EFFECT OF MIXING RATIOS OF MAIZE AND MUNG BEAN ON GROWTH AND WATER USE EFFICIENCY OF SPROUTED GREEN FODDER IN HYDROPONIC SYSTEM

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ABSTRACT

The study was carried out to investigate the effects of mixing maize and mung beans at different ratios of growth and water use efficiency of sprouted hydroponic fodder. A completely randomized design with three replications were used in which Maize an Mung beans were mixed at 100:0(T1), 75:25(T2), 50:50(T3), 25:75(T4) and 0:100(T5). All irrigated with only clean water for 9 days. The parameters measured were shoot height, root length, root layer thickness, yield, water use and efficiency. The results showed significant difference (P<0.05) in the shoot height, root length and root layer thickness. Also there was significant difference (P<0.05) on yield, water use and efficiency among the treatments. Average daily water use efficiency was similarly significant (P<0.05). On addictive effect analysis of growth and water use efficiency, T4(MB+M+MUE) and T3(M+MUE) was found to be most desirable. Hydroponic farmers are therefore at liberty to mix maize and mung bean (cereal and legume) at a ratio of up to 25;75 for improved growth of cereal fodder.

Keywords: Growth, Water use, Efficiency, Fodder, Hydroponic.

INTRODUCTION

Livestock need all the nutrients (energy, protein, water, minerals, and vitamins) for proper growth and performance [Kubkomawa, 2020]. Feed forms an important determinant of productivity and profitability of the livestock enterprise, as it constitutes more than 60% of the total cost of production (Mengistu and Alene, 2016). Seasonal availability of this resource poses a feeding constraint on livestock farmers and has a negative effect on the performance of the animal (Mengistu *et al*., 2021). Hydroponic fodder production which is a technology of growing plants in soilless medium, using water or dissolved nutrient can offer a quick alternative. Hydroponic fodder technology (HFT) produces green fodders that are rich in nutrients and free from diseases for livestock feeding. They are also referred to as auto-grass sprouted grain, sprouted green fodder, fresh fodder biscuit, and alfa culture (Das *et al*., 2022) .Supplementing feed with HF can help lower the cost of feeding and consequently the production cost, thereby increasing profitability (Adebiyi *et al*., 2018; Sujaya *et al*., 2020) The technology does not require any form of literacy for adoption making it ideal for alleviating poverty (by increasing profitability and reducing cost) among rural farmers (Uddin and Dhar, 2018).

MATERIALS AND METHODS

The research was carried out in the laboratory of the Department of Animal Production, Faculty of Agriculture, University of Jos. Jos is located on the coordinate 9.9487° N, 8.8911° E, of the equator and on an altitude of 1200 above sea level. Jos, Plateau State has a semi-temperate type of climate and experiences high rainfall of 11320 mm during the peak of the rainy season.

Maize seeds and mung beans were purchased from Katako market in Jos North Local Government. Water source was from the water supplied to the Faculty. Germination experiment was conducted in plastic trays with the dimensions OF 14X85X9 cm. Water collection container was done in the same way. Meter rule was used to measure height, measuring cylinder for volume and weighing scale for weight takings.Two experiments were conducted simultaneously. First was to evaluate the effect of different proportions of maize and mung beans on the height of sprouted green fodder in a hydroponic system and the second was the determination of the optimal proportion of maize and mung beans for maximizing water use efficiency of sprouted green fodder in a hydroponic system. A completely randomized design with three replications were used. Maize and Mung beans were mixed in five ratios, 100:0(T1), 75:25(T2), 50:50(T3), 25:75(T4) and 0:100(T5). Seed rate of 4.5kg/m² (Naik *et al*., 2015) was used. The parameters measured were weight of germination tray, daily volume of water use for watering, daily volume of water drained, daily fodder weight and final root length and shoot height.

Total water use was computed using the equation (Elmulthum *et al.*, 2023):

$$TWU = Total\ water\ added\ for\ irrigation - Total\ water\ drained\ from\ trays.$$

Water use efficiency was calculated using the following equation:

$$\text{WUE}=\frac{Total\ weight\ grain\ of\ fodder\ \left(\frac{kg}{tray}\right)}{TWU\left(\frac{m3}{tray}\right) daily\ WUE\ (DWUE)}$$

$$DWUE = \frac{Daily\ weight\ gain\ \left(\frac{kg}{tray}\right)}{DWU\ \left(\frac{m3}{tray}\right)}$$

Where;

$$Daily\ weight\ gain = \ weight\ gain\ in\ day(i+1) - Weight\ gain\ in\ a\ day\ i$$

DWU= Daily water use (total)

Average WUE (Avg. WUE);

$$Avg.\ WUE = \frac{WUE}{Number\ of\ days\ growing}$$

Data obtained were subjected to one-way analysis of variance (ANOVA) with a significant level P<0.05. (Using SAS JMP 13.2)

Results and Discussion

Table 1. Showed the shoot height, root length and root layer, thickness of the green fodder. The results showed significant difference (P<0.05) in the shoot height, root length of maize and mung beans as well as root layer thickness between the treatments.

Table 1: shoot height, root length and root layer thickness (cm)

Parameter	T1	T2	T3	T4	T5	SEM
Maize						
SH	14.867^{a}	17.533^{a}	19.400^{a}	19.267^{a}	- -	1.399
RL	12.000^{a}	14.367^{a}	14.767^{a}	14.967^{a}	- -	0.995
Mung bean						
SH	-15.733^{b}	17.100^{ab}	17.500^{ab}	20.333a		1.239
RL	-7.100^{b}	7.033^{b}	9.167^{a}	8.233^{ab}		0.546
RLT	1.700^{a}	1.333^{b}	1.167^{bc}	9.167^{c}	1.033^{c}	0.083

SEM: Standard error of mean ab in a group, means not connected by same letter are not significantly different.

The shoot height of maize observed in this experiment falls within the range of 11-30cm as reported by Naik *et al*. (2015) and that of mung bean were similar to 15-20cm as observed by Samreen et al. (2017). The root length was less than those of Ningoji *et al*. (2020), and Jeremiah *et al*. (2018). Root layer thickness is in agreement with that obtained by Soufan (2023).

The yield, water use and water use efficiency were significant (p<0.05) between the treatments. The yield values are similar to those observed by Ningoji (2020) and Jeremiah et al. (2018) but lower than 6-8 kg recorded by Kide et al. (2015).

Table 2: Yield, water use and water use efficiency

Treatment	Yield (kg/tray)	Water used(L/tray)	WUE(kg/L)
T1	0.142^{a}	0.943^{b}	0.150^{a}
T2	0.168^{a}	1.163^{ab}	0.143^{a}
T3	0.183^{a}	1.267^{ab}	0.142^{a}
T4	0.167^{a}	1.397^{a}	0.119^{a}
T5	0.181^{a}	1.507^{a}	0.120^{a}
SEM	0.022	0.092	0.010

T1 (100% maize) ,T2: (75% maize + 25% mung bean), T3 (50% maize + 50% mung bean). T4: (25% maize + 75 mung bean)

T5: (100 mung bean). SEM: standard error of mean. Abc- in a group, means not connected by same letter are significantly different.

The daily and average daily water use efficiency were highly significantly different (p<0.001) between the treatments Table 3. The result shows an increase in water used with increase in the percentage of mung bean in the mixture.

Table 3: Daily and average daily water use efficiency (kg/L)

Day	T1	T2	T3	T4	T5	SEM
1	$0.03\ 0^{a}$	0.037^{a}	0.037^{a}	0.017^{a}	0.063^{a}	0.020
2	0.220^{b}	0.360^{ab}	0.417^{ab}	0.507^{a}	0.547^{a}	0.051
3	0.127^{a}	0.147^{a}	0.133^{a}	0.137^{a}	0.053	0.022
4	0.220^{a}	0.097^{b}	0.130^{b}	0.113^{b}	0.080b	0.017
5	0.260^{a}	0.263^{a}	0.260^{ab}	0.127^{b}	0.123^{b}	0.027
6	0.243^{a}	0.200^{a}	0.207^{a}	0.150^{a}	0.157^{a}	0.021
7	0.190^{a}	0.083^{ab}	0.047^{ab}	0.010^{b}	0.017^{b}	0.035
8	0.060^{a}	0.083^{a}	0.047^{a}	0.020^{a}	0.000^{a}	0.041

9	0.017ab	0.10ab	0.027a	0.010ab	0.047b	0.015
Aveg.	0.015a	0.014a	0.014a	0.012a	0.012a	0.001

T1 (100% maize), T2: (75% maize + 25% mung bean), T3: (50% maize +50% mung bean), T4: (25% maize + 75% mung bean), T5 (100% mung bean), SEM: standard error of mean. Avg-Average, abc in a group , means not connected by same letter are significantly different.

The addictive effect of growth and water use efficiency was analyzed to find out which treatment is most significant on the basis of growth and WUE (Table 4).

This was done in two ways on the basis of general growth (maize and mung bean) that is M + MB +MUE and on the basis of maize that is M + MUE. There were significant differences ($p<0.05$) among the treatments for both M + MB + MUE and M + WUE. Therefore T3 is most recommended for the growth of maize green fodder and T4 for mung bean. Similarly treatments 1 and 2 are most desirable in terms of water use efficiency. Farmers are therefore encouraged to include legume in their cereal (HF) to about 75% to improve growth.

Table 4: Additive effect of growth and water use efficiency

Treatment	MB+M+MUE	M+MUE
1	0.572a	0.993a
2	0.998a	1.140a
3	1.053a	1.210a
4	1.071a	1.189a
5	0.566b	0.120b
SEM	0.048	0.057

T1 (100% maize), T2: (75% maize + 25% mung bean), T3: (50% maize + 50%) mung bean), T4: (25% maize + 75% mung bean), T5 (100% mung bean). SEM: standard error of mean, MB + M + MUE: additive effect of the height and shoot of mung bean and maize as well as MUE, M + WUE: additive effect of the height and shoot of maize as well as the WUE:

abc in group, means not connected by same letter are significantly different ($P<0.05$).

CONCLUSION

The mixture of cereal and legumes for the production of hydroponic fodder showed better performances in terms of growth. The additive effect also showed better performance of growth and water use efficiency. Growth performance of cereals at reasonable water use efficiency in hydroponic fodder could be improved by mixing cereals and legumes for HFP. More research could be conducted to discover other important aspects such as the nutritive value of the different mixtures, cost analysis and their effects on livestock performance.

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