On-farm Assessment of Forage Yields and Silage Quality of Intercropped Drought Tolerant Cereal and Legume Forage Crops (R7010)

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Abstract

It was concluded that intercropping cereals and legumes for silage produced high yields of good quality silage that were sufficient to supplement two cows during the dry season. The simple technology of ensiling in bags was successfully tested under farm conditions. Farmers showed confidence in the technology through nearly doubling the area planted to forage in just two years. Forage production, by farmers using their cropping land, was found to be a way of increasing the livestock carrying capacity of the communal grazing. The major benefit derived by the farmers participating in these studies were herd growth by 60% of farmers and improved livestock condition due to better nutrition.

Introduction

Farmers in the semi-arid areas of Zimbabwe keep cattle and milk them for their own consumption, but in the dry season, natural grazing is inadequate and cows dry off. If continuous rather than seasonal milk production is to be ensured and sustained, then production and conservation of good quality forages must be intensified. Conserving the natural pasture for the dry season is difficult because communally owned grazing lands cannot support livestock during this period and, being communally owned it is logistically difficult for the livestock farmer to cut natural pasture for conservation (Titterton *et al.*, 2000; Mhere *et al.*, 2001). Producing forage intensively in the farmer's field, which is protected and managed by the owner, could solve this problem.

The objective of this on-farm study was to verify an identified system of high quality forage production and conservation with active participation of farmers. It was hypothesised that it is feasible to intercrop high yielding and ecologically adapted cereal forages with herbaceous legumes for the purpose of producing high yields of forage for silage, under on-farm conditions in the Gulathi area of Matobo communal lands.

Activities

Informal Diagnostic Survey

This was carried out in the Gulathi area during the winter months of the 1998/99 season with the objective of understanding the different crop-livestock systems, constraints and potentials in an informal, intensive way combining field observations, discussions and interviews with farmers. A number of farmers in the community had been in contact with the station since the 1995/96 season.

Among the major constraints, lack of adequate grazing land, dry season feed shortages and soil fertility featured prominently. However, Matopos Research Station had over the years been involved in forage production, conservation and utilisation research activities, which could contribute towards alleviating these identified constraints.

On-farm Study (1): Forage Yields and Silage Quality of Hybrid Pennisetum or Sorghum (Sorghum Bicolor) (Moench) Intercropped with Cow Pea (Vigna Ungiculata) (Walp) or Dolichos Beans (Lablab Purpureus) (Sweet) under Limed and Unlimed Soil Conditions in the Gulathi Communal Lands.

Materials and methods

Treatments. These consisted of two cereals (Sorghum and hybrid *Pennisetum*), two legumes (cow pea or dolichos bean) intercropped in alternate rows. Two villages that differed by degree of water logging (wet, W; dry, D) were selected for the study. All forages were planted with and without agricultural lime application. A factorial arrangement of treatments in a split-split plot design which had one replication per farm in the 1998/99 season and 2 replications per farm in the 1999/2000 season. Data from the first season and second season was subjected to analysis of variance (ANOVA). The study was researcher-managed and farmer-implemented (RMFI), whose scope was limited to verifying productivity of the identified system of forage production.

Results

Forage yields. Considerable differences between the wet and dry areas were recorded with the wet areas producing more forage in both seasons (Tables 1 and 2). In the second season, crop growth was very impressive. However, after January 2000, waterlogging caused lodging of the sorghums, which were swamped by the dolichos bean. Higher cereal and legume forage yields were recorded during the second season (Table 2) than often recorded in on-station trials (Mhere *et al*., 2000) Both legumes grew well and contributed about 30% of the combined yields in both wet and dry areas. Legume yields averaged over all treatments were 5.0 t/ha. Ensiling mixtures with that amount of legume has resulted in good quality silage on station (Titterton, *et al* 2000).

Effects of lime application. No significant effects of lime on forage yields were recorded during the first year. In the second season, limed plots gave higher yields than unlimed, this being more consistent in the wet areas. Adding lime did not seem to affect both the legume yields and the contribution of legumes towards combined dry matter.

On-farm Study (2): Farmer-managed and Farmer-implemented Forage Production for Silage Using Sorghum and Hybrid Pennisetum Intercropped with Cow Pea and Dolichos Bean in Alternate Rows During the 1998/99 and 1999/2000 Seasons.

Materials and methods

Treatments. In the two areas, used in the first on-farm study, and concurrent with it, a farmer managed study, to assess biomass production of the 4 crop combinations used in the first trial, was conducted on large plot areas ranging from 0.15 to 0.4 ha, in two seasons (1998/99 and 1999/2000). Thirty farmers took part. All plots were limed at 550 kg /ha. and dressed, at planting, with 200 kg/ha of a compound fertiliser supplying 8N: 14P_2O: and K_2O.

Biomass from each of the four intercrops was harvested by hand, weighed to determine yields, sampled for further analysis with the rest being ensiled in strong polythene bags with a capacity of 50kg. Air exclusion was done by hand pressing and then sealed airtight by strings. The bags were stored in storerooms that were rat proof. During the first year hand operated chaff cutters were used and diesel operated cutters in the second season.

Results

The silage from the farmers' fields had protein levels of 65-90 g/kg DM; dry matter of up to 400g/kg; pH of 4.2 - 4 .8; NH_3-N % of total N of 9-11%; Ash, ADF and NDF of 110-130, 380- 410 and 510 - 610 g/kg DM, respectively.

During the second season, (1999/2000) 63 tonnes of silage were ensiled in 4771 bags. Each farmer made an average of 1.75 tonnes of silage in 132 bags. Average weight of each bag was 14 kg. As in trial 1, the wet areas recorded higher yields in both seasons. There were positive changes in the land planted to these forage crops which in a way revealed the impact the technology had on the farmers.

On-farm Study (3): Preliminary Feeding of Indigenous Cows Using Mixed Crop Silage

During the first year, 62 pregnant cows from 25 farms were fed with silage made by the farmers. The other farmers did not have pregnant cows and used the silage for draught animals and goats. The preceding rainy season was characterised by low rainfall in both areas (Table 3).

The concerns of the farmers to feed other animals, in addition to those that were pregnant, were accepted. The decision to feed all animals was based on the need to ensure survival of the herd, due to lack of grazing because of poor rains. The projects then monitored one or two pregnant cows per farm for 1.5 to 2 months, during which the cows were fed 4kg silage a day. This was considered to be a supplement on account of its good quality. Body weights, and condition scores were taken every 14 days.

Preliminary Results

Fed animals maintained body condition, with some gaining weight. Conception, re-conception and milk yields of the fed animals were monitored during the 1998/1999 season. The number of bags of silage available determined the length of the feeding period. The availability of silage in a drought year encouraged farmers to increase the area of land, management and yields of these forage crops during the 1999-2000 season.

Information Dissemination: 1998/99 Season

Towards the end of silage feeding during the first year, the projects organised a 'Farmer to Station' visit where the Gulathi farmers viewed the on-station feeding and discussed in detail their views, feelings, comparisons of the 4 feeding treatments.

The on-farm work at Gulathi during the 1998-99 season was very useful as a first year when farmers tested the intercropping agronomy and silage technology. Consultative meetings discussed the impact of the project activities from 1997-98 to 1998-99 seasons, which have led to wider awareness within the community and beyond.

Many enquiries on how to either join, get involved with, or start a similar project in the East, South and South-west of Gulathi have been received and those making enquiries seem to be conversant with what is taking place at Gulathi. These activities have raised awareness and changed the general perceptions towards dairy production by other stakeholders in Matabeleland (Mhere, in press).

The National Dairy Development Programme (DDP) together with an NGO (AFRICA NOW) has taken up the project for further funding and development. This will allow construction of a milk collection centre (MCC), employment of a resident project officer and purchase of improved animals and other activities.

Linkages among the main collaborators (Matopos Research Station, Agritex, Veterinary Department, University of Zimbabwe and the Department of Environmental Health) have been strengthened considerably.

Information Dissemination: 1999/2000 Season

Farmer training and Information Dissemination workshop 15.04.2000

A farmer led workshop was held to extend findings, share experiences, and build interaction and communication techniques of information exchange from farmer-to-farmer. Five groups were represented and a total of 75 participants attended.

a Farmer to farmer visits

Gulathi farmers hosted farmer groups from Wenlock (Gwanda), Irisvale, Esigodini, and Natisa.

b Farmer to station

A field day jointly organised by the project and the National association of Dairy farmers was attended by 26 producers on 28 April 2000.

c New initiatives

Four new projects were initiated within the Matobo district influenced by the project at Gulathi. These are Gulathi (Lukadzi x2), Vulindlela Ward (Lushumbi), Dema Ward (Natisa). In addition 3 wards in the Gwanda district are mobilising to initiate similar ventures.

d Strengthening of Linkages

Among the original collaborators: Agritex, Veterinary Department, Department of Health, and the District Council and DDP continue to be involved. New linkages have been established with three NGOs: Masiye training camp in Silozwi; ENDA Zimbabwe in the Dema and Vulindlela Wards; and Ethandweni children's' home in the Whitewaters / Natisa area.

Discussion

The differences in productivity among the treatments in the first year (19998/99) were largely, due to very low rainfall and delayed planting. These differences were not just confined to the experimental plots but were evident in the other 30 farms, resulting in double the yield in the wet, compared to the dry area, demonstrating the overriding effect of soil moisture on plant growth. In the second season differences in productivity among the six farms were attributed to individual farmer management, soil and factors other than rainfall.

The content of legumes in the intercrop biomass was similar to that recorded at Matopos on sandy soils, similar to those of Gulathi (Mhere *et al*, in press). The results showed that it was possible to intercrop cereals and legumes for silage within the smallholder sector. Ensiling mixtures where the legume content is about 30% of the biomass resulted in good silage quality in on-station trials (Titterton *et al*, 2000).

Effects of lime application were not evident during the first year due to very low rainfall and delayed planting. Although it is not a widespread practice in smallholder systems of Zimbabwe, lime application does create favourable growing environments for most crops by neutralising the hydrogen ions, that when in high concentrations, cause soil acidity. The second season showed some improvements in forage yields due to liming.

Although results of the feeding carried out in the first season were preliminary, the maintenance of body condition and weight are indications that animals can be sustained during harsh dry seasons. Post calving performance would be expected to be much better than that of unsupplemented cows.

The overwhelming response by different communities to the farmer-centred strategies used here clearly showed the relevance of the subject dealt with. It also showed the compatibility of the technology with the individual farmer problems, with local ecological, socio-cultural and economic conditions of these communities who view milk production as a vehicle for change. Dissemination activities attempted in this project showed the importance of farmer involvement in the whole process. It also showed that open communication and strong multidisciplinary teams are essential for appropriate technology development and testing.

Table 1: Soil characteristics of the two areas prior to planting in the 1998/99 season

Area	Soil colour	pH[1]	Mineral Nitrogen[2]	P_2O_5[3]	Exchangeable Cations			
					K_2O	Ca	Mg	Total
1. Dry	Pale brown	4.2	18	14	0.05	0.50	0.24	0.79
2. Wet	Light brown	4.5	25	47	0.08	0.63	0.30	1.01

[1] pH determined in 0.01M Calcium Chloride

[2] Mineral Nitrogen after incubation (Ammonium + Nitrate)

[3] Available P_2O_5 by resin extract

Table 2. Dry matter yields (tons) of sorghum (SG) and hybrid pennisetum (HP) intercropped with cowpeas (CP) and dolichos beans (DB) under on-farm conditions during the 1998/99 and 1999/2000 seasons

	Wet area							Dry area						
	Lime applied			No lime applied				Lime applied			No lime applied			
Farmer	**1**	**2**	**3**	**1**	**2**	**3**		**4**	**5**	**6**	**4**	**5**	**6**	
1998/1999 season														
HP + CP	17.9	8.7	5.8	21.9	8.6	10.6		9.1	2.8	2.8		7.3	5.3	2.5
HP+DB	17.5	6.4	11.0	17.6	6.6	12.5		9.1	4.2	1.7		4.7	4.7	2.7
SG+CP	18.5	15.1	9.8	25.0	5.2	10.6		5.4	5.0	2.3		4.8	4.0	2.4
SG+DB	11.9	10.4	10.1	15.0	5.3	10.9		4.1	4.2	2.3		3.9	3.2	3.0
Mean		16.4	10.1	9.1	19.9	6.4	11.1		6.9	4.1	2.7		5.2	4.3	2.7
1999/2000 season														
HP + CP	31.5	19.0	22.4	29.3	16.4	14.8		20.7	27.6	7.9		26.9	14.8	6.7
HP+DB	21.0	16.9	27.7	34.0	17.3	15.9		17.3	21.5	10.5		34.9	21.7	7.1
SG+CP	26.7	14.5	11.1	15.6	10.0	10.1		14.2	22.9	5.5		10.1	23.3	6.3
SG+DB	13.5	25.6	9.2	16.0	14.0	6.9		11.4	19.7	6.6		9.3	19.9	5.5
Mean		**23.2**	**19.0**	**17.6**	**23.7**	**14.4**	**11.9**		**15.9**	**18.3**	**7.6**		**20.3**	**19.9**	**6.4**

Table 3: Rainfall (mm) recorded in the Dry and Wet areas of Gulathi during the growing season of 1999/99 and 1999/2000 seasons.

Month	Wet area 1998/99	Dry area 1998/1999	Wet area 1999/2000	Dry area 1999/2000
October	16	0	15	6
November	44	36	184	110
December	115	50	139	269
January	84	56	227	197
February	62	46	465	413
March	40	43	76	86
Total	**361**	**231**	**1056**	**1081**

References

TITTERTON, M., MAASDORP, B.V., MHERE, O. and NYONI, L. (2000). Forage production and conservation for dry season feeding of dairy cows in the semi-arid regions of Zimbabwe. In: *Proceedings of the Second Workshop on Livestock Production Programme projects in Zimbabwe, Ingwe Lodge, Matobo, Zimbabwe* 22-23 *February* 1999. Smith, T., Mhunduru, J. and Richards J.I. (eds) NRIL, Pembroke, Chatham Maritime, Kent, ME4 4NN, UK. pp 23-34.

MHERE, O., MAASDORP, B.V., and TITTERTON, M. (in press). Smallholder forage production for supplementation of poor quality grazing 2: Forage sorghum and hybrid Pennisetum biomass production and silage quality. In: *Proceedings of the Grassland Society of Southern Africa and Grassland Society of Zimbabwe, Congress* 35, 31 *January* – 3 *February* 2000. Hurt, C.R (ed) Triangle, Zimbabwe.

MHERE, O. (in press). The Potential of Smallholder Dairying in Matabeleland. In: *Proceedings of the Smallholder Dry Areas Resource Management Project* (SDARMP), *Second Research – Extension Linkage Workshop*, 3-5 *August* 1999, *Bulawayo, Zimbabwe*