

GROWTH AND YIELD OF COOL SEASON FORAGE CROPS UNDER TARAI REAGION OF UTTARAKHAND

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(Received : 23 August 2016; Accepted : 27 September 2016)

SUMMARY

Field experiment was conducted during **rabi** season of 2012-2013 at Instructional Dairy Farm, G.B.P.U.A&T., Pantnagar (India) to evaluate performance of cool season forage crops/ varieties. The treatments consisted of seven crop varieties i.e. some imported varieties of these crops like Genie oat (Oat) and Baralfa IN (lucerne), Makkhan grass (rye grass) and Barduro (red clover) from Netherland have been tested in the present investigation with Mescavi variety of Berseem, UPO-212 variety of oat and local rye grass. The results showed that among oat varieties, crude protein per cent and dry matter digestibility was higher in genie oat than UPO-212. Crude protein per cent and dry matter digestibility was higher in makkhan grass compared with local rye. Highest green forage yield, dry matter yield, crude protein yield and digestible dry matter yield was obtained from Baralfa IN (lucerne) and least from Barduro (red clover) than remaining leguminous crops. Among oat varieties, green forage yield, dry matter yield, crude protein yield and digestible dry matter yield was higher in the UPO-212 than genie oat while among rye grasses, these yields was higher in the makkhan grass than local rye.

Key words : Berseem, crude protein content, green forage yield

India's livestock population is highest (529.7 million) in the world (Anonymous, 2011-2012) which is 20% of the world livestock, leading in mostly cattle (16%) and buffalo (55%) population and having world's second largest goat (20%) and fourth largest sheep (5%) population. At present, the country faces a net deficit of 63 % green fodder, 24 % dry crop residues and 64% feeds, respectively (Choudhary *et al.*, 2014). Country to this fact, the area under permanent pastures has been declining over the years and uncontrolled overgrazing has made them less productive. The area under fodder crops has almost remained static (8.3 million ha) for the last 3-4 decades (Midha *et al.*, 2014). In order to meet the fodder shortage for the growing animal population, the fodder growing area should ideally be around 12.0 million ha well distributed in different season to make round the year availability of fodder. The available cool season forages and their varieties are poor in quality, being deficient in available energy,

protein and minerals. Therefore to compensate the low productivity of the livestock, farmers maintain a large herd of animals, which adds to the pressure on land and fodder resources. The yielding potential of local cool season forage crops is declining day by day due to abiotic and biotic stresses. In order to overcome this problem new cool season forage crops/varieties need to be tested and introduced. In view, present study was done to make availability of quality fodder to animals throughout lean periods of available.

MATERIALS AND METHODS

The experiment was conducted at Forage Agronomy block of Instructional Dairy Farm (IDF), Nagla, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand, India during **rabi** season to evaluate suitable crops/varieties for longer term fodder available. The soil

Based on a part of information of M.Sc. thesis of the first author submitted to GBPUA&T, Pantnagar during 2014 (unpublished)

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of experimental site was silty clay loam having neutral reaction (7.2 pH), rich in organic carbon (0.86 %), (Walkley and Black, 1934), available nitrogen (284.48 kg/ha), (Subbiah and Asija, 1956), available phosphorus (21.80 kg/ha), (Olsen *et al.*, 1954) and available potassium (232 kg/ha), (Hanway and Heidel, 1952). The experiment consisted of 7 crop varieties {imported Genie Oat (oat), Baralafa IN (lucerne), Makkhan grass (rye grass) and Barduro (red clover)} from Netherland and indigenous varieties Mescavi (berseem), UPO-212 (oat) and Local

rye grass were tested in a randomized block design with 5 replications. Oat (100 kg/ha seed) was sown in 4 cm deep, rows opened at 25 cm while rye grass and makkhan grass (25 kg/ha seed) at 40 cm, berseem (30kg/ha seed) at 20 cm, red clover (10 kg/ha seed) at 25 cm and lucerne (25 kg/ha seed) at 20 cm row to row spacing were sown in 2 cm deep furrows opened with the help of hand hoe. Half quantity of the total dose of nitrogen through urea @ 120 kg N/ha (grasses), 25 kg N/ha (legumes); 60 kg P₂O₅/ha through single super phosphate and 40 kg K₂O/

TABLE 1
Growth parameters of different crops at different cuttings

Treatments	Plant height (cm/plant)					
	1	2	3	4	5	6
	Cutting					
Lucerne (Baralfa IN)	20.2	20.6	37.6	52.5	75.8	62.6
Red clover (Barduro)	10.6	10.7	18.1	32.0	38.3	36.7
Berseem (Mescavi)	27.8	32.0	61.7	69.0	78.8	76.3
Oat (Genie Oat)	51.4	52.1	61.9	54.6	52.0	47.4
Oat (UPO-212)	59.3	74.6	79.2	64.8	62.7	53.0
Rye grass (Makkhan grass)	38.2	38.5	50.7	56.0	63.7	61.4
Rye grass (Local rye)	38.6	45.4	62.7	63.0	65.2	63.2
SEm±	0.9	0.9	0.9	0.8	0.9	1.0
CD at 5%	2.6	2.5	2.5	2.2	2.5	3.1
	Number of tillers/plant					
Lucerne (Baralfa IN)	3.5	4.4	6.5	7.3	10.0	9.0
Red clover (Barduro)	3.5	4.3	6.7	7.8	13.0	12.0
Berseem (Mescavi)	4.0	5.0	8.3	9.2	10.0	9.0
Oat (Genie Oat)	3.9	8.0	6.8	5.9	5.0	5.0
Oat (UPO-212)	3.9	4.0	7.0	7.0	6.3	5.0
Rye grass (Makkhan grass)	5.0	6.0	11.3	10.9	9.0	8.0
Rye grass (Local rye)	5.1	7.0	8.9	9.7	9.0	7.0
SEm±	0.2	0.5	0.6	0.7	0.7	0.6
CD at 5%	0.5	1.6	1.8	2.0	2.0	1.8
	Dry matter accumulation through plants/m row length					
Lucerne (Baralfa IN)	24.8	24.4	10.0	55.2	122.4	131.2
Red clover (Barduro)	26.4	14.8	24.0	46.0	123.2	73.2
Berseem (Mescavi)	24.0	20.4	45.6	73.2	116.0	73.6
Oat (Genie Oat)	30.0	54.0	66.4	71.2	99.6	67.2
Oat (UPO-212)	27.6	28.4	54.0	63.6	74.8	73.6
Rye grass (Makkhan grass)	30.8	26.4	22.0	57.6	93.6	55.6
Rye grass (Local rye)	29.2	19.2	41.2	37.6	82.4	56.0
SEm±	3.2	4.8	4.8	6.8	12.4	5.6
CD at 5%	NS	13.6	14.0	20.4	NS	16.8
	Leaf : Stem (dry weight basis)					
Lucerne (Baralfa IN)	2.64	2.04	1.08	1.26	0.90	0.80
Red clover (Barduro)	2.32	2.08	1.61	1.39	0.86	0.76
Berseem (Mescavi)	1.72	1.21	0.85	0.70	0.67	0.53
Oat (Genie Oat)	3.15	1.76	1.16	1.28	0.83	0.75
Oat (UPO-212)	3.05	0.98	1.33	0.93	0.79	0.69
Rye grass (Makkhan grass)	3.27	1.64	1.51	1.15	0.67	0.60
Rye grass (Local rye)	1.92	1.28	1.94	0.77	0.48	0.40
SEm±	0.25	0.14	0.20	0.03	0.04	0.01
CD at 5%	0.73	0.40	0.57	0.09	0.13	0.03

ha through muriate of potassium were applied uniformly as basal. The remaining half dose of nitrogen was top dressed equally in 6 splits for first at 30 days after sowing and the remain nitrogen applied after each cutting. The crop was sown on 10th October of 2012-13. The crop was harvested at 55 days after sowing (first cut) with the help of sickle leaving stubble height of 5-6 cm from ground for uniform and quick re-growth of the crop. Subsequent cuttings were taken 30 days after each cutting till crops stop to re-growth. The harvested herbage was weighted immediately for green forage yield, and 500 g fresh sample from each net plot was taken to determine dry matter content. The samples were dried at 70°C ± 2 in hot air oven for moisture loss. The finely grinded dry samples using 2 mm sieve were used for nitrogen content by Micro kjeldahl method (Jackson, 1973). The crude protein content was determined by multiplying nitrogen per cent with 6.25 (AOAC, 1965) and digestible dry matter content by the nylon bag method (Mehrez and Ørskor, 1977).

RESULTS AND DISCUSSION

Crop growth

Plant height : Plants of Mescavi (berseem) were significantly taller compared to other crops at 4th, 5th and 6th cuttings, while at 1st, 2nd and 3rd cuttings, these plants were significantly taller than other leguminous forage crops (lucerne and red clover). The taller Mescavi (berseem) plants might be due to genetic makeup as well as the environmental conditions (Hasina *et al.*, 2013). Among oat varieties, plants of UPO-212 were significantly taller compared to genie oat at all cuttings. The plants of oat variety UPO-212 have been observed taller due to genetic makeup compared to other varieties (UPO-270 and JHO-822) of oat (Joshi *et al.*, 2000). Among rye grasses at 1st, 5th and 6th cuttings, both the varieties had statistically similar plant height, while at 2nd, 3rd and 4th cuttings, the plant height of local rye was significantly more compared to makkhan grass. Makkhan grass is perennial in nature which is mostly grown in temperate countries where the conditions are favourable for growth and it can sustain below 5°C temperature.

Number of tillers/plant : Among leguminous forage crops, numbers of tillers were higher in Mescavi (berseem) but it was statistically similar to Baralfa In (lucerne) and Barduro (red clover) at 1st, 2nd and 3rd

cuttings (Table 1). Tillers were higher in Mescavi (berseem) right from early growth stage due to favourable environmental (Hannaway and Larson, 2004). At 5th and 6th cuttings, number of tillers were significantly more in red clover compared with remaining leguminous forage crops which might be due to increase in favourable environmental conditions especially temperature (> 24°C) but late April onward decrease in tillers per plant was observed which is contradicting with vigorous growth obtained in summer. The branching is highly influenced by temperature, defoliation, mineral nutrition and inter-plant competition leading to reduction in tillers per plant. The location effect might be a reason for this contradiction as in the present investigation numbers of tillers were similar in berseem at 5th and 6th cuttings. Among oat varieties, numbers of tillers were significantly more in genie oat compared with UPO-212 at 2nd cutting, while it was statistically similar with UPO-212 at all other cuttings. This might be due to genetic makeup and slight increase in temperature (33.3°C/14.8°C) till April. These results are a kin to earlier work (Joshi *et al.*, 2005). Among rye grass varieties, at 1st, 2nd, 4th, 5th and 6th cuttings, the tillers were statistically similar in both varieties but at 3rd cutting, tillers were significantly more in makkhan grass compared to local rye. Local rye had slightly lower tillers at later stage due to increase in temperature and degeneration of roots as rye grass requires temperate climate.

Dry matter accumulation : Among leguminous crops, dry matter accumulation by plants was statistically similar at 2nd cutting but it was significantly higher in Mescavi (berseem) compared with lucerne and red clover varieties at 3rd cutting. Decline in dry matter of Mescavi (berseem) after 5th cutting might be due to degeneration of root at higher temperature causing leaf senescence. On the other hand lucerne accumulated significantly higher dry matter compared with remaining leguminous crops at 6th cuttings. Dry matter accumulations by Baralfa IN (lucerne) and Barduro (red clover) increased with advancement in cutting after 3rd cut. Lower dry matter accumulation at early cuttings might be due to lower temperature which might have reduced photosynthesis while at 6th cutting drought tolerance capacity of lucerne might have helped in leaf production. The capacity of plant to accumulate dry matter is determined by its rate of CO₂ fixation, photosynthetic area, duration of crop, tillers/plant and environmental factor besides management practices

TABLE 2
Quality parameters of different crops at different cuttings

Treatments	Dry matter content						
	1	2	3	4	5	6	7
	Cutting						
Lucerne (Baralfa IN)	11.6	14.6	13.5	20.2	21.9	24.4	25.9
Red clover (Barduro)	10.0	13.3	17.0	15.8	16.8	18.4	22.0
Berseem (Mescavi)	12.0	13.0	13.0	16.5	20.4	22.2	-
Oat (Genie Oat)	10.7	12.0	14.0	14.6	18.1	18.1	-
Oat (UPO-212)	11.2	13.0	16.0	16.6	21.2	21.0	-
Rye grass (Makkhan grass)	13.3	13.4	16.0	17.5	21.4	21.4	-
Rye grass (Local rye)	12.3	13.6	15.9	15.6	24.7	22.6	-
SEm±	0.3	0.2	0.2	0.5	0.5	0.5	-
CD at 5%	0.8	0.7	0.6	1.3	1.4	1.6	-
	Crude protein content						
Lucerne (Baralfa IN)	24.8	23.1	22.0	21.5	20.1	18.4	13.6
Red clover (Barduro)	22.4	21.4	21.5	21.6	21.8	18.1	13.5
Berseem (Mescavi)	25.1	24.6	24.0	22.0	22.6	18.0	-
Oat (Genie Oat)	16.7	16.1	15.3	15.0	14.7	7.6	-
Oat (UPO-212)	16.5	16.0	16.8	14.0	12.7	7.4	-
Rye grass (Makkhan grass)	17.5	16.9	17.0	15.5	15.3	11.0	-
Rye grass (Local rye)	17.3	16.7	16.8	15.3	15.1	10.5	-
SEm±	0.2	0.2	0.2	0.2	0.2	0.3	-
CD at 5%	0.6	0.6	0.7	0.6	0.6	0.8	-
	Dry matter digestibility content						
Lucerne (Baralfa IN)	86.0	85.6	80.8	74.4	63.6	58.8	55.2
Red clover (Barduro)	89.6	88.8	86.0	84.8	81.6	75.6	73.2
Berseem (Mescavi)	91.2	80.0	75.6	68.0	60.0	51.6	-
Oat (Genie Oat)	88.4	80.8	78.8	69.2	62.4	60.4	-
Oat (UPO-212)	88.8	78.0	76.8	66.4	61.6	57.6	-
Rye grass (Makkhan grass)	82.8	89.2	88.8	86.8	72.8	66.0	-
Rye grass (Local rye)	90.4	89.2	87.2	86.4	72.0	65.2	-
SEm±	0.9	0.8	0.9	0.8	0.8	1.1	-
CD at 5%	2.6	2.6	2.8	2.3	2.2	3.1	-

(Jasjeet *et al.*, 2011). Among oat varieties, dry matter accumulations by genie oat was significantly higher compared with UPO-212 at 2nd cutting while at 3rd, 4th and 6th cuttings it was statistically similar in both the varieties and decreased thereafter due to reduce plant height (Table 1), number of leaves, there by reduced CO₂ fixation at later stages (Echarte *et al.*, 2008). Among rye grasses, dry matter accumulations was by local rye significantly higher compared with makkhan grass at 3rd cutting while it was statistically similar with makkhan grass at 2nd, 4th and 6th cuttings.

Leaf : Stem ratio : Leaf:Stem ratio of Baralfa IN (lucerne) and Barduro (red clover) was statistically similar at 1st, 2nd, 3rd, and 5th cuttings, while that of Barduro (red clover) was significantly higher compared to berseem and lucerne varieties at 4th cutting. Leaf:Stem ratio of Baralfa IN (lucerne) was significantly higher

compared to remaining leguminous forage crops at 6th cutting. Decrease in leaf:stem ratio with advancement of crop age might be due to more dry matter accumulation in stem, while at 6th cutting higher leaf:stem ratio can be attributed to its perennial nature and drought tolerance capacity which caused production of leaves for which stored energy in roots was utilized (Jasjeet *et al.*, 2011). Leaf:Stem ratio of Barduro (red clover) declined continuously with advancement in growth duration of crop while at 4th cutting it was higher than berseem and lucerne varieties which might be due to less accumulation of photosynthetic material in stem. Among oat varieties, leaf:stem ratio of both the varieties was statistically similar at 1st, 3rd, and 5th cuttings while that of genie oat was significantly higher compared to UPO-212 at 2nd, 4th and 6th cuttings which might be due to reduction in number of leaves (Table 1) and more dry matter accumulation in stem.

Quality of Fodder

Dry matter content : Among leguminous crops, dry matter per cent of Mescavi (berseem) was at par with Baralfa IN (lucerne) at 1st cutting. Increased dry matter content of Mescavi (berseem) from 1st to 6th cuttings might be due to taller plants (Table 1), more number of tillers/plant (Table 1), number of leaves and more dry matter accumulation in plant. Positive correlation of berseem dry matter with stem weight, leaf weight, plant height and leaf weight has been observed by earlier workers (Tiwana and Puri, 2003; Alfred, 2012). Dry matter per cent of Barduro (red clover) was significantly lower compared to remaining crops (except genie oat) at 1st cutting which might be due to shorter plants height (Table 2). The results are akin to the results reported earlier Homolka *et al.* (2012). Dry matter of Baralfa IN (lucerne) was significantly higher compared to other crops at 2nd, 4th, 5th, 6th and 7th cuttings but at 3rd cutting, Barduro (red clover) accumulated significantly higher dry matter compared to remaining crops. Increased dry matter content of Baralfa IN (lucerne) from 2nd to 7th cuttings (except 3rd cutting) might be due to increased plants growth parameters (Table 1). Among oat varieties, dry matter per cent of UPO-212 was significantly higher compared to genie oat at all the cuttings except at 1st cutting. The taller plants and more number of tillers per plant (Table 1) might have enhanced the dry matter content (Singh, 1994). Dry matter per cent of both rye grass varieties increased with advancing age of crop till 5th cutting but later decreased due to senescence of leaves and degeneration of roots on account increase in temperature (Johnston *et al.*, 1993). Makkhan grass accumulated significantly higher dry matter compared to local rye at 1st and 4th cuttings, while at 5th cutting, dry matter per cent of local rye was significantly higher than makkhan grass.

Crude protein content : In general, crude protein content at each cutting exhibited decreasing trend with the advancing frequency of cuttings. Among leguminous Mescavi (berseem) contained significantly higher crude protein at 2nd, 3rd and 5th cuttings compared to other leguminous crops. Better absorption of nitrogen leading to higher crude protein content was a result of higher nitrogen content (Tiwana and Puri, 2003). Crude protein content of Barduro (red clover) was statistically at par with lucerne and berseem varieties at 4th, 6th and 7th cutting. This might be due to more number of tillers

per plant (Table 1) and more number of leaves (Drobna and Jancovic, 2006; Homolka *et al.*, 2012). Baralfa IN (lucerne) had highest crude protein but it was statistically at par with berseem and red clover variety at 4th, 6th and 7th cuttings. Lucerne is perennial crop and drought tolerance and can accumulate more nitrogen at later stage leading to better crude protein (Annicchiarico *et al.*, 2010). Among oat varieties, UPO-212 contained significantly higher crude protein compared to genie oat at 3rd cutting while both the oat varieties had statistically similar crude protein at 1st, 2nd, 4th and 6th cuttings. Higher crude protein per cent of UPO-212 might be due to more number of leaves at 3rd cutting which accumulate more nitrogen. Genie oat contained significantly higher crude protein at 5th cutting which might be due to more number of leaves but crude protein decreased with advancing age of crop. Results of earlier workers suggest that negative correlation exists between dry matter and crude protein yields in oats (Joshi and Singh, 1982). Crude protein content of both the rye grass varieties was statistically at par at all the cuttings. Decreasing trend was observed with advancing of crop to maturity due to leaves senescence Anonymous (2012).

Digestible dry matter : In general, the decline in dry matter digestibility is associated with increasing lignin content and a reduction in degradability of polysaccharides other than starch. Among leguminous crops, dry matter digestibility of Barduro (red clover) was significantly higher compared to lucerne and berseem varieties from 2nd to 7th cuttings, while at 1st cutting dry matter digestibility of Barduro (red clover) and Mescavi (berseem) was statistically at par. It might be due to lower fiber content in Barduro (red clover) compared to Mescavi (berseem) and Baralfa IN (lucerne). When red clover and lucerne are of similar fibre content, red clover is more digestible than lucerne providing more energy-dense forage to the diets of lactating dairy animals and also has higher concentrations of readily fermentable carbohydrate (soluble sugars and pectin) and lower concentrations of structural carbohydrate (Hoffman and Broderick, 2001). Dry matter digestibility of Mescavi (berseem) and Baralfa IN (lucerne) declined with advancement of crop age might be due to more fibre (ADF+NDF) content in plant. The nutritive value of lucerne (digestibility and protein content) decreased with advancing maturity by 0.3-0.5% per day from early flowering to near maturity stage (McDonald *et al.*, 2003). Dry matter digestibility of both

TABLE 3
Yields (Total of all cuttings) and productivity of different crops

Treatments	GYF (q/ha)	DMY (q/ha)	CPY (q/ha)	DDMY (q/ha)	Green forage productivity/ day (q/ha)	Dry matter productivity/ day (q/ha)
Lucerne (Baralfa IN)	1134.3	236.2	45.2	155.5	4.73	0.98
Red clover (Barduro)	498.8	86.1	17.4	69.6	2.08	0.36
Berseem (Mescavi)	976.9	162.9	36.3	109.0	4.65	0.78
Oat (Genie Oat)	472.5	67.1	9.6	49.4	2.25	0.32
Oat (UPO-212)	513.4	80.5	12.0	58.2	2.44	0.38
Rye grass (Makkhan grass)	609.9	100.6	16.3	85.0	2.9	0.48
Rye grass (Local rye)	511.9	84.7	13.5	70.9	2.44	0.40
SEm±	7.9	1.9	0.40	1.70	0.04	0.01
CD at 5%	23.1	5.5	1.2	5.0	0.12	0.03

the oat varieties was statistically similar at all the cuttings except 2nd and 4th cuttings which might be due to almost similar fibre content (Table 2). Observation made by earlier workers supports these findings (Joshi *et al.*, 2005). At 2nd and 4th cuttings, dry matter digestibility of genie oat was significantly higher compared to UPO-212.

Yield

Green forage yield : The total green forage yield was significantly more in the case of Baralfa IN (lucerne) compared to remaining crops which was mainly due to more cuttings (7 cuttings) followed by Mescavi (berseem). It might be due to taller plants (Table 1), perennial growth habit, drought tolerance, optimum temperature at late summer. Lucerne is drought tolerant because of it a deep root system with a straight taproot that can cover a depth of more than 15 m leading to more water and nutrient uptake (Jasjeet *et al.*, 2011). Barduro (red clover) yield was significantly less than other two leguminous crops due to its poor growth habit under unfavourable environment conditions, especially temperature thus even more number of cuttings (7) could not compensate the total green forage yield. The optimum temperature for red clover growth (25-27°C) was prevalent in the present study also. Among oat varieties, the total green forage yield of UPO-212 was significantly more than genie oat which might be due to more height, LAI and dry matter accumulation in leaves and stem (Joshi *et al.*, 2005). The total green forage yield of makkhan grass was significantly more than local rye. The results corroborate with the Anonymous (2012) on

rye grass.

Dry matter yield : The total dry matter yield was significantly more in the case of Baralfa IN (lucerne) followed by Mescavi (berseem) compared to remaining crops which was mainly due to more dry matter per cent (Table 2) and green forage yield (Table 3). Taller plants, perennial growth habit, drought and low/high temperature tolerance for growth might have enhanced dry matter accumulation by Baralfa IN (lucerne) plants (McDonald *et al.*, 2003). The total dry matter yield of Braduro (red clover) was significantly less than other two leguminous crops due to less green forage production and dry matter per cent. This result is akin to the findings of Litherland (2001). Among oat varieties, the total dry matter yield of UPO-212 was significantly more than genie oat. The genotypic and phenotypic behavior of variety under favourable environmental conditions during crop season led to its increased photosynthate distribution pattern with the advancement of the crop age (Chandra, 2000). In the case of rye grasses, the total dry matter yield of makkhan grass was significantly more than local rye.

Crude protein yield : In general, crude protein content at each cutting exhibited decreasing trend with the advancing frequency of cuttings and the crude protein yield is a function of crude protein content and dry matter yield. The total crude protein yield was significantly more in the case of Baralfa IN (lucerne) followed by Mescavi (berseem) compared to remaining crops which was mainly contributed by its high dry matter yield (Table 3) and crude protein content (Table 2). The total crude

protein yield of Barduro (red clover) was significantly less than other two leguminous crops due to less dry matter yield (Table 3) even more number of cuttings could not compensate the yield. These results corroborate the finding of Drobna *et al.* (2006) and Homolka *et al.* (2012). Among oat varieties, the total crude protein yield of UPO-212 was significantly more than genie oat It might be due to higher green forage yield (Table 3), dry matter yield (Table 3), dry matter content (Table 2) and crude protein content (Table 2). Higher crude protein yield of UPO-212 has also been reported by Roy (2005). The total crude protein yield of makkhan grass was significantly more than local rye.

Digestible dry matter yield (DDMY) : The total digestible dry matter yield of Baralfa IN (lucerne) was significantly more compared to remaining crops which was mainly contributed by its more digestible dry matter content, crude protein content and dry matter yield (Table 3) and more cuttings (7). Barduro (red clover) yield was significantly less than other two leguminous crops due to its poor dry matter yield (Table 3) and even more number of cuttings (7) and high digestible dry matter (Table 2) could not compensate the total digestible dry matter yield. The total digestible dry matter yield of UPO-212 was significantly more than genie oat. This result has also been observed by Joshi *et al.* (2005). Makkhan grass yielded significantly more total digestible dry matter yield than local rye. It is because of higher dry matter yield and digestibility. Since the digestible dry matter yield is a function of dry matter digestibility and dry matter yield, the crops having higher values of these parameter out yielded digestible dry matter yield over other crops/ varieties.

Green forage and dry matter productivity per day : Among leguminous forage crops, green forage and dry matter productivity per day was higher in lucerne variety Baralfa IN compared to Barduro (red clover) and Mescavi (berseem) crops while green forage productivity per day of lucerne variety Baralfa was at par with berseem variety Mescavi. Among oat and rye grass varieties, green forage and dry matter productivity per day was higher in UPO-212 and Makkhan grass, respectively.

On the basis of results obtained from the present study, it was concluded that the values for growth parameters and crude protein of Mescavi (berseem) were more compared to Barduro (red clover) and Baralfa IN

(lucerne), however green forage yield, dry matter yield, crude protein yield and digestible dry matter yield was more of Baralfa IN (lucerne) crop. Crude protein per cent and dry matter digestibility was higher in genie oat than UPO-212. Green forage yield, dry matter yield, crude protein yield and digestible dry matter yield was higher in the UPO-212 than genie oat. Local rye grass plants taller than makkhan grass however, makkhan grass had more tillers, crude protein per cent, dry matter digestibility and yields were higher in makkhan grass compared with local rye.

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