Influence of Maize and Cowpea Intercropping on Fodder Production and Characteristics of Silage

A. Azim, A. G. Khan*, M. A. Nadeem and D. Muhammad
Animal Nutrition Institute, National Agricultural Research Centre, Islamabad, Pakistan

ABSTRACT : A study was conducted to examine the influence of maize (*Zea mays*) and cowpea (*Vigna unguniculata*) intercropping on fodder biomass production and silage characteristics. Maize fodder was cultivated alone and intercropped with cowpea at seed ratio of 85:15 and 70:30. Fodder was harvested at heading stage (at about 35% dry matter). The data indicated significant increase in biomass and crude protein production of maize intercropped with cowpea at seed ratio 70:30 followed by seed ratio 85:15 as compared to maize alone. However, no ($p>0.05$) difference was observed in TDN production among the three treatments. Four types of silages from, I) maize alone, II) maize and cowpea (85:15), III) maize and cowpea (70:30) and IV) maize supplemented with 2.5% urea were prepared. After 60 days of ensiling period, silage samples were analysed for proximate composition and fermentation characteristics. Crude protein and lactic acid values of silages I, II, III and IV were 8.52, 9.82, 14.90 and 13.96% and 9.00, 9.38, 10.86 and 7.43%; respectively. *In situ* dry matter digestibility was maximum in silage III followed by silages II, IV and I. The results suggested that intercropping of maize and cowpea at seed ratio 70:30 increased fodder production and produced quality silage. (*Asian-Aus. J. Anim. Sci. 2000. Vol. 13, No. 6 : 781-784*)

Key Words : Intercropping, Maize, Cowpea, Silage

INTRODUCTION

In Pakistan, the cultivated area is about 20.34 million hectares, out of which only 16-19% is being utilized for fodder production (Bhatti, 1996). The fodder production is about 55-60 million tones annually (Bhatti and Khan, 1996) which provides 20.25% of total dry matter, 20% total digestible nutrients and 43% digestible protein in national feedstuffs pool mostly used for livestock feeding. The pressure on the cultivated land is increasingly mounting for production of cereal and cash crops, thereby, reducing the land available for fodder production and thus causing animal feed shortage. In order to minimize the fodder shortage, it is necessary to improve fodder production per unit land and also to preserve the surplus fodder during peak production in order to ensure adequate and uniform fodder supply throughout the year.

The practice of intercropping is gaining renewed interest among researchers due to the increasing evidence that intercropping can provide substantial yield advantages over sole cropping (Willey, 1979). Maize (non leguminous) is one of the most important crop grown for fodder production in Pakistan. The per hectare yield of maize is about 30 tones which is rather poor and is also low in protein content. Cowpea (leguminous) is reported to contain more than 18% crude protein (Khan et al., 1987) and its intercropping with cereal fodder i.e. maize or sorghum etc. seems to be logical technique to increase fodder yield as well as its nutritive value in terms of crude protein. It is better to grow silage crop together e.g. corn, millet, sorghum (non leguminous) with soybean (leguminous) for obtaining good quality silage (Ensminger and Olentine, 1978). The present study was, therefore, conducted to examine the influence of intercropping of maize and cowpea with different seed ratio on the fodder biomass and nutrients yield per unit of land and also to evaluate their effect on the fermentation characteristics of silage.

* Corresponding Author: A. G. Khan. Tel: +51-92-240576, Fax: +51-92-241495.
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MATERIALS AND METHODS

Cultivation of fodder

Maize (*Zea mays*), variety sarhad white and maize intercropped with cowpea (*Vigna unguniculata*), variety p-18 at seed ratio 85:15 and 70:30 were cultivated at a seed rate of 100 kg/ha in the experimental field of Livestock Research Institute, National Agricultural Research Centre, Islamabad, Pakistan. The field was fertilized by nitrophous at the rate of 250 kg/ha at the time of sowing and subsequently after 15 days of sowing were fertilized by urea at the rate of 125 kg/ha. During the experimental period, the field was irrigated from dam water 6 times with 15 days interval. The fodder was manually harvested approximately 75 days after sowing at heading stage (at least 35% dry matter) and green fodder yield was recorded. Fodder samples were analysed for proximate composition (AOAC, 1990). Production (per ha) of dry matter, crude protein and total digestible nutrients was

determined on the basis of proximate analysis. Total digestible nutrients was calculated from regression equation based on proximate analysis (Wardeh, 1981).

Silage preparation

Four types of silages were prepared from fodder produced as I) maize alone, II) maize and cowpea at seed ratio 85:15, III) maize and cowpea at seed ratio 70:30 and IV) maize fodder supplemented with 2.5% urea solution.

Fodder was manually harvested and chopped into 3 to 4 cm in length with electric driven chopper and ensiled into metallic drums lined with polyethene. Eight drums were used for each type of silage and packing was done by manual trampling on the fodder. Drums were sealed airtight with polyethene and kept at room temperature to allow for anaerobic fermentation for 60 days. After the ensiling period, samples were taken from the centre of ensiled mass of each drum for chemical analysis and in situ dry matter digestibility (DMD).

Chemical analysis and *in situ* DMD

Silage samples were analysed for pH (electrometrically), proximate composition (AOAC, 1990), water soluble carbohydrate (Dubois et al., 1956), lactic acid (Barker and Summerson, 1941 as modified by Pennington and Sutherland, 1956) and total volatile fatty acids by the distillation method (AOAC, 1990). Silage samples were also subjected to determine *in situ* DMD by the nylon bag technique as described by Orskov et al. (1980). To determine in situ DMD, rumen fistulated buffalo bull maintained on roughage based diet was used.

Statistical analysis

Data of fodder production and chemical analysis of different silages was statistically analysed using Analysis of variance and Duncan's Multiple Range Test was used to compare the treatment means (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Fodder yield

Data regarding green fodder and nutrients production (tons/ha) of fodder cultivated as maize alone and maize intercropped with cowpea at different seed ratios are presented in table 1. Results revealed an ($p<0.05$) increase in the yield of green fodder of intercropped fodder as compared to maize fodder alone. Maize intercropped with cowpea indicated that the increase in seed rate of cowpea exhibited a trend of increasing green fodder and crude protein yield. The maximum green fodder yield was obtained from maize intercropped with cowpea (70:30) and this increase was noted as 21%, whereas, increase in protein was 94% as compared to maize fodder alone. TDN production was 10.30, 10.44 and 10.47 tons/ha for I, II and III, respectively. No. ($p>0.05$) difference was noticed in TDN yield among the treatments. These results are in accordance with those of Gunasena et al. (1979), Nnadi and Haque (1988) and Singh (1992) who found that the total yield (green fodder and cereals) in an intercropping system is higher than that of their mono cropping. It is also reproted that the green fodder yield increased up to 50-60 tons/ha when maize intercropped with cowpea. Present results are also in agreement with Tomer (1976) who reported that in India cowpea is generally grown in mixture with jower, bajra and maize etc. to enhance the green fodder yield and supplement the nutritive value of non-leguminous fodder.

Table 1. Green fodder biomass and nutrient yield of maize and maize cowpea intercropped fodder

Fodder	Yield (tons/ha)			
	Green biomass	Dry matter	Crude* protein	TDN*
Maize	43^{c}	15.85^{c}	1.32^{c}	10.30
Maize* cowpea				
85:15	47^{b}	16.22^{b}	1.54^{b}	10.44
70:30	52^{a}	17.16^{a}	2.48^{a}	10.47

Means within same column with different superscripts differ ($p<0.05$).
* On dry matter basis.

Chemical composition of fodder

Results of chemical composition of maize and intercropped maize and cowpea fodder are given in table 2. Crude protein contents of maize intercropped

Table 2. Chemical composition of maize and maize cowpea intercropped fodder (% DM)

Parameter	Maize	Maize:cowpea	
		85:15	70:30
Dry matter	35.86	34.50	33.00
Crude protein	8.32^{b}	9.75^{b}	14.43^{a}
Crude fibre	23.29^{a}	22.90^{a}	20.95^{b}
Ether extract	2.36	2.23	2.18
Ash	5.95	6.21	6.32
Water soluble carbohydrate (WSC)	10.58^{a}	9.30^{ab}	8.91^{b}
Total digestible nutrient*	65.00	64.39	66.84

Means within same row with different superscripts differ ($p<0.05$).
* Calculated value.

with cowpea at seed ratio 70:30 was ($p<0.05$) higher as compared to maize fodder alone or maize and cowpea intercropped at seed ratio 85:15. There was a small increase ($p>0.05$) in crude protein of maize intercropped cowpea (85:15) as compared to maize fodder alone. However, this small increase in crude protein value improved significantly the total production of crude protein as presented in table 1. Crude fibre level decreased ($p<0.05$) with the intercropping of maize with cowpea at seed ratio 70:30 compared to other intercropping level. No ($p>0.05$) difference was observed in ether extract and ash contents among the fodders. The values of water soluble carbohydrate were 10.58, 9.30 and 8.91% for I, II and III, respectively. The value of WSC of fodder tended to be sufficient for good fermentation required for the preservation of fodder in the form of silage as reported by Wilkinson et al. (1983).

Fermentation characteristics of silages

Results of fermentation characteristics of different silages are depicted in table 3. Crude protein values of silages were 8.52, 9.82, 14.90 and 13.86%, respectively. Protein values of silages III and IV were ($p<0.05$) higher as compared to silages I and II. Higher ($p<0.05$) lactic acid was produced in the silage III prepared by the maize and cowpea intercropped fodder (70:30) as compared to others. Desirable pH values were found in all the silages. However, silage IV had higher pH (5.4) which is in agreement with those of Baintner et al. (1985) and Martin (1980) who observed that maize silage treated with urea or ammonia maintained a higher pH.

***In situ* dry matter digestibility**

Results of the *in situ* DMD are presented in table 3. *In situ* DMD of silages I, II, III and IV were 55.71, 59.32, 61.80 and 57.54%, respectively. No. ($p>0.05$) difference in the values of in situ DMD was observed in the intercropped fodder silages II and III. However, these were ($p<0.05$) higher than the silage prepared by maize fodder alone. The value of DMD of urea supplemented maize silage was also ($p<0.05$) higher than the silage prepared by maize fodder alone. These results are in agreement with those of Smith et al. (1975) who reported that legumes (cowpea, chickpea) are higher in digestibility than non-leguminous fodder (maize, sorghum, millet).

CONCLUSION

Based on the findings of this study, it may be concluded that intercropping of maize and cowpea at seed ratio 70:30 proved to be an effective way to increase fodder production and to make quality silage ensuring the supply of nutritionally rich silage for round the year feeding.

Table 3. Chemical composition (% DM), fermentation characteristic and *in situ* dry matter digestibility of silage

Parameter	Silage			
	Maize	Maize:cowpea		Maize (Urea)
		85:15	70:30	
	I	II	III	IV
Dry matter	33.87	32.40	30.28	27.36
Crude protein	8.52^{b}	9.82^{b}	14.90^{a}	13.86^{a}
Water soluble carbohydrate	1.10	1.00	1.37	1.56
Total volatile fatty acid	8.67	8.92	9.32	8.93
Lactic acid	9.00^{b}	9.38^{b}	10.86^{a}	7.43^{c}
pH	4.10	4.00	3.80	5.40
In situ DMD	55.70^{c}	59.32^{ab}	61.80^{a}	57.54^{b}

Means within same row with different superscripts differ ($p<0.05$).

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