THE EVALUATION OF A TEOSINTE-MAIZE HYBRID FOR FORAGE

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ABSTRACT

A teosinte- maize hybrid produced two cuts of forage. Under the experimental conditions the hybrid produced more digestible forage of a higher protein content than a single cut of maize. Single harvests of the hybrid did not produce as much as maize.

INTRODUCTION

Teosinte (**Euchlaena**) is a highly specialised wild grass, found throughout Mexico and Guatemala. It intercrosses freely with maize (both have 20 chromosomes), and is generally believed to be the direct ancestor of maize.

While there are many accounts in the literature of the forage production from maize there is hardly any information on forage from teosinte. Spillman (1922) reported that teosinte thrives in moist, fertile, tropical conditions; producing several cuts of succulent herbage. The yields of forage are enormous, placing teosinte at the head of the grasses in yield.

The cytology of intergeneric hybrids among American **Maydeae** has been well explored and recorded but there appear to be no data on forage production by these hybrids. Mumm (1960) in a backcrossing programme with teosinte on maize inbreds – to induce hard stems and prolificacy in maize – noted marked heterosis in the F1 generation. He suggested (pers.com.) that a teosinte-maize hybrid should be evaluated for forage production and sent seed of his own and Galinat's race of teosinte for crossing with maize.

MATERIALS AND METHOD

For economy, grain from a crop sown with hybrid grain, rather than true hybrid seed, is commonly sown in New Zealand for forage maize. Consistent with this practice Galinat's teosinte (pollen parent) was crossed with maize lines from experimental plots of Maris Carmine. Seed lines from plots of Maris Carmine, Maris Saffron, Maris Jade, and Maris Flame were the remaining varieties in a randomised block trial of four replicates.

The seed was planted in mid November at 20 plants per square metre, a population considered (Davies pers.com.) best for dry matter production for this time of sowing at Lincoln.

Each 2-row 8 m plot – 25 x 20 cm plant spacing – was separated by a buffer row of a mixture of the maize lines used. The trial sides and ends were buffered by two or more plots of the mixture. No irrigation was used.

A randomly chosen half of each replicate (i.e. 4 m) was cut at tasselling in late January (cut 1) to assess forage production. The crop and buffers were cut at a height of about 20 cm; just above the tops of the teosinte hybrid side shoots. A final cut at the dent stage, in late April (cut 2), was taken from the remaining half plots and from the regrowth from the first cut of the teosinte-maize hybrid.

Herbage samples from each plot at each cut were taken for dry matter, nitrogen and fibre content determination.

An estimate of the feed value of the whole plant was obtained from the product of the total yield and the sum of the component coefficients of digestibility and nitrogen content. These coefficients were obtained by the appropriate function, e.g. for digestibility.

$$\frac{100 - \%\text{ fibre content}}{100} \times \frac{\%\text{ composition of component part}}{100}$$

RESULTS

Bulk yield

Plant survival varied from 82% to 92% between varieties. But plant numbers were not correlated with plot yield ($r = 0.14$).

When harvested only once the hybrid produced less forage than maize (Table 1). There was negligible regrowth from maize, hence the lack of competition from regrowth maize may have favoured regrowth of the hybrid. Disregarding this possible assistance, the sum of yields from the first cut and the regrowth significantly exceeded the standard in yield.

The low yields are a reflection of the fertility of the trial site.

TABLE 1: Bulk yields of varieties kg/ha

Cut	1st	2nd
Line		
Teosinte hybrid	3220	5203
Maris Carmine	4828	6461
Maris Saffron	4438	5815
Maris Jade	4172	6202
Maris Flame	4404	5522
Teosinte hybrid 1st cut plus regrowth 2nd cut (4850 kg/ha)	-	8070
LSD .05	834	1052
CV	12.8%	11.3%

TABLE 2: Percentage allocation of dry matter as components

	1st cut		2nd cut				
Line	Leaf	Stalk	Leaf	Stalk	Cob	Husk	Grain
1	59.5	40.5	33.30	34.30	15.83	10.3	5.88
2	55.5	45.5	30.30	28.95	9.03	12.8	18.95
Regrowth (Line 1)			25.40	31.83	23.30	17.1	-
LSD .05	NS	NS	3.0	4.53	7.17	4.2	7.81
CV %	24	24	5.9	8.2	25.8	24.1	32.1

TABLE 3: Per cent fibre content of components

	1st cut		2nd cut				
Line	Leaf	Stalk	Leaf	Stalk	Husk	Cob	Grain
1	27.96	27.00	31.20	28.96	25.95	22.94	6.61
2	29.97	23.77	33.51	26.63	25.74	22.10	3.87
Regrowth (Line 1)			26.46	24.33	22.63	24.61	-
LSD .05	3.21	3.21	3.21	3.21	3.21	3.21	2.29
CV %	15.7	15.7	15.7	15.7	15.7	15.7	11.6

N.B. Error term computed from pooled component data, except for grain.

Composition of yield

There was no significant difference in proportion of leaf between the teosinte hybrid (Line 1) and Maris Carmine (Line 2) in the first cut, as shown in Table 2.

In the second cut significant differences in composition appeared. The teosinte hybrid produced significantly more leaf and stem, and rather more cob, but much less grain than the control.

The regrowth however produced no threshable grain, and its composition showed significantly less leaf but more cob than the 2nd cut of either line. Cobs from this treatment contained some non-separable small immature grain.

Percent fibre content

The Acid Detergent Fibre test (A.D.F.) determines chemically the quantity of indigestible fibre in a forage, and hence a measure of its *in vitro* digestibility.

In general (Table 3) the stalk and particularly the grain of the teosinte hybrid were more fibrous than in maize; the leaf less fibrous.

In contrast the leaf, stalk, and husk of the regrowth from the teosinte cross were significantly less fibrous than the plots of the cross left for the second cut. In this comparison the differences from maize reached significance with both leaf and husk.

Percent nitrogen of yield components

The percent nitrogen content of a feed insofar as ruminants are concerned – tentatively evaluates its portein content.

As expected, protein contents of leaf and stem in the first cut were considerably higher than in the second cut. Indeed the protein content of first-cut leaf was comparable in quantity with second-cut grain. The stem of the hybrid had a higher content than the leaf.

For maize, first-cut leaf was significantly ($P = .05$) higher than stem in protein; while in the second cut, grain clearly leads in protein content with stem last, for all the lines.

The most notable difference between varieties was the higher protein content of the stem and grain of the teosinte hybrid ($P = 0.05$).

Whole plant comparison

The tentative value of the whole plant can be obtained from the product of the total yield and the sum of the component coefficients of digestibility. Tables 1 – 3 provide estimates of total digestible DM/ha, and Tables 1, 2 and 4 give nitrogen/ha.

Table 5 shows that the total digestibility of maize (Line 2) was only marginally better than that of the hybrid, due undoubtedly to a high grain content. However, the total production of dry matter and digestible material, and particularly the protein production, from the first cut and subsequent regrowth, exceeded that of the standard.

DISCUSSION

After the first cut, the regrowth of the maize buffer rows on either side of the teosinte cross plots was slight. This factor may have improved the regrowth yield to some extent. Nevertheless in this trial, the teosinte hybrid produced two cuts of forage to one of maize. This increased the bulk dry matter production 25%, the digestible material by 20% and the nitrogen production by 50%. Similarly pasture

TABLE 4: Per cent nitrogen of components

	1st cut		2nd cut				
Line	Leaf	Stem	Leaf	Stem	Husk	Cob	Grain
1	1.82	1.96	1.38	0.93	1.19	1.44	2.43
2	1.92	1.37	1.24	0.86	o.90	1.53	2.00
3	2.17	1.56	1.14	0.89	0.91	1.26	2.16
4	2.03	1.61	1.16	0.77	0.90	0.98	2.09
5	2.25	1.40	1.26	0.89	1.04	1.54	2.07
Regrowth (Line 1)			1.66	0.96	1.16	1.49	–
LSD .05	NS	0.37	0.33	NS	NS	0.42	.26
CV%	20.9	15.0	16.8	17.4	19.8	20.1	7.8

TABLE 5: Whole plant comparison

	Line	Leaf	Stem	Cob	Husk	Grain	Total Digestibility	TD x DM Bulk
Digestibility								
1st	1	.4286	.2956				.7242	2332
Cut	2	.3887	.3468				.7355	3551
2nd	1	.2291	.2465	.1220	.0763	.0549	.7288	3792
Cut	2	.2015	.2124	.0703	.0951	.1821	.7614	4919
Regrowth		.1974	.2409	.1757	.1322	-	.7462	3619
Total from two cuts of hybrid								5951
							Total N	TN x DM Bulk
Nitrogen								
1st	1	.0108	.0079				.0187	60.21
Cut	2	.0107	.0062				.0169	81.59
2nd	1	.0046	.0032	.0012	.0023	.0020	.0133	69.19
Cut	2	.0038	.0025	.0012	.0014	.0038	.0126	81.41
Regrowth		.0042	.0031	.0035	.0020	-	.0127	61.59
Total from two cuts of hybrid								121.80

species under good grazing management with short well-grazed growth have higher quality than rank grass run to seed. It is speculated that a hybrid which could furnish several cuts of herbage during the season – like grass – would be preferable (if the expense could be borne) to any other.

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