Short Communication

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Performance of public and private sector developed lucerne (*Medicago sativa* L.) varieties for forage yield and quality

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Abstract
During two years of study mean green forage, dry matter and crude protein yield obtained from six lucerne varieties varied from 51.66 to 65.27 t/ha, 12.87 to 16.36 t/ha and 2.52 to 2.97 t/ha, respectively. Among all varieties, Anand lucerne 3 recorded greater green fodder (65.27 t/ha), dry matter (16.36 t/ha) and crude protein (2.97 t/ha) yields in comparison to T 9 and Alamdar 1 varieties. Significant differences were observed among varieties for yield attributes like plant height, leaf to stem ratio and dry matter accumulation. Non-significant differences were recorded among lucerne varieties for proximate parameters. However among lucerne varieties, mean variations for dry matter, crude protein, crude fat, crude fibre and silica were observed between (24.12 -25.09), (18.21 - 19.37), (1.95 -2.51), (26.34- 27.85) and (1.02- 1.19) per cent, respectively. Mean calcium content (1.60 %) was recorded significantly higher in Anand lucerne 3 whereas, mean copper content (11.88 ppm) was found to be significantly greater in Anand 2 variety. Lucerne varieties contain calcium (1.38- 1.60 %), phosphorus (0.34 - 0.38 %), magnesium (0.52 - 0.55%) and potassium (1.28 - 1.38 %). Mean micro-nutrient contents Cu, Zn, Mn and Fe varied between 9.21 - 11.88 ppm, 22.02 - 26.46 ppm, 46.68 - 55.33 ppm and 491.05 -707.79 ppm, respectively among lucerne varieties.

Key words: Dry matter, Forage yield, Lucerne, Minerals, Varieties

Lucerne (*Medicago sativa* L.) commonly known as *Rizka* is the third most important forage crop after sorghum and berseem in India and cultivated in around one million ha area (Pandey and Roy, 2011). In India during last 30-40 years many varieties of lucerne have been developed by public sector state agricultural universities and private sector seed companies yielding average green fodder in the range of 50 to 70 t/ha during eight months cultivation period from November to June. However, presently seed of only few lucerne varieties are commercially available in market for cultivation. The information on forage yield, nutritional quality and minerals content of these varieties particularly from private sector is scanty. In view of this, the present trial was undertaken to study the forage yield potential, quality parameters and mineral content of commonly grown popular varieties of lucerne under cultivation in north-western parts of India.

The experiment was laid out in a randomized block design with four replications consisting of six lucerne varieties annual and perennial type developed by state agriculture universities and private seed company at fodder demonstration unit (FDU) of National Dairy Development Board (NDDB), Anand (Gujarat) during two growing seasons *i.e.* 2011-12 and 2012-13. The annual type lucerne varieties used in trial were Anand 2, T 9 and Alamdar 1 and perennial type were Anand lucerne 3, RL 88 and Alamdar 51. Two popular lucerne varieties Alamdar 1 and Alamdar 51 developed and marketed by private seed company Alamdar Seed Pvt. Ltd, Kutch, Gujarat were included in trial. The soil of the experimental site was loamy in texture with EC (0.40), pH (8.2), total nitrogen (921 kg/ha), available P_2O_5 (24.16 kg/ha) and available K_2O (389.81 kg/ha). The soil contained DTPA-extractable Fe (7.44 ppm), Mn (18.9 ppm), Zn (2.36 ppm), available S (5.70 ppm) and Cu (1.82 ppm). The crop was sown manually on 28th November during 2011 and 2012. The total plot size was 5 x 5 square meter. The crop was sown with seed rate of 30 kg/ha keeping row spacing of 25 cm. All the treatments were fertilized with recommended dose of fertilizers (25:80:50 kg NPK/ha) as basal dose. Three hand weeding were done at 35 days after sowing, after first and third cut to control seasonal weeds. Ten irrigations were given during the crop growth period. The first cut was taken at 60 days stage and rest 5 cuts were taken at regular intervals of one month till the end of June month. Forage yield, yield

attributes and quality components were measured and analysed at each cut during both the years. The height of ten tillers was measured in centimetres from the base of the plant to the base of the inflorescence. Tillers from each net plot at two randomly selected spots of 0.50 metre row length were harvested and the tillers were counted and recorded as number of tillers per metre row length. Oven dry weight (at 70° C to a constant weight) after partitioning of whole plant into stem and leaf was also recorded. The sum of mean dry weight of stem and leaf represents dry matter accumulation per tiller (g). Leaf to stem ratio (LSR) represents relation between mean dry weight of leaf (3 leaflets, leaf stalk, stipule and bud) and dry weight of stem (stem and branchlets). LSR was worked out by applying the following formula.

$$LSR = \frac{\text{Leaf dry weight (g)}}{\text{Stem dry weight (g)}}$$

Dried samples were grounded (1 mm) for chemical analysis and the amount of N was found by using micro-Kjehldal method (Jackson, 1973). Proximate analysis of fodder samples for nutritive value was carried following the standard laboratory procedures recommended by (AOAC, 2005). Minerals content was determined according to Inductively Coupled Plasma-Optical Emission Spectroscopy, Perkin Elmer, OPTIMA-3300 RL (ICP-OES) test method. Data were analyzed statistically as per Snedecor and Cochran (1994).

Significant differences among lucerne varieties were observed with respect to mean green fodder yield (GFY), dry matter yield (DMY) and crude protein yield (CPY) on the basis of mean data of two years (Table 1). Mean GFY and DMY in lucerne varieties varied from 51.66 to 65.27 t/ha and 12.87 to 16.36 t/ha, respectively. Anonymous (2008) during three years of varietal trial on eight lucerne varieties under Indian conditions reported that mean GFY and DMY varied between 63.89 to 72.98 t/ha and 13.94 to 16.02 t/ha, respectively. Among all varieties, Anand lucerne 3 recorded significantly greater mean GFY (65.27 t/ha), DMY (15.17 t/ha) and CPY (2.97 t/ha) in comparison to T 9 and Alamdar 1 varieties. Patel and Kotecha (2007) observed non-significant differences between Anand 2 (GAUL 1) and Anand lucerne 3 (AL 3) varieties for GFY and DMY. Among annual type varieties, Anand 2 at par with Alamdar 1 recorded significantly higher GFY and DMY as compared to T 9 (Table 1). Mean yield levels were found at par between T 9 and Alamdar 1. Mean CPY ranged from 2.52 to 2.97 t/ha among lucerne varieties. However, non-significant differences were observed for CPY among annual and perennial varieties within their respective group for both the years (Table 1). Sabanci *et al*. (2013) reported mean CPY ranging from 1.79 to 2.34 t/ha among seven standard lucerne varieties.

Significant differences were observed among lucerne varieties for yield attributes like plant height, leaf to stem ratio (LSR) and dry matter accumulation per tiller (Table 1). Among all the varieties, Anand lucerne 3 recorded significantly higher mean plant height (82.77 cm) in comparison to varieties T 9 and Alamdar 51. Whereas, lucerne varieties T 9 and Alamdar 1 recorded significantly lower LSR in comparison to all other varieties. Mean LSR differences between Anand 2 (1.25) and other perennial varieties (1.18 -1.19) were found to be at par. Pathan and Kamble (2014) had reported mean plant height (79.7 cm) and mean LSR (1.01) in perennial lucerne. Significant differences were also observed in dry matter accumulation per tiller (g), when perennial variety Anand lucerne 3 recorded significantly greater mean dry matter accumulation per tiller (2.25 g) as compared to annual type varieties T 9 and Alamdar 1 (Table 1). On the basis of mean data, perennial variety Anand lucerne 3 was found superior to annual varieties T 9 and Alamdar 1 in term of mean GFY (26.34 % and 20.22 %) and mean DMY (27.12 % and 20.21 %), respectively. This may be attributed to cumulative effect of higher mean plant height (6.12 % and 1.42 %), mean LSR (19 % and 11 %) and mean dry matter accumulation per tiller (11 % and 13 %) by Anand lucerne 3 in comparison to T 9 and Alamdar 1 varieties, respectively. Fick *et al*. (1988) reported that lucerne yield is affected by weight and height of individual stem

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Among different lucerne varieties non-significant differences were recorded for mean proximate parameters (%) for dry matter content (24.12 to 25.09), crude protein content (18.21 to 19.37), crude fat content (1.95 to 2.51), crude fibre content (26.34 to 27.85) and silica content (1.02 to 1.19) (Table 2). Julier *et al*. (2000) also reported non-significant differences between lucerne varieties for forage quality parameters. These results may be attributed to reason that main effect on lucerne forage quality belongs to plant stage. Kharage *et al*. (2014) had also reported similar variations in ten promising lucerne genotypes for dry matter and crude protein contents between (16.91 to 23.27 %) and (18.06 to 20.82 %), respectively from pre-flowering to post-flowering stages in Maharashtra.

Mean variations in macro-minerals content among lucerne varieties were found to be significant only in case

Table 1. Mean yield and yield attributes of different lucerne varieties

Varieties	Yield (t/ha)			Yield attributes			
	Green fodder	Dry matter	Crude protein	Plant height (cm)	No. of tillers /metre row length	Leaf to Stem ratio (LSR)	Dry matter accumulation per tiller (g)
Annual type							
Anand 2	61.26	14.80	2.78	80.76	46	1.25	2.26
T 9	51.66	12.87	2.53	77.99	46	0.99	2.02
Alamdar 1	54.29	13.61	2.52	81.61	47	1.05	2.00
Perennial type							
Anand lucerne 3	65.27	16.36	2.97	82.77	48	1.18	2.25
Alamdar 51	61.63	15.16	2.93	76.25	48	1.18	2.08
RL 88	60.21	14.82	2.75	79.26	46	1.19	2.22
S Em ±	2.34	0.57	0.10	1.29	1	0.04	0.06
CD at 5 %	7.05	1.73	0.32	3.88	NS	0.11	0.17

Table 2. Mean proximate parameter (%) of different lucerne varieties

Varieties	Dry matter	Crude protein	Crude fat	Crude fibre	Silica
Annual type					
Anand 2	24.12	18.93	2.08	26.34	1.11
T 9	24.94	19.03	1.95	26.42	1.13
Alamdar 1	25.09	18.50	2.02	27.85	1.19
Perennial type					
Anand lucerne 3	25.07	18.21	2.36	27.15	1.14
Alamdar 51	24.62	19.37	2.51	27.01	1.02
RL 88	24.64	18.64	1.95	27.14	1.18
S Em ±	0.31	0.48	0.78	0.66	0.10
CD at 5 %	NS	NS	NS	NS	NS

Table 3. Mean macro-minerals and micro-mineral contents in different lucerne varieties

Varieties	Per cent (%)				Parts per million (ppm)			
	Calcium (Ca)	Phosphorus (P)	Magnesium (Mg)	Potassium (K)	Copper (Cu)	Zinc (Zn)	Manganese (Mn)	Iron (Fe)
Annual type								
Anand 2	1.47	0.36	0.55	1.38	11.88	25.88	55.33	707.79
T 9	1.47	0.38	0.53	1.33	9.62	26.46	51.05	505.28
Alamdar 1	1.38	0.38	0.55	1.29	9.80	22.02	46.68	491.05
Perennial type								
Anand lucerne 3	1.60	0.34	0.52	1.28	9.21	22.59	50.88	590.45
Alamdar 51	1.54	0.37	0.55	1.30	9.34	23.86	52.06	544.38
RL 88	1.50	0.35	0.54	1.30	10.04	23.66	51.86	649.29
S Em ±	0.08	0.01	0.03	0.05	0.37	1.89	3.02	65.48
CD at 5 %	0.18	NS	NS	NS	1.34	NS	NS	NS

of calcium (Table 3). Mean calcium (Ca) content was recorded higher in Anand lucerne 3 (1.60 %) but the differences were found significant only with Alamdar 1 variety. All lucerne varieties were found at par amongst themselves for other macro-minerals phosphorus (P), magnesium (Mg) and potassium (K) content (Table 3). Results showed that lucerne varieties contain Ca (1.38 to 1.60 %), P (0.34 to 0.38 %), Mg (0.52 to 0.55 %) and K (1.28 to 1.38 %). Kidambi *et al*. (1989) revealed that forages for ruminants should contain minimum 0.3 % Ca and 0.2 % Mg content. In this study, K content in lucerne varieties was observed greater than the limits (6.5 g/kg) as determined by (NRC, 1980). Stanisavljevic *et al*. (2008) reported that Ca, P and K concentration in dry matter of lucerne varieties ranged between 16.91 to 17.42 g/kg, 2.43 to 2.51 g/kg and 14.65 to 15.29 g/kg, respectively but the differences were found non-significant.

Variations in micro-minerals content were found to be significant only in case of copper (Cu) and non-significant differences existed for zinc (Zn), manganese (Mn) and Iron (Fe) contents among lucerne varieties (Table 3). The Cu content (11.88 ppm) in Anand 2 variety was found to be significantly greater than other varieties. NRC (1996) has recommended Cu content level of 10 ppm in forages. In this trial, mean Cu, Zn, Mn and Fe contents varied between 9.21- 11.88 ppm, 22.02 – 26.46 ppm, 46.68 – 55.33 ppm and 491.05 -707.79 ppm, respectively among lucerne varieties. It has been suggested that 30 mg/kg Zn is a critical dietary level, although it has been recommended that concentrations of 12-20 mg/kg are adequate for growing ruminants (Anonymous, 1980).

On the basis of study, it may be concluded that newly notified perennial variety Anand lucerne 3 developed by Anand Agriculture University, Anand, Gujarat was best option for green fodder production in north-western parts of country specifically in Gujarat. Results also proved that private company developed lucerne varieties are not superior to State Agriculture Universities developed varieties in term of forage yield and quality.

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