Comparison of Four Maize Cultivars (*Zea mays* L.) as Winter Forage in Sudan

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Abstract

Winter forage availability in Sudan is constrained by lack of a suitable annual winter forage crop. The main forage crop grown is Abu70 (*Sorghum bicolor*) which is a summer crop that yields 7.6-8.4 t/ha in summer but much less in winter. There is, therefore, need for a winter high yielding forage crop that exceeds Abu70 in productivity and quality. This study was aimed to evaluate four forage maize cultivars as potential winter crops in central Sudan in terms of productivity and quality. An experiment was conducted using four maize forage cultivars. The experiment lasted for two consecutive seasons 2010/11 and 2011/12 at Soba, Khartoum. A Randomized Complete Block Design (RCBD) with four replicates was used. The cultivars tested were Damazin, North Sudan, Hytech 2031and Hytech 2055. Yield/ha, crude protein (%) and digestibility (%) of the cultivars were assessed. Crude protein and digestibility of Abu70 were also determined while yield was estimated as a mean value from the huge data available on this traditional crop from literature. It was found that cultivars Hytech 2031 and Hytech 2055 yileded 11.73 and 13. 71 t/ha dry matter respectively while Damazin and North Sudan yielded 7.09 and 7.76 t/ha respectively. These differences were significant.. Crude protein was also higher for the maize cultivars compared with Abu70 being 8.18, 7.9, 8.07, 8.22 and 5.78% for Damazin, North Sudan, Hytech 2031, Hytech 2055 and Abu70 respectively. Digestibility was 68.6, 70.2, 71.3, 71.3 and 64.9% for the five forage crops respectively. It was concluded that Hytech2055 cultivar might be suitable for maize forage production during the winter season in central Sudan.

1- Introduction:

Forage production is of paramount importance for livestock production in Sudan. The RPA (2015) found a negative feed balance for livestock and the current feed gap was estimated at 56-million-ton DM. Production of large quantities of high-quality forage crops could be one of the alternatives to bridge the huge forage gap in Sudan (Khair, 2011). This necessitates expanding irrigated forages vertically and horizontally. Selection of cultivars for forage production is an important management practice, because it influences the nutritive value and results in high yielding fodder cultivars (Graybill *et al.*1991).Digestibility could be affected by plant genetics and all fodder of forage corn could be affected by variety (Frey, et al. 2004). When maize was grown as winter forage it gave high yield with high protein, butforage yield of Abu70 is suboptimal when sown in winter in Khartoum (Kambal, 1983). El Karouri and Mansi (1980) found that the optimum sowing periods of sorghum variety Abu Sabeen and maize variety 113 were found to be February to October and November to January respectively. Abde Rahman et al (2008) found similar results at Hudeiba Research Station, Sudan, Maize proved to be most suitable forage as it is characterized by high energy and protein content compared to other cereal forage crops (Ipperisiel*et al.* 1989). The reason behind planting maize for green forage production is to obtain succulent vegetative part in a comparatively short time. In Sudan, maize can be grown to produce forage in winter season to solve the problems of livestock feed shortage during this period. The main objective of this study was to evaluate forage maize as a potential crop during the winter season in central Sudan to mitigate the acute shortage of forage for livestock during the dry season.

2- Materials and Methods

2.1-Description of the Study area: The study was conducted for two consecutive seasons 2010/2011 and 2011/2012at the Demonstration Farm of the College of Forestry and Range Sciences, Sudan University of Science and Technology, Soba Khartoum (latitude 15^{o} 16 Nand longitude. 31^{o} 34 E). The Climate is tropical semi-arid with rainfall about 150 mm and mean temperature (6-46)^{o}C.

2.2Land preparation: The experimental site was disc ploughed and left for 15 days exposed to the sun. It was then disc harrowed to crush clods and leveled out to maintain a well leveled seed bed and then followed by ridging up to 0.7m between rows which were oriented in a north-south direction. Individual plot size was 4 × 5 meters consisting of 5 ridges. The treatments were arranged in a Randomized Complete Block Design (RCBD) with four replicates, each block had 12 plots.

2.3 Cultural practices: Seeds were sown on the 24th of December 2010 and 27th of December 2011 in the first and second season, respectively. Sowing was done manually on the two sides of the ridge, 3 seeds of maize were drilled in each hole, intra-row spacing was 10 cm apart, the seed rate used was 107 kg/ha. The plots were irrigated immediately after sowing and thereafter at intervals of 10-15 days according to need. Plots were hand weeded before and after the experiment was sown, till the crop gave a complete cover.

2.4 Treatments: Four maize cultivars (two local and two exotic) were obtained. They had either yellow or white seeds. The cultivars were: Damazin, North Sudan, Hytech- 2031 and Hytech- 2055.

2.5 Parameters measured:

2.5.1 Yield parameters: Yield parameters (Fresh forage yield (tons/ha) and dry forage yield (tons/ha)) were measured at the harvest (milk stage). In each plot the middle ridge was used for sampling.

2.5.1.1 Fresh forage yield (tons/ha): The measurement of fresh yield was conducted by harvesting green forage in an area of ($0.7m^2$) chosen from the middle ridge as destructive samples. A sickle was used for clipping plants around five cm above the soil surface. The samples were weighed using a spring balance immediately in the field to get the fresh weight. Final fresh yield was calculated in tons per ha.

2.5.1.2 Dry matter production (tons/ha): Dry forage production was determined using the same samples used for fresh yield. Fresh samples were dried at 60°C for 48 h in afan assisted ovan until a constant weight was reached. Final dry matter yield was calculated in tons per ha

2.5.2 Crude protein (CP%):

Forage samples were analyzed for their proximate components. Crude protein (CP%) content was measured by the Kjeldahl method as N*6.2 and the DM was determined by drying the samples at 105°C overnight according to AOAC methods (AOAC ,1990).

2.5.3 feed intake and digestibility;

The feed intake and digestibility of the four cultivars of fodder maize were compared with those of Abu70 (control). The experiment was instituted for70 days. The forage was prepared by harvesting all the plots. Four cultivars of maize (Damazin, North Sudan, Hytech- 2031 and Hytech- 2055) were harvestedand fed to rams. Forage sorghum (Abu70) was purchased from Soba agricultural project. Forages were dried under shade and kept in a safe place. Feed offered and refusals of the previous day were weighted and sampled. The feed intake was measured by subtracting refusals from feed offered. Digestibility bags and harnesses were made of canvas and used to collect faeces. After the determination of DM intake and DM faeces, the digestibility of DM was calculated as:

$$\text{Digestibility} = \frac{\text{DM intake (g)} - \text{DM faeces (g)}}{\text{DM intake (g)}} * 100$$

2.6 Statistical analysis:

Statistical analysis was performed using Statistical Analysis System (SAS, 1988). The data collected on yield and Crude protein (CP%) content over two seasons were subjected to analysis of variance (ANOVA), as well as DM intake and digestibility coefficients. The Duncan's Multiple Range Test was applied to compare the significance of differences among the various treatment means.

Results and Discussion

3.1- Forage yield:

As shown in Table 1, the differences between the cultivars in fresh and dry matter yields were highly significant ($P<0.001$). The highest value of the fresh and dry matter yield resulted from C4 (Hytech2055) cultivar followed by C3 (Hytech2031) cultivar. C1(Dmazin) and C2(North Sudan)which had the lowest fresh and dry matter yields . The variation in forage yield among varieties could be attributed to the differences in genetic makeup plants. These results are in line with those ofAhmad*et* *al*. (2012) and Kusaksiz (2010) who reported significant differences in green forage yield and quality among different maize cultivars.

Table (1): Effect of cultivars on fresh and dry matter forageyield (ton/ha) of maize.

Cultivars	Damazin	North Sudan	Hytech-2031	Hytech-2055	S. L	SE±	C.V%
Fresh forage	28.44 b	30.23 b	47.86 a	56.48 a	***	1.112	27.05
Dry matter forage	7.09 b	7.76 b	11.73 a	13.71 a	***	0.268	27.16

SE= Standard Error, C.V= coefficient of variation, S.L=significance level,

3.2- Crude protein content

The **Crude protein content** of the four forage maize cultivars as compared with Abu 70.It was found that Abu 70 showed the lowest value of 5.78 % of CP% compared with the highest value for maize cultivar Hytech2055 (8.22%) and the lowest maize cultivar North Sudan (7.9%). Other chemical components differed slightly. Similarly, Agabani (2008) reported that Abu 70 showed the lowest CP value of 5.9 % compared with three sweet potato varieties. Also,Khogali*et al*. (2011) revealed that fodder Abu 70 was lower than fodder beet in crude protein (6.30%) and ash (6.09%) and higher in crude fiber (27.50%). Abu 70 is the traditional forage crop grown under irrigation in Sudan. Its productivity and chemical composition have been intensively investigated. It was grown in the same area though not in the treatments sequence.The value for CP is in line with what is found in the literature in Sudan.

3.3- digestibility

Table 2 shows the mean of the four maize varieties had higher digestibility than Abu 70 though the differences were not significant (P>0.05). (Hytech 2055) and (Hytech 2031) had the highest digestibility than the other cultivars. These results agree with Olorunnisomo, (2010) who reported dry matter digestibility of sun-dried maize of (71.8%). On the other hand, the digestibility of DM for Abu 70 in this study was higher than that reported by Anon. (1980) at 48.5 % and Agabani (2008) at 49.5%.

Table (2): Mean digestibility from four maize cultivars and Abu 70 when fed to sheep.

Parameters	Cultivars					SE±	C.V	S.L
	Damazin	North Sudan	Hytech 2031	Hytech 2055	Abu 70			
Number of animals	5	5	5	5	5	–	–	–
Mean body weight	27.30	26.98	27.44	27.54	27.40	0.458	9.069	NS
Digestibility	68.55	70.18	71.28	71.32	64.93	0.934	6.309	NS
DMI (g/day)	647.09	619.44	652.37	622.46	575.40	23.67	24.718	NS

SE= Stander Error, C.V= coefficient of variation, S.L=significant level,

4- Conclusions and recommendations:

Forage maize in this study produced high dry matter yield with good quality as winter forage crop. The maize cultivar (Hytech2055) produced higher yields than the other cultivars in this study by(Hytech2031) and the lowest yield was found in (Dmazin) cultivar. Maize cultivars (Dmazin, North Sudan, Hytech2031 and Hytech2055) proved to be superior as feed due to their high crude protein content, intake and digestibility by sheep compared with Abu 70. The maize cultivar (Hytech2055) can be preferred because of the high forage and protein yield. Biomass yield of Hytech2055 and Hytech2031 in the winter is twice as much of Abu-70 in the summer (Kambal, 1983). Practices involving cultivars are strongly **recommended** and further research is needed to establish optimum combination. Cultivars (Hytech2055 and Hytech2031) can be **recommended** for forage maize cultivation in the winter season in central Sudan.

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References:

Abdle Rahman, A. M., Ali E. S., Hamada, A. A. and Siraj O. M. (2008). Optimum sowing time for maize (Zea mays L.) in Northern Sudan. Sudan Journal of Agricultural Research. 12 pp: 1-10.

Agabani, N.H. M. (2008). Use of sweet potato (Ipomea batatus) forage as an animal feed. M.Sc.Thesis , Sudan Academy of Sciences , in Animal nutrition.

Ahmad, W., Ahmad, A.U. H., Zamir, M. S. I., Afzal, M., Mohsin, A. U., Khalid, F. and Gillani, S. M. W. (2012). Qualitative and quantitative response of forage maize cultivars to sowing methods under subtropical conditions. J. Anim. Plant Sci. 22(2),pp: 318-323.

Anon. (1980). Utilization ofesidues of sweet potato (Ipomoea batats) in cattle feeding. CTVM. Trop. Inf. Leaflet 15 (6), pp: 2.

AOAC. (1990). Association of Official Analytical Chemists. Official methods of analysis. 15th ed. Arlington, VA.

El Karouri, M. O. H. and Mansi, M. G. (1980) Performance of Sorghum (Sorghum vulgare) and Maize (Zea mays) as Forages in Irrigated Saline Soils of the Sudan Journal WidgetExperimental Agriculture .16 (04): 431-436.

Frey, T. J., Coors, J.G., Shaver, R. D., Lauer, J. G., Eilert, D.T. and Flannery, P. J. (2004). Selection for silage quality in the Wisconsin quality Synthetic and related maize populations. Crop Science 44, 1200-1208. http://dx.doi.org/10.2135/cropsci2004.1200 7/5/2014.

Graybill, J.S., Cox, W.J. and Oils, D.J. (1991). Yield and quality of forage maize as influenced by hybrid, planting date and plant density. Agron. J. 83 (3): 559–565.

Ipperisiel, D., Alli, I., Machenze, A. F. and Mehuys, G.R. (1989). Nitrogen distribution, yield, and quality of silage corn after four nitrogen fertilization. Agron. J., 81: 783–789.

Kambal, A. E. (1983). Comparative performance of some varieties of sorghum, maize and pearl millet forage production in different seasons. Sudan Agricultural Journal. 10: 46- 60.

Khair, M. A. M. (2011). Messages to upgrade the production and consecution of forage in Sudan. Training and Publication Administration, Agricultural Research Corporation , Wad Madani, Sudan. (in Arabic).

Khogali, M. E., Dagash, Y. M. I. and El-Hag, M. G. (2011). The feeding value of fodder beet (Beta vulgaris var. Crassa) versus fodder sorghum abusabein (Sorghum bicolor L. moench) under Sudan conditions. Assiut Vet. Med. J., 57 (128): 34-54.

Kusaksiz, T. (2010). Adaptability of some new maize(zea mays l.) cultivars for silage production as main crop in mediterranean environment. Turkish J. Field Crops. 15(2): 193-197.

Olorunnisomo, O. A. (2010). Nutritive value of conserved maize, amaranth or maize amaranth mixture as dry fodder for growing West African Dwarf sheep. Livestock Research for Rural development. 22(10).

Range and pasture administration. (RPA). (2015). Feed Gap of livestock- 2014 and future vision. Ministry of Animal Wealth.

SAS. (1988). SAS/StatTM User's guide, Release 6.1 Edition.