Effect of triticale silage on milk yield, quality and digestibility of indigenous lactating cows under stall fed condition

N.R. Sarker, M. Asaduzzaman, K.S. Huque, E. Haque and S. R. Waddington

Executive summary

The study was conducted to determine the effect of feeding triticale silage on milk yield, quality, intake and digestibility of indigenous lactating cows under stall fed condition. To achieve the above objectives, a total of fourteen mid lactating Pabna cows were selected having 2 - 5 lactation and between 175-286 kg initial body weights. All the experimental cows were selected having daily initial milk yield of 2.5-5.50 litre. The selected cows were randomly allocated into two treatment groups on the basis of daily milk yield and each treatment group having 7 cows. Similar management practices were provided to all the experimental cows and they were kept in open sided tail to tail housing system. All the lactating cows were provided individual pen on stanchion barn having about 10 x 3.75 x 10 ft. dimensions with facilities for separate milking and collection of faces. Roughage (triticale silage) feeds were supplied three times in a day (8 a.m, 12 a.m. and 4 p.m.) and concentrate feeds were provided two times daily before milking of cows (7 a.m. and 3 p.m.) during the whole experimental period. Triticale silage and rice straw was supplied *ad libitum* (about 20 % extra to that of the intake) as the basal diet. In addition to triticale silage, concentrate mixture was offered daily on the basis of milk production by following the equation, C= 0.5+ 0.7x Milk. Fresh and clean water were supplied four times daily. Cows and floor of pen were washed daily before milking. The trial was continued for 9 weeks. The study reveals that overall average roughage DM intake was non-significantly (P>0.05) higher in straw group (3.73 ± 0.04 kg/cows/d) than the silage (3.16 ± 0.0 6 kg/cows/d) group. Total estimated metabolizable energy (ME) intake was significantly (p<0.05) higher in silage group (792.55 ± 7.20 kJ/kg $W^{0.75}$/day) than that of rice straw group (775.21 ± 7.66 kJ/kg $W^{0.75}$/day). Similarly, the total estimated metabolizable protein (MP) intake was also significantly (p<0.05) higher in triticale silage group (8.47 ± 0.08 g/kg $W^{0.75}$/day) than that of the rice straw (7.89 ± 0.08 g/kg $W^{0.75}$/day) group (Table 1).

Table 1. Average intake of nutrient by the lactating cows fed *ad. libitum* silage and straw with con. mixture

Parameters	Experimental groups		Level of significance
	Silage group (Mean ± SE)	Straw group (Mean±SE)	
Average roughage dry matter intake (kg/d)	3.16 ± 0.06	3.73 ± 0.04	NS
Average concentrate dry matter intake(kg/d)	3.84 ± 0.06	3.18 ± 0.05	NS
Average total dry matter intake (kg/d)	7.00 ±0.06	6.91± 0.05	NS
Average total dry matter intake as % of live weight	2.87 ± 0.03	2.79 ± 0.03	NS
Average total dry matter intake(g/kg $W^{0.75}$/d)	113.00 ± 1.03	110.74±1.09	*
Average total ME intake (MJ /d)	49.06 ± 0.42	48.42 ± 0.55	*
Average total ME intake (kJ/kg $W^{0.75}$/d)	792.55 ± 7.20	775.21±7.66	*
Average total MP intake (kg/d)	524.78 ± 4.77	509.43±5.89	*
Total MP intake (g/ kg $W^{0.75}$/d)	8.47 ± 0.08	8.15 ± 0.08	*

The average daily milk yield was statistically higher (P<0.05) in silage feeding group (4.65 ± 0.05 Litre/d) than that of rice straw (3.41 ± 0.07 Litre/d) group. Further, the results indicated that there was no significant difference in the milk dry matter (12.42 ± 0.26 vs. 12.47 ± 0.42), milk fat (4.43 ± 0.07 vs. 4.17 ± 0.09) and milk protein (3.38 ± 0.09 vs. 3.31 ± 0.05) for the silage and rice straw groups (Table 2).

Table 2. Effect of straw and silage feeds on milk yield and quality of mid lactating cows

Parameters	Experimental groups		Level of significance
	Silage group (Mean ± SE)	Straw group (Mean ± SE)	
Group average initial milk yield (Lit./day)	3.14 ±0.48	3.14 ± 0.82	NS
Group average milk yield (litre/d)	4.65 ± 0.05	3.41 ± 0.07	*
Group average increase of milk (Litre/day)	0.51 ± 0.02	0.27 ± 0.03	*
Group average milk dry matter (%)	12.47 ± 0.42	12.42 ± 0.26	NS
Group average milk fat (%)	4.43 ± 0.07	4.17 ± 0.09	NS
Milk protein (%)	3.38 ± 0.09	3.31 ± 0.05	NS

The average daily live weight gain was significantly higher (P<0.05) in silage group (1.27 ± 0.30 kg/d) compared to the rice straw (0.873 ± 0.07 kg/d) group. The feed conversion ratio was also higher (P<0.05) in silage group (5.52 kg DM/kg gain) than the rice straw group (7.91 kg DM/kg gain) (Table 3). The trend of milk production in triticale silage group and rice straw are also presented in Fig. 1.

Table 3. Average daily live weight gain of silage and straw groups lactating cows during 9 wks of the trial

Parameters	Experimental groups		Level of significance
	Silage group (Mean ± SE)	Straw group (Mean ± SE)	
Initial body weight (kg)	228.29 ±14.78	235.43 ±12.13	*
Final body weight (kg)	299.86 ±13.63	274.71 ±12.14	*
Daily live weight gain(kg/d)	1.27 ± 0.30	0.873±0.07	*
Feed conversion ratio (kg DM /kg gain)	5.52	7.91	*

Digestibility coefficients of DM (67.37 ± 1.94 vs. 59.28 ± 1.94), OM (69.97 ± 5.75 vs. 59.38 ± 5.5), ADF(59.15 ± 2.22 vs. 56.93 ± 1.52),CP (64.19 ± 4.23 vs. 59.73 ± 3.89) and Ash (78.07 ± 70.26 vs. 70.25 ± 0.95) were significantly higher (P<0.05) in silage group than the rice straw group (Table 4).

Table 4. Co-efficient digestibility of some nutrients in mid lactating cows fed triticale silage and rice straw

Parameters	Experimental groups		Level of significance
	Silage group (Mean ± SE)	Straw group (Mean ±SE)	
Digestibility coefficient of dry matter (DM)	67.37 ± 1.94	59.28 ± 1.94	*
Digestibility coefficient of Organic matter (OM)	69.97 ± 5.75	59.38 ± 5.5	*
Digestibility coefficient of Acid Detergent Fiber (ADF)	59.15 ± 2.22	56.93 ± 1.52	*
Digestibility coefficient of Crude Protein (CP)	64.19 ± 4.23	59.73 ± 3.89	*
Digestibility coefficient of Ash	78.07 ± 70.26	70.25 ± 0.95	*

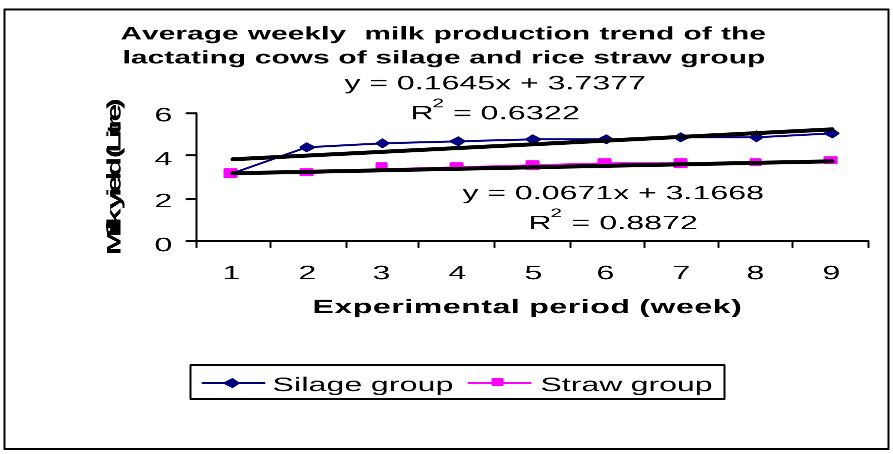

Figure 1. Average weekly milk yield trend of the lactating cows fed silage and rice straw over 9 weeks of the experimental period.

From the above discussions, it can be concluded that the effect of triticale silage had beneficial effect (P<0.05) on intake, milk yield, milk quality, live weight gain, feed conversion ratio and digestibility of the mid lactating cows than the rice straw fed group under the prevailing intensive management and environmental condition. Further comprehensive study is needed to arrive at a definite conclusion on the effect of feeding triticale silage on milk production and its quality.

Study the agronomical practices on green biomass, grain yield of triticale and their nutritive evaluation

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Executive summary

To determine the agronomical practices on green biomass and grain yield of triticale, a 2x3x5 Factorial design was followed and the experiment was conducted at Pachutia Research Farm of BLRI with 20x 8 sq. m plot size. There were 3 treatments in each factor. The factor 1 had three treatment groups. i.e. G_0 = Zero cut, G_1 = Single cut at 35 days ,G_2 = Double cut (one at 35 DAS and another at 50 DAS) and Factor 2 also had three treatment groups. i.e. F_0 = Cut the whole at milk stage of grain, F_1 = Cut at 40 DAS, F_2 = Double cut (one cut at 40 DAS and another at 65 DAS). The each treatment had five replications. After land preparation, the land was divided into 30 plots each having a size of 20x8 sq.m. All the treatents were randomly assigned in each plot to provide equal chance of each treatment in the experimental land. All the intercultural operations and irrigation were done as per recommendation of the triticale production manual.

The biomass (t/ha) yield of fresh triticale under different cutting intervals are presented in Table 1. The results indicated that the fresh biomass yield of F_2 treatment at 65 days cut was significantly ($p<0.05$) higher F_1 (16.30± 30) and F_2 (17.48± 0.78) treatment groups at 40 days cut. The yield was higher at 65 days , because after Ist cut the whole plant was cut at 65 days just above the ground. Biomass yield of triticale (t/ha) was significantly higher (16.34± 0.98) and (16.38± 1.61) in G_1 and G_2 treatment groups (Table 2).

Table 1. Triticale biomass yield of forage treatment group

Parameters	Different treatment groups				Level of significance
	F_1 (40 days) (Mean ± SE)	F_2 (40 days) (Mean ±SE)	F_2 (65 days) (Mean ±SE)	F_0 (95 days) (Mean ±SE)	
Biomass yield (t/ha.)	$16.30^d \pm 0.98$	$17.48^c \pm 0.78$	$29.12^a \pm 0.92$	$18.22^b \pm 0.71$	*

SE: Standard error of mean; [abcd] Means with different superscripts in the same row differ significantly; *Significant at 5% level.

Table 2. Triticale biomass yield of grain treatment group

Parameters	Different treatment groups			Level of significance
	G_1(35 days) (Mean ± SE)	G_2 (35 days) (Mean ± SE)	G_2 (50 days) (Mean ± SE)	
Biomass yield (t/ha.)	$16.34^a \pm 0.98$	$16.38^a \pm 1.61$	$2.47^b \pm 0.21$	**

SE: standard error of mean; [ab] Means with different superscripts in the same row differ significantly at 1% level.

The straw, grain, rachis + husk yield triticale are shown in Table 3. It indicates that straw yield (t/ha) of triticale under zero cut was significantly ($p<0.05$) higher (16.48 ± 0.92) than the yield of Ist cut (9.37± 1.12) and (11.65± 1.30) for G_1 and F_1 or 2nd cut (5.39± 0.52) . The grain yield of zero cut was also significantly ($P<0.05$) higher (5.46±0.38 ton/ha) than the yield of Ist cut (3.69± 0.58) and 3.24± 0.39 t/ha) respectively for G_1 and F_1 treatment groups. The proportion of botanical fractions of grain head revealed that cutting significantly ($P<0.05$) affected the proportion of grain ($p<0.01$) rachis + husk ($p<0.01$) of seed head of triticale. Triticale that were allowed to grow only after one cutting in its growing period, produced highest proportion of grain (21-22%) compared to zero cut (18.81%). The grain head such as rachis + husk yield varies from 2.87 ± 0.19 t/ha to 7.02± 0.30 t/ha for Ist and 2nd cut and zero cut respectively. The proportion of yield was significantly ($p<0.05$) higher $_{F1}$ treatment group followed by G_0, G_1 and G_2 treatment groups respectively. The study reveals that there was no significance difference ($p>0.05$) in DM contents between the Ist cut (35 days after sowing) of the treatment groups $G_1$and G_2 (Table 4). On the other hand, DM contents between F_1 and F_2 were significantly different ($p<0.05$) at Ist cut (40 days after sowing). The DM was highest at 95 days cut triticale (58.97± 2.26) compared to 65 days cut triticale (18.82± 0.53). Table 4 also reveals that the ADF content of triticale forage increased with the increase of age of the plant. The ADF content was highest in 95 days cut triticale compared to 35 days and 40 days cut. The ADF values between G_1 (23.03± 1.14) and G_2 (23.69 ± 0.61) treatment groups did not differ significantly ($p<0.05$) but there was a significant difference ($p<0.05$) in ADF contents between F_1 (29.19±1.00) and F_2 ((30.34±1.01) treatment groups. Similar trend was also observed incase of crude protein content of triticale forage. The highest crude protein content was observed in Ist cut triticale (27.16-

27.61) followed by 40 days (21.99- 22.99), 65 days (17.84 ± 0.79) and 95 days (8.93 ± 0.37) respectively. Ash content was highest in Ist cut (35 days after sowing) triticale forage (12.96- 13.49) followed by 40 days (11.98-10.77), 65 days (7.47 ± 0.42) and 95 days (6.69± 0.45) respectively. In general, it was observed that the ash content in triticale forage decreased with the increase of maturity of the plant.

Table 3. Treatment effect on straw, grain and rachises and husk of triticale

Parameters	Different treatment groups				Level of significance
	G_0 (Mean ± SE)	G_1 (Mean ± SE)	G_2 (Mean ±SE)	F_1 (Meant± SE)	
Straw (Ton/ha.)	$16.48^{a} \pm 0.92$	$9.37^{c} \pm 1.12$	$5.39^{d} \pm 0.52$	$11.65^{b} \pm 1.30$	**
Grain (Ton/ha.)	$5.46^{a} \pm 0.38$	$3.69^{b} \pm 0.58$	$2.43^{c} \pm 0.10$	$3.24^{b} \pm 0.39$	**
Rachises and husk (Ton/ ha.)	$7.02^{a} \pm 0.30$	$4.19^{b} \pm 0.51$	$2.87^{c} \pm 0.19$	$4.61^{b} \pm 0.69$	**
% of straw	$56.76^{b} \pm 1.24$	$54.17^{c} \pm 1.05$	$50.01^{d} \pm 2.99$	$59.89^{a} \pm 2.43$	*
% of grain	$18.81^{c} \pm 0.95$	$21.24^{b} \pm 2.47$	$22.97^{a} \pm 1.62$	$16.61^{d} \pm 1.11$	*
% of rachises and husk	$24.35^{b} \pm 1.13$	$24.59^{b} \pm 2.15$	$27.01^{a} \pm 2.06$	$23.47^{c} \pm 1.99$	*

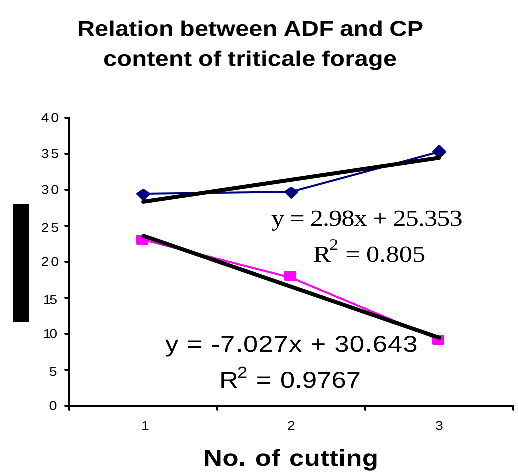
SE: standard error of mean; [abcd] Means with different superscripts in the same row differ significantly; ** Significant at 1% level and *Significant at 5% level.

Table 4 . Effect of cutting on nutritive value of fresh triticale

Parameters	Treatment groups						Level of significance
	F_1(40d) (Mean± SE)	F_2 (40d) (Mean± SE)	F_2 (65d) (Mean± SE)	F_0 (95d) (Mean± SE)	G_1(35d) (Mean± SE)	G_2 (35 d) (Mean± SE)	
Dry matter (%)	$12.89^{d} \pm 0.35$	$13.79^{c} \pm 0.82$	$18.82^{b} \pm 0.53$	$58.97^{a} \pm 2.26$	$12.78^{d} \pm 0.51$	$12.98^{d} \pm 0.53$	*
Organic matter (%)	$88.02^{b} \pm 0.42$	$89.23^{b} \pm 0.90$	$92.52^{a} \pm 0.74$	$93.04^{a} \pm 0.43$	$87.04^{c} \pm 0.45$	$86.50^{c} \pm 0.97$	*
ADF (%)	$29.19^{c} \pm 1.00$	$30.34^{b} \pm 1.01$	$29.62^{c} \pm 1.29$	$35.15^{a} \pm 1.62$	$23.03^{d} \pm 1.14$	$23.69^{d} \pm 0.61$	*
Crud Protein (%)	$22.99^{b} \pm 0.71$	$21.99^{b} \pm 0.73$	$17.84^{c} \pm 0.79$	$8.93^{d} \pm 0.37$	$27.16^{a} \pm 1.16$	$27.61^{a} \pm 1.39$	*
Ash (%)	$11.98^{b} \pm 0.42$	$10.77^{c} \pm 0.90$	$7.47^{d} \pm 0.74$	$6.96^{d} \pm 0.42$	$12.96^{a} \pm 0.45$	$13.49^{a} \pm 0.97$	*

SE: standard error of mean; d: Days ; [abcd] Means with different superscripts in the same row differ significantly; *Significant at 5% level.

The inter-relationship between crude protein and ADF content of triticale forage is shown in Fig. 1. It indicates that increase in cutting interval negatively correlated with the crude protein content of triticale forage (R^2 = 0.9767; Y= -7.027 + 30.643). This relationship suggests that the increase in a single cutting may decrease at least 7 % crude protein of triticale forage. On the other hand, cutting number has a positive relationship with the ADF content of triticale faorage (R2=0.805;Y=2.98x+25.353). This equation suggests that the increase in cutting frequency may also increase almost 3% ADF of the triticale forage. From the above findings, it may be concluded that triticale forage and grain can be used as a supplement to ruminants and poultry diet.



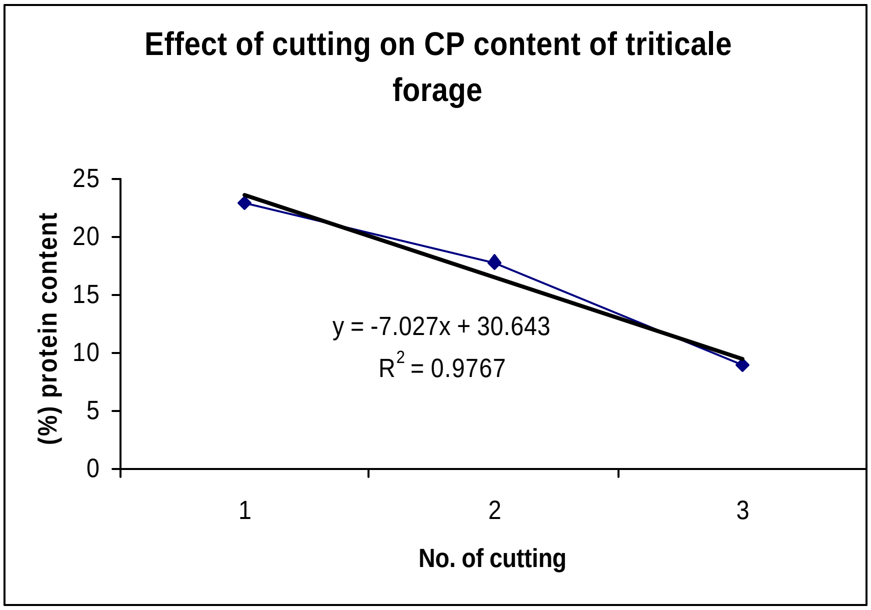


Fig. 1. Relationship between number of cutting and crude protein content of triticale forage

On the other hand, Fig. 2 shows that cutting positively correlated with the ADF content of triticale forage (R^2= 0.805; Y= 2.98x +25.353). The relationship presented in the equation suggested that one unit increase of cutting may increase almost 3% ADF content of triticale forage.

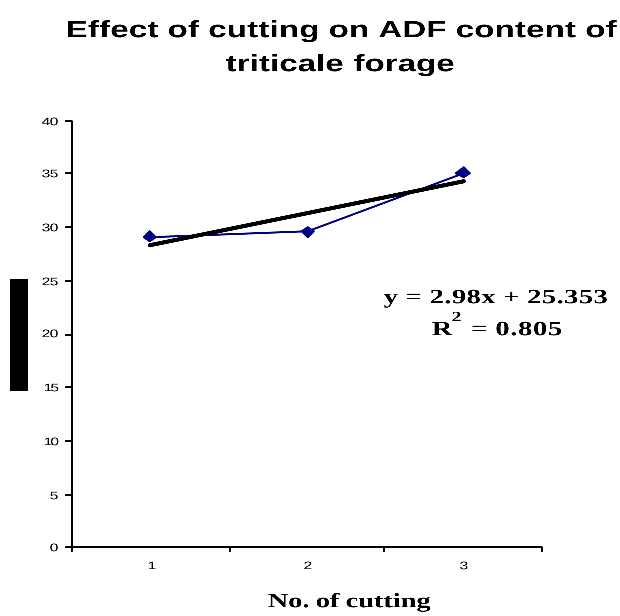


Fig 2. Relationship between cutting number and ADF content of triicale forage

Fig 3. shows the inter-relationship between CP and ADF content of triticale forage. The inter-relationship showed that cutting interval was positively correlated with the ADF content and negatively correlated with the CP contents.

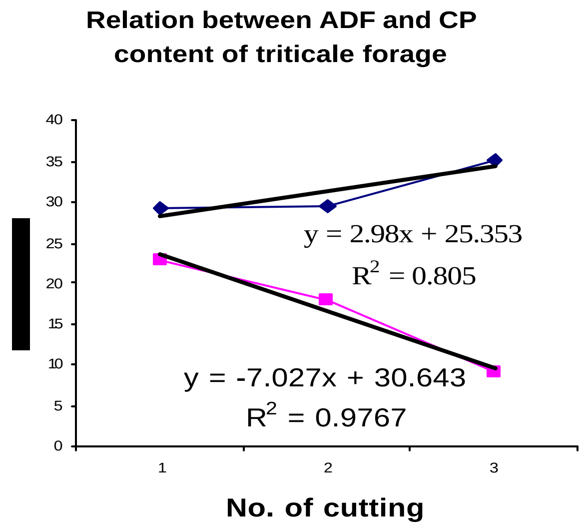
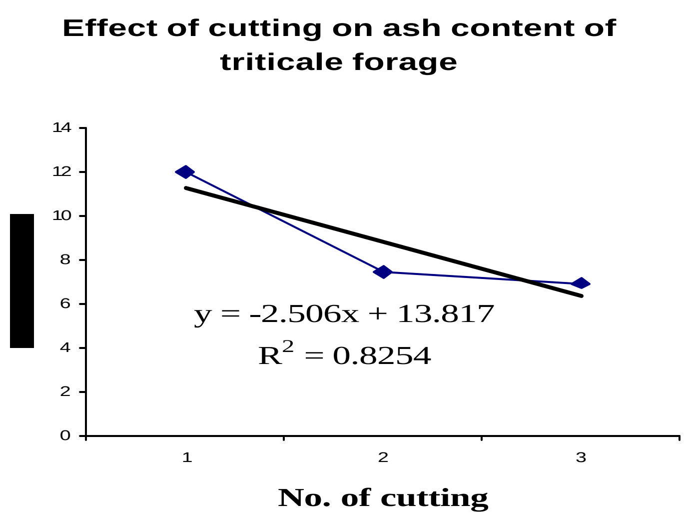


Fig 3. Relationship between ADF and CP with cutting number

Fig. 4. shows that the increase in cutting negatively correlated with the ash content of triticale forage (R2= 0.8254; Y= -2.506x+ 13.817). This relationship indicates that with the increase in a single cutting may decrease 2.5% ash content of triticale forage.



Fi g 4. Relationship between cutting number and ash content of triticale forage

Similar trend of chemical composition were observed incase of triticale hay as mentioned earlier for fresh triticale. It observed that the DM contents was significantly ($p<0.05$) increased with the increase of cutting date. The values of DM contents for 65 days cut was significantly ($p<0.05$) higher (97.19± 0.23) followed by 50 days (92.90± 0.74), 40 days (77.87± 0.43) and 35 days (70.99 ± 0.45) respectively. Similarly, ADF content of hay was increased with the increase of cutting days. The highest ADF value (38.68± 0.65) was observed in 65 days cut hay followed by 50 days (30.77 ±0.92), 40 days (30.13 ±0.28) and 35 days (26.62 ±0.23) respectively. Further, it was revealed that there was a significant difference of ADF contents among different treatment groups except between 40 days and 50 days hay. In contrast, the crude protein content of hay was decreased with the increase of cutting days except 35 days cut. Hay prepared from 65 days cut contained lower CP values compared to 35, 40 and 50 days cut (Table5).

Table 5 Effect of cutting on chemical composition of Triticale Hay

Parameters	Experimental groups				Level of significance
	35 days (Mean ± SE)	40 days (Mean ± SE)	50 days (Mean ± SE)	65 days (Mean ± SE)	
Dry matter (%)	70.99[d] ±0.45	77.87[c] ±0.43	92.90[b] ±0.74	97.19[a] ±0.23	*
Ash (%)	15.47[a] ±0.30	14.48[b] ±0.32	10.32[c] ±0.37	9.44[d] ± 0.09	*
Organic matter (%)	84.53[d] ±0.30	85.42[c] ±0.30	89.68[b] ±0.36	90.56 [a]±0.09	*
ADF (%)	26.62[c] ±0.23	30.13[b] ±0.28	30.77[b] ±0.92	38.68[a] ±0.65	*
Crude Protein (%)	21.95[c] ±0.25	25.79[a] ±0.25	23.71[b] ±0.89	11.77[d] ±0.22	*

SE: standard error of mean; [abcd] Means with different superscripts in the same row differ significantly; *Significant at 5% level.

Figure 1. Average roughage DM intake (kg/d) by the lactating cows of silage and straw fed during 9 weeks of the experimental period.

Figure 3. Average weekly milk yield trend of the lactating cows, fed silage and rice straw over 9 weeks of the experimental period.

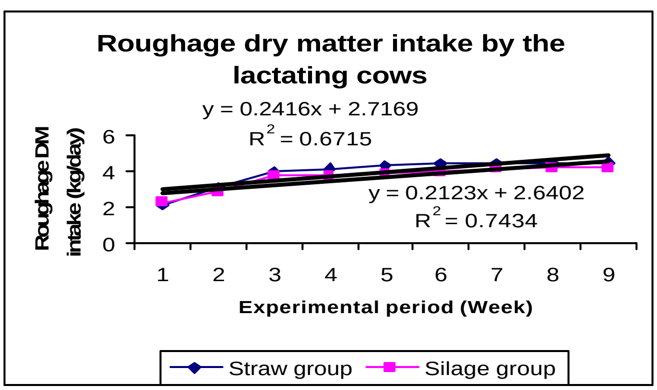


Table 6. Chemical composition of triticale hay produced under farmer's condition

Parameters	R1st cut	R 2^{nd} cut	J 1^{st} cut	J 2^{nd} cut	Level of significance
DM	11.2360^{a} ±.41512	12.4780^{c}±.84958	11.2400^{a}±.56635	14.1600^{d}±.40295	*
OM	83.6300^{d} ±.37753	87.4740 ^{c}±1.35020	88.3950 ^{b}±.50862	89.7320 ^{a}±.30265	*
ADF	41.1900 ^{a}±.29271	35.7540 ^{c}±2.62612	37.8075 ^{b} ±2.67485	42.8220 ^{a} ±.31267	*
CP	29.5900 ^{a}±.36300	25.5860 ^{b} ±.36322	29.7425 ^{a}±.42911	25.1320 ^{b} ±.27621	*
Ash	16.3700 ^{a} ±.37753	12.5260 ^{b} ±1.35020	11.6050 ^{c} ±.50862	10.2860^{d}±.28923	*