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Effect of cutting intervals and additives on quality silage production from hybrid napier

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Abstract

An experiment was conducted to study the effect of cutting intervals and additives on quality silage production from hybrid napier. The experiment was laid out in factorial CRD with two factors *i.e.*, ensiling materials from different cutting intervals (E_1: 45 days, E_2: 60 days and E_3: 75 days) and additives (A_1: urea- 2%, A_2: jiggery- 2%, A_3: urea- 1% + jiggery- 1%, A_4: molasses- 2% and A_5: no additives) using hybrid napier (variety, Suguna) fodder. It was observed that quality silage can be prepared by ensiling the fodder harvested at 45 days interval with 2% urea or 1% urea and 1% jiggery as additives.

Keywords: Additives, Cutting interval, Hybrid napier grass, Quality silage

Abbreviations: ADF: Acid detergent fibre; **AIA:** Acid insoluble ash; **CF:** Crude fibre; **CP:** Crude protein; **EE:** Ether extract; **NDF:** Neutral detergent fibre; **NFE:** Nitrogen free extract; **NS:** Non-significant; **RP:** Recovery percentage; **TA:** Total ash

India is the leading country in milk production and livestock population. India accommodates nearly 20 per cent of the world's livestock. Although India has a very large population of livestock, the productivity of milk and other livestock products per animal is very low compared to developed countries in the world. Lack of availability of good quality green fodder throughout the year is the major constraint for high productivity of animals. Future development and growth of livestock are highly associated with the scope of availability of fodder from cultivable land, forest, pastures and grazing lands and also preservation of green fodder for lean season to ensure the year round availability (Shah *et al.,* 2011).

Kerala state has the highest percentage of crossbred animals with higher genetic potential for milk production, but the productivity is very low. Here also non-availability of good quality fodder is prominent. Although the per capita land availability is very less in Kerala, but high yielding varieties are expected to tackle the problem of fodder shortage. Among the fodder crops hybrid napier is the most popular fodder crop in Kerala, especially under rainfed conditions (Savitha and George, 2014). Compared to other fodder grasses it has good nutritional quality as well as high yield potential. However, appropriate cutting management is essential for high yield as well as quality of napier grass.

In south India the fodder shortage is severe during summer months due to high temperature. So ensiling is an alternative method to tackle this fodder shortage. Silage preserves the green fodder for a long time and also it is more nutritious than hay. For improving the nutrient content as well as quality, additives can be used. But use of inexpensive available materials as additives is expected to be very helpful for the rural farmers. Since this will reduce the loss of fodder during ensiling and also help to improve the quality and shelf life of silage. Keeping this in view, the present experiment was undertaken to study the effect of cutting intervals and additives for production of quality silage from hybrid napier grass.

The study was conducted during 2015-2016 at Kerala Livestock Development Board (KLDB) Farm, Dhoni, Palakkad. The hybrid napier variety Suguna released from Kerala Agricultural University was used for the study. The crop was raised as per the package of practices recommended by Kerala Agricultural University (KAU, 2011). The crop was harvested at different cutting intervals (45, 60 and 75 days). The harvested fodder was immediately chopped using chaff cutter. Then it was wilted under sun for 2-3 hours to reduce the moisture content to an optimum limit. The additives were prepared by mixing with water, and applied @ 30 ml/kg green fodder and thoroughly mixed with the wilted fodder. After thorough mixing, the silo bags were filled compactly and tied tightly. The experiment was laid out in factorial CRD, with 15 treatment combinations and 3 replications. It had two factors *i.e.* ensiling materials from different cutting intervals (E_1: 45 days, E_2: 60 days and E_3: 75 days) and additives (A_1: urea- 2%, A_2: jiggery- 2%, A_3: urea- 1% + jiggery- 1%, A_4: molasses- 2% and A_5: no additives).

The prepared silage was opened after 60 days of ensiling. Samples were collected for quality analysis. The pH of silages was recorded by using a pH meter. Crude protein (Simpson *et al.,* 1965) and crude fibre (Sadasivam and Manickam, 1996) contents were determined following standard procedures. Acid insoluble ash, ether extract and nitrogen free extract contents were estimated according to AOAC (1990). The fibre components including neutral detergent fibre and acid detergent fibre were determined according to Van Soest *et al.* (1991). Dry matter recovery (DMR) percentage was also calculated (Dantas *et al.*, 2014). The data on various parameters were analyzed statistically by using analysis of variance (ANOVA) technique factorial CRD and significance was tested by 'F' test (Snedecor and Cochran, 1967).

Colour is one of the important quality parameter of silage. Based on colour itself the silage quality can be assessed by visual observations. According to FAO (2005), light green to greenish brown is ideal for silage prepared from grass and maize, pale green and straw yellow is ideal for wilted grass silage. In the present study, the different additives tried for ensiling produced silage of pale green, light green, greenish brown and yellowish green. The silage with urea as additive showed a more greenish colour compared to others. The results on colour variations of silage from different fodder crops revealed that colour of napier bajra hybrid silage prepared in bunker silo without any additives was greenish yellow to brownish (Naik *et al.,* 2013), while colour of hybrid napier silage was light green to brown with the addition of molasses (Delena and Fulpagare, 2015).

No significant difference was noticed in pH of silage among the cutting intervals, additives and their interactions. The pH of all the silage was in acceptable range (3.7- 4.8). The lower pH obtained at 45 days cutting interval might be due to the presence of more water soluble carbohydrates in the early stages of growth. pH mainly represents the fermentation quality of silage, which reflects the changes occurred during ensiling. Lactic acid is the primary acid in good silage and therefore, is usually responsible for most of the drop in silage pH. Further fermentations that produce lactic acid result in the lowest losses of DM and energy from the crop during storage. Similar range in pH values were also observed by Venkataramanan *et al*. (2014) in *Phalaris aquatica.*

Though the different additives tried in this experiment did not show any significant influence on the total ash content in silage but the cutting intervals and interaction between cutting intervals and additives significantly influenced the total ash content of silage (Table 1). Fodder harvested at 45 days interval recorded the lowest ash content. Considering the interaction between cutting intervals and additives it was noticed that the different treatments registered lowest ash content, except in silage with fodder harvested at 75 days interval. The results obtained in the present study were in agreement with that of Aganga *et al.* (2005). Ash content in silage gives information about the organic matter as well as the mineral content in the fodder. Sometimes the highest ash content in the diet might cause some kidney problems to the cattle. Studies conducted by Ranjhan (1977) indicated that the optimum ash content in feed is below 10%. The silage prepared from the fodder harvested at 75 days interval had values more than 10%.This might be due to the presence of more minerals at longer maturity period or the possible contamination of fodder with soil due to lodging or more growth.

Lowest acid insoluble ash content (1.16%) was recorded with fodder harvested at 45 days interval. Additives and interaction between cutting intervals and additives didn't influence the acid insoluble ash content in silage (Table 1). The acid insoluble ash content is the acid insoluble portion of total ash content and indicates the amount of silica present in the sample. Higher acid insoluble ash indicates poor quality of feed and sometimes shows the adulteration of feed resources (Ranjhan, 1977).

ADF is the portion of the forage that remains on the filter after a finely ground forage sample is treated with a detergent and strong acid. It includes largely digestible cellulose, indigestible lignin and inorganic silica. ADF is important because it is negatively correlated with digestibility of forages. As the ADF increases, the forage becomes less digestible, primarily because of increase in the amount of indigestible lignin. Fodder harvested at 45 days interval recorded the lowest value. In case of additives, 2% molasses had the lowest value (Table 1). Interaction effects also significantly affected the ADF values. E_1A_4 (fodder harvested at 45 days interval + molasses 2 %) recorded the lowest value of 24.75%. Nayigihugu *et al* (1995) reported that increasing molasses levels lowered pH, ADF, and NDF percentages in bermuda grass silages.

Table 1. Effect of cutting intervals, additives and interaction effects on pH, TA, AIN, ADF and NDF contents of silage

Treatment	pH	TA (%)	AIA (%)	ADF (%)	NDF (%)
Ensiling material (E)					
E_1	4.24	6.67	1.16	27.65	44.54
E_2	4.32	8.45	1.63	33.55	51.93
E_3	4.53	10.56	1.80	44.07	61.81
SEm (±)	0.13	0.24	0.08	0.37	0.54
CD (P < 0.05)	NS	0.49	0.18	0.80	1.17
Additives (A)					
A_1	4.28	8.25	1.45	37.12	55.21
A_2	4.46	8.25	1.57	35.22	51.45
A_3	4.46	8.86	1.65	35.01	53.91
A_4	4.10	8.72	1.49	31.42	49.11
A_5	4.50	8.72	1.48	36.69	54.11
SEm (±)	0.16	0.31	0.11	0.48	0.70
CD (P<0.05)	NS	NS	NS	1.03	1.51
Interaction (E x A)					
E_1A_1	4.56	7.00	1.07	28.86	46.34
E_1A_2	4.06	5.76	1.23	28.29	44.28
E_1A_3	4.53	7.00	1.30	28.58	46.05
E_1A_4	3.76	6.73	1.04	24.75	40.73
E_1A_5	4.26	6.84	1.18	27.78	45.30
E_2A_1	4.16	7.63	1.65	35.71	55.08
E_2A_2	4.53	7.56	1.53	33.71	49.84
E_2A_3	4.23	9.52	1.90	33.64	52.76
E_2A_4	4.10	8.05	1.28	29.80	48.23
E_2A_5	4.56	9.50	1.79	34.88	53.74
E_3A_1	4.13	10.13	1.65	46.78	64.22
E_3A_2	4.80	11.42	1.97	43.66	60.22
E_3A_3	4.63	10.05	1.78	42.81	60.22
E_3A_4	4.43	11.39	2.16	39.71	58.38
E_3A_5	4.66	9.81	1.46	47.41	63.30
SEm (±)	0.28	0.53	0.19	0.84	1.22
CD (P<0.05)	NS	1.09	NS	1.79	NS

NDF fraction contains the cell wall material including cellulose, hemicellulose, lignin and silica. The NDF values were also showed a similar trend as in the case of ADF values. But the interaction between cutting intervals and additives didn't influence the NDF content in silage (Table 1). Low NDF contents are usually desired for forage crops since these materials complicate digestion and consequently decrease the quality. NDF contents recorded in the present study were similar to the values reported by Rodrigo *et al.* (2010).

It was noticed from the data that there was a reduction in crude protein in silage when the cutting intervals were increased (Table 2). The highest crude protein content (11.59%) was obtained from fodder harvested at 45 days interval. This high crude protein in silage could be attributed to the proportionate increase in crude protein content of green fodder harvested at 45 days interval. The crude protein content of younger grasses might be higher than mature grasses as the fibre content increases with maturity. Among the additives, urea- 2% recorded significantly higher crude protein content (10.55%) which was at par with urea- 1% + jiggery- 1%. The results of the present study were in agreement with the observations of Hamza *et al.* (2009) in whole corn silage and Ishrath and Thomas (2016) in hybrid napier silage. Interaction had no significant effect in crude protein content of silage.

Though cutting intervals significantly influenced crude fibre content, additives and interaction effects didn't significantly influence the crude fibre content. When harvest interval was increased, there was an increase in crude fibre content. The lowest value of 29.01% was

Table 2. Effect of cutting intervals, additives and interaction effects on CP, CF, EE, NFE and recovery percentage of silage

Treatment	CP (%)	CF (%)	EE (%)	NFE (%)	RP (%)
Ensiling material (E)					
E_1	11.59	29.01	1.61	51.11	93.00 (9.66)
E_2	9.67	39.15	2.07	39.91	90.66 (9.54)
E_3	8.09	42.90	1.91	36.12	91.13 (9.57)
SEm (±)	0.26	0.71	0.08	0.57	0.09
CD (P < 0.05)	0.54	1.45	0.17	1.16	NS
Additives (A)					
A_1	10.55	37.27	1.99	41.47	91.89 (9.61)
A_2	9.45	36.70	1.45	43.48	89.33 (9.55)
A_3	10.52	36.87	2.09	41.19	92.44 (9.64)
A_4	9.46	36.69	1.79	43.22	91.22 (9.50)
A_5	8.93	37.57	2.02	42.53	93.11 (9.67)
SEm (±)	0.34	0.92	0.11	0.73	0.127
CD (P<0.05)	0.69	NS	0.22	1.50	NS
Interaction (E x A)					
E_1A_1	13.31	30.79	1.33	47.48	94.33 (9.73)
E_1A_2	10.90	29.14	1.64	52.53	92.44 (9.64)
E_1A_3	12.69	28.62	1.45	50.18	95.00 (9.77)
E_1A_4	10.95	26.92	1.95	53.44	93.00 (9.67)
E_1A_5	10.06	29.54	1.73	51.20	91.22 (9.50)
E_2A_1	10.15	37.21	2.07	41.60	92.33 (9.63)
E_2A_2	9.71	38.81	1.51	41.74	85.00 (9.24)
E_2A_3	10.06	39.05	2.30	37.73	91.00 (9.56)
E_2A_4	9.32	39.11	2.07	40.12	90.67 (9.54)
E_2A_5	9.11	41.59	2.43	38.36	94.33 (9.73)
E_3A_1	8.23	43.79	2.60	35.24	90.00 (9.51)
E_3A_2	7.73	42.15	1.20	36.16	90.33 (9.77)
E_3A_3	8.77	42.95	2.53	35.69	91.33 (9.58)
E_3A_4	8.09	44.05	1.36	36.09	90.00 (9.31)
E_3A_5	7.65	41.56	1.90	41.56	94.00 (9.72)
SEm (±)	0.59	1.59	0.19	1.59	0.22
CD (P<0.05)	NS	NS	0.39	NS	NS

The values in parenthesis represent square root transformed values

observed from the fodder harvested at 45 days interval. Present findings were in agreement with the findings of Khandaker and Uddin (2013) and Naik *et al.* (2013).

Highest ether extract (EE) content (2.07 %) was observed in E_2 (fodder harvested at 60 days interval) which was at par with E_3 (fodder harvested at 75 days interval (Table 2). Khandaker and Uddin (2013) reported EE content of 0.23% from maize silage harvested at 75 days maturity and prepared in synthetic nylon bag silos. Among the five additives tried, highest ether extract value (2.09 %) was observed in A_3 (urea- 1% + jiggery- 1%) which was at par with A_5 (no additives) and A_1 (urea 2%) indicating that the additives had comparatively lesser role in deciding the ether extract content. This was in conformity with the findings of Naik *et al.* (2013), who reported a lower ether extract content of 1.1 % from napier bajra hybrid silage prepared in bunker silo without using any additives. When interaction effect was analyzed E_3A_1 (fodder harvested at 75 days interval + urea 2 %) recorded highest value (2.60 %) which was at par with E_3A_3, and E_2A_3 (Table 2).

The highest nitrogen free extract (51.11 %) was observed from the fodder harvested at 45 days cutting interval (Table 2). This might be due to the higher crude protein and lower crude fibre content in silage prepared from fodder harvested at 45 days cutting interval because the nitrogen free extract is a calculated value by subtracting crude fibre, crude protein, ether extract and ash contents from

100. Silage with 2% jaggery or 2% molasses recorded highest nitrogen free extract content. Here also the lower values of other silage parameters resulted in higher nitrogen free extract content (Table 2). Similar result was observed by Hamza *et al*. (2009) in whole corn silage with 2% urea and Naik *et al.* (2013) in napier bajra hybrid silage. The interaction of cutting intervals and additives significantly influenced the nitrogen free extract content in silage. E_1A_4 (45 days + molasses- 2%) showed highest nitrogen free extract (53.44%) which was at par with E_1A_2 and E_1A_5 (Table 2).

Recovery percentage in silage was in the range of 85-95%. Neither cutting intervals nor additives influenced the recovery percentage of silage (Table 2). The recovery percentage was directly related to crude fibre content. Crude fibre content of green fodder was within the acceptable range of 26% to 41%, and that might be the reason for high recovery percentage of silage.

From the study, it was concluded that better quality silage from BN hybrid can be prepared by ensiling the fodder harvested at 45 days interval with 2% urea or 1% urea and 1% jaggery as additives.

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