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PERFORMANCE OF RAMBOUILLET CROSSBRED GRAZING ON ALPINE PASTURES OF PAKISTAN UNDER TRANSHUMANT SYSTEM

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ABSTRACT

The two studies reported performance of Rambuoillet crossbreds (ewes and rams) with local sheep breed Khutta under grazing system of transhumant.

Analysis of variance revealed that Rambouillet crossbred ewes were initially 16 percent heavier than their age mates of local breed. Within each genotype, ewes <1 year old were significantly ($p<.01$) lighter than >1, >2, >3 and >4 years old. Although Rambouillet crossbred ewes were 17 percent heavier, pattern of differences in BW of various age groups of both genotypes at the start of movement for grazing toward alpine pastures of northern areas (First recording) was almost the same. However ewes of local genotype-Khutta lost more BW (6.7 kg) during movement back to low land areas (Second recording) compared with Rambouillet crossbred ewes (4.1 kg). BW of Rambouillet crossbred ewes remained higher than local ewes even during winter (+17 %) and summer (+19 %). Analysis of variance further revealed that BW of >4 years old ewes of both genotypes were 30 and 38 percent higher than their <1 year old age mated. A significant interaction ($p<0.05$) was also observed between age and reproductive cycle with effects on BW of both genotypes. Rambouillet crossbred ewes were found more prolific with a fertility rate 85 percent compared with 80% in Khutta local breed. Survival rate among Rambouillet crossbred lambs was 93.4% compared with 84.3 percent in locals. Rams flushed with concentrate before breeding season differed in efficiency of weight gain. Minimum feed required for each kg weight gain was 8.1 kg in group 2 compared with 9.5 and 10.7 in groups 3 and 1 with significant differences ($p<.05$). Improvement in BCS was higher (45%) in rams of group 3 compared with 31.2 and 18% for groups 2 and 1, respectively. Feed required per unit of improvement in BCS was 1.4 kg in group 3 followed by 1.8 and 4.8 in groups 2 and 1. Analysis of variance revealed that cost of weight (Rupees per Kg) was lowest (153) in group 2 compared with 217.8 and 188.1 in groups 1 and 3, respectively.

KEY WORDS: Rambouillet crossbreds, Alpine pastures, performance and Pakistan.

INTRODUCTION

More than 68 percent of total land area of Pakistan is arid and semi-arid. Due to ecological constraints like low rainfall these areas are unsuitable for normal agricultural (Rafiq, 1995 and Umrani et al., 1995).

Arid and semi-arid areas of Pakistan also include Swat Valley with a total area of 5337 sq km located at an altitude of 600 meters (GoP, 1999). Natural resources of Swat Valley include livestock species of cattle, buffaloes, goats and sheep rear under transhumant system of management. The area has only one breed of sheep namely Khutta. Workers like Nawaz et al. (1992), Rafiq et al. (1996) and Abdur et al. (2003) had reported that Khutta breed, as compared with other breeds at elevated areas, is genetically poor, undocumented (Khan et al. (2007) and face malnutrition and health problems. Interaction between ecological factors

with physiological low ammonia concentration in the rumen fluid (less than 5mg/100 ml) (Miller and Thompson, 2003) had limiting effects on body weight, fertility rate and milk production and accompanied with retarded growth among lambs and reduced productive life span with socioeconomic implications. In order to improve genetic make up of local ignored sheep breeds of Kaghani and Khutta (Ibrahim et al., 2011), Government of Pakistan introduced exotic blood of Rambouillet during 1993-94 in Kaghan and Swat valleys of Pakistan.

The objective of this study was to measure changes in BW and overall performance of Rambouillet crossbred ewes in comparison to Khutta local breed while grazing under transhumant system between Swat Valley and alpine pastures of northern areas of Pakistan. The objectives of the study also included measuring effect of strategic feeding of concentrate (flushing) on BW and BCS in rams before introducing for breeding.

MATERIALS AND METHODS

Two experiments were applied, the first concerned with changes in body weight (BW, kg) of Rambouillet crossbred ewes grazing under transhumant system of Swat valley.

LOCATION

The study was conducted in Swat Valley lying from 34° 34 to 35° 55 north latitude and 72° 08 to 72° 50 east longitude. It covers an area of 5337 sq km with an altitude of 600 meters (Rafique, 1997 and GoP, 1999).

SELECTION OF EXPERIMENTAL FLOCKS

After collection of base line information about sedentary grazers and their flocks through a designed questionnaire, 60 flocks having local Khutta or their crossbreds with Rambouillet were primary selected. Based on flock composition and consent of farmers, 20 flocks with a total number of 1632 were selected for the trials. Out of these, 16 flocks composed of 1295 Rambouillet crossbred ewes (nominated Nimchai in local language) plus 4 flocks of local Khutta breed comprised of 337 ewes.

COMPOSITION OF PLANT BIOMASS AND IN-VITRO DIGESTIBILITY

Species composing plant flora, their biomass production and utilization were surveyed and studied with the help of Pakistan' Forest Institute Peshawar, Khyber Pukhtunkhaw (KP). According to plant questionnaire during 1996-98 paired pet species cover was estimated visually. The current growth of vegetation was clipped 2.3 cm above ground level. The material was separated into grasses, forbs and shrubs, weighed and then air dried for a week, re-weighed, analyzed as per AOAC (1990) and subjected to in-vitro digestibility according to procedure described by Terry and Tilley (1964).

Grazing movements

Flocks of Rambouillet crossbreds and Khutta ewes were grazed between Swat area and high lands Alpine pastures as per traditions. Flocks usually moved to highlands during mid May and come back during September to low land areas of KP and northern Punjab. During stay in low land area flocks were allowed to graze post-harvest residues of cereal crops, road side grasses and trees followed by house-hold kitchen items.

Supplemental feeding

Ewes during movements always accompanied rams for breeding purposes. However ewes were bred during September-October with lambing during March-April throughout the study period. On abdominal palpation pregnant ewes were separated and supplemented with Multi-nutrients urea molasses blocks (MNUMBs) during last month of pregnancy and early lactation till weaning at 90 days. These MNUMBs were offered during their stay in corrals after grazing till next morning. This supplementation continued till 90 days of lambing as per traditions of the valley. This cycle of movements continued from 1996 to 1998. Both flocks were on the same route and pasture but managed separately.

In addition to MNUMBs interventions included vaccination against infections and drenching against infestations. MNUMBs used as supplement contained 16 percent crude protein and 75 percent total digestible nutrients (TDN) as described by Rafiq et al. (2007).

The study was conducted for a period of 3 years during 1996-1998..

The second experiment concerned with the **effect of flushing on body weight (BW±SE) and body condition score (BCS, %) of Rambouillet rams before breeding season.**

LOCATION

This study was conducted at Livestock Experimental Station (LES), Jaba District Mansehra of KP Province of Pakistan. This station has been center for multiplication of Rambouillet breed since 1993-4

RAMS

For this purpose 33 Rambouillet rams based on their BW, were divided into 3 groups with 10, 12 and 11 assigned to group 1, 2 and 3, respectively managed for a period of 63 days. Adult rams of 58.4±2.7 kg were designated as group-1. While rams of medium and smaller bodyweight of 37.1±1.9 and 29.5±1.4 kg respectively were placed in group 2 and 3. They were fed under intensive conditions.

COMPOSITION OF EXPERIMENTAL FEED

The concentrate feed offered to rams, contained 14 percent crude protein (CP) and 76 percent total digestible nutrients (TDN). Daily feed allowance was increased by 10 percent based on refusals collected every day. Animals were allowed to have limited access to grazing. Common salt and drinking water was freely available.

BODY CONDITION SCORE (BCS)

Body condition score of rams under all groups was assessed as per SCA, 1990. Data was also collected on feed intake, initial BW and final BW (kg).

STATISTICAL ANALYSIS

Data recorded on quantity, quality of plant biomass and changes in BW of Khutta and Rambouillet crossbred ewes at the start and end of grazing movement towards Alpine pastures, during winter and summer seasons, fertility rate and survival rate among lambs during 1996-98, were subjected to analysis of variance using a General Linear Model (GLM), Program (Minitab version 1). A least significant difference (LSD) method was used (Steel and Torrie, 1984) for the identification of statistically significant differences among means. Benefits obtained from flushing rams before breeding season were subjected to economic analysis using standard procedure as described by Gittinger (1982).

RESULTS AND DISCUSSION

PRODUCTION AND QUALITY OF BIOMASS

In the first experiment, survey of vegetation revealed that dominating species of trees are Olea cuspitada and Acacia modesta. Shrub genera included Dodonaea, Wimbania, Rhazya, Gymnosporia, Momotheca and Corissa with a cover of 11 percent.

The important grass species were Chrysopogon montancus and Heteropogon contortus each with a cover of 13-15 and 9-14 %, respectively. Seven forbs species were found but with non-significant cover. Salient features of vegetation pertaining to biomass production, utilization and in-vitro digestibility of Alpine pastures has been given in Table 1.

Table 1. Seasonal production (kg, dry matter), utilization (%) and in-vitro digestibility (%) alpine pastures (Rafique, 1997)

	Grasses			Forbes			Shrubs		
	Forage production	Forage utilization	In-vitro digestibility	Forage production	Forage utilization	In-vitro digestibility	Forage production	Forage utilization	In-vitro digestibility
June	11^{d}	21^{d}	42.8^{d}	21^{d}	17^{c}	47.6^{d}	8.0^{d}	32^{d}	53.74^{cd}
July	94^{ab}	68^{ab}	64.4^{a}	242^{ab}	70^{ab}	58.0^{a}	44.0^{a}	62^{ab}	80.84^{a}
August	106^{a}	74^{a}	51.2^{b}	251^{a}	73^{a}	56.7^{ab}	36.0^{ab}	60^{bc}	62.57^{bc}
September	72^{c}	67^{bc}	50.3^{bc}	187^{c}	73^{a}	55.8^{bc}	28.0^{bc}	63^{a}	64.09^{b}
Mean	70.7	57.5	52.2	175.2	58.2	54.5	29.0	54.25	65.31

Means with different superscripts differ significantly (p<.01).

This vegetation was grazed by flocks of Khutta and Rambouillet crossbreds. Flocks of both genotypes, owned by sedentary grazers, started moving toward upland Alpine pastures during mid May, 1996 and arrived at Alpine pastures during first week of June, 1996. Animals covered a distance of 230 km and arrived at the area with an altitude of 4181 meters. Shepherds along with their flocks had 6-8 stops, each for one night. Flocks grazed these pastures for almost 9-10 hours daily. Animals were provided drinking water daily but common salt after every 10 days. This practice continued till September, 1998.

Body weight (BW, kg) of Khutta and Rambouillet crossbred ewes under various age groups was recorded at the start of project, start of trial, movements toward alpine pastures (first recording) and movement from alpine pasture to low land areas (second recording), has been shown in table 2.

Analysis of variance showed that Rambouillet crossbred ewes with a mean BW of 32.1 kg were 16 percent heavier (p<0.01) than local Khutta with a BW of 26.8 kg. Within each genotype, ewes of <1 year old were 31.8 percent lighter (p<0.01) than elders with an age of >1, >2, >3 and >4 years whom having BW of 26.3, 28.4, 29.4 and 30.2 kg, respectively. Whereas ewes of Rambouillet crossbreds with an age of <1 year were 31 percent lighter than elders (>1, >2, >3 and>4 year) of the same genotype. However BW of ewes of >1, >2, >3 and >4 years old within each genotype were differed but non-significantly.

Table 2: Mean changes in body weight (BW±SE) of Local and Rambouillet crossbreds before and at the end of movements toward Alpine pastures.

Age groups (Year)	Initial BW		First recording		Second recording	
	Khutta	Rambouillet	Khutta	Rambouillet	Khutta	Rambouillet
0	19.5^{e}±0.2	23.6^{e}± 0.2	18.8^{e}±0.3	22.8^{e}±0.2	20.7^{e} ±0.3	25.2^{e} ±0.4
1	26.3^{cd}±0.6	31.5^{cd} ± 0.3	26.2^{cd}±0.6	31.8^{cd}±0.4	26.8^{cd}±1.5	30.9^{e} ±0.3
2	28.4^{bc}±0.7	34.1^{bc}±0.3	29.3^{bc}±1.0	34.5^{bc}±0.3	26.2^{bc}±1.0	33.4^{bc} ±0.4
3	29.4^{ab}±0.5	35.4^{ab}±0.3	29.6^{ab}±0.6	36.2^{ab}±0.4	29.1^{cd}±0.9	34.2^{ab} ±0.5
4	30.2^{a}±0.4	36.1^{a}±0.2	30.8^{a}±0.5	37.0^{a}±0.3	25.2^{a} ±0.7	34.4^{a} ±0.3

Means with different superscripts differ significantly (P<.01)

Similar pattern of differences in mean BW of Khutta and Rambouillet crossbreds was observed at the time of departure to Alpine pastures (First recording). Mean BW of Khutta ewes at the start

of movements toward alpine pastures was 17 percent lower ($p<0.01$) than Rambouillet crossbreds. Within each genotype ewes' BW with an age of <1 year was 35 percent lower than >1, >2, >3 and >4 years old ewes. As shown in table 2, ewes of both genotypes at the end of grazing on alpine pasture had lost 2-5 percent BW which was more in Khutta than Rambuoillet crossbreds. In consistent with previous mean BW, ewes of Khutta was 19 percent lower than Rambouillet crossbreds. Ewes of each genotype <1 year old were 22-24 percent lighter than groups age >1, >2, >3 and >4 years old which also differed in-between but non-significantly.

On return from Alpine pastures, flocks of both genotypes grazed on low land areas of KP and northern Punjab where intensive agriculture is practiced. So flocks could be grazed so closely. As a result farmers could not measure BW either of ewes during late gestation or lambs at birth and weaning.

These variations observed in BW and overall performance of various age groups of ewes of both genotypes can be attributed to their genetic make up, adaptability to local climatic conditions, efficiency of feed utilization during various seasons and physiological conditions, which are in line with those reported by Aboul Naga et al. (1981), Coop (1989), Rafiq et al. (1990) and Al-Nakib et al. (1996).

Table 1 shows that in-vitro digestibility was highest during months of July and August and could satisfy nutritional requirements for the growth of sheep of <1 to >1 year old. This is in line with observations reported by Devendra (1989) that digestibility of a feed stuff is affected by stage of maturity, botanical composition and voluntary intake. Higher digestibilities than 60 percent recorded particularly for shrubs, encourages increasing DMI and efficiency of utilization of volatile fatty acids (VFAs) constituents particularly propionic and butyric acids. Losses in BW of remaining age groups of ewes of both genotypes clearly show that available vegetation qualitatively as well as quantitatively did not satisfy their nutritional requirements for a long period. Lower losses in BW of Rambouillet crossbreds than Khutta further indicate that genotypes differ in feed utilization. Literature shows that Rambouillet and Merino breeds are more efficient in nutrient utilization than most of other world breeds and can easily survive under low nutritional conditions (Coop, 1989). Workers like Snowder and Glimp (1991) recorded losses in BW of Suffolk, Polypay and Columbia at a rate of 12-29, 4-7 and 5-7 % than in Rambouillet ewes.

These changes in BW and overall reproductive performance of both genotypes are in line with those reported by Nawaz and Meyer (1991) and Forgorty et al. (1992). Workers like Nawaz and Meyer (1991) studied the effects of genotypes and mating weight on ovulation (OR), litter size (LS) and uterine efficiency (UE) in Coopworth, Polypay and their crossbred ewes. Polypay dams were exhibited higher OR ($p<0.05$) and LS ($p<0.01$) than daughters of Coopworth type ewes with heterosis estimates of 6 and 7 %, respectively. Polypay derived ewes also exhibited higher UE than other genotypes ($p<0.05$). Only Polypay sired ewes showed a significant relationship between BW and reproductive performance. The estimated response to a 10 % BW increase was 9 % for OR and 6% for LS. They reached to conclusion that increasing BW to 64 kg at mating may not improve reproductive performance but Polypay seems to be exceptional one and may continue to respond until reaching some higher mean BW. Similar observations have been recorded by Forgorty et al. (1992) on Booroola Merino*Dorset (BD), Trangle Merino*Dorset (TD) and Border Leicster* Merino (BLM). Their observations also revealed that in addition to ewe crossbred type (genetic make up) climatic factors also affect ewe’s body weight ($p<0.01$), litter size and its survival rate. These workers had recorded maximum survival rate at a BW of 45 kg for BD and TD and at 56 kg for BLM, respectively. They emphasized the maintenance of adequate nutrition during the last

75 days of gestation, a pre-requisite not only for placental development but also for fetal growth. McCrab et al. (1992) had drawn similar conclusions that maternal weight possibly act as body reserves protect and enhance placental growth during a period of maternal malnutrition. This coincides with the early observations of Aboul-Naga et al. (1981) that seasonal variation in climatic conditions and type of feed available, as shown in table 1, leads to differences in body weight (as given in table 2 and 3) and reproductive performance of ewes. They opined that milk production of summer or autumn lambing could be improved by increasing quality and quantity of feed (through supplemental feeding) with associated cost. Overall performance of both Khutta and Rambouillet crossbreds coincided with early findings of West et al. (1991) and Nawaz et al. (1992) that suboptimal feeding and management factors also contributed in low productivity of genotypes.

Rafiq et al. (1990) recorded a loss of 33 % of initial BW in Balochi ewes grazing on rangeland dominated by Artimezia meritimia and Holoxylon griffthi. Later on, supplementation with appropriate sources of energy and N not only led to improvement in BW but also in fertility rate. These losses in BW given in table 2 and 3 are consistent with findings of Javed et al. (1993), Rafiq (1995) and Muir et al. (1998) that due to low feed supply animals lose BW, become emaciated and prone to diseases particularly during late gestation and early lactation. Workers like Dost (1996), Rafiq et al. (1996) and Rauniyar et al. (2000) reported that over stocking and inadequate rain are among major factors responsible for deterioration of rangelands. As a result livestock in hilly and mountainous areas suffer with chronic deficiency of feed and fodders leading to losses in BW and low productivity (Rathore, 2005; Singh and Bohra, 2005 and Aziz 2006). Literature shows ammonia concentration in rumen fluid of animals fed on poor quality roughages or grazed on poor rangelands is too less (5-8 mg/100ml) than required for synthesis of microbial proteins to be absorbed in small intestine (Miller and Thompson, 2003). Under these circumstances urea molasses feed blocks are highly useful supplement in improving feed intake and digestibility with desirable effects on traits of economic importance. It is therefore assumed that supplementation with urea molasses blocks might have minimized weight losses in both genotypes during late gestation and lactation.

Literature shows that supplements like urea molasses not only improve feed intake but also body weight. Workers like Hadjipanayiotou et al. 1993) during a series of trials recorded that weight loss of 56g /day in Awassi sheep was reduced to 6 g/day when fed on urea blocks (UBs). Sheep with UBs were in positive energy balance. Response to UBs was greater when basic diet was composed of only poor quality roughages, since improved the efficiency of utilization. This resulted in improved animal performance which otherwise could be obtained by using greater amount of conventional energy and protein supplement. In a similar study Rafiq et al. (1996) observed an improvement in weight gain from 10.6 to 54.3 g/day when Rambouillet crossbred lambs were given access to licking urea molasses blocks under grazing conditions of Kaghan valley of Pakistan. Shahid et al. (1996) recorded a similar improvement in response of Balochi sheep given supplements during late gestation resulting in higher birth weight and reduction in mortality rate of lambs from 16.7 to zero percent. This improvement in response of grazing sheep was consistent with those reported by Muir et al. (1998) that losses in BW regardless of their genetic make-up are due to malnutrition during late gestation and early lactation which not only affects size of fetus but also growth rate. This response can be further improved if nutrients supplement supplied according to requirements of host animal as well as ruminal microbes.

REPRODUCTIVE PERFORMANCE

Analysis of parameters pertaining to reproduction revealed that Rambouillet crossbred was more prolific with a fertility rate of 85

percent compared with 80 for Local Khuta breed . Survival rate among lambs was 93.4 percent compared with 84.3 percent for local Khutta-an indicating that Rambouillet breed well adapted to local climatic conditions and grazing system.

Workers like Miller and Thompson (2003) reported that poor winter nutrition of pregnant ewes causes foetal restriction during pregnancy which affects wool follicle development in offspring leading to reduction in wool production during the whole life span. Under these circumstances urea molasses blocks provide opportunity to improve animal productivity by supplying readily available energy since Rafiq et al. (2007) recorded higher BW of Lohi sheep when supplemented with multi-nutrients urea molasses blocks (MNUMBs) than those without (control). Lambs suckling ewes given MNUMBs during lactation period that extended 16 weeks grew faster (122g/day) with 10-15 % higher survival rate than control flock that grew 97 g/day. The better BW and reproduction performance accompanied supplementation with appropriate sources of energy and N exerts a desirable effect on traits of economic importance in sheep graze either poor quality pastures or post harvest residues of cereal crops.

SECOND EXPERIMENT

FEED INTAKE, BW AND BCS OF RAMS

As shown in table 4, rams in group 1 grew 128.6±22 g/day with final weight of 66.5±1.9 kg which was significantly higher (p>.05) than groups 2 and 3 with a final weights 44.5±1.9 and 36.2±kg and growth rates of 119.0±19 and 116.0 ±20.0 g/day. Rams in group 1 consumed 1.4 kg feed /day which was significantly higher (P>0.05) than rams of groups 2 and 3 (0.9 and 1.0 kg feed/day, respectively).

EFFICIENCY OF FEED UTILIZATION PER UNIT

Rams differed in ratios of feed conversion to weight gain , where poorer conversion rate of 13.1kg for each kg weight gain was noticed with group 2 compared with the other two groups (with similar rates of 10.9 and 10.7 kg feeds / kg gain for groups 1 and 3 (P < 0.05). Whereas body condition score (BCS) was the highest in lambs in group 3 (44.0 percent) followed by group 2 (31.2) and group 1 (20.0 percent), respectively. It was estimated that amount of ration required for getting good BCS was 2.27 kg/ animal unit.

Table 3. Effect of flushing on bodyweight (BW±SE) and body condition score (BCS, %) of Rambouillet rams before breeding season.

Parameters	Groups			Overall mean	F-ratio
	Class 1 >2 years (n=10)	Class 2, 1-2 years (n=12)	Class 3 <1 years (n=11)		
Initial BW	58.4±2.7^{a}	37.1±1.9^{b}	29.5±1.4^{bc}	41.5±1.1	**
Final BW	66.5±1.9^{a}	44.5±1.9^{b}	36.2±1.4^{bc}	48.9±1.2	**
Change in BW g/day	128.6±2	119±2	116±2	117	ns
Initial BCS	3.1±0.1^{a}	2.6±0.2^{ab}	2.0±0.1^{c}	2.6±0	*
Final BCS	3.8±0.1^{a}	3.4±0.1^{ab}	2.9±0.1^{c}	3.4±0	*
Change in BCS as %age of initial BCS	18.4^{ab}	30.1^{b}	45.0^{a}	31.0	**
Total weight gain, kg	8.0^{a}	7.4^{ab}	6.7^{c}	7.4^{ab}	*
Total feed consumed	88.2^{a}	56.7^{bc}	63.0^{b}	69.3	**
Feed consumed/unit of BCS	4.8^{a}	1.8^{bc}	1.4^{cd}	2.2^{ab}	**

Means with different superscripts differ significantly. (*=p<.05), ** (p<.01) and ns non-significantly.

Table 4: Cost-benefit analysis of flushing Rambouillet rams before breeding season as per Gittinger (1982).

Parameters	Groups			Overall mean	F-ratio
	Class 1 >2 years (n=10)	Class 2, 1 to 2 years (n=12)	Class 3 <1 years (n=11)		
No rams	10	12	11	11	**
Initial live weight (Kg)	58.4 ^{a}±2.7	37.1^{b}±1.9	29.5^{bc}±1.4	41.5±1.2	**
Final live weight (kg)	66.5^{a}±1.9	44.5^{b}±1.9	36.2^{bc}±1.4	48.9	**
Total weight gain, kg/ram	8.1	7.4	6.7	7.4	ns
Total feed intake, kg/ram	88.2^{a}	56.7^{bc}	63^{b}	69.3	**
Feed conversion ratio, FCR	10.9	13.1	10.6	10.7	ns
Weight gain, g/day	128.6^{a} ±2	119.0^{ab}±	116.0^{bc}±	117.0	*
Feed intake, kg /day/ram	1.4	0.9	1	1.1	ns
Feed efficiency	9.2^{bc}	13.2^{a}	11.6^{ab}	10.6	*
Cost of feed, Rs/ram[1]	1764.0^{a}	1134.0^{bc}	1260.0^{b}	1386.0	**
Return on live weight gains	2025.0^{a}	1850.0^{b}	1675.0^{bc}	1850.0	**
Cost of feed/kg live weight gain	217.8^{a}	153.2^{c}	188.1^{ab}	187.3	**
Benefit cost ratio	1.15^{bc}	1.63^{a}	1.33^{b}	1.33	*

**-significant (p<.01), *-significant (p<.05) and ns-non significant.
[1]Feed price: Rs20/kg and US$1=Rs85.

Results in table 4 show that rams at age 1-2 years had better growth rate (p< 0.05) compared with older age (Class-1) or younger age (C;ass-3). Analysis revealed that cost of feed to produce 1 kg live weight gain was cheapest in age class 2 (Rs 153.2/kg) and most costly in class 1 (Rs 217.8/kg). This suggest that the effect of flushing on live weight gain of Rambouillet rams before breeding season is relatively less economical in groups 1 and 3

Since vegetation during summer and early autumn is composed mainly of cell wall contents (CWCs) deficient in energy and N, this affects productivity of grazing stock including ewes and rams, through low concentration of rumen ammonia and poor synthesis of microbial protein (Abou el Naga et al, 1981 and Rafiq, 1999). Under such situation, as shown in tables 3 & 4, animals responded to supplementation with concentrate feeding. Relation between age and growth requirements might have led to variations in groups responses (Rafiq et al, 2007). Similar performance of Rambouillet and Mernio crossbreds with Kage breed of Nepal has been reported by Ghimire (2011) indicating that they have adapted to local climatic conditions of Himalayan region.

CONCLUSIONS

Losses in body weight of ewes regardless their genetic make up provide sufficient evidence that available ranges need rehabilitation through reseeding and rotational grazing so that sufficient biomass could produced. The low losses in body weight of Rambouillet crossbred can be referred to their efficient utilization of available feed than local Khutta. These losses can be further minimized by supplementation with appropriate sources of energy and N. Similarly, flushing with concentrate can improve physical and efficiency of rams during summer or mating ??? season.

However in order to avoid any risk, suggesting treatments in similar experiments including low cost feeds needs further tests along with information on secondary products in the economic analysis.

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