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Effect Of Irrigation Interval On Growth And Forage Yield Of lablab (*Lablab purpureus* L.) Cultivars In The Sudan Savanna, Nigeria

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ABSTRACT

Field experiments were conducted during the dry season of 2025 at two locations, Audu Bako College of Agriculture Teaching and Research Farm, Dambatta (first location) located at 12.317° N, 8.5300E, and Yadakwari town (second location), Garun Malam Local Government, Kano State located at 11.700°N, 8.4200E, to evaluate the Effect of Irrigation Interval on the Growth and Forage Yield of Lablab (Lablab purpureus L.) Cultivars under Sudan Savanna conditions. The aims were to determine the best irrigation interval that produces optimum forage yield of lablab, the cultivar that thrives best under the subjected condition and to ascertain if lablab could grow and produce forage after 12 days without irrigation. The treatments consisted of three irrigation intervals (4, 8, and 12 days) and two cultivars of lablab (Rongai white and Rongai brown), arranged in a Randomized Complete Block Design (RCBD) with three replications. At the first location, the result revealed significant differences in the performance of lalab as affected by irrigation interval, the result showed that 12-day irrigation interval produced significantly higher forage yield (0.8 t ha-). Meanwhile yield performance among irrigation intervals at the second location was statistically similar. No notable difference was observed among the cultivars across the locations. The results also revealed that lablab could grow and produce optimum forage after 12 days without irrigation, In fact, it grows and produces forage best at longer irrigation interval according to result obtained from the first location. The second location however, recorded much higher overall forage yield (1.7 t ha-) than the first location. The findings suggest that lablab can be successfully cultivated with limited irrigation frequency in the Sudan Savanna. It is recommended that further studies should extend the irrigation interval beyond 12 days in order to find out the maximum days that lablab can stay active and productive without irrigation. Further studies should also employ the use of tensiometer so that the exact soil moisture necessarily needed by lablab for growth and forage production can be known.

Keywords: *Lablab purpureus*, Lablab cultivar, Irrigation interval and forage yield.

1. INTRODUCTION

In Nigeria, the conflicts between herders and farmers have continued to escalate, through the factors such as population growth, urbanization and climate change (Salkida, 2020). The conflicts have resulted in significant loss of lives, displacement of people and economic losses. The expansion of Agricultural land for crop production has reduced the availability of grazing land for herders. Herder-farmer conflicts in Nigeria are a series disputes over arable land resources across Nigeria, the conflicts have been especially prominent in the North Central of Nigeria since the return of democracy in 1999. Conflicts have also taken place in Northwestern Nigeria between the Farmers and the Herders. Despite the conflict fundamentally being a land use conflict, in some regions of Nigeria (Particularly North-Central) it has taken on dangerous religious and ethnic dimensions mostly because most of the farmers are Christians of various ethnicities while most of the herders are Muslim Fulanis who make up about 90% of the Nigeria's pastoralists (ICG, 2018).

Lablab is a dual-purpose legume, being grown as fodder legume sown for grazing and conservation in broad-acre agricultural systems in tropical environments with a summer rainfall, it is also traditionally grown as pulse crop for human consumption in south and Southeast Asia and Eastern Africa, flowers and immature pods are used as vegetables (Ewansila et al., 2007). It is a fast-growing self pollinated annual legume extensively grown in the tropical and subtropical regions of Asia and Africa (Naeem et al., 2020). It has a bushy and twining growth habits and is grown by smallholders for young leaves, pods, seeds, and is an excellent pasture legume for cut-and-carry dairy cattle production and for fattening sheep (Kongjaimun et al., 2022). Lablab is one of the most palatable legumes for cattle and its hay or silage improves the overall quality of high fibre roughages such as grass hay and cereal stover, mainly during the dry season (Soul, 2017).

Water scarcity is an important limitation for forage growth in grasslands in arid regions (Ates et al., 2012, Ren et al., 2017). Studies have shown that irrigated grasslands may have higher and more stable rates of yield (Jensen et al., 2001, Dantas et al., 2016, Sanches et al., 2017). However, achieving high output yields with less irrigation in an efficient and sustainable manner is one of the key challenges in artificial grasslands in arid areas. One effective way to solve water scarcity problems is by optimizing plant water usage that leads to yield enhancement, water use efficiency, and improve nutritional levels by applying deficit irrigation (English et al., 1990).

Irrigation is a crucial factor in crop productivity in many regions of the World (Farhadi et al., 2022). Various strategies have been developed to mitigate the adverse effects of limited irrigation on crops, including the cultivation of drought-tolerant species and cultivars (Khazaei et al., 2010; Sorkheh et al., 2011), optimised irrigation scheduling (Jamshidi et al., 2020; Ebrahimian et al., 2020) and the use of suitable and water-saving irrigation methods (Baghdadi et al., 2021; Ashoori et al., 2021; Baghdadi et al., 2023). According to Baghdadi et al. (2021), effective irrigation management can significantly impact the forage production potential and water-use efficiency of forage sorghum.

Lablab plays a critical role in providing animal feed, it is essential to understand the effect of irrigation management techniques on the forage yield of Lablab cultivars. It is of vital importance to gain a comprehensive understanding of the influence of irrigation intervals on forage production potential of the lablab cultivars. Hassan et al. (2013), reported that when lablab was intercropped with maize, the result indicated that at 3 days irrigation interval, the height of lablab was 40% lower than that of maize, at 6 days irrigation interval, maize plant height was 19% higher than that of lablab. However, at 9 days irrigation interval the height of lablab was 20% higher than that of maize. This result can be explained by the fact that lablab is a drought tolerant plant and therefore tend to resist the dry spell imposed by the irrigation. At 9 days irrigation interval, lablab also showed 50% increase in LAI which indicates that the variety used in the study could tolerate water stress beyond 9 days under irrigation without adversely affecting performance. There was also a strong and positive correlation between plant height and irrigation interval.

MATERIALS AND METHODS

Experimental sites

The experiment was conducted in two locations. The first location of the study was Audu Bako College of Agriculture Teaching and Research Farm Dambatta, which is located on latitude 12.317° N and longitude

8.5300E in the Western part of Kano State, along Kano-Daura road. The soil is characterised as Sandy loam. The soil pH in the area ranges between 4.2-6.8 (slightly acidic).

The the second location was Yadakwari town, which is located on latitude 11.700°N and longitude 8.4200E along Kano-Kaduna road in Garun Malam local Government of Kano State. The soil is characterised as sandy loam that is slightly darkish in colour (slightly silt). The pH ranges between 5.28-6.71 (moderately acidic).

Experimental materials

i. Two seed cultivars (Rongai brown and Rongai white) obtained from National Animal Production Research Institute (NAPRI) Shika, Zaria.

ii. Bigger measuring tape: For mapping out fields and demarcation.

iii. Smaller measuring tape: For measuring plant height and leaf area.

iv. Sign boards: For labeling subplots, to indicate the cultivar and its irrigation schedule randomly allocated to it.

v. Hoe: For land clearing, weeding, creating and clearing of furrows and harvesting.

vi. Pen and book: For data entry

vii. Calculater: For calculating parameters

viii. Sensitive weighing balance: For determining the fresh and dry weight of the forage.

Treatments and experimental design

The experiment consisted of 3 irrigation levels (4 days interval, 8 days interval and 12 days interval), two lablab cultivars (Rongai brown and Rongai white) replicated 3 times. Therefore, the treatments are; Cultivar, Irrigation at 4 days interval, Irrigation at 8 days interval and Irrigation at 12 days interval. The treatment plots were laid in Randomized Complete Block Design (RCBD) with a factorial treatment structure. The total plot size was 155m2. After clearing and leveling, the plot was divided in to 3 blocks with a space of 1m between the blocks. Each block consisted of 6 treatment plots that were 4m2 in size, with a space of 0.5m between them. The cultivars and irrigation intervals were randomized across each block. Therefore, after replication, a total number of 18 treatment plots were realized on the whole field.

Agronomic practices;

Land Preparation.

The land was prepared by weeding and ploughing to prepare a good seedbed in order to obtain a good seed-to-soil contact. After clearing, the field was then mapped out, and divided in to blocks and sub-plots.

Sowing.

The seeds were sown at the rate of 3 seeds/hole with 70 and 75cm as inter-row and intra-row spacing respectively. Therefore, there were 4 stands of lablab on each sub-plot.

Watering.

After sowing the cultivars randomly on each block, the sub-plots were watered uniformly to the field capacity at 3 days interval, up to 7 days after sowing when germination was fully established, to provide a conducive environment for proper germination and avoid irregular or incomplete germination due to water stress. When germination was fully established, the sub-plots on each block were allocated either of the three irrigation intervals (4, 8 and 12 days) randomly.

Weeding.

First and second weeding were conducted at 3 and 6 weeks after sowing respectively, to prevent moisture, nutrients and space competition with the weeds, as well as preventing pests and diseases buildup.

Fertilizer Application.

NPK 15:15:15 (balanced fertilizer) was applied in two split doses at the rate of 20kg per hectre across the locations at 4 and 6 weeks after sowing.

Harvesting

Harvesting was conducted at 8 weeks after sowing using hoe, the plants were cut from the base.

Data collection.

Data was collected at the interval of 2, 4, 6 and 8 weeks after sowing (WAS) from the 2 randomly tagged plants on each treatment plot.

RESULTS AND DISCUSSION

The Plant Height at the first location was significantly higher at 12 days irrigation interval. There was no marked difference at 2 and 8 weeks after sowing. No significant difference was observed across the cultivars, interaction was also not considerable. At the second location, there was no notable differences observed across the irrigation interval, notable difference was observed at the cultivar level, where Rongai brown was taller than Rongai white at 4 and 6 weeks after sowing. At 2 and 8 weeks after sowing no notable difference observed. No major interaction observed among the Cultivar and Irrigation Interval.

In terms of number of leaves, At the first location, notable difference was observed among the irrigation intervals, at 12 days irrigation interval plant had the highest number of leave at 4, 6 and 8 weeks after sowing. The difference was not notable and 2 weeks after sowing. Rongai white also had notable higher higher number of leaves than Rongai white at 4, 6, and 8 weeks after sowing. No major difference was observed at 2 weeks after sowing. Interaction was not significant. In the other hand, no notable difference was observed among the irrigation intervals at the second location, notable difference was observed among the cultivars at 4 weeks after sowing with Rongai brown having the higher number of leaves than Rongai white. No notable difference was observed at 2, 6 and 8 weeks after sowing. Interaction was not significant.

At the first location, a major difference was observed among the irrigation intervals at which 12 days irrigation interval had significantly highest Leaf Area per Plant. Rongai white also showed notable higher Leaf Area per Plant than Rongai brown. No interaction was observed. At the second location, no major difference was observed among the irrigation intervals and cultivars across all the developmental stages. Interaction was not significant.

Substantial difference was observed among the irrigation intervals in which 12 days irrigation interval had significantly highest Leaf Area Index at the first location than the remaining intervals. Rongai white had higher Leaf Area Index than Rongai brown substantially at 4 and 6 weeks after sowing. No major interaction observed. At the second location, there was no notable difference observed among the irrigation intervals. Rongai brown had notable higher Leaf Area Index than Rongai white at 4 weeks after sowing. Interaction was not significant. It is determined by dividing the total leaf area by ground area allocated to the crop. Watson, 1957.

At 6 weeks after sowing, there was a major difference among the irrigation intervals in the first location, where 12 days irrigation interval had notably highest Leaf Area than the remaining intervals. No significant difference was observed among the Cultivars. Interaction was also not substantial. At the second location, there was no marked difference among the irrigation intervals, major difference was observed among the cultivars where Rongai brown had higher leaf Area than Rongai white at 4 weeks after sowing. Interaction was not significant. Leaf Area was determined by multiplying the length and the bridth of the leaf and then multiply them by 0.75 as conversion factor as described by Adesoji et al. (2013).

At the first location, there was a notable difference among the irrigation intervals showing 12 days irrigation interval having the highest Leaf Area Duration. Rongai white was notably higher than Ronagi brown. Interaction was not substantial. At the second location, no substantial difference was observed among the Irrigation Intervals and Cultivars, no substantial difference was observed among the interaction as well. It is determined by using a formular suggested by Radford, in 1967.

At the first location, 12 days irrigation interval had the heaviest fresh forage than the remaining irrigation intervals. No considerable difference was observed among the Cultivars, interaction was not significant. At the second location, there was no notable difference observed among the Irrigation Intervals and the Cultivars, interaction was also not significant.

At the first location, 12 days irrigated crops produced the highest yield in tonnes per hectre, No significant difference was observed among the cultivars. Interaction was also not substantial. No major difference was observed among the Irrigation Intervals, Cultivars as well as Interaction at the second location. But the second location produced much higher forage yield (1.7 t ha-) than the first location.

The Dry weight at the first location differed significantly among the irrigation intervals and the cultivars. 12 days irrigated crops produced the heaviest dried forage (hay), Rongai white was significantly higher than Rongai brown, interaction was not significant. At the second location, there was no significant difference among the Irrigation Intervals, Cultivars and Interaction.

LAR is the relative leaf area to dry weight of a plant to show a total plant biomass that is contributing to photosynthesis. The result shows that at the first location 8 days irrigated crops had the highest leaf area ratio, no significant difference was observed among the cultivars. No significant difference was observed at the second location among the irrigation intervals and the cultivars. No interaction was observed at both the locations.

There are positive and negative correlation that are either significant or none-significant between the parameters at the first location. Plant height, number of leaves, Leaf Area per plant, Leaf Area Index, Leaf Area Duration, Fresh weight and Dry weight had a positive and significant correlation with the yield. This means the yield increases with an increase in the aforementioned parameters at the location, therefore they are directly related to each other. Leaf Area and Leaf Area Ratio had a negative and non significant correlation with the yield. This shows that they decrease with the increase in the yield or the yield decrease with an increase in them, but this factor is not significant, therefore nothing can be observed or seen with respect to it.

All the parameters increased with an increase in weeks after sowing as shown across the locations. This corresponds to the findings of Munza et al. (2022) where they reported that Fresh and dry forage yields increased as cutting was delayed from 6WAS to 12 WAS. Rotte et al. (2025) also reported that plant height and dry matter increased steadily from 30 days after sowing to harvest. All the significant differences were observed after 2 WAS, This can be attributed to the fact that roots and leaves that facilitate water and nutrient uptake and light interception for photosynthesis become more established with an increase in days after sowing. These factors were also reported by Hassan et al. (2014) and Anthony et al. (2021).

Irrigation interval of 12 days showed a better result than shorter irrigation intervals across all the parameters at the first location. This is supported by Hassan et al. (2014) who reported that the fresh forage yield of lablab showed an increasing trend at irrigation interval of 3 days, but further increase in irrigation interval to 6 days, produced higher forage yield. At 9 days irrigation interval, lablab showed 50% increase in LAI which is significantlly higher than 3 and 6 days irrigation intervals. This indicates that Lablab could tolerate water stress up to 9 days under irrigation without adversely affecting the performance.

Hassan et al. (2013) also reported that at 9 days irrigation interval, the height of lablab was 20% higher than that of maize. This result can be explained by the fact that lablab is a drought tolerant plant and therefore tend to resist the dry spell imposed by the irrigation scheduling. It also corresponds with the finding of Muhammad et al. (2005) who reported that dry matter yield increased as the intervals of days after irrigation increased from 5 to 10 during the 77 days growth period. Wider irrigation interval of 10 days resulted to significant higher dry matter yield compared to 5 and 7 days irrigation intervals.

No significant difference was observed among the irrigation intervals at the second location. Lablab inherent drought tolerance and deep root system enable it to extract water from the soil (Striker and Colmer, 2017). This can also be attributed to the total dryness before irrigation event. This agrees with the finding of Hassan et al. (2014) who reported that At 3, 6 and 9 days irrigation no significant difference was observed on number of leaves of lablab. Therefore, number of leaves of lablab was not different with irrigation frequency.

The interaction between irrigation intervals and cultivars (Rongai Brown and Rongai White) for all measured parameters was statistically non-significant ($p > 0.05$). This indicates that both cultivars exhibited similar physiological and morphological responses to the varying irrigation schedules. Irrigation effects on growth and yield were the same and did not depend on cultivar characteristics. The absence of interaction shows the same genotype performance across water regimes, indicating similar water-use strategies and drought adaptability. This agrees with the finding of Gholami et al. (2022) on effect of water regimes on yield response of local and foreign cultivars of olive. The forage yield obtained in this study (0.8 t ha- and 1.7 t ha- for the first and the second location respectively) is within the range of what was obtained by Muhammad et al. (2005) at 11 WAS cutting age. It is also within the range of what was obtained by Ogedegbe et al. (2011) at the cutting age of 6 WAS.

The Correlations between Growth and Yield parameters of lablab at the 2 locations in 2025 dry season showed that Plant height, Number of leaves, leaf area per plant, Leaf area index, Leaf Area duration, Fresh weight and dry weight had a significant positive correlation with the forage yield. This shows that all the aforementioned parameters had a direct impact on the yield, all the crops that had higher value of them had higher forage yield. Leaf Area and Leaf Area Ratio had a negative but no significant values at the first location and the second location respectively. This agrees with the finding of Ali et al. (2023), A highly significant positive correlation was observed between the yield and plant height, number of branches, leaf area index, number of nodes per plant, number of pods per plant, pods length, and pod width in 2019, 2020 and 2021 wet seasons. But Negative correlation was observed between the yield and crop growth rate in all the research seasons.

Table 1: Effect of Irrigation Interval, Cultivar and their interaction on Plant Height (cm) of Lablab (*Lablab purpureus* L.) in Dambatta and Yadakwari during 2025 dry season.

Treatment	**Plant Height (cm)**							
	2WAS	4WAS	6WAS	8WAS	2WAS	4WAS	6WAS	8WAS
	Dambatta						**Yadakwari**	
I.I								
4	3.92	7.68ab	28.93b	102.53	5.85	16.50	91.85	164.62
8	4.12	6.88b	23.00b	93.40	5.68	21.13	99.67	184.65
12	3.93	10.28a	40.48a	110.42	6.22	14.75	122.65	172.82
SE±	0.37	0.89	3.59	9.14	0.54	3.52	17.52	18.92
Cultivar								
Rongai brown	4.27	7.71	29.60	100.91	6.19	22.99a	128.43a	185.78
Rongai white	3.71	8.86	32.01	103.32	5.64	11.93b	81.01b	162.28
SE±	0.30	0.73	2.93	7.46	0.44	2.88	14.30	15.45
Interactions								
DAI x CUL	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same letter within a treatment group are not statistically different at 5% level of probability using DMRT. NS = Not Significant * = Significant at 5% probability level ** =Highly significant at 1% probability level I.I= Irrigation interv.

Table 2: Effect of Irrigation Interval, Cultivar and their interaction on Fresh Weight (g) Yield (t ha-), Dry Weight (g) and Leaf Area Ratio (cm^2/g) of Lablab (*Lablab purpureus* L.) in Dambatta and Yadakwari during 2025 dry season.

Treatment								
	FW(g)	Yield(t ha-)	DW(g)	LAR (g/cm^2)	FW (g)	Yield(t ha-)	DW(g)	LAR(g/cm^2)
	Dambatta				**Yadakwari**			
I.I								
4	187.42b	0.48b	40.58b	255.32b	555.7	1.39	113.17	216.15
8	155.42b	0.38b	32.25b	378.67a	635.4	1.59	147.92	198.69
12	320.92a	0.78a	73.33a	245.99b	671.1	1.68	132.00	212.30
SE±	30.31	0.07	6.51	38.66	122.51	0.31	16.62	30.19
Cultivar								
Rongai brown	182.39	0.46	38.28b	325.70	699.3	1.75	151.67	196.85
Rongai white	260.11	0.64	59.17a	260.94	542.1	1.36	110.39	221.25
SE±	24.75	0.06	5.31	31.57	100.02	0.25	13.57	24.65
Interactions								
DAI x CUL	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same letter within a treatment group are not statistically different at 5% level of probability using DMRT. NS = Not Significant * = Significant at 5% probability level ** = Highly significant at 1% probability level I.I = Irrigation

CONCLUSION

Conclusively, the Study demonstrates that lablab can be effectively cultivated in the Sudan Savanna with minimal irrigation without compromising yield. Soil properties and moisture availability significantly influence crop performance. These findings provide practical guidance for farmers on sustainable forage production of lablab and the optimization of irrigation strategies under semi-arid conditions.

RECOMMENDATION

Future studies should extend irrigation intervals beyond 12 days to determine the maximum period that lablab can remain productive without adversely affecting the forage yield in Sudan Savanna. Furthermore, future experiments should include precise soil moisture monitoring to better quantify its impact on the performance of lablab cultivars.

REFERENCES

Ali S., Ahmed S. F, Lawal M., Yunusa M. S and Ekama D. E (2023). Effects of phosphorus rates, sowing date and variety on growth and yield of hyacinth bean (*Lablab purpureus* (L.) Sweet) in Ringim, Jigawa State, Nigeria. Journal of Agriculture, Forestry and Environment, 2023, 7(1): 129 - 138

Anthony J. W, Charles K. G., James W. M. and John O. O. (2021). Biomass Yield And Quality Of Fodder From Selected Varieties Of Lablab (Lablab Purpureus L) In Nandi South Sub-County Of Kenya. Online Journal of Animal and Feed Research volume 11 Issue 1:28 35 January 25, 2021.

Ashoori N., Abdi M., Golzardi F., Ajalli J. and Ilkaee M.N (2021). Forage potential of sorghum-clover intercropping system in semi-arid conditions. Bragantia. 2021;80:e1421. doi: 10.1590/678-4499.20200423.

Ates, S., Tongel, M.O. and Moot, D.J. (2012). Annual herbage production increased when sub clover overdrilled into grass-dominant dryland pastures. Proc. N. Z. Grassl. Assoc. 2012, 72, 3–10.

Baghdadi A., Golzardi F., Hashemi M. (2023). The use of alternative irrigation and cropping system in forage productivity may alleviate the water scarcity in semi-arid regions. Journal of science and Food Agric. 2023 doi 10.1002/jsfa.12574

Baghdadi A., Paknejad F., Golzardi F., Hashemi M., Ilkaee M.N (2021). Suitability and benefits from intercropped sorghum-amaranth under partial root-zone irrigation. Journal of science anf Food Agric. 2021;101:5918-5926. doi: 10.1002/jsfa.11244.

Dantas, G.D., De Faria, R.T., Dos Santos, G.D., Dalri, A.B., Palaretti, L.F.(2016). Herbage yield and quality of irrigated Brachiaria in Autumn and Winter. Eng. Agricola 2016, 36, 469–481.

Ebrahimian H., Dialameh B., Hosseini-Moghari S.M., Ebrahimian A. (2020). Optimal Conjunctive use of aqua-agriculture reservoir and irrigation canal for paddy fields (case study: Tajan irrigation network, Iran) paddy water Environ. 2020;18:499-514. doi:10.1007/s10333-020-00797-5

English, M.J.; Musich, J.T.and Murty, V.V.N. (1990). Deficit irrigation. In Management of Farm Irrigation Systems; Hoffman, G.J., Howell, T.A., Solomon, K.H., Eds.; ASAE: St. Joseph, MI, USA, 1990.

Ewansila, S. U., Chiezey, U. F., Tarawali, S. A., and Iwuafor, N. O. (2007). Potential of fattening Diets by Smallholder Farmers of Zimbabwe. In A. M. Whitbread, & B. Growth and Yield of Diverse Lablab (Lablab purpureus) Germplasm in http://www.2.ctahr.Hawaii.edu/sustainag/SustainableAg/GreenManures/lablab.

Farhadi A.,Paknejad F., Golzardi F., Ilkaee M.N., Aghayari F. (2002). Effects of limited irrigation and Nitrogen rate on the herbage yield, water productivity, and nutritive value of sorghum silage. Commun. Soil Sci. Plant. Anal.20222;53:576-589. doi:10.1080/001003624.2021.2017959.

Gholami, Rahmatollah, N. F Hoveizeh, S. M Zahedi, H. Gholami and P. Carillo (2022). Effect of three water regimes on morph-physiological, biochemical and yield responses of local and foreign olive cultivars under field conditions. BMC Plant Biology, 22, Article 2773.

Hassan M.R, , J. T. Amodu , I. R. Muhammad , G. E. Jokthan , S. B. Abdu , B. Abdullahi , H. Y. Adamu , A. Musa, I. Sani and T. T. Akpensuen (2014). Forage Yield and Quality of Lablab (*Lablab purpureus* L. Sweet) Intercropped With Maize (Zea mays L.) With Flooded Irrigation System in the Semi-Arid Zone of Nigeria. Journal of Agricultural Science; Vol. 6, No. 11; 2014

Hassan M.R; I.R. Muhammad; G.E. Jokthan; J.T. Amodu, S. B. Abdu; B. Abdullahi; H.Y. Adamu; S. Yashim; M.S. Tamburawa; U. Ado and S.A. Abubakar (2013). Effect of Planting Pattern and Irrigation Frequency on Forage Yield and Chemical Composition of Lablab (*Lablab Purpureus* (L.) Sweet) in Combination with Maize (Zea mays L.). Nigerian Journal of Animal Science. 2013, 15:179-190 nternational Crisis Group (2018). Stopping Nigeria's Spiralling Farmer-Herder Violence. Africa Report No. 262. Brussels: International Crisis Group.

Jamshidi S., Zand-Parsa S., Kamgar-Haghighi A.A, Shahsavar A.R., Niyogi D. (2020). Evapotranspiration, crop coefficient, and physiological responses of citrus trees in semi-arid climatic conditions. Agric. Water Manag. 2020;227:105838. doi 10.1016/j.agwat.2019.105838

Jensen, K.B., Asey, K.H., Waldron, B.L. (2001). Dry matter production of orchard grass and perennial ryegrass at five irrigation levels.Journal of Crop Science 2001, 41, 479–487.

Khazaei H., Monneveux P., Hongbo S., Mohammady S. (2010). Variation for stomatal characteristics and water use efficiency among diploid, tetraploid and hexaploid Iranian wheat landraces. Genet. Resour. Crop Evol. 2010;57;307-314. Sdoi: 10.1007/s10722-009-9471-x.

Kongjaimun, A., Takahashi, Y., Yoshioka, Y., Tomooka, N., Mongkol, R. and Somta, P. (2022). Molecular analysis of genetic diversity and structure of the Lablab (Lablab purpureus (L.) sweet) gene pool reveals two independent routes of domestication. Plants. 2022;12(1):57

Muhammad I.R, B. Abdullahi, A.K Mohammed, R.J Tanko, M.S Kallah and J.P Alawa (2005). 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 savannah zone of Nigeria. Nig. J. Anim Prod. 2005, 32(2):280-286.

Munza B.M, Tanko, R.J, Yerima J., Lewi F., and Ado, A.Y (2022). Forage yield and quality of white lablab (Lablab purpureus L. sweet) as influenced by intra row spacing and cutting age. Department of Animal Science, University of Maiduguri, Maiduguri, Borno State, Nigeria.

Naeem, M., Shabbir, A., Ansari, A.A., Aftab, T, Khan, M.M. and Uddin, M (2020). Hyacinth bean (Lablab purpureus L.)–An underutilised crop with future potential. Scientia Horticulturae. 272.

Ogedegbe, S.A ., Ogunlele, V.B., Olufajo O.O., and Odion E.C (2011). herbage yield of Lablab (Lablab purpureus L. sweet) as influenced by Phophorus application, cutting height and age in a semi arid Enviroment, Nigeria. International journal of Agricultural research 6(11): 789-797, 2011.

Radford, P.J (1967). Growth analysis formulae: Their use and abuse. Crop Science, 7(3), 171-175.

Ren, X.Y., Xu, Z.W., Isbell, F.,Huang, J.H..,Han, X.G., Wan, S.Q., Chen, S.P., Wang, R.Z., Zeng, D.H., (2017). Jiang, Y. Exacerbated nitrogen limitation ends transient stimulation of grassland productivity by increased precipitation. Ecol. Monogr. 2017, 87, 457–469.

Rotte Sai Mithra, LK Arvadiya, Sonal S Tripathi and Devika M Patel (2025). Effect of irrigation scheduling, mulching and cereal intercropping on growth and yield of vegetable indian bean (Lablab purpureus L. Sweet) under south Gujarat conditions. International Journal of Research in Agronomy 2025; 8(7): 1801-1809.

Salkida, A. (2020)."Fulani: Villain and Victim of Militia Attacks?" HumAngle. Retrieved 2023-05-12

Sanches, A.C., Gomes, E.P., Rickli, M.E., Friske, E., Fasolin, L.P. (2017). Productivity and nutritive value of Tifton 85 in summer, with and without irrigation under different Nitrogen doses. Eng. Agricola 2017, 27, 246–256.

Sorkheh K., Shiran B., Khodambshi M., Rouhi V., Ercisli S.(2011). In vitro assay of native Iranian almond species (Prunus L. spp) for drought tolerance. Plant Cell Tiss. Organ Cult. 2011;105:395-404. doi:10.1007/s11240-010-9879-1

Soul, W. (2017). Effects of Vigna unguiculata and Lablab purpureus on methanogenesis, haematological parameters and the quality of meat from Xhosa Lop Ear goats. Diss. PhD Thesis. Department of Livestock and Pasture Sciences, Faculty of Science and Agriculture, University of Fort Hare Alice, South Africa.

Striker, G.G and Colmer, T.D (2017). Flooding tolerance of forage legumes. Journal of Experimental Botany, 68(8), 1851-1872.