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Productive response of subtropical and tropical corns for forage purposes in a semi-arid region

Respuesta productiva de maíces subtropicales y tropicales con fines forrajeros en una región semiárida

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ABSTRACT

The yield of dry matter, its morphological components, and some characters of the corn plants in the Faculty of Agronomy and Veterinary of the Autonomous University of San Luis Potosí, at 22.23 ° LN and at 100.85 ° LO, at 1,835 m a.s.l. in mild dry weather. 26 corn genotypes were used, under irrigation in Spring-Summer. The sowing was carried out in plots of 5 rows of 0.90 cm wide x 5 meters long. A seed was deposited every 12 cm at a depth of 7 cm. It was fertilized with 160-40-00 (N-P-K). Ten plants were randomly marked on each plot. The harvest was done in corn at ½ of the milk line. 10 plants were randomly marked on each plot. The harvest was done in corn at ½ of the milk line. The yield of dry matter (YDM), plant (YDMP), corn (YDMC), corn: complete plant (RCCP) ratio and plant: complete plant (RPCP) ratio, Number of leaves per plant (NLEAVES), and of corn (NCORN), Plant height (PH), Stem diameter (SD). The best YDMP was shown by OjitalCT (17.8 t ha^{-1}) and Tampiqueño1 (17.0 t ha^{-1}). TlanchiHgoA2 showed the highest value of YMDC (12.7 t ha^{-1}) and for YDM (28.6 t ha^{-1}), which makes these genotypes viable for semi-arid areas.
Keywords: Corn, yield, dry matter, morphological components and Creoles.

RESUMEN

Se estimó el rendimiento de materia seca y de sus componentes morfológicos y de algunos caracteres de las plantas de maíz en la Facultad de Agronomía y Veterinaria de la Universidad Autónoma de San Luis Potosí, a 22.23° LN y a 100.85° LO, a 1,835 m s.n.m. en clima seco templado. Se utilizaron 26 genotipos de maíces, bajo riego en Primavera-Verano. La siembra se realizó en parcelas de 5 surcos de 0.90 cm de ancho x 5 metros de largo. Se depositó una semilla cada 12 cm a una profundidad de 7 cm. Se fertilizó con 160-40-00 (N-P-K). Se marcaron 10 plantas al azar en cada parcela. La cosecha se realizó en elote a ½ de la línea de leche. Se midió el rendimiento de materia seca (RMS), de planta (RMSP), elote (RMSE), relación Elote:Planta completa (RELPC) y Planta:Planta completa (RPPC), Número de hojas por planta (NHOJAS), y de elote (NELOTES), Altura de planta (AP), Diámetro de tallo (DT). El mejor RMSP lo mostró OjitalCT (17.8 t ha^{-1}) y Tampiqueño1 (17.0 t ha^{-1}). TlanchiHgoA2 mostró el mayor valor de RMSE (12.7 t ha^{-1}) y para RMS (28.6 t ha^{-1}), lo que hace que estos genotipos sean viables para zonas semiáridas.
Palabras clave: Maíz, rendimiento, materia seca, componentes morfológicos y criollos

INTRODUCTION

Forage corn production in Mexico is of great importance, because it represents a basic and important energy food source for the growing production of dairy cattle, and it is estimated that from 2010 to 2018 it went from 2,374,623 to 2,529,672 heads, which represents an increase of 155,049 heads (6.5%); Jalisco (14%), Durango (11.8%), Chihuahua (11.4%), Coahuila (9.5%), Guanajuato (7.8%), Hidalgo (7.8%), Puebla (7.0%), Querétaro (4.6%) and Mexico (4.1%) (SIAP, 2020a). An aspect that makes the search for quality and lower-cost feeding alternatives important, to reduce feeding costs and make the dairy industry more profitable; since in the dairy basins of Mexico, corn silage is commonly used in the feeding of dairy cattle, and it constitutes 30 to 40% of the dry ration in cows in production (González *et al.,* 2005) .

Among the forages that are most consumed and produced in the lagoon region, dairy region, is corn; being the second most important crop, after alfalfa (González-Salas *et al*., 2018). On the other hand, the constant growth of the number of head of cattle in the lagoon region, demands an increase in the production of forage maize and raises the need to identify materials with good forage characteristics, so among the selection criteria to identify hybrids adequate, it is the one that present high grain yield, productivity and high forage quality (Sánchez *et al*., 2011).

On the other hand, forage maize production in Mexico has had little progress, since the seed industry has not made available to producers a wide diversity of forage maize varieties, which show greater productive potential to improve green forage yields to ensile. There are data that the area sown in Mexico for 2018 was 603,326 ha, with an average yield of 29 ton/ha of green forage; and for 2010 there was a planted area of 535,621 ha, with an average yield of 24 ton/ha of green forage (SIAP, 2020b); which shows that there has been an increase of 67,705 ha (12.6%), but the yield is still low, despite having had an increase of 5 ton/ha (20.8%). The cultivation of corn for silage in Mexico presents low yield of dry matter per hectare, low grain content and high fiber, which causes the digestibility and energy of the forage to be low. This situation is due in part to the use of hybrids considered as foragers, of high height and great capacity to produce forage, but with poor nutritional value; since in general these genotypes are sown at high population densities, which causes a low quantity of grain (Núñez *et al*., 2005). In addition, their training was not for forage maize (Peña *et al*., 2004).

In the search to improve the yields and quality of forage maize, various studies have been carried out to evaluate various improved varieties and creoles from some regions, in order to provide alternatives to improve yields and offer corn genotypes that offer higher profitability and quality forage. Among them, Zaragoza-Esparza *et al*. (2019) evaluated 12 genotypes in Valles Altos, and observed that the highest dry matter yields were for the Búho hybrids, 501 x 497, 504 x 408, Puma 1163, H-48, 501 x 555 and 501 x 410 with 26.4, 25.6, 25.5, 25.4, 24.7, 24.7 and 24.3 t ha^{-1} of dry matter, respectively; and 74.0, 64.1, 68.8, 75.0, 69.4, 65.8 and 65.8 ton/ha of green forage, respectively.
The plant height of the studied genotypes was variable, and higher for Puma 1167, Puma 1163, H-48, 504 x 408 and H-51 AE with 2.4, 2.3, 2.2, 2.2 and 2.2 m, respectively. This shows that there are alternative varieties on the market for producers who cannot access

the varieties offered on the market by international companies. Sánchez *et al*. (2019) evaluated six commercial hybrids in a tropical region, and observed differences between genotypes and that the height varied from 203.1 to 167.2 cm. The number of leaves was from 10.7 to 9.6 leaves plant^{-1}, the number of corn plant^{-1} from 1.26 to 1.0, the stem diameter 5.7 to 4.8 cm, the weight of leaves plant^{-1} was between 162.3 to 122.9 g; Stem weight was 130.8 to 81.4, forage yield from 38.8 to 30.7 ton ha^{-1}. Likewise, population density influenced yield, since at a higher density of 83,333 plants ha^{-1}, it showed the highest forage yield with 41.8 ton ha^{-1}.

Another study in trilinear maize evaluated in a dry tropical region by Rivas *et al.* (2018), they observed variability in the studied parameters, and the best genotypes showed RMS from 32.8 to 27.6 t ha^{-1}, for leaves from 5.7 to 5.0 t ha^{-1}, for stem 19.1 to 13.6 t ha^{-1}, for corn 8.9 at 8.5 t ha^{-1}; and the percentage of the morphological components was for leaves from 16 to 22%, corn 26 to 35% and stem 43 to 58%; aspects that will influence the total dry matter yield of the genotypes and their quality.
So the objective of the present study was to estimate the dry matter yield, morphological components and some characters of the plants of 26 maize genotypes, originating from subtropical and tropical regions, under conditions of a dry climatic climate.

MATERIAL AND METHODS

Location

The research was carried out at the Faculty of Agronomy and Veterinary Medicine of the Autonomous University of San Luis Potosí, located in the Ejido Palma de la Cruz, municipality of Soledad de Graciano Sánchez, SLP, at Km. 14.5 of the San Luis Potosí Highway. Matehuala, which is located at 22° 13´ 39.8 ”North Latitude and 100 ° 50´ 58.3” West Longitude, at 1,835 m a.s.l The climate is dry temperate; with an annual average temperature of 17.1 °C. Rainfall is 362 mm (García, 2004).

Genetic material and treatments

23 genotypes of local maize, collected in subtropical and tropical regions of Mexico (Nayarit, Veracruz and Hidalgo), two local genotypes and an improved one from the semi-arid region under study were used to compare them; which functioned as treatments (table 1).

Procedures

An experiment was carried out with 26 corn genotypes, under irrigation conditions in the spring-summer cycle, to define their productivity, under the following scheme:
The sowing was carried out in April. Plots of 5 rows 0.90 cm wide x 5 meters long were traced, and one seed was deposited per blow every 12 cm, at a depth of 7 cm manually (92,463 seeds/ha). The fertilization was carried out with a dose of 160-40-00 (N-P-K), applying all the phosphorus (P), and a third of the nitrogen (N) to the crop at sowing and

the other two thirds of the N; one was applied one month and the other part two months after planting, respectively. Weed control was done with post-emergence herbicides (Gesaprin®) with a manual knapsack sprayer, 25 days after sowing (DAS), once the corn seedlings had emerged (12 to 15 cm); and a second 40 days later, with the same product and in the same way.

Table 1. List of genotypes evaluated as treatments.

Genotype	Origin	Region
RazaJala	White corn of the local Jala breed from the Valles de Jala, Nayarit	Subtropical
Tampiqueño1	Tampiqueño local white corn from the Valles de Jala, Nayarit	Subtropical
Tampiqueño2	Tampiqueño local white corn from the Valles de Jala, Nayarit	Subtropical
AForrajero	Local yellow corn for forage purposes in the Valles de Jala, Nayarit	Subtropical
AElotero	Local yellow corn for corn purposes in the Valles de Jala, Nayarit	Subtropical
FcoIMadJala	White corn of the Jala race introduced to high areas of Jala, Nay.	Subtropical
SantaFeJala	Local white corn from the highlands of Jala, Nayarit	Subtropical
HojeroUze	Selected third cycle white corn, introduced to the south of Nayarit	Subtropical
PapantlaIntrJala	White-loving corn from Papantla, Veracruz. with interregression of the Jala race	Tropical
PapantlaIntrJala2	White corn from Papantla, Veracruz with interregression of the Jala race	Tropical
PapIntrJalaAmc	Pale Yellow Corn of Papantla, Ver. With interregression of the Jala race	Tropical
PapantlaIntrJala1	Papantla white corn, Ver. With interregression of the Jala race	Tropical
OjitalIntrPap	Yellow corn from Castillo de Teallo, Ver. Interregresión Papantla, Ver.	Tropical
OjitalCT	Local white corn from Castillo de Teallo, Ver.	Tropical
BVPbaja	Local white corn from Bellavista, Papantla, Ver.	Tropical
AS948-2	Third cycle commercial white corn	Subtropical
TlanchiHgoA1	Local yellow Tlanchinol corn, Hgo.	Subtropical
TlanchiHgoA2	Local yellow Tlanchinol corn, Hgo.	Subtropical
TlanchiHgoA3	Local yellow Tlanchinol corn, Hgo.	Subtropical
TlanchiHgoA4	Local yellow Tlanchinol corn, Hgo.	Subtropical
TlanchiHgoA5	Local yellow Tlanchinol corn, Hgo.	Subtropical
TlanchiHgoA6	Local yellow Tlanchinol corn, Hgo.	Subtropical
TlanchiHgoA7	Local yellow Tlanchinol corn, Hgo.	Subtropical
Forrasierra	Commercial yellow corn for the Central Zone of San Luis Potosí	Semi-arid
Cerritos	Cerritos local white corn, San Luis Potosí	Semi-arid
Mexquitic	Local white corn from Mexquitic, San Luis Potosí	Semi-arid

The irrigation was by gravity, and it was applied on average every 21 days after the emergency, with an approximate sheet of 10 mm, and until when the corn was in the state of ½ of the milk line. 10 plants were marked for each plot in complete random competition, and identified with a label to measure the evaluated variables.

The harvest was made at 120 to 135 DAS, depending on how the corn reached the ½ of the milk line of each respective genotype. For this, the marked plants were harvested at ground level, weighed with a 20 kg manual hanging scale (GAMO®), with an approximation of 0.5 kg. To then separate the components, stem + leaf and corn that were weighed individually, on a digital scale (TORREY® Model EQ-5/10), with a capacity of 5 kg and an approximation of 1 g. Each component was crushed and ground in a green forage mill with blades and hammers (NOGUERA®). A 200 g sample of the ground material was taken for each component, and they were deposited in brown paper bags, previously identified by genotype and repetition; which were taken to a forced air stove to dry them for 120 h at 55 °C. Once dry, they were weighed on an Ohaus brand digital scale, with a capacity of 300 g and an approximation of 0.1 g, and the percentage of DM was determined. The percentage of DM of each sample and of each component was multiplied to the green matter, calculated per hectare from the 10 plants sampled.

Variables studied

Of ten plants in complete competition harvested in green, once weighed and registered in the log, they separated into two components: corn and whole plant (stems+leaves); The corn and the whole plant were weighed in green on a TORREY® Brand scale, Model EQ-5/10, with a capacity of 5 kg and an approximation of 1 g. They were minced separately in a hammer forage crusher with blades, and a 200 g sample was taken and placed in a brown paper bag, which was taken to a forced air drying oven, to determine the DM; then it was weighed on a CS200 (Ohaus®) balance, with an approximation of 0.1 g, in such a way that two component variables were obtained:

Yield of dry matter of complete plant (stem+leaf) (YDMP).

Corn dry matter yield (YDMC).

Yield of dry matter (YDM), was obtained by adding the two components plant and corn.

Corn: complete plant (RCCP) ratio. It was obtained dividing the yield of the DM of the corn, by the yield of the DM of the complete plant (Corn, Stem + Leaves).

Plant: complete plant ratio (RPCP). The yield of the stem+leaf DM was divided by the yield of the whole plant.

Number of leaves per plant (NLEAVES). The number of leaves for each plant was counted, data that was recorded individually for the 10 plants with complete competition taken at random, from the experimental unit.

Number of corn per plant (NCORNS). The number of corn on the 10 randomly selected plants was counted.

Plant height (PH). It was measured with a tape measure, from the base of the stem to the insertion base of the leaf blade with the sheath of the last leaf, in the 10 randomly selected plants

Stem diameter (SD). The ten randomly selected plants were measured in the lower internode with a manual vernier.

Experimental design

The experimental design was completely randomized, with six repetitions for RMS and 10 repetitions for NLEAVES, NCORNS, PH and SD; where the experimental plot was 5 furrows 0.90 m wide and 5 m long.

The data obtained was analyzed using the SAS® Version 9.3 statistical package and the Tukey test $P < 0.05$ was performed for the comparison of means (SAS, 2011).

RESULTS AND DISCUSSION

Plant dry matter yield

YDMP showed significance (Table 2), where OjitalCT and Tampiqueño1 showed the highest values with 17.8 and 17.0 t DMP ha^{-1}, followed by the TlanchiHgo2, PapantlaIntrJala, TlanchiHgoA7 and AS948-2 genotypes with 15.7, 14.6, 14.6 and 14.0 t DMP ha^{-1}, respectively. The genotype with the lowest value was TlanchiHgoA3 with 3.4 t DMP ha^{-1}. Values higher than those of Elizondo y Boschini (2002), in Creole maize and improved in a mountainous humid forest, with values of 11.3 and 7.4 t TLDM (DMP) ha^{-1}, respectively. For leaf from 5.7 to 5.0 t ha^{-1} and for stem 19.1 to 13.6 t ha^{-1}. Values lower than those observed by Rivas *et al*. (2018), in maize evaluated in dry tropics for leaf of 24.8 to 18.6 t ha^{-1} of stem+leaves (DMP). Similar to those obtained by Elizondo-Salazar (2011), with 7.8 and 13.8 t of stem+leaves (DMP) ha^{-1} for improved and native corn, respectively.

Corn dry matter yield

YDMC showed significant differences (Table 2), where the genotypes with the highest values were TlanchiHgoA2, with 12.7 t DMC ha^{-1} and FeliUzeta followed, with 9.0 t DMC ha^{-1}. The genotype with the lowest value was FcoIMaJala with 1.2 t DMC ha^{-1}. Values similar to those obtained by Rivas *et al*. (2018) in trilinear hybrids evaluated in dry tropics from 8.9 to 8.5 t DMC ha^{-1}, and lower than those obtained by Elizondo y Boschini (2002) in native and improved maize in a humid mountainous forest, with values of 10.7 and 15.3 t DMC ha^{-1}, respectively; and those of Elizondo-Salazar (2011), with 3.1 and 1.5 t of DMC ha^{-1} for improved and native corn, respectively. This demonstrates the high productivity of tropical, semi-tropical and temperate maize, compared to mountain maize. In addition to observing variability of this component between genotypes, this character may well be used for future improvement.

Dry matter yield

The YDM was significant between genotypes (Table 2), where the highest value was obtained by the TlanchiHgoA2 genotype, with 28.6 t DM ha^{-1}; which was followed by the OjitalCT genotype, with 25.5 t of DM ha^{-1}. The lowest value was shown by the TlanchiHgoA3 genotype, with 8.1 t DM ha^{-1}. These results are similar to those observed by Zaragoza-Esparza *et al*. (2019) from 26.4 to 24.3 t ha^{-1} in hybrid corn. Data less than those of Parra (1996) for 23 genotypes of Creole corn and two commercial varieties, with a range of 18.13 to 33.9 t DM ha^{-1} for 1991; to those of Rivas *et al.* (2011) for trilinear maize, evaluated in Valles Altos with 47.2 to 34.3 t DM ha^{-1}, and those of Rivas *et al*. (2018) for trilinear maize evaluated in the subtropical region, with results of 32.8 to 27.6 t DM ha^{-1}. It was lower than those obtained in 1992 in a range of 54.1 to 23 t DM ha^{-1} with a density of 62 thousand plants ha^{-1}, and higher than those observed by Sánchez *et al.* (2011), for Creole corn, which showed the highest yield with 44.2 t of green matter ha^{-1}; that if it considers a dry matter percentage of 35% by the state in which it was harvested. It would have a yield of 15.5 t DM ha^{-1} under hot humid conditions, and those of Elizondo y Boschini (2002) in creole maize with values of 11.6 t DM ha^{-1}.

Plant Ratio: Complete Plant

The RPCP showed significant differences (Table 2), where the highest value was obtained by the FcoIMaJal genotype, with 0.91; which was followed by PapIntrJalaAmc, with 0.80 and PapantlaIntrJala, Tampiqueño1 and Tampiqueño2, with 0.76 for all three. On the other hand, Rivas *et al.* (2018) observed leaf values of 0.16 to 0.22 and stem values of 0.43 to 0.58, which adding together the two components would give 0.59 to 0.80 of RPCP, a little less than what was observed in this investigation. Rivas *et al*. (2011) observed other values for trilinear maize, evaluated in Valles Altos with 0.77 to 0.55.

Corn: Complete Plant Ratio

The RCCP showed statistical difference between genotypes (Table 2), where TlanchiHgoA3 showed the highest value with 0.61; followed by the Forrasierra genotype, with 0.53; while the lowest value was obtained by FcoIMaJal, with 0.10. Data greater than those observed by Rivas *et al*. (2011) with values for trilinear maize evaluated in Valles Altos, with 0.45 to 0.23, and those of Rivas *et al*. (2018**)** with corn 0.26 to 0.35. This character is important to select in forage maize, because a proportion greater than 54% of corn can ensure an *in vitro* digestibility (IVD) greater than 68% (Peña *et al*., 2004) and showed less than 50% of FDN, for presenting a satisfactory energy value (Núñez *et al*., 2003).

Table 2. Comparison of means of Dry matter Yield, of complete plant (stem + leaf) and corn, and component relationships with plant of 26 genotypes. Soledad de Graciano Sánchez, S. L. P.

GENOTYPES	YDMP	RMSE	YDM	RPPC	RPCP
PapantlaIntrJala1	11680 abc	4555 bc	16235 abc	0.73 b	0.27 abcd
FcoIMaJal	10487 abc	1198 c	11685 bc	0.91 a	0.10 d
RazaJala	12712 abc	3461 bc	16173 abc	0.69 b	0.31 abcd
Forrasierra	5547 bc	6356 abc	11903 bc	0.47 b	0.53 ab
PapIntrJalaAmc	12462 abc	3171 bc	15634 abc	0.80 ab	0.21 cd
PapantlaIntrJala2	10020 abc	3208 bc	13227 bc	0.76 ab	0.24 bcd
TlanchiHgoA6	10842 abc	5334 bc	16176 abc	0.68 b	0.32 abcd
AS948-2	14017 ab	7064 abc	21081 abc	0.67 b	0.33 abcd
OjitalIntrPap	9751 abc	4356 bc	14107 abc	0.70 b	0.30 abcd
PapantlaIntrJala	14623 ab	5923 abc	20546 abc	0.72 b	0.29 abcd
TlanchiHgoA7	14596 ab	5958 abc	20553 abc	0.72 b	0.29 abcd
TlanchiHgoA4	11768 abc	6845 abc	18613 abc	0.63 b	0.37 abcd
HojeroUze	11100 abc	8959 ab	20063 abc	0.56 b	0.44 abc
Cerritos	13249 abc	7561 abc	20810 abc	0.65 b	0.35 abcd
Tampiqueño1	17031 a	6164 abc	23195 abc	0.76 ab	0.24 bcd
TlanchiHgoA1	11415 abc	6769 abc	18184 abc	0.63 b	0.38 abcd
TlanchiHgoA5	10153 abc	3764 bc	13917 abc	0.72 b	0.29 abcd
TlanchiHgoA2	15863 ab	12712 a	28582 a	0.56 b	0.44 abcd
Tampiqueño2	11920 abc	3823 bc	15743 abc	0.76 ab	0.24 bcd
AForrajero	9228 abc	7036 abc	16263 abc	0.57 b	0.43 abcd
AElotero	10749 abc	5459 abc	10787 bc	0.63 b	0.38 abcd
TlanchiHgoA3	3427 c	4621 abc	8047 c	0.39 b	0.61 a
SantaFeJala	10895 abc	7305 abc	18199 abc	0.65 b	0.35 abcd
OjitalCT	17822 a	7655 abc	25477 ab	0.70 b	0.30 abcd
BVPbaja	11313 abc	4705 bc	16018 abc	0.71 b	0.29 abcd
Mexquitic	9999 abc	5998 abc	15997 abc	0.62 b	0.39 abcd
Average	11641	5768	17200	0.69	0.34
MSD	10522	7328	15161	0.55	0.38

*Letters a,b,c,…., different per column show significant differences. YDMP=Yield of dry matter of the plant (stem+leaves). YDMC=Yield of dry matter of corn. YDM=Yield of dry matter. RPCP=Plant: complete plant ratio. RCCP = Corn: whole plant ratio. MSD = Minimal significant difference.

Height

For height, the results showed significant differences between genotypes (Table 3), where Tampiqueño1 showed the highest value with 241.8 cm, and the genotype, PapantlaIntrJala2 followed with 231.9 cm. On the other hand, the commercial hybrid Forrasierra showed the lowest value with 135.8 cm. The data showed great variability in plant height. These results are similar to those found by Parra (1996), who observed a height range of 245 to 169 cm for 23 creole corn genotypes. in 1991, and 239 to 175 cm. in 1992; like those observed by Sánchez *et al.* (2011), for Creole corn with 244 and 216 cm of height, from a warm humid region; also to those of Sánchez *et al.* (2013), who obtained heights of 247 and 216 cm for a creole and 195 to 165 cm in commercial hybrids, in a humid tropical region in two experiments. This height is similar since the Creoles that showed a greater height in this investigation come from warm and semi-warm regions; like those observed by Zaragoza-Esparza *et al*. (2019), with values of 2.4, 2.3, 2.2, 2.2 and 2.2 m for the largest maize in Valles Altos. Greater than those observed by Sánchez *et al*. (2019), for tropical maize, with values of 203.1 to 167.2 cm. Less than observed Rivas *et al*. (2011), who obtained values for trilinear maize evaluated in Valles Altos from 284 to 201 cm; and those of Rivas *et al.* (2018**)**, in maize evaluated in the dry tropics, with a range of 264 to 195 cm; Yescas *et al*. (2015), with values ranging from 257 to 282 cm; Borroel *et al*. (2014), with 243 to 221 cm; Montemayor *et al*. (2006**)** with a range of 172 to 156 cm and Rivas *et al*. (2006) from 255 to 159 cm.

Table 3. Comparison of means of plant height, stem diameter and number of leaves of 26 corn genotypes. Soledad de Graciano Sánchez, S. L. P.

GENOTYPE	PLANT HEIGHT (cm)	DIAMETER OF STEM (cm)	NUMBER OF LEAVES
PapantlaIntrJala1	205.8 bcdefgh	2.74 abcd	16.3 bcdefg
FcoIMaJal	211.3 abcdef	2.59 abcdef	16.5 bcdef
RazaJala	217.9 abc	2.96 a	19.0 a
Forrasierra	135.8 i	2.14 h	12.4 i
PapIntrJalaAmc	214.0 abcde	2.57 abcdef	17.5 abcd
PapantlaIntrJala2	231.9 ab	2.82 abc	17.0 abcde
TlanchiHgoA6	198.1 bcdefgh	2.59 abcdef	15.5 defgh
AS948-2	213.2 abcdef	2.87 ab	17.8 abc
OjitalIntrPap	220.3 abc	2.84 abc	17.3 abcd
PapantlaIntrJala	196.3 cdefgh	2.75 abcd	15.8 bcdefg
TlanchiHgoA7	199.7 bcdefgh	2.57 abcdef	15.4 defgh
TlanchiHgoA4	211.2 abcdef	2.56 abcdefg	17.7 abcd
HojeroUze	192.1 cdefgh	2.30 efg	17.2 abcde
Cerritos	182.3 defgh	2.36 defg	15.0 efgh
Tampiqueño1	241.8 a	2.57 abcdef	17.3 abcde
TlanchiHgoA1	212.1 abcdef	2.68 abcde	16.3 bcdefg
TlanchiHgoA5	179.8 fgh	2.44 cdefg	16.5 bcdef
TlanchiHgoA2	209.2 abcdefg	2.68 abcde	17.0 abcde
Tampiqueño2	215.8 abcd	2.43 cdefg	17.2 abcde
AForrajero	173.0 h	2.29 efg	15.6 cdefgh
AElotero	181.4 efgh	2.24 fg	14.1 ghi
TlanchiHgoA3	208.2 abcdefg	2.33 defg	14.4 fghi
SantaFeJala	204.4 bcdefgh	2.43 defg	15.5 dfegh
OjitalCT	200.0 bcdefgh	2.52 bcdefg	17.2 abcde
BVPbaja	209.0 bcdefg	2.33 defg	18.0 ab
Mexquitic	175.3 gh	2.22 gh	13.5 hi
Average	201.5	2.53	16.3
MSD	34.0	0.43	2.32

*Letters a,b,c, ... different by column show significant differences. MSD=Minimal significant difference.

Stem diameter

The stem Diameter showed statistical significance (Table 3), where the RazaJala genotype showed the highest value with 2.96 cm, followed by AS948-2 with 2.87 cm; while the commercial hybrid Forrasierra showed the lowest value with 2.14 cm. Thus, a great variability was observed between genotypes for SD, being a character that can be used for selection and genetic improvement. Data greater than those observed by Parra (1996) for 23 creole corn genotypes, in a range of 2.01 to 1.28 cm in 1991 and from 1.93 to 1.36 cm in 1992; and similar to those observed by Rivas *et al*. (2011) for trilinear maize evaluated in Valles Altos with 2.71 to 2.30 cm.

Number of leaves

NLEAVES showed significant differences (Table 2), where the genotype with the highest value was RazaJala with 19.0 leaves of plant^{-1}, followed by BVPbaja with 18.0 leaves of plant^{-1}; while the commercial hybrid Forrasierra presented the lowest value with 12.4 leaves of plant^{-1}. Values similar to those of Rivas *et al*. (2018) with 17.0 to 14.2 in trilinear maize evaluated in the dry tropics. Data greater than those obtained by Parra (1996) in 21 creoles, obtaining a range of 16.4 to 14.5 leaves per plant, and many greater than those of Sánchez *et al*. (2019) with values of 10.7 to 9.6 leaves plant^{-1}, and similar to those of Rivas *et al.* (2011) trilinear maize evaluated in Valles Altos with 14.9 to 12.5. This character is important to select in corn because it is one of the components that give the genotypes greater nutritional value, as it is more digestible (Paliwal, 2001).

CONCLUSIONS

Regarding the number of leaves, the RazaJala, BVPbaja and AS948-2 genotypes with values ranging from 19 to 17.8 leaves, showed the highest values, which makes them recommendable to select or recommend them for this considerable range. As for total dry matter yield, the best genotypes were TlanchiHgoA2 and OjitalCT, demonstrating productive characteristics that can be taken into account for dry matter production. For the dry matter yield of the plant (stem+leaf), OjitalCT and Tampiqueño1 showed the highest value, which makes these genotypes viable for dry matter production in stem and leaf; also for good performance. According to the evaluation, it was observed that there are genotypes from the subtropical and tropical regions, which show satisfactory and better productive behavior than other local and improved hybrids in semi-arid regions, such as Tampiqueño1, OjitalCT and TlanchiHgoA2; therefore, they could be recommended to be evaluated more broadly at the commercial level to be used as forage corn alternatives, or to be considered in breeding programs for forage purposes.

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