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Research article

Evaluation of maize hybrids and composites for fodder yield and ensiling quality

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Abstract

There are number of hybrids and composites in maize which are used for silage making by farmers. The objective of the present study was to find out the promising high yielding and better-quality silage cultivar. A study was undertaken during, *Rabi* 2019-20 and *Kharif* 2020 in randomized block design (RBD) with three replications consisting of 13 maize hybrids and three composites. The African Tall recorded significantly higher plant height (333.39 cm), number of leaves/plant (13.83) and green fodder yield (51.92 t/ha) compared to all other hybrids and composites. While dry matter yield was higher in maize hybrids, P 3401(16.85 t/ha) followed by DMRH 1410 (15.45 t/ha). Crude protein yield (1.09 t/ha) was also higher in P 3401 followed by PMC 6 and P 3396 (1.01 t/ha). The pH of silage in all maize genotypes was in acceptable range. NDF content varied from 49.48 to 55.11% and 53.19 to 59.39% in green fodder and silage stage, respectively. ADF content varied between 24.45 to 28.55% in green fodder and 28.74 to 33.34% in silage. But difference was found non-significant for both NDF and ADF in silage and green fodder. Based on this study, African Tall, P 3401 and DMRH 1410 were identified as promising maize genotypes for higher biomass yield and quality silage preparation for ruminant animals.

Keywords: Fodder, Maize genotypes, Nutrition, Quality silage

Introduction

Maize (*Zea mays* L.) is cultivated throughout the year in all states of the India for various purposes including grain, fodder, green cob, sweet corn, baby corn and popcorn (Kumar *et al*., 2020; Rakshit *et al.,* 2021). Indeed, maize is an ideal crop for forage due to its rapid growth, high biomass and good palatability (Kumar *et al.,* 2018). With the expansion of maize cropping area, it has gained importance among mixed crop livestock farmers for fodder and silage purpose. Pandey and Roy (2011) reported that maize is exclusively grown as a fodder crop in 9 lakh hectares area in the country. India is the world's largest dairy producer with 187 million tons recorded during 2019 and has set a target of 330 million metric tons (MMT) by 2034 (FAOSTAT, 2020). In India, cultivation of forage covering only about 4% of the agricultural land is not adequate to support 535.78 million animals (Livestock Census, 2019). Even though the milk productivity of an animal depends on the genetic background, the availability of quality green fodder as fresh or in conserved form in sufficient quantities with the dairy farmers is going to play an important role in increasing productivity of milch animals (Mahanta *et al*., 2020). One recent estimates of the fodder requirement keeping the animal census and dry, green and concentrates requirement of animals based on their age, sex, mulching, work nature etc. suggest 23% and 14% deficit in green fodder and dry fodder, respectively (Roy *et al.,* 2019). To fulfill this deficit maize can play an important role as it has the potential to produce large biomass which has largely remained less-utilized as fodder crop and also has better potential as silage.

The silage is the preserved form of the harvested crop, prepared by anaerobic fermentation through bacteria that convert soluble carbohydrates into lactic acid, similar to that found in pickle or achaar (Chaudhary *et al.,* 2012). Silage can be an ideal source of quality fodder for dairy animals and it can be stored for a long duration and fed to animals throughout the year, particularly during the lean periods/summers when cheap green fodder is not available from fields. In India, public and private sectors are selling fodder or dual-purpose maize hybrids for silage production. Several factors including type of corn variety, fertilizer dose, spacing and environment affect the quantity and quality of silage production. Hence selection of maize genotype (composite or hybrid) for cultivation as silage is the most important factor due to genetic characteristics. Gujarat is a major maize silage producing state. The information regarding the performance of different kinds of maize genotypes for fodder yield, nutrient content and silage quality under Central Gujarat condition is, however, limited. Because some of the farmers growing maize composites cultivars not hybrids for silage purpose. Therefore, the present study was taken up to evaluate the newly developed maize hybrids for their yield, whole plant composition and ensiling characteristics under north Indian climatic conditions as compared to available fodder maize composites.

Materials and Methods

Plant material and experimentation: The experiment was taken up during, *Rabi* 2019-20 and *Kharif* 2020 at Fodder Demonstration Unit (FDU) of National Dairy Development Board, Anand (Gujarat) situated at 22° 33' N latitude and 72° 57' E longitude at an elevation of 41 meter above mean sea level. The soil of the experimental site was loamy in texture. During *Rabi* 2019-20, crop was sown on 26th December, 2019 and harvested on 7th April, 2020. Whereas during *Kharif* 2020, crop was sown on 20th July, 2020 and harvested on 26th September, 2020. The average rainfall, maximum and minimum temperatures were 0.10 mm, 31.99ºC and 16.63ºC in *rabi*, while 74.40 mm, 32.70ºC and 26.20ºC in *kharif* seasons, respectively. The experiment was laid out in randomized block design (RBD) with three replications consisting of sixteen maize genotypes (Table 1). African Tall was used as check for yield and quality parameters.

The total plot size was 4.0 m × 4.0 m with net plot area of 2.8 m × 2.8 m (7.84 m^2) at harvest. The crop was sown with seed rate of 20 kg/ha at row and plant to plant spacing of 60 cm × 25 cm. After sowing, the plots were immediately irrigated to ensure proper germination. All other agronomic practices like irrigation, hoeing, weeding, inter culturing etc. were carried in similar manner for all plots to exploit full potential of the genotypes. The soil of the experimental site was loamy in texture with EC- 0.24 dS/m, pH- 7.68, organic carbon- 0.43%, available potash- 317 kg/ha. The soil contained DTPA-extractable Fe (7.26 ppm), Mn (19.85 ppm), Zn (4.63 ppm), available S (5.89 ppm) and Cu (1.44 ppm). Each plot was fertilized with 20 ton/ha farm yard manure, 200 kg/ha N, 75 kg/ha P_2O_5 and 90 kg/ha K_2O. Full dose of farm yard manure, phosphorus, potassium and one-third dose of nitrogen were applied as basal dose and remaining nitrogen fertilizer was top dressed in equal doses at 30 and 45 days after sowing in maize rows as band placement. To control weeds, atrazine herbicide was applied as pre-emergence @ 0.75 kg a.i./ha followed by hand weeding and earthing up operation at 25 days after sowing. Optimum moisture level was maintained during crop growing duration by surface irrigations. Major insects-pests of maize were kept in check by alternate tank sprays (knapsack sprayer) Chlorantraniliprole 18.5 SC (80 ml/acre) @ 0.4 ml/litre of water; Thiamethoxam 12.6% + Lambda Cyhalothrin 9.5% ZC (50 ml/acre) @ 0.25 ml/litre of water; Spinetoram 11.7% SC (100 ml/acre) @ 0.5 ml/litre of water; Emamectin benzoate 5% SG (80 g/acre) @ 0.4 g/litre of water. The crop was harvested at optimum dry matter content for ensiling at around 90 days duration for recording of growth, yield and quality components related to fodder.

Data recording: Yield of fodder and growth attributes were measured and analyzed at harvest on both the seasons. From each net plot area, total number of plants at two randomly selected spots of 2.8 meter row length were counted and averaged out as number of plants per meter row length. Growth data was recorded from six randomly selected plants from same area. At harvesting time, growth and development parameters, brix content (˚brix) and biomass yield of every treatment was determined. Brix content (˚brix) was recorded in green stalk juice of same six plants by using hand refractometer. For estimation of dry matter content in green fodder of maize genotypes at harvest, 300 g chopped fodder samples were dried in oven separately at 75°C for 48 h to achieve constant weight. Plot-wise fresh fodder yield was multiplied by respective dry matter content (%) to get dry weight in kg per plot and was expressed dry matter yield in ton per hectare (t/ha).

Silage preparation and observations: For ensiling purpose following Muck and Kung (2007), randomly selected fodder from each treatment was chaffed by using 2 HP power chaffcutter to 1-2 cm length pieces. Well mixed chaffed fodder was tightly filled, compacted and sealed manually in air-tight plastic containers of 8 kg capacity for ensiling without use of any culture or additives in containers. After 45 days, sealed containers were opened and chemical analysis of silage samples were done for pH, dry matter content, crude protein, neutral detergent fiber (NDF), acid detergent fibre (ADF). The pH of silage was recorded on the basis of fresh wet sample by using hand-held digital pH meter. For this purpose plot-wise 50 g of silage sample was mixed in 150 ml of distilled water in a glass beaker and after 10 minutes, sensor of hand-held pH meter was dipped in silage solution to record pH reading. Wet silage samples (300 g) were oven dried at 75°C for 48 hours to achieve constant weight for dry matter content in silage and thereafter, fine grinded (1 mm) for lab analysis. Total nitrogen (N), crude protein and proximate nutrients of silage samples were carried out following the standard laboratory procedures (AOAC, 2012). NDF and ADF content in fodder and silage were analyzed as per Van Soest *et al.* (1991). The total soluble solids (TSS) brix was estimated by placing a drop of stem juice on the surface of hand refractometer. Two season's data was pooled and statistical analysis of pooled data for ANOVA was carried out for determining significance of treatment as given by Sheoran *et al.* (1998).

Results and Discussion

Growth parameters of maize genotypes: Pooled analysis of two seasons' data showed significant difference in plant height among composites and hybrids (Table 1). National check maize composite, African Tall recorded significantly higher plant height (333.39 cm) than all other genotypes. Fodder maize composites recorded higher group mean plant height than hybrid maize genotypes. However, on the basis of group mean data, public and private sector hybrids were found to be of equal height. Among the maize hybrids, three public sector maize hybrids, *viz*., DMRH 1419, DMRH 1410 and DHM 117 recorded plant height over 230 cm. Further, significant differences were also observed for number of leaves/plant and number of leaves above cob amongst maize genotypes. The check African Tall recorded significantly higher (13.83) number of leaves/plant, but it was at par with CoHM 6 and J 1006. However, number of leaves above cob was recorded significantly higher in DHM 117 (6.30) in comparison to DMRH 1419, HQPM-1, P 1844, P 3401 and J 1006. Differences were found to be non-significant for stem girth, number of cobs/plant and green leaves weight/plant amongst maize genotypes. Significant differences were also observed amongst maize genotypes for green biomass weight/plant, green stem weight/plant and leaf: stem (L:S) ratio. Significantly higher green biomass/plant (1.35 kg) and green stem weight/plant (0.94 kg) were observed in check, African Tall in comparison to other genotype. This might be due to combined effect of higher green stem and green leaves weight/plant. Green biomass weight/plant between private and public sector maize hybrids was found to be statistically at par amongst themselves except P 1844. On the basis of group mean, green biomass weight was observed higher in fodder maize composites in comparison to maize hybrids. L:S ratio was observed significantly higher (0.51) in private sector maize hybrids P 3401 and SCH 200 as compared to check, African Tall, J 1006 and PMC 6. Overall, mean L:S ratio was observed higher in public sector maize hybrids (0.44) followed by private sector maize hybrids (0.38) in comparison to fodder maize composites (0.29). Kumar *et al*. (2016) also reported L:S ratio (0.30) in forage maize genotype.

Fodder and nutrient yields of maize genotypes: Statistical differences were found significant for green fodder yield (GFY), dry matter yield (DMY), crude protein yield (CPY), good quality silage yield and grain content in silage (Table 2). The check African Tall recorded significantly higher GFY (51.92 t/ha) as compared to all other genotypes. Whereas maize hybrid P 3401 recorded significantly higher DMY (16.85 t/ha) but it was at par with maize hybrids, *viz*., IMHB 1532, DMRH 1308, DMRH-1410, P 3396 and maize composite African Tall. The CPY was also significantly higher in maize hybrid P 3401 in comparison to hybrids, *viz*., DMRH 1301, DMRH 1419, PJMH 1, HQPM-1, SCH-200, P 1844, African Tall and J 1006. Overall, mean GFY was observed higher in fodder maize composites, whereas, mean DMY and CPY were higher in private sector maize hybrid P 3401. Higher green fodder yield in African Tall was also reported earlier (Bhagat *et al*., 2017; Singh and Chaudhary, 2021). Significantly higher green fodder yield in maize composite African Tall

Table 1. Performance of various maize genotypes for various growth parameters (pooled means of two years)

Genotypes	PH (cm)	ST (cm)	NOL	NOLaC	L:S	FBW (kg)	GLW (kg)	GSW (kg)	WGC (kg)
Public sector maize hybrids									
IMHB 1532	219.61	5.17	13.03	6.17	0.45	0.82	0.14	0.43	0.24
DMRH 1301	217.41	5.88	13.03	6.13	0.41	0.81	0.14	0.31	0.25
DMRH 1308	214.09	5.56	12.14	6.08	0.41	0.85	0.15	0.48	0.23
DMRH 1410	233.81	5.39	12.61	6.25	0.45	0.80	0.14	0.44	0.23
DMRH 1419	237.70	5.53	11.75	5.81	0.46	0.65	0.14	0.42	0.25
PJMH 1	222.61	5.06	12.28	6.11	0.46	0.75	0.13	0.28	0.23
CoHM 6	225.04	5.22	13.22	6.08	0.45	0.80	0.20	0.29	0.26
DHM 117	234.59	6.06	12.09	6.30	0.44	0.70	0.16	0.37	0.27
HQPM 1	191.38	6.31	11.11	5.64	0.44	0.83	0.16	0.35	0.32
Group mean	221.80	5.58	12.36	6.06	0.44	0.78	0.15	0.37	0.25
Private sector maize hybrids									
SCH 200	223.30	5.21	12.67	6.11	0.51	0.82	0.16	0.42	0.24
P 3396	217.17	5.72	11.95	6.17	0.39	0.89	0.13	0.45	0.30
P 3401	228.42	5.39	11.97	5.78	0.51	0.86	0.15	0.39	0.32
P 1844	222.59	5.33	10.89	5.61	0.12	0.66	0.11	0.29	0.26
Group mean	222.87	5.41	11.87	5.92	0.38	0.81	0.14	0.39	0.28
Maize composites									
PMC 6	268.49	6.17	12.37	6.21	0.28	1.10	0.17	0.65	0.28
African Tall	333.39	5.99	13.83	6.20	0.23	1.35	0.19	0.94	0.22
J 1006	254.56	5.31	13.28	5.83	0.37	0.91	0.15	0.53	0.23
Group mean	285.48	5.82	13.16	6.08	0.29	1.12	0.17	0.71	0.24
SEM	6.77	0.28	0.27	0.14	0.04	0.08	0.02	0.07	0.02
CD (P<0.05)	19.66	N/A	0.79	0.42	0.12	0.23	N/A	0.20	0.06
CV (%)	5.02	8.63	3.78	4.15	17.38	16.4	18.24	27.23	13.71

PH: Plant height; ST: Stem thickness; NOL: Number of leaf per plant; NOLaC: Number of leaf above cob/plant; L:S: Leaf to stem ratio; FBW: Fresh biomass weight/plant; GLW: Green leaf weight/plant; GSW: Green stem weight/plant; WGC: Weight of green cobs/plant;

might be attributed to greater plant height, number of leaves/plant and green biomass weight/plant as compared to other genotypes. Kumar and Singh (2004) and Imran *et al.* (2010) observed positive correlation between green fodder yield with plant height and number of leaves/tillers. Singh *et al.* (2020) also observed significant variation in GFY, DMY and CPY among maize genotypes.

Good quality silage production depends on combination of few critical factors such as green fodder yield, dry matter yield, brix and grains present in conserved fodder. The fodder must contain reasonable moisture (60-65%), energy (55-60%) and protein (6-9%) during pre-ensiling period. Gourley and Lusk (1978) indicted that the grain component of the silage was the preponderant source of energy and fermentation would not convert a poor forage into a high-quality silage. In this trial, grain content (6.13 t/ha) was observed significantly higher in maize hybrid P 1844 in comparison to all other genotypes (Table 2). Maize hybrid P 3396 also recorded significantly higher grain content in silage (4.78 t/ha) in comparison to many maize hybrids PJMH 1, DHM 117, HQPM 1 and fodder composites, *viz*., PMC 6, African Tall and J 1006. Significant differences were observed amongst maize genotypes for green cobs weight/plant, weight of dry grains/cob and 100 grain weight (Table 2). Weight of green cob/plant (0.32 kg) was significantly higher in two maize hybrids P 3401 and HQPM 1 but it was at par with CoHM 6, P 3396, P

Table 2. Performance of various maize genotypes for fodder and nutrient yields (pooled means of two years)

Genotypes	GFY (t/ha)	DMY (t/ha)	CPY (t/ha)	GYS (t/ha)	WG (kg)	TW(g)	NoB
Public sector maize hybrids							
IMHB 1532	40.06	14.62	0.99	4.24	0.10	20.00	1.03
DMRH 1301	39.23	13.02	0.84	4.02	0.09	15.70	1.00
DMRH 1308	44.93	14.65	0.96	4.64	0.10	19.30	1.00
DMRH-1410	43.44	15.45	0.95	4.73	0.10	16.40	1.00
DMRH 1419	36.77	14.16	0.84	3.94	0.09	20.03	1.00
PJMH 1	34.32	11.34	0.78	3.77	0.08	19.73	1.00
COHM 6	41.03	14.54	0.97	4.48	0.10	22.20	1.00
DHM 117	41.36	14.26	0.98	3.64	0.08	16.37	1.00
HQPM 1	33.11	9.70	0.68	2.74	0.08	16.30	1.00
Group mean	39.36	13.53	0.89	4.02	0.09	18.45	1.00
Private sector maize hybrids							
SCH 200	37.18	13.41	0.86	3.90	0.09	19.17	0.92
P 3396	40.81	14.72	1.01	4.78	0.11	19.17	1.00
P 3401	45.88	16.85	1.09	4.64	0.10	18.13	1.00
P 1844	32.07	12.60	0.82	6.13	0.13	21.23	1.00
Group mean	38.99	14.40	0.95	4.86	0.11	19.43	0.98
Maize composites							
PMC 6	43.77	13.76	1.01	2.49	0.05	15.37	1.11
African Tall	51.92	14.72	0.89	1.41	0.04	12.27	0.95
J 1006	41.74	12.93	0.75	2.80	0.06	13.33	1.06
Group mean	45.81	13.80	0.88	2.23	0.05	13.66	1.04
SEM	2.07	0.77	0.05	0.31	0.01	0.57	0.04
CD (P<0.05)	6	2.24	0.15	0.9	0.01	1.64	N/A
CV (%0	8.84	9.7	9.78	13.78	9.47	5.51	7.1

GFY: Green fodder yield; DMY: Dry matter yield; CPY: Crude protein yield; GYS: Grain yield in silage, t/ha; WG: Weight of grains/cob; TW: 100 kernel weight; NoB: Number of cobs/plant

1844 and PMC 6. However, weight of grains/cob was recorded significantly higher in P 1844 (0.130 kg) than other genotypes. Maize hybrids CoHM 6 (22.20) and P 1844 (21.23) at par amongst themselves recorded significantly higher 100 grain weight than other genotypes. In field trials consisting of 10 maize hybrids, 100 seed weight varied in two maize hybrids from 22.03 g in Corn-4620 to 25.75g in Corn-4558 (UPCAR, 2015). On the basis of group mean, lower green cob weight/plant, grains weight/cob and 100 grain weight were observed in maize fodder composites, which might be due to higher green biomass yield/plant. Vijay *et al.* (2017) reported that in general, the seed yield in forage cultivars was comparatively low due to lower seed setting ability.

Chemical composition of maize silage: Significant differences were observed amongst maize genotypes on chemical composition of silage for dry matter (DM) and CP contents. ^{0}Brix (total soluble sugar) content varied significantly amongst maize genotypes green stalk juice. However, non-significant differences were observed amongst maize genotypes for pH, NDF and ADF content in silage (Table 3). Dry matter (%) is an important attribute to evaluate the quality of forage crops and it has a significant positive impact on the performance of dairy animals. DMRH 1419 (37.22%) at par with maize hybrids IMHB 1532, DMRH 1410, CoHM 6, SCH 200, P 3401 and P 1844 recorded higher DM content than remaining genotypes. Mean DM content was observed higher in private sector maize hybrids (34.12%) and lower in fodder maize composites

Table 3. Chemical composition of silage and different maize genotypes (pooled means of two seasons)

Genotypes	DM (%)	TSS	pH	CP (%)		NDF (%)		ADF (%)	
				Fodder	Silage	Fodder	Silage	Fodder	Silage
				Public sector maize hybrids					
IMHB 1532	33.78	10.33	4.17	7.07	7.98	49.48	56.29	24.45	31.70
DMRH 1301	31.97	10.08	3.93	6.65	7.51	53.62	55.10	27.09	31.39
DMRH 1308	31.56	8.40	4.10	6.70	7.28	51.43	53.19	25.25	28.74
DMRH 1410	33.95	9.98	4.12	6.20	7.22	53.75	54.96	28.25	31.01
DMRH 1419	37.22	9.98	4.03	6.32	7.55	52.73	55.16	26.19	30.81
PJMH 1	31.22	10.55	3.98	7.27	7.55	52.00	57.05	26.13	31.30
CoHM 6	33.67	9.95	3.85	6.72	7.37	52.69	55.76	27.05	30.64
DHM 117	32.72	9.53	4.20	7.06	7.32	55.11	56.13	28.03	30.38
HQPM 1	27.95	10.58	4.03	7.16	7.96	50.38	53.38	25.02	29.86
Group mean	32.67	9.93	4.05	6.79	7.53	52.35	55.22	26.38	30.65
				Private sector maize hybrids					
SCH 200	34.72	11.07	4.10	7.04	7.10	55.46	59.39	28.55	33.34
P 3396	33.06	10.08	3.93	7.08	7.42	52.24	57.58	26.02	32.13
P 3401	33.73	9.33	4.00	6.81	7.29	52.88	56.31	26.57	30.07
P 1844	34.95	10.15	4.13	7.52	7.90	52.38	53.90	27.14	29.35
Group mean	34.12	10.16	4.04	7.11	7.43	53.24	56.80	27.07	31.22
				Maize composites					
PMC 6	30.89	11.77	3.98	7.54	7.63	51.41	56.35	25.99	30.47
African Tall	27.38	11.38	3.93	6.35	7.15	54.02	55.12	27.91	31.62
J 1006	29.52	9.34	4.13	6.06	6.99	52.27	58.82	26.77	31.98
Group mean	29.26	10.83	4.01	6.65	7.26	52.57	56.76	26.89	31.36
SEM	1.42	0.43	0.1	0.22	0.27	1.2	1.34	0.92	1.2
CD (P<0.05)	4.12	1.25	NS	0.64	NS	NS	NS	NS	NS
CV (%)	7.6	7.35	4.49	6.6	8.05	4.5	5.34	7	8.74

PH: Plant height; ST: Stem thickness; NOL: Number of leaf per plant; NOLaC: Number of leaf above cob/plant; L:S: Leaf to stem ratio; FBW: Fresh biomass weight/plant; GLW: Green leaf weight/plant; GSW: Green stem weight/plant; WGC: Weight of green cobs/plant;

(29.26%) in silage. Lower DM content in fodder composites might be due to late maturity period in comparison to maize hybrids. Similar results were also observed by Saleem *et al.* (2007) who reported significant variation among the maize genotypes for dry matter contents. Hundal *et al.* (2020) also observed significant variation in maize silage for dry matter content which ranged from 29.45 to 35.44%.

TSS or ˚brix represents the percentage by mass of total soluble solids of a pure aqueous sucrose solution. PMC 6 (11.77) was statistically at par with African Tall (11.38), SCH 200 (11.07), HQPM-1 (10.58) and PJMH 1 (10.55) recorded significantly higher ˚brix content over remaining maize genotypes. Overall, mean ˚brix was recorded highest (10.83) in fodder maize composites and lowest (9.93) in public sector maize hybrids. During the trial, more than 9 ˚brix in stalk juice of all the maize genotypes indicated availability of sufficient quantities of sugars for fermentation and rapid decline in pH during ensiling. The pH of an ensiled sample is a measure of its acidity. Lower pH in silage indicated higher content of lactic acid as this acid was stronger than the other acids (acetic, propionic and butyric) in silage (Singh *et al.*, 2020). pH differences in silages were statistically non-significant, however, differences varied from 3.85 to 4.17. Good quality silage was reported to contain silage pH below 4.2 (Singh *et al.*, 2020). The pH values of maize genotypes silage obtained in this study were within the recommended range of 3.7-4.2 (Karsten *et al*., 2003). Kung *et al.* (2018) indicated typical concentrations of pH varied between 5.5-6.0 and 3.7-4.0 in freshly chopped maize fodder and properly ensiled maize silage, respectively.

In fodder, significantly highest CP content was observed in PMC 6 (7.54%) in comparison to other genotypes but it was at par with maize genotypes of IMHB 1532, PJMH 1, DHM 117, HQPM 1, SCH 200 and P 3396. Lowest crude protein content was observed in fodder composite J 1006 (6.06%). Overall, CP content varied from 6.99 to 7.98% in maize genotype for silage but difference was non-significant. Htet *et al*. (2016) reported that the CP content was higher (P<0.01) in silage than the forage in maize. Similarly, Hawu *et al.* (2022) reported the highest CP content in maize:legume mix silage at 20:80 proportion. The CP content was higher in silage than fodder that might be due to release of non-ammonia nitrogen (N) during ensiling period (Huber *et al*., 1980). Basit *et al.* (2018) also reported significant differences in crude protein content amongst 9 maize genotypes, which ranged between 5.47 to 11.00%. It was observed that different cultivars of maize intended for silage production had 7.1 to 8.8% CP concentration (Pinto *et al.,* 2010; Hundal *et al.,* 2019). Further, crop yield, stage of maturity at harvest and level of fertilizer-N applied to the crop could also influence N content which affected the protein content (Fairey, 1982). NDF and ADF contents were non-significant amongst maize genotypes for fodder and silage. However, NDF content ranged from 49.48 to 55.11% in green fodder, while it was 53.19 to 59.39% in silage, respectively. ADF contents varied from 24.45 to 28.55% and 28.74 to 33.34% in fodder and silage, respectively. Results were in close conformity with Garg *et al.* (2005) who observed similar level of NDF (59.45%) and ADF (40.21%) contents in maize green fodder.

Conclusion

Amongst 13 tested maize hybrids and composites, fodder maize composite African Tall emerged as best genotype for green fodder yield with yield over 50 t/ha. However, on the basis of dry matter yield, two maize hybrids P 3401and DMRH 1410 were best with yield over 15 t/ha. Further, pH of all maize germplasm silage was under acceptable limit of 4.2. However, on the basis of crude protein yield over 0.90 t/ha, 8 hybrids *viz*., P 3401, P 3396, PMC 6, IMHB 1532, DHM 117, CoHM 6, DMRH 1308, and DMRH 1410 were found superior. Based on better crop yield and nutritive value as silage for ruminant animals, maize genotypes *viz*., African Tall, P 3401 and DMRH 1410 were identified as promising among all genotypes tested.

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