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Influence of irrigation intervals on dry matter yield, concentration of crude protein, calcium and phosphorus in *Lablab purpureus* and *Sorghum almum* fodder in the sudan savanna zone of Nigeria

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Abstract

Irrigation trials were conducted in the late dry season (March to June) with Lablab (Lablab pupureus) and Colombus grass (Sorghum almum) in the Sudan savanna of Nigeria. The objective of this study was to determine the dry matter yield (tDM/ha), crude protein (CP), calcium (Ca) and phosphorus(P) in dual-purpose lablab bean and Sorghum almum at 3 irrigation schedules (5, 7 and 10 days irrigation interval). The results obtained showed dry matter yield in lablab increased ($P<0.05$) and varied from 1.7 to 11.7 tDM/ha. Calcium and P concentrations differed significantly ($P<0.05$). Mean CP for lablab was 15.57%. Dry matter yield obtained for Sorghum almum varied ($P<0.05$) from 11.07 to 19.6 tDM/ha. Concentration of CP and Ca rose and declined thereafter with a mean concentration of 9.86% for CP and 0.08% for Ca while P declined consistently ($P<0.05$). Intervals of irrigation days had a relationship ($P<0.05$) with tDM/ha, Ca and P in lablab. The increasing trend in forage yield with increased irrigation interval showed optimum irrigation interval was not attained. It is therefore recommended that longer irrigation intervals be tried to determine the optimum irrigation interval after which forage yield would be depressed due to moisture stress. From the results of the present study Sorghum almum and lablab would be grown successfully at 10-day irrigation interval.

Key words: *Lablab purpureus; Sorghum almum*; yield; calcium; phosphorus; irrigation intervals.

Introduction

The Savanna zone of West Africa is a suitable environment for industrious livestock production but the low yields of the indigenous fodder species from native rangelands and seasonal bush fires make year round fodder availability one of the factors limiting livestock production. The situation is more brutal during the late dry season and early part of the rainy season. In the Sudan savanna zone livestock production and irrigation agriculture are the predominant agricultural activities. There exist therefore large irrigation schemes in these traditional livestock production zones and most of the peasant farm-

ers inhabiting these areas are acquainted with dry season farming producing most of the time excess perishable horticultural crops (Muhammad *et al.* 1997). Irrigated pasture trials by de Leeuw (1972), Akinola, (1975) Kallah and Mzamane (1984); Ariba, (1987) in the Savanna zone of Nigeria have shown that various grass and legume forages can be grown out-of-season with varying degree of success. It is speculated that pasture production for dry season can provide feed of high quality at the time of use and it is an alternative cropping rotation that can break pest cycle while providing livestock with fodder of high quality. The objective of this study was therefore to determine the dry matter yield, crude protein, calcium and phosphorus in dual-purpose lablab bean and a very fast growing Columbus grass *Sorghum almum* at 3 irrigation schedules. It is hoped that the culture of pasture production could be integrated into the *fadama* programmes of the peasant farmers.

Materials and Methods

Irrigation trials were conducted in the late dry season (March to June) with a legume fodder crop Lablab (*Lablab pupureus*) and a fodder grass Columbus grass (*Sorghum almum*) at Talata Mafara (12° 33'N; 06° 05'E; Altitude 1150 mm) in the Sudan savanna of Nigeria. The pasture crops were established on a well prepared check basin plots measuring 4m x 2m, laid in completely randomized block design replicated 3 times. Lablab was planted at the rate of 2 seeds per hill in 50 cm x 25 cm spacing. Fertilizer applied was single super phosphate (SSP) at the rate of 80kgP/ha at planting. *Sorghum almum* was established by drilling seeds at rate 10kg/ha seed rate in a 50 cm spacing between rows. Fertilizer applied was NPK at rate of 100kgN 50KgP and 50KgK per hectare. The fertilizer applied to the grass was in split dose, half at planting and the second dose at 4 weeks after establishment. All plots were irrigated at 5, 7 and 10 days irrigation interval using surface irrigation method and harvested 15 cm above ground level after 77 days of growth. At this stage both Lablab and Columbus grass were physiologically at full bloom stage of maturity. Harvested forage was sub sampled from fodder harvested using 1m x 1m open-ended quadrat in 3 replications; oven dried at 65°C for 3 days and was used for dry matter determination. Data was analysed using SAS package (1987) and differences between treatment mean were considered significant at 5% level (Steel and Torrie, 1980). Relationships between irrigation interval and yields and quality variables were established using regression analysis.

Chemical analysis

Samples were ground to pass 1.0 mm screen in Christy and Norris for chemical analysis. The ground materials were analyzed in duplicates to assay the concentration of nitrogen by procedure of kjeldhal as described by AOAC (1990). Crude protein (CP) calculated as %N x 6.25. Samples were analysed for calcium (Ca) by wet digestion technique described by Ranjhan and Krishna (1980) followed by atomic absorption spectrometer using a double beam digital photometer (Shmadzu: Model AA650). Phosphorus (P) was estimated using Spectronic 20 (Baush and Lomb) described by A.O.A.C. (1990).

Results

Visual observation showed that forage germination and establishment was good and within 10 days after planting. Table 1 shows dry matter yield, concentration of crude protein, calcium and phosphorus in lablab and *Sorghum almum* crops grown at 3 irrigation intervals in the Sudan savanna of Nigeria. Dry matter yield increased as the interval of days after irrigation increased from 5 to 10 during the 77 days growth period. Dry matter yield was significant ($P<0.05$) and varied from 1.7 to 11.7 tDM/ha. Wider irrigation inter-

Table 1. Mean dry matter yield (DMt/ha), crude protein, calcium and phosphorus of irrigated *Lablab purpureus* and *Sorghum almum* in the Sudan savanna of Nigeria

Irrigation interval (days)	DMt/ha	CP (%)	Ca (%)	P (%)
		Lablab purpureus		
5	1.70[c]	14.59	8.77[a]	2.27[c]
7	3.40[b]	16.28	8.89[a]	2.50[b]
10	11.70[a]	16.28	7.35[b]	2.74[a]
Mean	5.6	15.57	8.33	2.50
SEM	0.428	2.947	0.277	0.141
		Sorghum almum		
5	11.07[c]	8.9	0.07[c]	0.23[a]
7	16.80[b]	10.90	0.09[a]	0.20[b]
10	19.60[a]	9.79	0.08[b]	0.19[c]
Mean	15.82	9.86	0.08	0.21
SEM	1.165	0.785	0	0.066

[a,b,c] *Means within column with different super scripts differ significantly (P<0.05)*

val of 10 days resulted in significantly higher (P<0.05) dry matter yield compared to 5 and 7 days irrigation interval. The trend obtained for Ca concentration was not definite but differed significantly (P<0.05). The concentration of P increased significantly (P<0.05) with increase in irrigation intervals. Mean CP for lablab was 15.57%.

Dry matter yield obtained for *Sorghum almum* showed similar trend characteristic with lablab. Dry matter yield was significant (P<0.05) and varied from 11.07 to 19.6 tDM/ha. Elongation of irrigation interval to 10 days resulted in significant (P<0.05) higher dry matter yield compared to 5 and 7 days irrigation interval. Concentration of crude protein and calcium rose and declined thereafter with a mean concentration of 9.86% for CP and 0.08% for Ca. Phosphorus declined consistently (P<0.05) with increased irrigation interval.

Regression of the intervals of irrigation days on dry matter yield, CP, Ca and P (Table 2) demonstrated that P levels in *Sorghum almum* declined with increased intervals of days of irrigation. Dry matter yield and concentration of CP were positive but calcium content was not affected. The values obtained for the slope in lablab were positive. Intervals of irrigation days showed a significant (P<0.05) relationship between DM, Ca and P in lablab.

Discussion

A major challenge facing livestock production this zone of Nigeria is shortage of feed for most part of the year (about 8 months of the year). Making feed available within the long dry season for livestock in the Sudan savanna zone would enhance the livestock productivity. Herbage yield of lablab varies widely (0.60 to 6.8t) even in the

Table 2. Relationships between irrigation intervals (days after irrigation) and dry matter yield (tDM/ha), crude protein, calcium and phosphorus) of *Lablab purpureus and Sorghum almum.*

	Slope (b)	Intercept (a)	R-Value	Significance level
		Lablab purpureus		
DMt/ha	2.06	-9.51	0.92	**
CP (%)	0.22	13.97	0.01	ns
Ca (%)	0.26	6.44	0.44	*
P (%)	0.09	1.82	0.48	*
Sorghum almum				
DMt/ha	1.65	3.75	0.75	*
CP (%)	0.13	8.86	0.04	ns
Ca (%)	0.00	0.05	0.33	ns
P (%)	-0.01	0.26	0.03	ns

** significant at P<0.01 * significant at P<0.05 ns = not significant

same locality (Bogdan 1977; Hendricksen and Minson 1985 a,b). The mean dry matter yields obtained in the present study agree with earlier results reported for lablab grown under rainy season in the Northern Guinea savanna zone of Nigeria (Tanko *et al.*, 1992; Amodu *et al.*, 1992, Lamidi *et al.*, 1997). The increasing trends in forage yield obtained in the present study suggested that lablab tolerates longer irrigation intervals which implies that it's a legume that could be intensively cultivated for ruminant production in the zone. The high yield recorded for 10 days irrigation interval resulted from good establishment after germination with less weed infestation while the low yield obtained with 5 days irrigation interval could be attributed to water logging with high weed population mainly of *Cyperus rotundus* and *Imperata cylindrica* grasses. Perhaps the soil moisture condition was favourable for the weeds. The crude protein contents obtained at different irrigation intervals were not influenced in this study but within the range reported earlier in the same location by Tanko *et al.* (1990), Hena *et al.* (1990) and also agree with data reported elsewhere (Hendricksen and Minson, 1985a&b).

Herbage yield of *Sorghum almum* obtained in the present study agreed with earlier results reported for *Sorghum almum* grown under rainy season in the Northern Guinea savanna zone of Nigeria (Muhammad, 1993; Muhammad *et al.*, 1997; Kallah *et al.*, 1999, Omokanye *et al.*, 2001). The increasing trends in forage yield obtained in the present study suggested that *Sorghum almum* is tolerant to ten days moisture stress and would be grown with little (7 times) irrigation frequency. The high yield recorded for 10 days irrigation interval resulted from good establishment after germination with less weed infestation as in the case of lablab. The crude protein contents obtained at different irrigation intervals showed an inverted parabolic pattern in this study but were within the range reported earlier for *Sorghum almum* grown in northern guinea savanna of Nigeria (Muhammad, 1993; Kallah *et al.*, 1999).

Calcium and phosphorus make up 70% of the total mineral elements in body and have vital functions in almost all tissues in the body and

must be available to livestock in proper quantities and ratio. Calcium and P play special role in the proper functioning of the rumen microorganism especially those which digest plant cellulose, utilisation of energy from feeds, protein metabolism amongst other functions (Mcdowell *et al.*, 1993). These authors recommended 0.30% Ca and 0.25%P levels as the critical levels for ruminant needs in thc warm wet climates. Perhaps the concentration of Ca and P obtained in the present study may not all be available for utilization by the animal, however, for lablab the concentration of Ca and P were quite above the recommend level (Table 1). Mcdowell *et al.* (1993) reported the maximum tolerable level for Ca is 2% for cattle and sheep while for P the maximum tolerable level is 0.6% for sheep and 1.0% for cattle above these levels it is postulated that Ca and P may interfere with the availability of other minerals (Mn, Fe, Zn). Considering Ca or P alone a paradoxical potential toxicity or interference with the availability of other minerals may be of serious concern to stovers. However, when Ca is considered in conjunction with P as Ca: P ratio the recommended lower and upper critical dietary Ca:P ratio are 1:1 to 7:1 in the tropics (Mcdowell *et al.*, 1993). The mean Ca: P ratio (3.3:1) values obtained in the present study is within the recommcnded range and would meet the Ca:P ratio requirement for ruminant livestock, suggesting that livestock supplemented with irrigated lablab in this zone will meet their Ca and P requirement.

Contrary trend was observed for Ca and P concentration in *Sorghum almum*. This trend is however in agreement with values reported for *Sorghum almum* grown under rainfed condition (Muhammad 1993, Kallah, *et al.*, 1999). When Ca is considered in conjunction with P as Ca: P ratio, the ratio obtained for *Sorghum almum* was less than 1. This suggests that livestock on *Sorghum almum* basal diet will respond positively to both Ca and P supplementation in this zone. In strategic feeding system the high levels of Ca and P in the lablab could be of advantage to the farmer when both forages are fed in equal proportions (1:1). The Ca:P ratio is greater than 1, thus providing the required Ca:P ratio to the ruminant livestock.

Conclusion

The present study reveals that with little irrigation frequency 5-6 times within the growing cycle, quantitative and qualitative fodder could be produced out of the growing season in the drier ecological zones where rainfall is a major fodder production constraint. Feed produced in the dry season under irrigation is green at the time when fodder from rangelands are dried, low in crude protein or not available. The increasing trend in forage yield with increased irrigation intervals shows that optimum intervals for irrigation has not been attained. There is therefore the need to try longer irrigation intervals to determine the optimum irrigation interval after which forage yield would be depressed due to moisture stress. From the results of the present study *Sorghum almum* and lablab would be grown successfully at 10 day irrigation interval.

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