitrogen free extract.

Average progeny-performance of each inbred can be determined by the mean performance of each inbred in all possible single crosses where it occurs (n-1 crosses per inbred). The mean performance of non-parental single crosses, is the most adequate and effective, since there is a close correspondence between predicted and realized yields of double crosses in maize.

Table 2 Shows that the means ranged from the highest entry P6 (57.33, 57.33, 95.67 and 9.73) for days to 50% flowering, for days to 50% Silking, days to maturity, crude protein, to the lowest entry TZEI 124, TZEI 125, P5, P1x P2, P4 X P5, (49.00, 51.33, 144.13 and 87.00) for days to 50% flowering, Plant height and days to maturity with a CV (4.67, 8.89 and 12.97) respectively. P1 shows highest mean for Ear length (20.33cm) and ear diameter (38.53cm) with CV of 11.1 and 76.65 respectively. TZEI 25 shows highest mean for percentage Ash (24.4%) followed by P1 x P2 (17.2%), P3 shows highest mean for moisture (18.63%) while check TZEI 124 has the lowest mean (12.90%) with CV of 2.98%. P6 shows highest mean for crude protein (97.3%) while P4 X P6 and P2 x P3 shows highest mean for Ether (50.6) and Nitrogen Free extract (87.13) respectively.

4. Conclusion and recommendations

The data indicate that seeds of the studied genotypes vary greatly in term of days to 50% flowering, days to 50% silking, anthesis silking interval, plant height, ear height, days to maturity, ear length, ash, crude protein, fats, crude fiber contents, ether and nitrogen free extract. The variability observed is both genetic and environmental which may influence the individual chemical composition. These results will be useful to know about the physicochemical properties of the studied maize genotypes and may guide us in designing strategies that maximize the utility of maize genotypes.

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Table 4: Mean Squares for 16 Traits of Maize Evaluated at Wudil and Bagauda during 2022 raining season

Source of Variation	DF	DFF	DFS	ASI	PH	EH	DM	EL (cm)	ED(cm)	Gwt (kg)	Ash (%)	Moisture (%)	Crude Protein(%)	Crude Fat (%)	Ether (%)	Nitrogen Free Extract (%)	Yield (kg/ha)
Location	1	0.24	0.03	0.167	417.33	373.26	1.5	1.31	140.17	358208267	1.54	7.18	0.27	5.17	0.8	1.66	5644
Block(Rep*Location	24	3.7	7.43	2.71**	243.71	112.1473	7.99	3.8	142.81	8286009.6	0.52	0.22	0.25	0.02	0.03	1.4	1556.83
Rep(Location)	4	14.32	8.69	1.31	187.88**	275.114	18.77**	6.48	119.39	17529012.7*	0.58	0.39		0.22**	0.02	0.98	3581.184
Entry	24	24.4**	25.02**	3.55**	450.87**	372.41**	26.72**	20.32**	178.17	6836077	0.69	5.96**	3.28**	0.14**	0.85**	5.15**	1081.9
Location*Entry	24	0.06	0.14	0.162	171.92	97.88	0.25	0.19	130.32	8876710.9	0.65	4.97**	2.86**	0.35**	0.47**	6.62**	8747.879
Error	72	5.91	8.72	1.49	228.08	112.12	7.01	3.42	139.64	6530670	0.6	0.26	0.29	0.026	0.08	2.26	1678.16

Key: DF: Degrees of Freedom, DFF: Days to 50% flowering, DFS: Days to 50% silking, ASI: Anthesis Silking Interval, Plant Height, EH: Ear Height, DM: Days to Maturity, EL: Ear Length, ED: Ear Diameter, Gwt: Grain weight

Table 5: Mean Performance of 16 Traits of Maize Evaluated at Wudil and Bagauda during 2022 raining season

Entry	DFF	DFS	ASI	PH	EH	DM	EL	ED	Gwt	GY	Ash	Moisture	Crude Protein	Crude Fat	Ether	Nitrogen Free Extract
P1	52.83c-g	52.83b-f	3.17a-e	187.17a-c	84.10b-e	90.3b-g	20.33a	38.53a	13017.00b	71649.00a	1.36b-d	17.71c-e	8.96b	1.14j-m	3.95g-k	85.46a-f
P2	54.00bc	54.00b-d	2.33b-f	146.83hi	67.62f	93.00ab	13.90i-k	10.62b	10673.00b	69570.00a	1.52b-d	16.48i-l	9.18ab	1.16i-m	409e-h	83.80fg
P3	54.33bc	54.33a-c	2.67a-f	167.72d-g	81.30c-e	90.67b-e	15.82f-i	13.70b	12375.00b	73228.00a	0.91b-d	18.63a	7.71c-g	1.50a-e	3.95g-k	86.25a-d
P4	51.33d-h	51.33c-g	2.17c-f	159.78f-i	74.20d-f	87.33gh	14.07ij	12.55b	11810.00b	67691.00a	1.27b-d	16.96f-j	7.81c-f	1.14j-m	4.54bc	85.67a-e
P5	53.00b-g	53.00b-f	3.00a-e	144.13i	72.12ef	90.00b-h	13.03jk	13.73b	12087.00b	69092.00a	0.65d	17.99b-d	7.46e-g	1.01m	3.55l-n	87.01ab
P6	57.33a	57.33a	3.33a-d	118.85j	53.45g	95.67a	11.88k	9.75b	11917.00b	50476.00b	1.24b-d	16.39j-l	9.73a	1.31e-j	4.24c-g	83.43g
P1 X P2	50.33gh	50.33e-g	2.67a-f	186.22a-c	87.82a-c	87.00h	19.33ab	15.47b	13353.00b	69663.00a	1.72ab	18.43ab	8.05c-e	1.34c-h	3.75j-n	85.10c-g
P1 X P3	51.67c-h	51.67c-g	2.67a-f	179.32b-e	83.70b-e	88.83e-h	15.62g-i	13.95b	12522.00b	69663.00a	1.47b-d	17.43d-g	6.90hi	1.53a-c	4.30c-f	85.82a-e
P1 X P4	49.33h	52.83e-g	3.50a-c	182.18a-d	91.88a-c	87.67e-h	18.60a-d	14.93b	13220.00b	66772.00a	1.23b-d	16.92g-k	7.24f-h	1.05lm	3.78j-m	84.40a-f
P1 X P5	51.33d-h	55.00c-f	3.67ab	155.53f-i	81.75c-e	88.00e-h	15.27hi	14.90b	12998.00b	69050.00a	1.23b-d	16.81h-l	9.22ab	1.11k-m	3.77j-m	85.07d-g

P1 X P6	53.17b-e	55.67b-e	3.17a-e	164.33e-g	81.53c-e	88.00e-h	18.90a-c	15.33b	13318.00b	71674.00a	1.33b-d	17.76c-e	7.14g-i	1.34e-h	4.47b-d	86.39a-d
P2 X P3	50.67gh	53.33d-g	2.67a-f	185.82a-c	90.13a-c	87.33gh	17.57b-g	14.87b	13160.00b	68876.00a	1.17b-d	17.30e-g	7.15g-i	1.22i-l	4.21d-h	87.13a
P2 X P4	50.67gh	54.00c-g	3.33a-d	183.87a-d	83.70b-e	87.67e-h	16.98c-h	14.22b	12670.00b	68990.00a	1.57a-c	17.51d-f	8.28c	1.68a	3.81j-l	84.97d-g
P2 X P5	49.33h	51.33g	2.00d-f	172.83b-f	82.70b-e	88.00e-h	17.45b-g	14.30b	13002.00b	66696.00a	1.24b-d	16.90g-l	7.79c-f	1.35c-g	3.99f-j	85.75a-e
P2 X P6	55.67ab	55.67ab	3.00a-e	164.08e-h	84.20b-e	92.00bc	16.30e-h	14.03b	12580.00b	74671.00a	1.03b-d	17.57c-e	8.00c-e	1.36c-h	4.34b-e	85.40b-f
P3 X P4	51.67c-h	55.67b-e	4.00a	169.88c-f	75.40e-f	89.33c-h	17.92b-f	15.100b	13077.00b	69727.00a	0.94b-d	17.20f-h	9.03b	1.57ab	3.65k-n	84.32e-g
P3 X P5	51.00e-h	53.00d-g	2.50b-f	172.80b-f	81.08c-e	88.17e-h	16.60e-h	15.10b	12995.00b	68669.00a	0.89b-d	17.00f-i	8.11cd	1.50a-d	3.75j-n	85.74a-e
P3 X P6	53.00b-g	55.83b-e	2.83a-e	183.77a-d	92.07a-c	90.50b-f	16.25e-h	15.10b	13152.00b	71352.00a	1.02b-d	17.22e-h	7.47e-h	1.47b-f	3.88i-k	86.15a-d
P4 X P5	50.33gh	52.67e-g	2.33b-f	152.93g-i	80.18c-e	87.00h	17.87b-f	13.90b	13030.00b	67818.00a	0.71cd	17.58c-e	8.06c-e	1.35c-h	4.64b	85.11c-f
P4 X P6	53.67b-e	55.67b-e	1.83ef	167.72d-g	82.75b-e	90.50b-f	16.58d-h	22.27b	16838.00a	72766.00a	0.89b-d	16.32l	8.14cd	1.29f-k	5.06a	84.86d-g
P5 X P6	55.67ab	57.00bc	1.33f	159.60f-i	67.60f	90.83b-d	15.58g-i	13.72b	12323.00b	73820.00a	1.03b-d	16.51i-l	7.61d-g	1.06lm	3.44n	86.81a-c
TZEI 13	51.67c-h	51.67c-h	2.00d-f	177.70b-e	84.67b-d	88.17e-h	16.53d-h	15.33b	13218.00b	69651.00a	0.98b-d	18.39ab	8.26c	1.29g-k	4.06e-j	84.91d-g
TZEI125	49.67h	53.33d-g	3.33a-d	188.57ab	94.53ab	87.50f-h	17.80b-f	14.50b	13022.00b	67860.00a	1.30b-d	18.13a-c	7.11g-i	1.16i-m	3.49mn	86.97ab
TZEI 25	51.33d-h	53.00d-g	2.00d-f	178.98b-e	84.98b-d	88.33e-h	17.92b-f	15.57b	13598.00b	70146.00a	2.44a	16.35kl	6.60i	1.34e-h	3.92h-k	85.59a-e
TZEI 124	49.00h	51.67fg	2.67a-f	198.65a	97.82a	87.00h	18.13b-e	14.27b	12595.00b	68169.00a	1.23b-d	12.90m	8.18cd	1.47b-g	4.47b-d	84.73d-g
MEAN	52.08	54.76	2.73	169.94	81.66	89.15	16.65	15.42	12905.3	69112.2	1.21	17.14	7.97	1.31	4.04	85.51
CV%	4.67	5.39	44.72	8.89	12.97	2.97	11.1	76.65	19.8	18.74	63.54	2.98	6.71	12.49	6.79	1.76

Key: DF: Degrees of Freedom, DFF: Days to 50% flowering, DFS: Days to 50% silking, ASI: Anthesis Silking Interval, Plant Height, EH: Ear Height, DM: Days to Maturity, EL: Ear Length, ED: Ear Diameter, Gwt: Grain weight

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