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Effect of Manure Levels and Alfalfa (*Medicago sativa*) Cultivars Intercropping on Dry Matter Yield Napier Grass (*Pennisetum purpureum* L.) Under Irrigation in Kobo District, Ethiopia

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Abstract

The experiment was conducted at Sirinka Agricultural Research Center, Kobo sub center trial site, under irrigation to evaluate the rate of farm yard manure and Alfalfa (*Medicago sativa*) cultivars on the growth, dry matter yield and chemical composition of *Pennisetum purpureum* acc no. ILRI 14984. The experimental plots were irrigated with water. The experiment was a 4 × 3 factorial arrangement in RCBD design with three replication and combination of four different farmyard manure rates (0 t/ha, 8 t/ha, 10 t/h, 12 t/ha) and three different *Medicago sativa* cultivars combination (pure(sole) Napier, Hunter river, Hairy Peruvian). Napier grass was evaluated for biomass yield (dry matter yield). No significance difference was observed between dry matter yields ofgrass fertilized with 8 t/ha and unfertilized ($P>0.05$). But, grass fertilized with 12 t/ha had significant difference between control (T1 and with the rest of the rates ($p<0.05$). Non significance difference ($P>0.05$) was recorded in dry matter yield between grass intercropped with Hunter river (21.74 t/h) and sole Napier (20.29 t/ha) in dry matter yield.

Keywords: Dry matter yield; Farmyard manure; Hairy Peruvian; Hunter river

Introduction

Napier grass is a popular fodder for rearing the livestock because of its higher biomass yield, and its suitability for feeding the dairy cattle, sheep and goats. Problem of Napier grass production arises mainly due to lack of proper knowledge in adopting the recommended cultivation practices [1]. Like other tropical grasses, Napier grass is considered to be high in structural cell wall carbohydrates that increase rapidly with advance in maturity, whereas on the contrary is true with its crude protein (CP) content and digestibility. This implies the need for production strategies that can help improve the CP concentration and digestibility of Napier grass. One such approach is to establish it in association with legume species to make use of the yield advantage of Napier grass and the high CP content and digestibility of legume species. To this effect, the uses of tropical legumes like alfalfa (Medicago sativa) which are perennial in association with productive, but high cell wall fiber containing grass species such as Napier grass could be an advantage in improved supply of nutrients to livestock. Napier grass (Pennisetum purpureum) is a long-lived, tall, perennial bunch grass which has been well known in tropical and subtropical areas and widely grown from sea level to over 2000 m.a.s.l. The herbage can be killed by light frosts but the underground parts remain alive unless the soil is frozen, and growth resumes rapidly when conditions become ideal. Experience at Holetta also showed that Napier grass attains the recommended harvesting height of 1-1.5 m before the occurrence of frost in the months of October-January when it remains dormant, but resumes active growth with the commencement of short rains in March.

In Ethiopia, different forage species have been evaluated for adaptability and yield potential in the different agro ecology zones of the country. Accordingly, Napier grass has been recommended for fodder production and gaining acceptance and popularity in areas ranging from lowlands to the cooler parts of Ethiopian highlands [2]. Using of legume-grass pasture has advantage than pure stand forages [3,4]. Forage species recommended for the different agro ecological zones of Ethiopia have been evaluated and selected for adaptability and herbage yield in pure stands. Napier grass forage legume mixture can improve the nutritional plane of stock as forage legumes generally have a higher nutritive value than tropical grasses and also have the ability to fix atmospheric nitrogen through their symbiotic association with rhizobia [4].

Various researches has been conducted concerning adaptation, yield performance of different herbaceous legumes and grasses including Napier grass in pure stand form and in the form of grass – legume mixture (Oat-vetch, Desmodium-Napier grass, Napier grass-Alfalfa) in rain fed condition in Eastern Amhara [2].

In view of the scarcity and high cost of inorganic fertilizer, researchers have shifted attention to examining the performance of crops with organic manure considering that organic manure is cheap and readily available [5]. The production and persistency of grass depends on soil fertility, fertilizer application, water supply and cutting management [6].

Materials and Methods

The research was conducted at Sirinka Agricultural Research Center in Kobo sub center site which is located in North Wollo Zone of Kobo district; the district has livestock population of cattle 242,621; sheep 32,602; goat 118, 375; mule 574; camel 13,863; horse 44; poultry 156,126; beehives 4,194 [7]. The site has well organized and modern irrigation facilities. The area has an altitude of 1460 masl. Kobo district shares 43.74% of the total 47,292.7 ha of irrigable land of North Wollo,

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which is equivalent to 5.5% of the total irrigable land of the region [8]. It has rainfall 692.8 mm on average and minimum temperature of 22°C and maximum temperature of 30°C on average. The site is located at 12°9'N latitude, 39°38'E longitude, 570 km of Northeast of Addis Ababa and 50 km from the zone town, Woldiya.

Experimental design and treatments

Twelve treatments with three replicates of four different farmyard manure rates (0 t/ha, 8 t/ha, 10 t/ha and 12 t/ha) and three different cultivar combination of Alfalfa to Napier grass (sole Napier, Hunter River and Hairy Peruvian) were used. The levels of farm yard manure were in factorial combination with the cultivars. The experiment was laid out in a Randomized Complete Block Design (RCBD).

The Napier grass cultivar used was ILRI 14984 which is reported to be best adapted to the study area. The spacing used was 0.5 m between plants and 1 meter between rows.

There were 4 rows in a plot having 8 plants in a row with a total of 32 plants in the plot [9]. The grass was harvested when it reached about 1 m height [10]. After each harvest the total dry matter yield was determined by taking fresh samples of 500 g of each plant parts (stem and leaf) which were taken from representative samples from harvestable middle rows. The samples were taken to SARC for drying forced-air in a draft oven at a temperature of 65°C for 72 h [11].

Alfalfa

Hairy Peruvian and Hunter Riveralfalfa Cultivars were used which were brought from Debreziet Agricultural Research Center forage germplasm section. The Alfalfa seeds were uniformly drilled in the rows and then evenly coveredwith soil. They were planted between two rows of Napier grass. Spacing between rows of elephant grass and alfalfa was 30 cm [12]. There were about three rows of alfalfa between consecutive rows of Napier grass. Weeds were controlled through a combination of manual weeding and hoeing. The planting material was irrigated twice per week.

Data collection

Growth data: A sample of five culms of plants were randomly selected and tagged from the inner rows of each plot and used for the evaluation of growth parameters [9]. Plant height was determined by measuring beginning from its base to the longest leaf with a steel tape. Leaf number was determined by counting the number of leaves on each stand from the oldest to the one just emerging from the five stands of Napier grass. Leaf length was measured from the tip to the ligules of elephant grass which was conducted by using a meter rule on five stands that were previously selected. Leave width have been conducted by measuring the length of the leaf half way and at that point measure its width on five stands. Tiller number was determined by direct counting of the tillers from five plants that were randomly selected. The basal circumference is circumference of a collection of tillers per plant and was measured using meter around the base of Napier grass.

Green forage yield: Green forage yield per ha was estimated based on green herbage harvested/cut from sampling area. The green forage yield expressed (t/ha) wasdetermined by the following equation [13].

Dry matter yield

Dry matter yield is the oven-dried mass of herbage expressed in terms of t/ha. Dry matter yield was estimated by multiplying the estimated green forage yield with dry matter content of the herbage [13].

Methods of data analysis

The following mathematical model was applied to analyze the effect of all possible factors. $Y_{ijk}=\mu+M_i+A_j+(MA)_{ij}+BK+eijk$

Where: Yijk=individual observation

μ=Overall mean

$M_{i=}$ith Manure level effect

A_j=jth Alfalfa cultivar effect

$(MA)_{ij}$=ijth Manure level and alfalfa cultivar interaction effect

$B_{k=}$kth Block effect

eijk=Residual error

All the data obtained was subjected to Analysis of Variance in RCBD and the treatments means were separated using Duncan multiple range test using SAS (version 9) package. Correlation analysis was done using Pearson correlation test. One sample t-test was employed for soil nitrogen analysis. Data from the four harvests were pooled and analyzed together.

Results

Dry matter yield of Napier grass

At the first harvest (Table 1), there was no significant difference ($p>0.05$) between rates of 0t/ha and 8t/ha on dry matter yield of Napier grass and also there was no significant difference among Pure Napier grass and the other cultivars and also between cultivars on yield. But, there was significant different among the different FYM rate on forage yield ($p<0.05$) (10 t/ha FYM gave less dry forage yield than 12 t/ha but more yield than the other rates). Rate of FYM and cultivars had significant effect to dry matter yield of Napier grass (Table 2); 12 t/ha have very highly significant effect ($p<0.001$) on dry matter yield of Napier grass at the second harvest. There was no significant difference ($p<0.05$) among cultivars intercropped with Napier on yield of the grass during Second harvest. FYM-farm yard manure, SN-sole Napier, HP- hairy peruvian, HR-hunter river, SEM-standard error of means , GM-grand mean, CV-coefficient of variation, Sig-significance level at alpha 0.05.

During third harvest FYM level 12t/ha gave the highest dry matter yield (5.32t/ha) than the other rates numerically; but, statistically there was significant different between it and 0t/ha FYM. There was no significant difference ($p>0.05$) among farmyard manure rate10 and 8t/ha and 12t/ha FYM (Table 2). Cultivars have no significance difference on both DMY of Napier grass.

Treatment	Description
T1	without manure+sole Napier grass
T2	without manure+Napier grass intercropped with Hairy Puruvian (Alfalfa)
T3	without manure+Napier grass intercropped with Hunter river(Alfalfa)
T4	8 tone/ha+sole Napier grass
T5	8 ton^{-1}ha manure+ Napier grass intercropped with Hairy puruvian (Alfalfa)
T6	8 ton^{-1}ha manure+Napier grass intercropped with Hunter river(Alfalfa)
T7	10 ton^{-1}ha manure+sole Napier
T8	10 ton^{-1}ha manure+Napier grass intercropped with Hairy puruvian(Alfalfa)
T9	10 ton^{-1}ha manure+Napier grass intercropped with Hunter river (Alfalfa)
T10	12 ton^{-1}ha manure+Sole Napier
T11	12 ton^{-1}ha manure+Napier grass intercropped with Hairy puruvian(Alfalfa)
T12	12ton^{-1}ha manure+Napier grass intercropped with Hunter river(Alfalfa)

Table 1: Description of the treatments.

Treatments	Dry matter yield of Napier grass				
	1st	2nd	3rd	4th	Means of combined analysis
FYM (t/ha)					
0	3.72c	1.44d	3.66b	4.08d	14.55c
8	3.93c	2.59c	4.12a	5.19c	15.94c
10	8.08b	3.55b	4.23a	6.34b	21.63b
12	11.56a	6.13a	5.32a	8.19a	29.99a
cultivar					
SN	6.95	2.77b	4.63	5.95	20.29ab
HP	6.04	3.48a	4.09	5.93	19.55b
HR	7.48	4.04a	4.26	5.97	21.74a
GM	6.82	3.43	4.33	5.95	20.53
SEM	6.04	0.69	0.97	0.39	11.29
CV (%)	36	24	21.57	10.51	16.37

a,b,c,d.Means with different superscript within columns are significant(P<0.05).

Table 2: Dry matter yield (t/ha) of Napier grass as influenced by levels of manure and intercropping of *Medicago sativa* cultivars.

During the 4th harvesting time, different rates of farmyard manure have shown good influence on dry matter yield of Napier grass.12 t/ha FYM showed best performance than the rest of the rates; that means as rate of FYM increases, their effect on Napier grass drymatter yield also increases. There was no significant effect (p>0.05) due to cultivar difference on yield of Napier. As a result using either of the two cultivars for intercropping with Napier grass can improve both the quality and quantity of animal feed.

The mean combined analysis of dry matter yield of Napier grass throughout the four harvesting period was 20.53 t/ha. As shown from Table 2, FYM rate of 12 t/ha gave better yield than the other rates under irrigation condition. There was no significance difference in dry matter yield between manure rates of 0 and 8t/ha.

The mean dry matter yield of Napier grass was 20.53 t/ha in the study site. Grass fertilized with 12t/ha produce higher yield than the other rates.

Discussion

Nowacki and Weznikas [14] who found that high rates of N application increased the DM yield of grasses. Desai and Deore [15] reported that DM yield increased with increasing N application. Valentim et al. [16] and Siddiqui [17] also reported that application of N to Mott grass increased its DM yield significantly over control. In another study, also reported that significant linear increase in the dry matter yield of guinea grass, with an increasing rate of the FYM application at all harvests [18-21].

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