LABLAB (LABLAB PURPUREUS) IN BY-PRODUCTS BASED DIETS FOR LACTATING COWS IN BOTSWANA

B. KIFLEWAHID AND B. MOSIMANYANA
ANIMAL PRODUCTION RESEARCH UNIT
P. BAG 0033, GABORONE, BOTSWANA

ABSTRACT

Dairy cattle feeding was based on crop stovers supplemented with Lablab (Lablab purpureus) and post - harvest residues. Lablab was introduced to thirty small scale dairy farmers. Average Lablab dry matter yield by thirty farmers (Ton/Ha) for 0 and 100 kg/Ha single superphosphate (10.5%P) fertilizer rate were 1.23 and 1.44, respectively, but not different ($P<.05$). Average dry matter yield (Ton/Ha) at 0, 100 and 250 kg/Ha rate, on-station, were 1.41, 1.56 and 1.70, respectively, but not different ($P<.05$). Phosphorus fertilization did not show significant ($P<.05$) effect in dry matter yield due to low seasonal rainfall and distribution patterns in the project areas (262 to 414 mm rainfall). Total quantities of Lablab hay, sorghum/millet stover and sorghum chaff/husks harvested by thirty farmers was 34.1, 56.4 and 7.2 Tons dry matter, respectively.

Sorghum and millet stover dry matter yield (Ton/Ha), on-farm, range from 0.66 to 1.74 and 0.78 to 1.00, respectively. On-station dry matter yield (Ton/Ha) ranged from 1.87 to 3.46 for different sorghum stover varieties. Dry matter yield (Ton/Ha) for millet, maize and Cowpea stovers were 2.42, 3.04, and 1.19, respectively.

The dry matter and nutrient contribution of leaves, stems and twines and roots to whole Lablab, Tswana Cowpea and ER-7 Cowpea were assessed. Dry matter contribution by leaves to whole Tswana Cowpeas (57.8%) were higher than Lablab (47.0%) and ER-7 Cowpeas (48.0%). Overall the total dry matter and nutrient contribution of leaves to whole plants was higher than stems and twines in all three crops.

Average daily milk yield / cow / day (excluding milk left for calf) for Simmental - Tswana crossbred and Tswana cows fed sorghum stover based diets supplemented with either 15% Lablab (diet A) or 25% sorghum bran (diet B) were 2.2 and 3.4; 1.4 and 1.6 kg/day, respectively. The results showed significant differences ($P<.05$) between breeds but not within breeds fed the different diets. Average lactation length (days) and milk yield / cow / lactation (kg) for Simmental - Tswana and Tswana cows were: 273 and 223; 760 and 338, respectively. Average birth weight for Simmental - Tswana calves (34 kg) were greater than for Tswana calves (28 kg).

INTRODUCTION

The major objective of the Small Scale Dairy Production Project was to increase milk and milk products for both subsistance and commercial use, in the traditional communal farms of the Gaborone region. The project covers six localities involving thirty farmers who participate fully in dairy production research.

In order to achieve optimal production objectives, a technical and management package incorporating the approaches and strategies related to baseline survey, animal feeding, management inputs, breeding

and health, fodder production and utilization, milk marketing and extension linkages were developed (APRU 1985, DPR 1985-86).

The major constraint identified was lack of adequate feed (quantity and quality) to sustain milk production particularly during the dry season. The research emphasis has been to integrate fodder crops into the farming system and establish a practical feeding programme based on planted fodder and crop residues.

This paper focuses on the nutritional characteristics and use of Lablab (Lablab purpureus) in crop by-products based diets for lactating Simmental-Tswana crossbred and Tswana cows in small scale dairy farms in Botswana.

METHODOLOGY

Feed Production and Conservation

The project introduced Lablab to thirty participating farmers. Each farmer was provided with 20 kg of Lablab seed and 100kg of single superphosphate fertilizer (10.5% P) to plant one hectare of land. The fertilizer was applied to half of each hectare allocated for planting Lablab. The seed was planted either in rows using planters or by the traditional method of broadcasting.

Three Ha of Lablab was also planted at Sebele Agricultural Research Station. Superphosphate was applied at the rate of 0 , 100, 250 kg/Ha on each of the three 1 Ha plots. Half of each plot was row planted while traditional broadcusting was used on the other half. An additional 27 Ha of land were planted for bulk production and to examine the optimal stage of harvest and appropriate methods for harvesting, drying and storage.

Lablab and crop stover yields were measured using 2 metres radius circular sub-plots from three random locations in each farmers' plots and at Sebele Station. After measuring yield the plants were harvested, sun dried and stored for dry season feeding. After the harvesting period the total quantities of Lablab, crop stovers and post-harvest residues stored by each farmers were estimated. Dry matter yields were also measured for several sorghum varieties millet and maize screened on-station.

Nutritive Value

Three replicate samples of fresh whole plants, leaves, stems and roots were obtained from Lablab, Tswana and ER-7 cowpea plots to determine the dry matter and nutrient contribution of each plant part. Three replicate samples of sorghum stover, millet stover, sorghum chaff, sorghum husks and sorghum bran were also submitted for laboratory analysis.

The fresh whole plants and plant parts were air-dried (60oC) prior to grinding in a Wiley Mill (1 mm screen). The dried and ground samples were saved in air-tight bottles and analysed (in duplicate) for organic matter, crude protein, crude fibre, ash, Ca and P according to methods approved by AOAC (1975) and in vitro dry and organic matter digestibility according to Tilley and Terry (1963) procedures.

Feeding Trial

Dry season feeding trial was carried out to determine the voluntary feed intake (VFI) and performance of Simmental-Crossbred and Tswana lactating cows fed sorghum stover supplemented with either 15% Lablab (diet A) 25% sorghum bran (moroko) (diet B) and 100% sorghum stover (diet C).

Treatments A, B and C contained 7.40%, 7.01% and 5.56% crude protein; 55.56%, 63.73% and 53.90% , estimated TDN, respectively. In treatment A Lablab was mixed with the stover by hand at the time of feeding; in treatment B the Sorghum bran was fed separately in split used-oil drums. The animals were also supplemented with ad lib bonemeal-salt (1:1 ration) and vitamins A, D, E. The treatments A and B were randomly allocated to six each of twelve farmers. Voluntary Feed Intake (VFI) was determined in all treatment groups by measuring the daily weight of all feed offered and weighed-back over a period of seven days and for a maximum of four lactating cows per farm. Statistical analysis using the t-test (Snedecor and Cochran 1967) was conducted on the performance data obtained from the lactating cows that completed the trial.

Dairy Cattle Performance

Daily milk yields were recorded by each farmer on record forms provided by the project. Each farmer was provided with two calibrated 10 litre plastic milk buckets for recording milk yield. Milk records were collected and summarized by project staff at the end of each month. All lactating, in-calf and non-pregnant cows were weighed, prior to watering in the morning, during the first week (between days 1 to 5) of each month.

Calf Performance

The identity of the calf and its breed, sex, dam number, initial birth weight and birth date were recorded. Initial birth weights were measured using a heavy duty spring balance. Subsequent monthly weights were measured using an electronic mobile cattle scale with the rest of the herd.

RESULTS AND DISCUSSION

Feed Production and Conservation

The average dry matter yield (ton/ha) of Lablab hay by farmers and at the Sebele Research Station is shown in Table 1. Average dry matter yield for 0 and 100 kg/ha single superphosphate fertilizar application were not significantly different ($P < .05$) at 1.23 (range 1.00 - 1.60) and 1.44 (range 1.09-1.94) Ton/ha, respectively. The dry matter yield at Sebele Station for 0, 100 and 250 kg/ha single superphosphate application were 1.41, 1.56 and 1.70, Ton/ha respectively, but also were not significantly different ($P < .05$). The results also showed no significant diffeerences ($P < .05$) in dry matter yield between farmers' fields and Sebele Station. Phosphorus fertilizer application resulted in no change in plant constituents.

Table 1. Dry Matter Yield (Ton/Ha) of Lablab Hay (Lablab Purpureus) From Project Farms (1) and Sebele Research Station as Influenced by Fertilizer Application Rate (2)

Location and Number of Farmers	Fertilizer Application Rate (kg/ha)		
	0	100	250
Oodi (4)	1.32	1.37	-
Bokaa (8)	1.00	1.09	-
Kopong (2)	1.60	1.94	-
Mmopane (4)	1.08	1.20	-
Gabane (4)	1.12	1.64	-
Kumakwane (8)	1.24	1.42	-
Mean	1.23a	1.44a	
Sebele Mean	1.41a	1.56a	1.70a

(1) Data from three replicate yield measurements from each of 30 project farmers plots.

(2) Single superphosphate fertilizer (10.5%P)

Means in same row and column with same superscript (a) are not significantly different ($P<.05$)

Random soil samples taken for soil nutrient analysis from farmers' field and Sebele Station were generally acidic in all locations, with pH 4.50 - 4.90 at Sebele Station. There was a wide variation in soil phosphorous content for farmers' field (3.40 - 13.85ppm) and at Sebele Station (4.91 - 15.82 ppm). Several findings have shown that phosphorous fertilization increases dry matter yield, crude protein content by stimulating nodulation, and dry matter digestibility of fodder legumes (Hague et at 1986). The result from this fertilizer trial could not be conclusive due to the low seasonal rainfall experienced in the project area (262 to 414mm range) . The low yields and lack of response to superphosphate application could largely be attributed to this. Dry matter yields of Lablab did not appear to relate closely to variations in rainfall patterns in the project area. For example at Oodi (414mm, 1.32 ton/ha DM) yields were lower than Kopong (262mm, 1.60 ton/ha DM). These observations may also be attributed to planting time, rainfall distribution and differences in soil characteristics.

The average dry matter yield (ton/ha) of crop stovers on project farms and at Sebele Station is shown in Table 2. The yields of sorghum and millet stovers by farmers varied from 0.61to 1.74 and 0.78 to 1.00 tons/ha of dry matter, respectively. Dispite similar rainfall patterns sorghum and millet stover yields from the Sebele Station crop screening trial plots were higher than those from the farmers fields.

Maize stover yields of 3.04 ton/ha were achieved on-station but farmers maize generally failed. The higher on-station yields are largely attributed to the effects of time of planting and use of fertilizer. Farmers harvested sorghum and millet stovers only..

Although farmers intercropped cowpeas with either sorghum or millets the yields were not measured. However, the dry matter yield (ton/ha) for pure stands of Tswana cowpeas and ER.7 cowpeas at Sebele station was 1.19 and 1.32 ton/ha respectively.

Table 2 Dry matterYield (tons/ha) of Crop Stovers Harvested by Project Farmers (1) and Sebele Research Station(2)

Location and number of farmers		Type of Feed				
		Sorghum Stover	Millet Stover	Maize Stover	Cowpea (Tswana)	Cowpea (FR7)
Oodi	(3)	1.45	1.00	-	-	-
Bokaa	(3)	0.61	0.82	-	-	-
Mmopane	(2)	0.66	0.78	-	-	-
Gabane	(1)	1.35	-	-	-	-
Kumakwane	(2)	1.74	-	1.22	-	-
		3.44(a)	2.42(e)	3.04(f)	1.19	1.32
Sebele		1.87(b)	-	-	-	-
Station		3.46(c)	-	-	-	-
		3.46(d)	-	-	-	-

(1) Data from three replicate yield measurements from each farmer's plot
(2) Sorghum, millet, maize and Cowpea stover yields from Sebele Agronomy and Botswana Agricultural College screening trials.

(a) Segaolane
(b) Town
(c) 65 D
(d) Marupantsi
(e) Serere 6A
(f) Kalahari Early Pearl (KEP).

At the end of the harvest season all farmers stored Lablab hay, crop stovers and sorghum chaff/husks for dry season feeding. As shown in Table 3, there was a wide range in total quantities of feed conserved. Whereas all farmers harvested Lablab from their 1ha plots, harvesting of crop stovers primarily depended on the family labour available and the size of their planted field. Average quantities of Lablab hay, sorghum/millet stover and and sorghum chaff or husks harvested by farmers ranged from 1.04 to 1.65, 0.65 to 3.42 and 0.14 to 0.33 ton dry matter respectively.

The total quantities of Lablab hay, sorghum/millet stover and sorghum chaff/ husks harvested by all the thirty participating farmers was 34.09 56.44 and 7.17 tons dry matter, respectively. In addition a few farmers harvested small quantities of cowpea stover.

Table 3 Quantities of Crop Residues and Lablab Hay (tons DM) Conserved by Project Farmers (1985-86

Locattion and number of farmers	Lablab Hay	Sorghum/Millet Stover	Sorghum Chaff/ Husks (Moko)
Oodi (4)	5.39	13.68	0.96
mean	1.35	3.42	0.24
Bokaa (8)	8.30	19.42	1.59
mean	1.04	2.43	0.20
Kopong (2)	3.29	4.23	0.29
mean	1.65	2.12	0.14
Mmopane (4)	4.55	2.60	0.99
mean	1.14	0.65	0.25
Gabane (4)	4.24	6.56	0.72
mean	1.06	1.64	0.18
Kumakwane (8)	8.32	9.92	2.62
mean	1.04	1.24	0.33
Total (30)	34.09	56.41	7.17
Overall Mean	1.14	1.88	0.24

The major constraint observed during harvesting and conservation of Lablab was the duration of time required to dry the stems. Lablab leaves dry and shatter within three days while it takes upto 6 weeks for the stems to dry completely. In view of this various methods of drying and storage using tripods, stoo king on the ground and combining three rows into one row were tried at Sebele Station. Methods of drying had no effect on duration of drying time but the crop was baled more efficiently from stooks and tripods with minimum dry matter loss due to leaf shattering, mouldiness or termite damage.

Nutritive Value

Lablab and crop stover samples were submitted for laboratory nutritive value analysis (Table 4). There was a wide variation in dry matter percent within the sorghum and millet stovers harvested by different farmer. The variation in dry matter percent was attributed to the stage of maturity of the crops when harvested. Conversely there was much less variation in dry matter percent of Lablab harvested at the flowering stage.

The average nutrient compositions and in vitro dry and organic matter digestibility of Lablab, crop stovers and post-harvest residues are shown in Table 5. The mean crude protein and crude fibre percentage of Lablab, cowpea stover, sorghum stover and millet stover were: 16.44 and 27.67; 15.67 and 21.08; 6.37 and 32.52; 5.75 and 35.94; respectively. On average the Lablab and cowpea stover contained 2.5 times more crude protein than the sorghum and millet stovers. As shown in Table 5 the dry matter and organic matter digestibilities of Lablab and cowpea stover were higher than those of sorghum and millet stover. The higher digestibility coefficients are attributed to the higher crude protein and lower crude fibre content in Lablab and cowpea stover than in the sorghum and millet stovers.

In view of these nutritional findings, diets for lactating and in calf dairy cows in the project areas were based on combinations of home grown Lablab, cowpea, sorghum and millet stovers and post-harvest residues such as sorghum bran (moko) and sorghum husks/chaff.

Table 4 Dry Matter Percent of Crop Stovers and Lablab Conserved by Project Farmers (1985-86

Location	Sorghum Stover	Millet Stover	Maize Stover	Cowpea Stover	Dolichos Lablab
Oodi	40.39	39.10	-	-	21.55
Bokaa	32.40	33.30	-	-	22.30
Kopong	-	-	-	-	24.72
Mmopane	35.66	30.03	-	-	24.90
Gabane	35.30	-	-	24.75	27.50
Kumakwane	40.54	-	53.79	20.35	23.91

Table 5 Nutrient Composition and In Vitro Dry Matter and Organic Matter Digestibility of Crop Stovers and Fodder Legumes Conserved by Project Farmers (1985-86)

Feed	% Composition of Dry Matter						DMD	DOM
	Organic Matter	Crude Protein	Crude Fibre	Ash	Ca	P		
Lablab	90.77	16.44	27.67	9.23	0.32	0.17	59.92	57.07
Cowpea stover	89.12	15.67	21.08	10.88	0.20	0.23	74.06	70.08
Sorghum stover	91.55	6.37	32.52	8.45	0.40	0.14	54.85	49.83
Millet stover	89.46	5.75	35.94	10.54	0.44	0.08	52.23	45.10
Sorghum chaff	93.61	5.46	36.56	6.39	0.48	0.12	55.47	49.67
Sorghum husks	89.96	7.20	26.82	10.04	0.33	0.20	54.41	47.18
Sorghum bran	97.32	11.48	3.15	2.68	0.38	0.31	56.90	48.30

(1) Mean data from three replicate samples per farmer's field.

The fresh and dry matter contribution of leaves, stems twines and roots to whole Lablab, Tswana cowpea and ER-7 cowpea plants is shown in Table 6. The percentage dry matter contribution to whole plants by leaves of Tswana cowpeas (57.8%) were higher than Lablab (47.0%) and ER-7 cowpeas (48.5%). Stems and twines for Lablab (46.6%) and Er.7 cowpeas (40.5%) were higher than Tswana cowpeas (31.1%). Overall on both fresh and dry matter basis the contribution of leaves to whole plant was higher than stems and twines in all three crops. Roots constituted a very small portion of the total dry matter in the plants studied.

Table 6 Fresh and Dry Matter Percent Contribution By Plant Parts to Whole Lablab and Cowpea Residue (1)

	Dolichos Lablab		Cowpea (tswana		Cowpea (ER-7)	
Plant Parts	Fresh	Dry	Fresh	Dry	Fresh	Dry
Leaves	53.3	47.0	62.9	57.8	57.4	48.0
Stems and Twines	42.8	46.6	30.0	31.1	35.0	40.5
Roots	3.9	6.4	7.1	11.1	7.6	11.5
Whole Plant	100.0	100.0	100.0	100.0	100.0	100.0

(1) Mean data from three replicate samples of whole plants divided into plant parts.

The nutrient composition of fresh Lablab, Tswana cowpeas and ER-7 cowpeas is shown in Table 7. There was a marked difference in crude protein and crude fibre percentages between leaves, stems and twines and roots in all plants. The crude protein and crude fibre percentage of fresh leaves of Lablab, Tswana cowpeas and ER-7 cowpea were: 19.37 and 19.32; 21.24 and 13.13; 22.86 and 11.52; respectively. The average crude protein content of leaves was not greatly different. Stems and twines were generally lower in crude protein and higher in crude fibre than the leaves. However, as shown in Table 7, there was less difference in the crude protein content of leaves and stems/twines in the cowpea plants than in the Lablab plants.

Summaries of the mean dry and organic matter in vitro digestibility coefficients of fresh Lablab, Tswana cowpea, ER-7 cowpea whole plant and plant parts are given in Table 8. Digestibilities of the dry matter and organic matter in Lablab leaves were higher (67.85, 62.22) than in stems and twines (56.97, 50.78), but in the cowpeas the digestibilities of the stems and twines were higher than in the leaves. Between the plants the digestibilities of dry matter and organic matter were higher in Tswana and ER-7 cowpeas (73.57% and 73.85%) than in Lablab (67.85%).

Table 7 Nutrient Composition of Lablab and Cowpea Residue Whole Plant and Parts(1)

	Dry Matter (%)	Composition of Dry Matter (%)					
		Organic Matter	Crude Protein	Crude Fibre	Ash	Ca	P
Lablab							
Leaves	21.62	87.78	19.37	19.32	12.22	0.68	0.14
Stems and Twines	26.71	92.71	11.50	37.08	7.29	1.11	0.10
Roots	41.04	93.94	6.03	45.37	6.06	0.98	0.06
Whole	25.28	91.48	16.55	30.30	8.52	0.56	0.16
Cowpea (Tswana)							
Leaves	16.91	84.94	21.24	13.13	15.06	0.52	0.27
Stems and Twines	19.08	90.30	20.95	18.50	9.70	0.29	0.30
Roots	28.75	92.96	12.66	18.54	7.04	0.18	0.24
Whole	21.20	85.41	21.46	16.83	14.59	0.26	0.16
Cowpea (ER7)							
Leaves	19.14	85.03	22.86	11.52	14.97	0.50	0.26
Stems and Twines	26.50	92.49	19.38	21.30	7.51	0.25	0.31
Roots	34.72	94.66	11.12	23.46	5.34	0.18	0.24
Whole	25.44	88.49	19.23	18.31	11.51	0.36	0.26

(1) Data from three replicate samples of whole plants from Sebele Research Station.

Table 8 In Vitro Dry Matter and Organic Matter Digestibility (DMD and DOM) of Lablab and Cowpea Residue Whole Plant and Parts(1)

	DMD (%)	DOM (%)
Lablab		
Leaves	67.85	62.22
Stems and Twines	56.97	50.78
Roots	46.93	43.79
Whole	60.77	55.09
Cowpea (Tswana)		
Leaves	73.57	71.48
Stems and Twines	84.23	82.70
Roots	74.30	73.34
Whole	72.29	71.72
Cowpea (ER7)		
Leaves	73.85	73.14
Stems and Twines	77.54	77.04
Roots	76.68	76.21
Whole	71.42	69.80

(1) Means represent data from three replicate samples.

Feeding Trial (Dry Season)

The average chemical composition and voluntary feed intake by farmers' lactating cows fed diets of 85% sorghum stover + 15% Lablab (treatment A), 75% sorghum stover + 25% sorghum bran (treatment B) and 100% sorghum stover (treatment C) were presented previously (DPR 1986).

Chemical analysis of the Lablab and sorghum bran supplemented diets indicated that the crude protein percentages were 7.40 and 7.01, respectively and higher than the sorghum stover only diet which contained 5.56% crude protein. The crude protein content of sorghum stover was lower than the minimum 7.0% required for maintenance. In treatment A and B the crude protein contribution to the diet by Lablab and sorghum bran was 37.7% and 39.4%, respectively. In terms of the crude protein contribution to the sorghum stover based diet 15% Lablab was equivalent to 25% Sorghum bran.

Mean daily dry matter intake (DMI) during the trial period for the three treatments was lower for the Lablab diet (8.27 kg DM/day) than for the Sorghum bran (10.21 kg DM/day) and the sorghum stover only (8.96 kg DM/day) diets.

Dairy Cattle Performance

The Lactation data of the Simmental-Tswana crossbred and Tswana cows fed diets of sorghum stover supplemented with 15% Lablab or 25% sorghum bran, are summarized in Table 9. Complete Lactation data of the cows fed the sorghum stover only diet could not be obtained since farmers started to supplement their cows with either Lablab or sorghum bran prior to the end of the lactation period.

The average Lactation length of Simmental-Tswana crossbred and Tswana cows fed the 15% Lablab and 25% sorghum bran diets were 270 and 240; 276 and 206 days; respectively. Lactations for Simmental-Tswana cows were longer ($P<0.5$) than for Tswana cows. There were no significant differences ($P<.05$) in lactation length within breeds fed different diets.

Average daily milk yield/cow/day for Simmental-Tswana crossbred and Tswana cows fed the 15% Lablab and 25% sorghum bran diets were 2.2 and 3.4; 1.4 and 1.6; kg/day respectively. Within breeds the milk yields were higher for cows fed the sorghum bran but not significantly ($P<0.05$). There were wide variations in daily milk yield within breeds and between treatments. These observations could be attributed to the variation in genetic potential of the individual Simmental-Tswana crossbreds and Tswana cows owned by the different farmers (APRU 1986, DPR 86-87)

Table 9 Milk Yields(1) of Simmental - Tswana (SX) (2) and Tswana (TS) Cows Fed Sorghum Stover Supplemented With Lablab or Sorghum Bran(3) (1985-86)

	15% Dolichos Lablab + 85% Sorghum Stover		25% Sorghum Bran + 75% Sorghum Stover	
	SX	TS	SX	TS
Number of lactating cows	5	12	5	12
Average lactation length (days)	270a	240b	270a	206b
Total milk yield/herd (kg)	2941.3	4080.6	4655.0	4040.1
Average lactation yield/cow (kg)	588.3a	340.0b	931.0a	336.66b
Average milk yield/cow/day (kg)	2.2a	1.4b	3.4a	1.66b

(1) Excluding milk left over for calf
(2) Milk recording period 1st lactation (Nov. 85 - Sept. 86)
(3) Plus ad lib bonemeal - salt (1:1 ratio) and vitamin A,D,E.

Means in the same row with different superscripts (a,b) were significantly different ($P<.05$).

The average milk yield/cow/lactation for Simmental-Tswana cows fed the 15% Lablab and 25% sorghum bran diets were 583.3 kg and 931.0 kg, respectively. These values were not significantly different ($P<.05$) due to the large variation in milk yield within the Simmental-crossbreds. The milk yields of the Tswana cows for the two treatment (340.0kg, 15% Lablab diet and 336.7kg for 25% sorghum diet) were also not significantly different ($P<.05$).

At the end of the lactation period total milk produced by ten Simmental-Tswana and twenty four Tswana cows was 15,717.4kg of which 7596.7kg was from the ten crossbred cows and 8,120.7kg from the twenty-four Tswana cows. On average under similar feeding and management systems each Simmental-Tswana crossbred cow produced 2.25 times more milk than Tswana cows. These observations are comparable to data obtained from similar trials on-station (APRU 1986, DPR 86-87).

Average seasonal liveweight change patterns for both Simmental-Tswana crossbred and Tswana cows were similar. Despite dry season weight loss average initial liveweights for Simmental-Tswana (422 kg) and Tswana cows (379 kg) were not greatly different than weights for the same Simmental-Tswana (417 kg) and Tswana cows (365 kg) recorded after twelve months.

Calf Performance

The average liveweight changes of all calves are summarized in Table 10. Birthweights of Simmental-Tswana calves (34 kg) were higher than Tswana calves (28 kg). Growth patterns of both breeds were similar. In terms of management all calves had access to their dams until the end of the lactation period and weaning coincided with the end of the lactation. On-station trial results have indicated that suckling prior to milking not only stimulates milk let down but also prevents premature drying off. Average liveweight at 12 months of age for Simmental-Tswana and Tswana calves were 147 kg and 124 kg, respectively. Unlike dry season weight losses experienced by adult cows the calves gained weight throughout the year.

Table 10 Monthly Liveweights of Simmental-Tswana (SX) and Tswana (TS) Calves (1985-86)

Breed	No.	Birth Weight	Liveweight for Age in Months											
			1	2	3	4	5	6	7	8	9	10	11	12
SX	7	34	43	55	75	86	97	105	111	119	129	133	141	147
TS	25	28	35	43	49	60	72	82	92	102	110	115	119	124

CONCLUSION

The feeding system for in-calf and lactating Simmental-Tswana crossbred and Tswana cows is based on local feed resources. The dry season feeding strategy using high protein farmer grown Lablab hay (Lablab purpureus) in association with crop by-products and residues has been a significant intervention in small scale dairy farms in Botswana. Despite low seasonal rainfall thirty dairy farmers participating in the project harvested and stored 34.1, 56.4 and 7.2 Tons Dry matter of Lablab hay, sorghum / millet stover and sorghum chaff / husks, respectively.

The study demonstrated that there was no significant effect ($P<.05$) of single superphosphate (10.5%) application on dry matter yield of Lablab in both farmers and on-station trials. However, wide variations in Lablab and crop stover yields (Ton/Ha) were observed within and between farmers and project localities.

Chemical analysis results showed that on average Lablab hay and cowpea stover contained 2.5 times more crude protein than sorghum and millet stovers. When Lablab and cowpea whole plants were partitioned into leaves, stems and twines and roots; the dry matter and nutrient contribution of leaves was higher than stems and twines.

A comparative feeding trial (on-farm) based on sorghum stover supplemented with either Lablab or sorghum bran showed that under farmers management conditions Simmental-Tswana crossbred cows produced 2.25 more milk per lactation than Tswana cows.

REFERENCES

A.O.A.C. 1975, Official Methods of Analysis (12th Ed.). Association of Agricultural Chemists, Washington, D.C.

A.P.R.U.. 1985. Animal Production Research Unit. Livestock and Range Research in Botswana, **Annual Report 1984-85.** Government Printer, Gaborone, Botswana.

A.P.R.U. 1986. Animal Production Research Unit. Livestock and Range Research in Botswana, **Annual Report 1985-86.** Government Printer, Gaborone, Botswana.

D.P.R. 1986. Dairy Project Annual Report, 1985-86. Animal Production Research Unit, Gaborone, Botswana.

D.P.R. 1987. Dairy Project Annual Report, 1986-87. Animal Production Research Unit, Gaborone, Botswana.

Hague , I., Nnadi, L.A. and Mohamed - Saleem M.A. 1986. Phosphorous management with special reference to forage legumes on Sub-Saharan Africa. In Hague, I., et al ed., Potentials of forage legumes in farming systems of Sub-Saharan Africa. Proceedings of a workshop held at ILCA, Addis Ababa, Ethiopia, 16-19 September, 1985, 100-119.

Snedecor, G.W. and Cochran W.G. 1967 Statistical methods. (6th Ed.) . Lowa State University Press, Ames.

Tilley, S.M.A and Terry, R.A. 1963. A two stage technique for the in vitro digestion of forage crops. I. Brit. Grassl. Soc., 18:104.