Effect of irrigation and fertilizer management on the performance of selected forages

25 Nov 2022

Bahir Dar,

Ethiopia

Outline

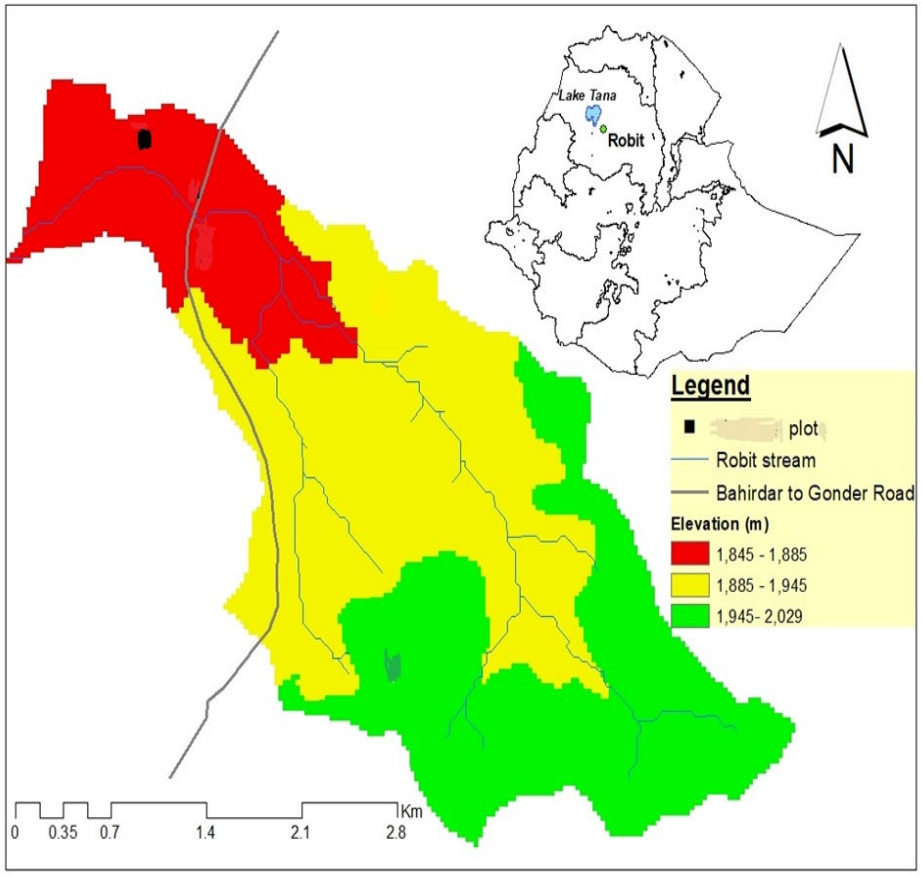
- Introduction
- Materials and Methods
- Result and discussion
- Conclusion

Introduction and Problem Statement

- Mixed small holder farming system
- Livestock contribution
- Feed shortage
- Pressure on resource
- Water and nutrient as major inputs
- Water-saving for crop production is needed
- Quantifying the crop response to irrigation
- Lack of information on fodder suitability

Materials and Methods

- Robit Bata Kebele
- Rented plot 37.265°E, 11.41 and 1851m
- About 20km north of Bahir town
- Area is about 1034ha
- Has a sub-tropical climate
- Average annual RF of 1500 m
- Temp ranges from 11.6 27.10C
- Mainly irrigated vegetables



Experimental design

- Randomized Split-Split plot design

Replication I				Replication II				Replication III		
I2/F3	I2/F2	I2/F1		I3/F2	I3/F3	I3/F1		I1/F2	I1/F3	I1/F1
V8I2F3	V2I2F2	V3I2F1		V10I3F2	V5I3F3	V4I3F1		V6I1F2	V9I1F3	V1I1F1
V5I2F3	V10I2F2	V9I2F1		V8I3F2	V3I3F3	V10I3F1		V7I1F2	V1I1F3	V5I1F1
V2I2F3	V6I2F2	V7I2F1		V9I3F2	V10I3F3	V8I3F1		V5I1F2	V4I1F3	V3I1F1
V1I2F3	V3I2F2	V5I2F1		V6I3F2	V7I3F3	V2I3F1		V9I1F2	V8I1F3	V10I1F1
V7I2F3	V9I2F2	V6I2F1		V4I3F2	V1I3F3	V5I3F1		V3I1F2	V2I1F3	V8I1F1
V10I2F3	V5I2F2	V1I2F1		V2I3F2	V9I3F3	V3I3F1		V4I1F2	V7I1F3	V6I1F1
V4I2F3	V8I2F2	V10I2F1		V1I3F2	V4I3F3	V7I3F1		V2I1F2	V6I1F3	V9I1F1
V9I2F3	V7I2F2	V8I2F1		V5I3F2	V6I3F3	V1I3F1		V10I1F2	V3I1F3	V4I1F1
V6I2F3	V4I2F2	V2I2F1		V3I3F2	V8I3F3	V9I3F1		V1I1F2	V10I1F3	V7I1F1
V3I2F3	V1I2F2	V4I2F1		V7I3F2	V2I3F3	V6I3F1		V8I1F2	V5I1F3	V2I1F1
I1/F2	I1/F1	I1/F3		I2/F1	I2/F2	I2/F3		I3/F1	I3/F2	I3/F3
V4I1F2	V3I1F1	V1I1F3		V6I2F1	V7I2F2	V2I2F3		V10I3F1	V9I3F2	V8I3F3
V2I1F2	V6I1F1	V4I1F3		V9I2F1	V3I2F2	V8I2F3		V7I3F1	V1I3F2	V5I3F3
V8I1F2	V9I1F1	V7I1F3		V1I2F1	V10I2F2	V6I2F3		V2I3F1	V5I3F2	V4I3F3
V10I1F2	V4I1F1	V8I1F3		V7I2F1	V1I2F2	V5I2F3		V3I3F1	V2I3F2	V6I3F3
V1I1F2	V10I1F1	V5I1F3		V3I2F1	V2I2F2	V4I2F3		V9I3F1	V6I3F2	V7I3F3
V6I1F2	V7I1F1	V9I1F3		V5I2F1	V4I2F2	V1I2F3		V8I3F1	V10I3F2	V2I3F3
V5I1F2	V1I1F1	V3I1F3		V2I2F1	V6I2F2	V7I2F3		V4I3F1	V8I3F2	V9I3F3
V7I1F2	V2I1F1	V6I1F3		V8I2F1	V9I2F2	V10I2F3		V5I3F1	V3I3F2	V1I3F3
V9I1F2	V5I1F1	V10I1F3		V4I2F1	V8I2F2	V3I2F3		V1I3F1	V7I3F2	V3I3F3
V3I1F2	V8I1F1	V2I1F3		V10I2F1	V5I2F2	V9I2F3		V6I3F1	V4I3F2	V10I3F3
I3/F1	I3/F3	I3/F2		I1/F3	I1/F1	I1/F2		I2/F3	I2/F1	I2/F2
V1I3F1	V9I3F3	V10I3F2		V5I1F3	V6I1F1	V4I1F2		V7I2F3	V2I2F1	V3I2F2
V10I3F1	V5I3F3	V4I3F2		V3I1F3	V2I1F1	V1I1F2		V9I2F3	V8I2F1	V6I2F2
V8I3F1	V7I3F3	V9I3F2		V2I1F3	V1I1F1	V5I1F2		V3I2F3	V6I2F1	V10I2F2
V2I3F1	V8I3F3	V6I3F2		V7I1F3	V10I1F1	V3I1F2		V1I2F3	V9I2F1	V5I2F2
V4I3F1	V1I3F3	V3I3F2		V9I1F3	V7I1F1	V6I1F2		V10I2F3	V5I2F1	V8I2F2
V3I3F1	V4I3F3	V8I3F2		V1I1F3	V3I1F1	V2I1F2		V5I2F3	V7I2F1	V9I2F2
V9I3F1	V2I3F3	V5I3F2		V6I1F3	V8I1F1	V7I1F2		V4I2F3	V10I2F1	V1I2F2
V7I3F1	V10I3F3	V2I3F2		V8I1F3	V5I1F1	V9I1F2		V6I2F3	V4I2F1	V2I2F2
V5I3F1	V6I3F3	V1I3F2		V4I1F3	V9I1F1	V10I1F2		V8I2F3	V3I2F1	V7I2F2
V6I3F1	V3I3F3	V7I3F2		V10I1F3	V4I1F1	V8I1F2		V2I2F3	V1I2F1	V4I2F2

- 3 Irrigation Scheduling
  - Based on soil moisture
    - **I100**, **I80** and **I60**
- 3 different fertilizer rates
  - Manure (30Mg/ha) and
  - UREA 100 and 300Kg/ha
- 10 forage verities/cultivars
- Plot size $9m^2$
- A buffer of 1m between plots

Forage variety	Method of planting	Plant spacing	Density/ha
Napier grass (Pennisetum purpureum) 16791	Cuttings	.5 m x .5m	
Napier grass (Pennisetum purpureum) 16819	Cuttings	.5 m x .5m	
Napier grass (Pennisetum purpureum) 16803	Cuttings	.5 m x .5m	
Panicum maximum 144	root splits	.5 m x .5m	
Desho grass (Pennisetum glaucifolium) ArekaDZF590	root splits	.5 m x .25m	
Brachiaria decumbens 10871	root splits	.5m x .25m	
Brachiaria mutica 18659	root splits	.5m x .25m	
Desmodium uncinatum 6765 - legume	Seed	.3m b/n rows	6 kg/ha
Stylosanthes hamata 75 - legume	Seed	.3m b/n rows	6 kg/ha
Stylosanthes scabra 140 legume	Seed	.3m b/n rows	6 kg/ha

- The soil moisture content was monitored before irrigation
- Irrigation was scheduled on 7-day intervals (Dadrasan et al. 2015)
- The weekly irrigation water amounts for I100 treatment was estimated based on the equation (Rostamza et al. 2011).

$$I_n = \frac{(Fc - \theta i) * D * A}{100 * \eta}$$

- Each plot was watered individually through a watering can.
- To avoid a runoff after irrigations, both ends of planting rows was blocked by soil.

- During harvest the following measurements was made:

➢Total Biomass, plant height, tiller number, leaf to stem ratio, leaf area, root depth, residual soil nitrate

➢Fresh and oven-dry (60˚C for 48 hours/until constant weight) weight of the stems and leafs.

➢These data was then be aggregated for the whole plant-based on the dry matter (DM) proportion

Irrigation water use efficiency (IWUE)

- The IWUE for biomass yield of the various fodder types was determined as:

$$IWUE = \frac{DMY}{Irrigation\ water\ applied}$$

Data analysis

- To see the effect of irrigation amount and fertilizer type and rate and the interaction effect of irrigation amount and fertilizer rate and type on

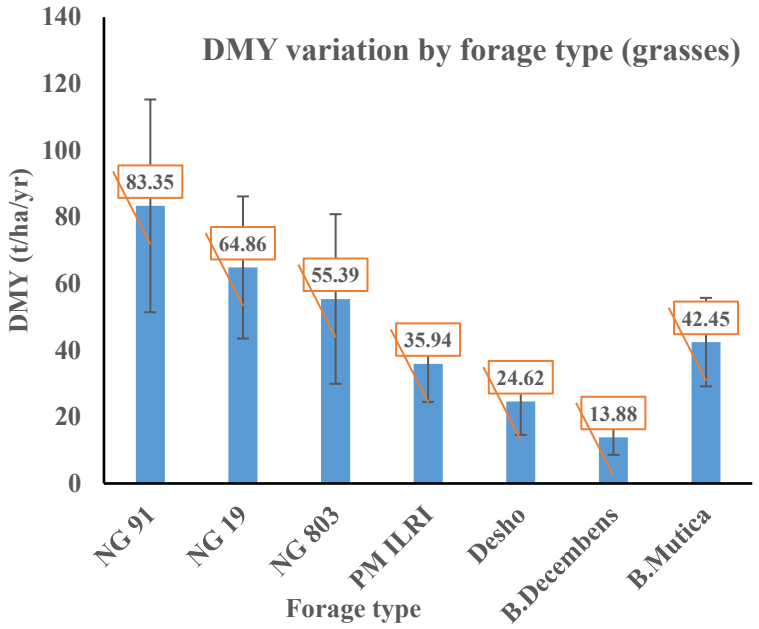
✓biomass and water use efficiency of the various fodder types

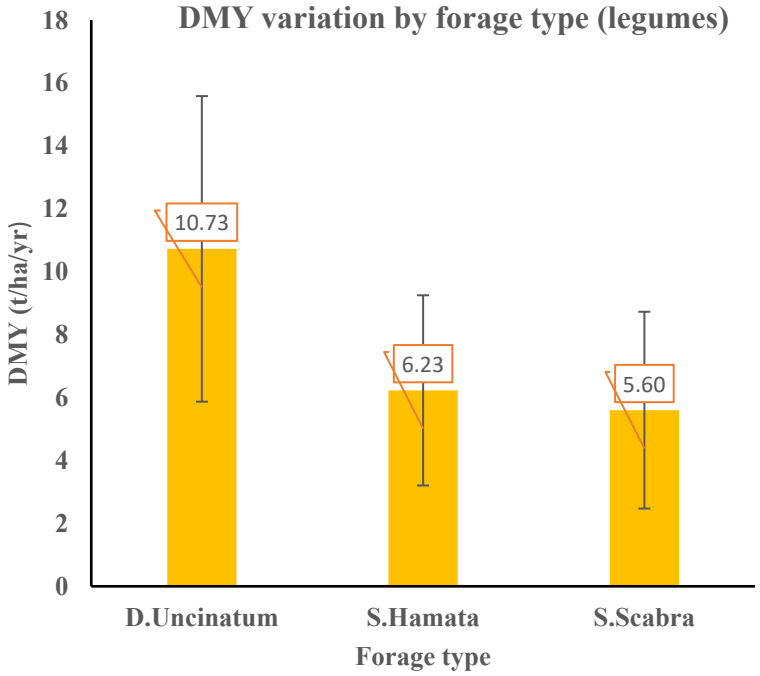
- Analysis of variance (ANOVA) was used.
- Mean comparisons was made by the LSD method with $P < 0.05$.
- The analyses was conducted using SPSS.

Effect of forage type on DMY

- High variability ($p<0.001$)
- Maximum 83.35 for NG 16791
- Minimum 13.88 for B. Decumbens
- Mean 45.78 t/ha/yr

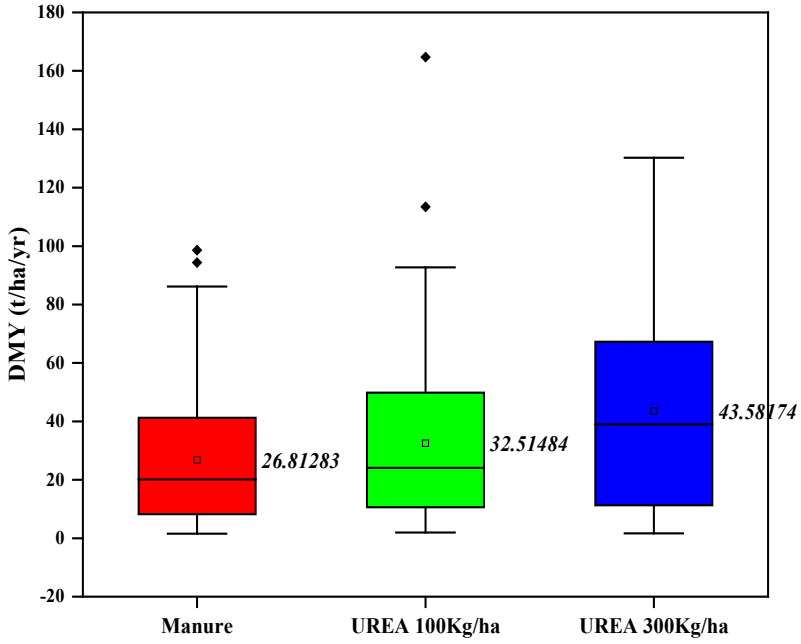
- High variability ($p<0.01$)
- Maximum 10.73 for Desmodium
- Minimum 5.6 for S.Scabra
- Mean 7.52 t/ha/yr



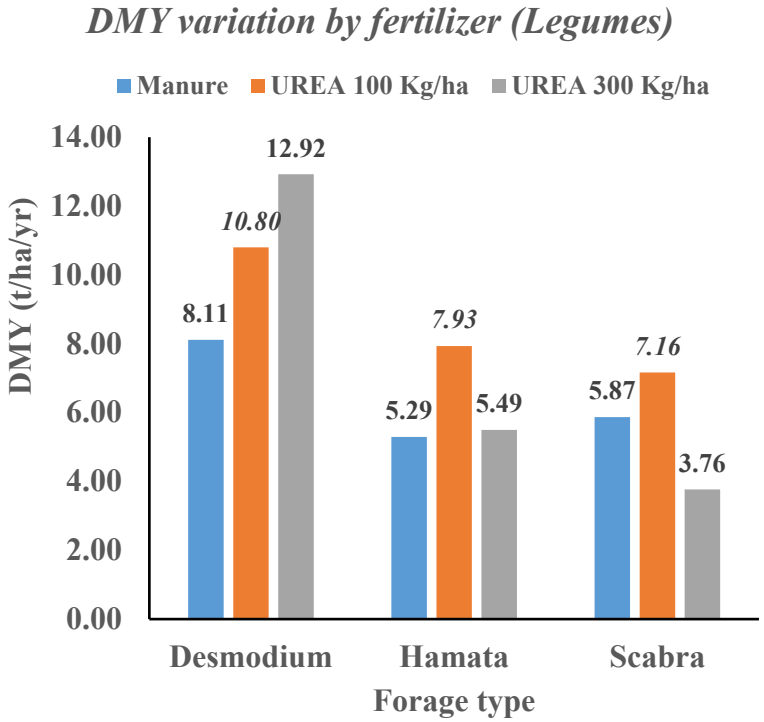


Effect of fertilizer on DMY

- UREA 300 Kg/ha highest (43.58 t/ha/yr)
- Manure lowest (26.81 t/ha/yr)

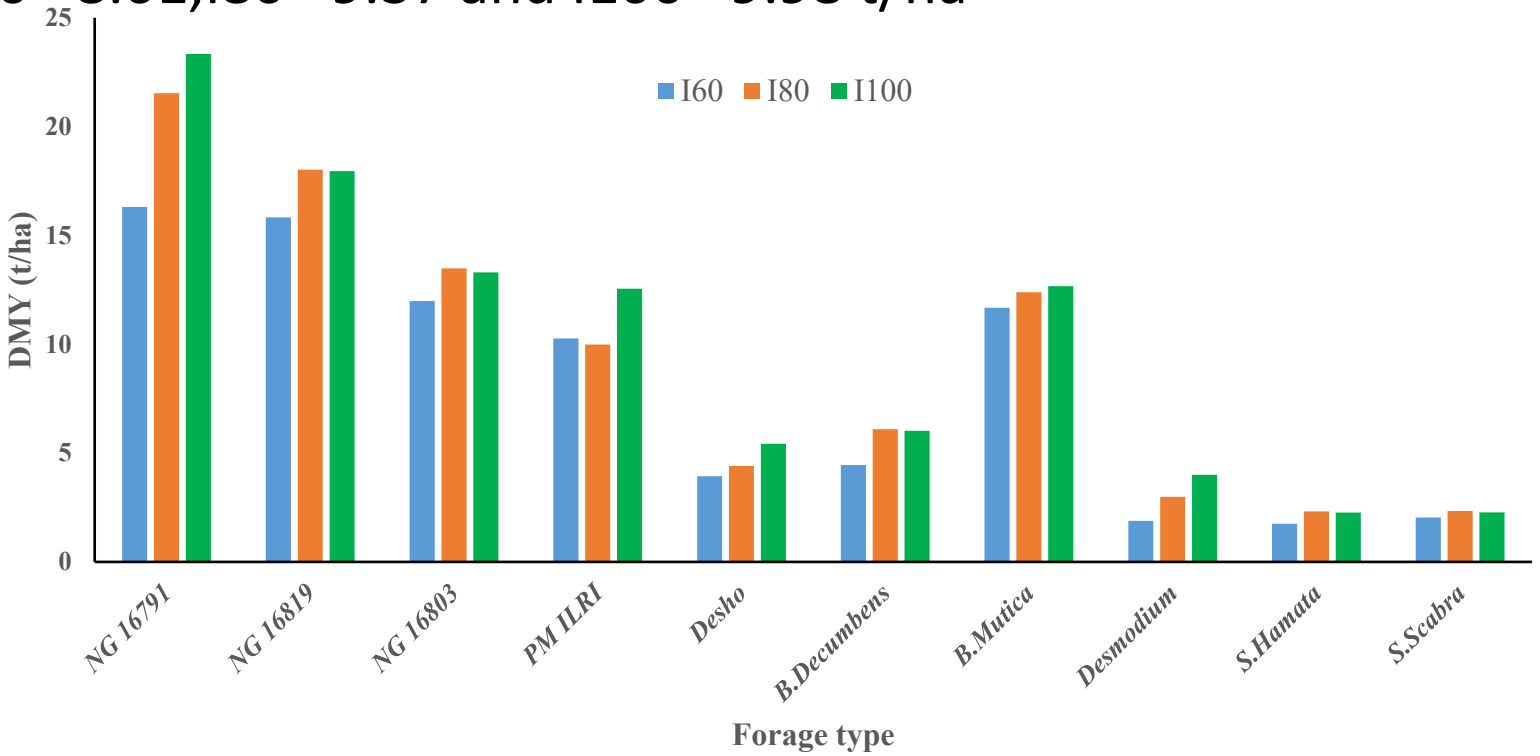


- Manure (6.42 t/ha/yr) ⟹ lowest
- UREA 100 Kg/ha (8.4) ⟹ Highest
- UREA 100 Kg/ha (7.4)

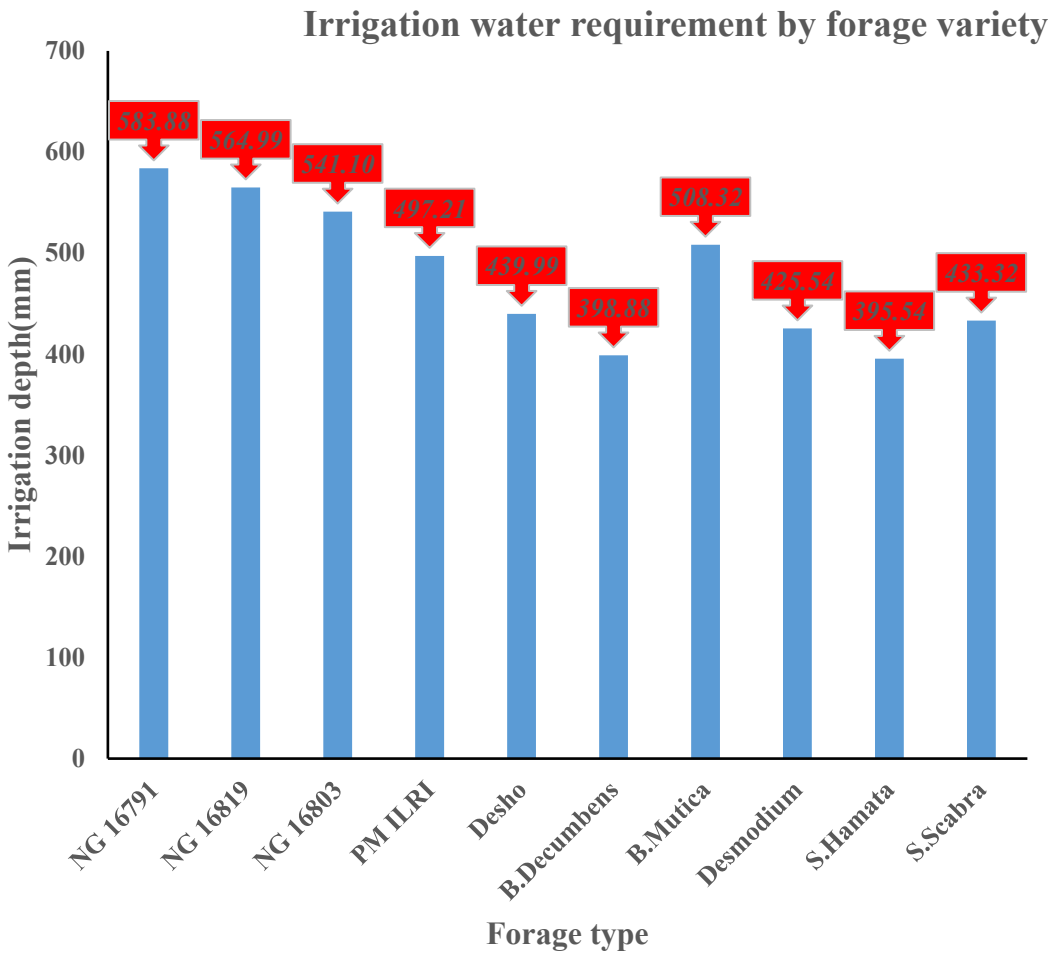


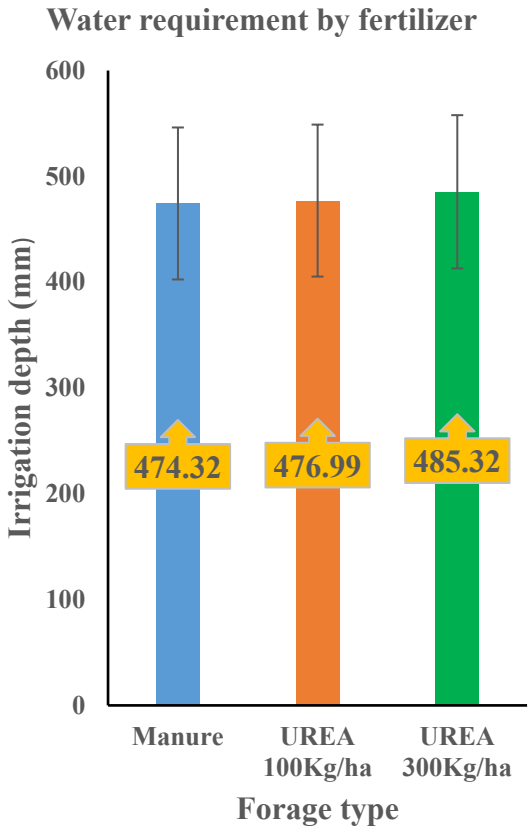
Effect of Irrigation on DMY

- No significant effect (p=0.216)
- I100 had highest DMY while I60 yield lowest DM
- I60= 8.01,I80= 9.37 and I100= 9.98 t/ha



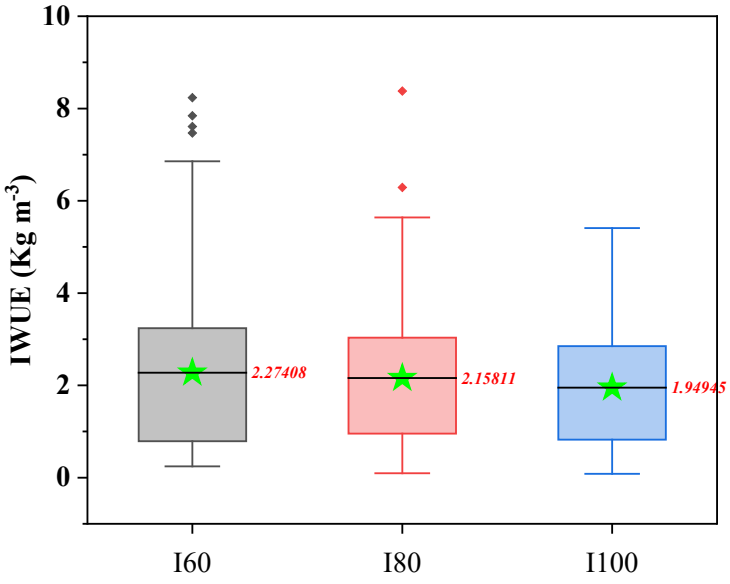
Irrigation water requirement by forage type and fertilizer





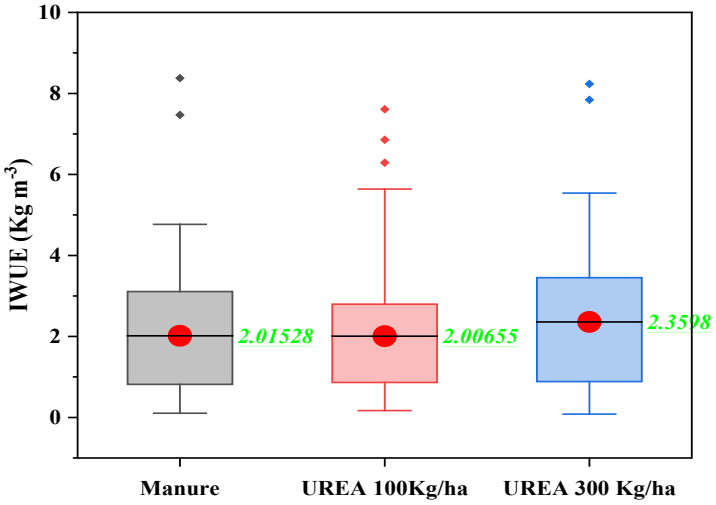
Effect of irrigation on IWUE

- No significant effect (p=0.401)
- I60 had highest, I100 had lowest WUE



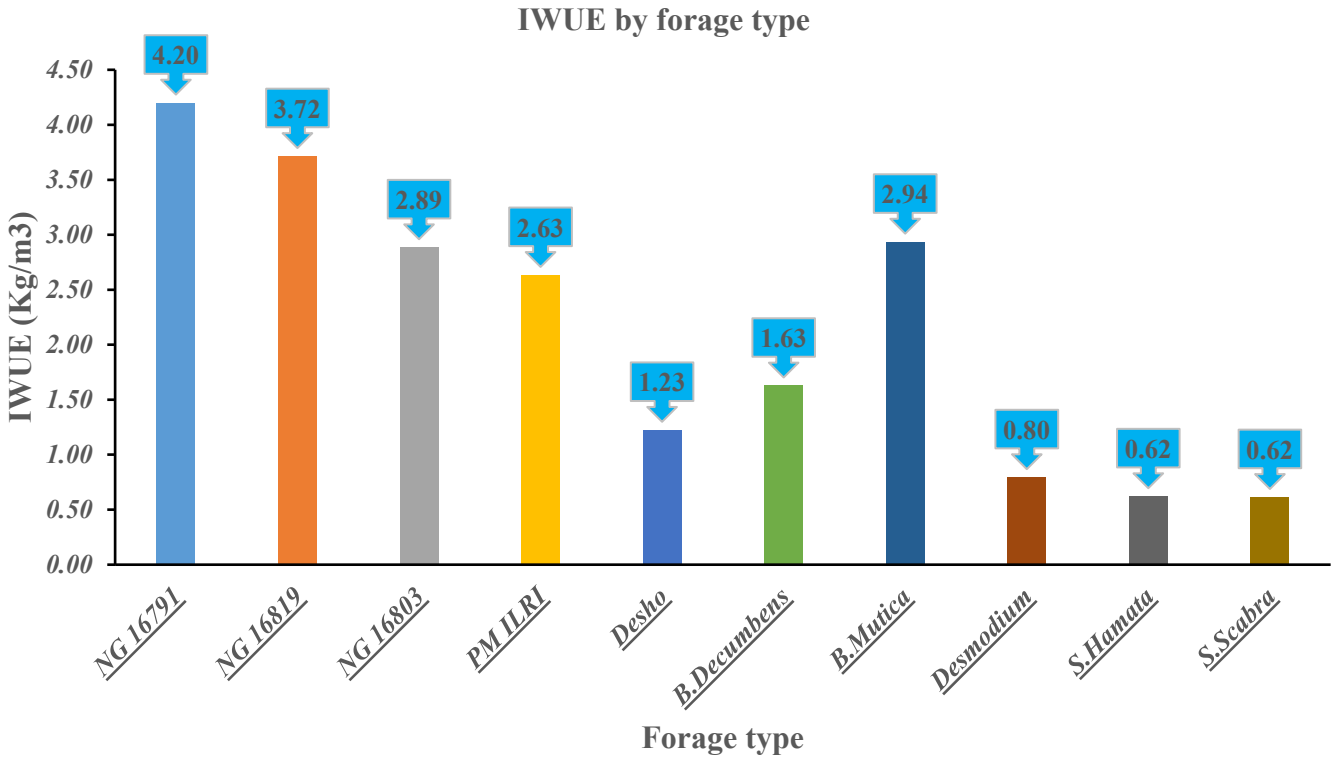
Effect of fertilizer on IWUE

- No significant effect (p=0.253)
- UREA 300 Kg/ha had highest
- UREA 100 Kg/ha had lowest WUE



Effect of forage type on Irrigation water use efficiency

- Significant ($p<0.001$)
- NG 16791 had highest (4.2) whilst Stylo's had lowest (0.62)



Conclusion

- Full irrigation gave highest DMY but low WUE
- Application of UREA at a rate of 300 Kg/ha had highest DMY and WUE
- Forage type affected both DMY and IWUE
- NG 16791 had the highest DMY and IWUE
- Among grasses B. Decumbens had the lowest DMY and Desho had the lowest IWUE.
- Among legumes Desmodium had the highest DMY and IWUE
- 40 and 20% decrease in irrigation water caused a yield reduction of 24.6% and 6.6% only while increasing the IWUE by 16.65 and 10.7% respectively
- When water is scarce, deficient irrigation can be a good management option

Acknowledgements

- This work is financed by ILSSI project led by ILRI
- It is implemented in a partnership with Bahir Dar university and Andasa livestock research center


THANK
YOU