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Technological intervention in alfalfa to combat fodder scarcity in Changthang Ladakh, India

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Abstract
Alfa-alfa (*Medicago sativa* L.) is one of the most important temperate legume species, used to lessen the lack of forage during the critical fall-winter period in Changthang Eastern Ladakh, India. However, its utilization has been restricted mainly because of its lack of persistence in theses high altitude region. This study evaluates the fresh herbage yield and persistence of alfalfa in three physiographic regions of eastern Ladakh, in cluster I, cluster II and cluster III. Experiments were carried out for five year growing seasons and results were compared. The Cluster I and Cluster III villages were more adequate for alfalfa forage production, enabling better yield and persistence.

Keywords: Eastern Ladakh, high altitude, alfalfa, forage, yield, quality

Introduction
Alfalfa (*Medicago sativa* Linn.) is the most important temperate legume commonly known as 'Alfalfa'. It belongs to the family Fabaceae. It is widely found in the Caucasian region and in the mountainous regions of Iran, Afghanistan and adjacent localities. The cultivated form is assumed to be arisen in western Persia, later spread to other regions of the world. It is highly valued as a legume fodder in USA where millions of acres are devoted to this species. Alfalfa gives high-quality forage yield in many regions of the world and has the highest feeding value of all commonly grown hay crops (Crop Protection Compendium CD-Rom, 2003) [9]. The forage can easily be grown and is regarded as key forage for high-producing ruminants because of its richness in protein, palatability, high calcium and vitamin content (FAO, 1999) [10]. Alfalfa should be used as a supplement for crop residues and natural hay in mixture of 30 percent alfalfa and 70 percent other roughages (Mengistu, 2002) [2] because of its very high feed value. It has been reported that including alfalfa in a crop sequence improved subsequent crop yields and quality (Tan and Li, 1957; Hobbs, 1987; Caporali and Onnis, 1992; Geng *et al.*, 1995) [23, 12, 6, 11].

Since part of the production is concentrated around the cold season, it becomes an alternative crop for feeding during that period, when rangelands usually present little growth and low quality or snow covered. In spite of being well adapted to the local edaphic and climatic conditions, the species presents a low persistence problem. It is one of the high-yielding perennial forage crop which can rapidly regenerates many new stems after harvest, and it can be harvested multiple times during the growing season (Lamm *et al.*, 2012; Brink *et al.*, 2015) [18, 5].

Alfalfa (*Medicago sativa* L.) was widely planted and a dominant pasture in most of the region in Ladakh especially in central, north and western part, where they can get the multi cut from these species. Alfalfa has gained its popularity with farmers in the region for crop–livestock mixed farming systems. Many studies on agronomic characteristics of alfalfa have been reported (Cheng *et al.*, 2005; Geng *et al.*, 1995; Hu *et al.*, 2002) [7, 11, 13]; however, being so popular in other parts of Ladakh alfalfa was not that popular in eastern Ladakh. Eastern Ladakh, commonly known as 'Changthang' is widely covered by the vast rangelands majorly used by the *Changpa* herders for migratory grazing. The major parts of the landscape are suitable for livestock husbandry rather than crop cultivation, however, further growth of the sector will be as much dependent upon the availability of fodder (Kunzes *et al*., 2021) [17].

These rangelands are known for its finest *pashmina* wools across the world, which has led to the increase in the livestock population especially goats. To sustain such a huge livestock population there is need to supply nutritious quality fodder.

However, fodder availability in the region is scarce and the available rangelands used by them are degraded. This has resulted in the supply of the fodder from the lower regions of Ladakh and other regions of India. Despite this, there is general scarcity of fodder leading to incremental cost increases. The cost of fodder reaching these nomadic communities is far more expensive, so introduction of fodder or forage crops suitable for the area is highly required. Krishi Vigyan Kendra, Nyoma a farm science center has conducted a trial on evaluation of fodder in the high altitude rangelands of Ladakh. The main objective of the study was to combat the fodder scarcity and to provide winter fodder availability at low cost to the herding community of the region.

Methodology

Description of study site

The study was conducted from 2015 to 2019 under the programme of Krishi Vigvan Kendra based at Nyoma block of Changthang region at 4000m elevation. The organization covers the elevation ranges from 3500 to 4500m. The trial was conducted in fifteen villages at different elevations under three clusters. The clusters are mainly the group of villages falling under same altitude. Changthang area is a high-altitude cold desert with cold and arid climate, with an annual mean temperature range between +30 ˚C and -35 ˚C.

Table 1: Cluster with communities and agro-forestry systems of the Eastern Ladakh

Cluster	Village	Lifestyle	Agroforestry Systems
Cluster I	Nidder, Mudh, Nyoma Mahe	Semi-nomadic	Agrisilvipastoral
Cluster II	Hanley Punguk, Shadoh Khaldoh and Naga	Semi-nomadic	Agripastoral
Cluster III	Liktse, Tukla, Hemiya and Kungyam	Sedentary	Agrisilvipastoral

Crop establishment and management

Alfalfa was broadcasted in rows 30 cm apart in each plot with a seeding rate of 30 kg per hectare (1.5kg/ kanal). The seeds are sown in April-May, harvested in the end of the season in August in lower elevation and August end in higher elevated areas. The plots were harvested above the soil surface at the early flowering stage.

The study was conducted for five years at different sites in Changthang region of Ladakh. The whole area was clubbed in three clusters (Table 1). Cluster I (Mudh, Nidder, Mahe, Nyoma), cluster II (Hanley Punguk, Shadoh, Naga, Khaldoh) and Cluster III (Liktsey, Nee, Tukla, Kungyam, Hemiya). The area is located between 3400masl-4200masl. The lifestyle of the communities is nomadic, semi-nomadic and sedentary. The treatments were arranged in Randomized Block Design (RBD) with three replications. The study period represented the five years of alfalfa (*Medicago sativa* L.) vegetation across different elevation and the analyses were done at the end of the season. Average plant height and whole plant yield of Fresh herbage per hectare were also calculated.

Results and Discussion

Alfalfa was cultivated with the randomized block design with three replications. The alfalfa stands were irrigated mostly between 10-12 days interval in lower elevated regions and 12-15 days interval in higher elevated areas.

Growth

The species had the longest growing period of approximately 100 days (Table 2). The height of 1 to 5-year-old alfalfa stands is appended in Table 3.

Table 2: Maximum forage yield profit of alfalfa occurred in the different year

Planting date and harvesting date for Alfa-alfa			
Cluster	**Sowing Time**	**Irrigation**	**Harvesting Time**
Cluster I	1-15 May	12-15 days	July
Cluster II	1-15 June	12-15 days	August
Cluster III	15-25 June	10-12 days	August

Table 3: The mean of plant height (cm) of alfalfa of three clusters

Cluster	Year				
	2015	**2016**	**2017**	**2018**	**2019**
Cluster I	46	120	87	86	81
Cluster II	4	0	0	0	0
Cluster III	50	132	92	89	79

It has been observed that there is variation in the plant height in three clusters in different years. Table 2 shows the average plant height across the three clusters. The highest plant height of the is the average height in the randomly selected from the fields was 132cm obtained from Liktsey village, while the lowest plant height was recorded during the first year with 50cm in cluster III. In 2016, In cluster II, the germinated seeds were completely eroded from the site and reason could be due harsh winter where temperature drops down to -30˚C to-35˚C, similar observation was also recorded in their study by Jacob *et al*., 2016 [15]. Therefore, the lowest plant height was observed in cluster II. In village Mudh 46cm in Cluster I whereas highest was observed in Hemiya village i.e 120cm in cluster I. In 2017 the highest plant height was seen in cluster III followed by cluster I. Similarly in 2018 and 2019 the heights of the plant were reduced in general cluster I and cluster II. The reason for the difference in height can be elevation or altitudinal effect with varied climate vagaries at its critical growth stages.

Alfa-alfa Yield

The means of the alfalfa yield of the biomass of fresh herbage yield (FHY) shown in Table 4. Fresh herbage yield of alfalfa (38 qtl ha-1) was highest in 2015-16 in Liktsey village while lowest yields (36 qtl ha-1) in Mahe village in cluster I. In 2016-2017 the highest yield was recorded in Tulka village (44

qtl ha-1) cluster III and lowest was in Mudh village (36 qtl ha-1) in cluster I. In 2017-2018, the highest yield was recorded in cluster III in village Liktsey (42 qtl ha-1) whereas lowest in Nidder village (33 qtl ha-1) in cluster I. In 2018-2019 highest yield was again seen in Nidder village in Cluster I whereas lowest in Cluster III Hemiya village. These results were in agreement with Forbes and Watson (1992) [10] who stated that soil factors, which influence root growth and development and thereby affect the yield of a crop, can be classified as nutritional, biological or physical including soil temperature, aeration and resistance to penetration by roots. As it is expected, the fresh herbage yields of alfalfa cultivars, being perennial crops, increased significantly in the second year compared to the first year. Alfalfa achieves fresh herbage yield from 40-50 t ha-1 and 12 to 19 t ha-1 dry matter yield (Katić, 2000; Nešić *et al.*, 2005; Stanisavljević *et al.*, 2006) [16, 19, 21]. Unfortunately, the fresh herbage yield obtained in Eastern Ladakh is about 4-5 t ha-1 (Table 3).

Table 4: Fresh herbage yield in Eastern Ladakh

Year	Yield (qt)		
	Highest	Lowest	Average
2015-2016	38	29	36
2016-2017	44	36	40
2017-2018	42	33	38
2018-2019	42	32	37

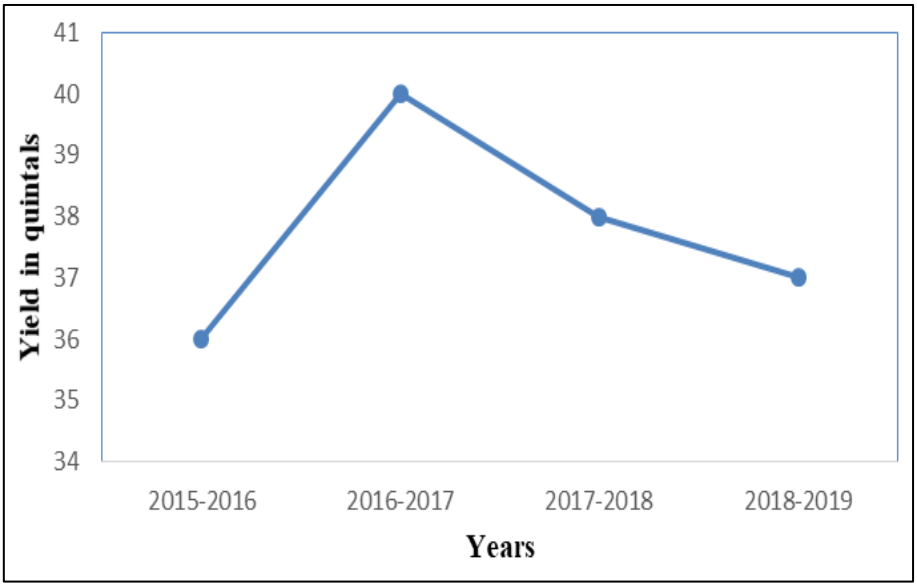

Fig 1: Average Yield of Alfalfa in Changthang Region

Average fresh herbage yield of different cultivar was given by Yasar and Riza 2015 [24] (117594-139688 kg ha-1), which is comparatively very high to our yield in Changthang Region. These could be due to the different genotypic characteristics of the cultivars tested in the experiment and it appears that adaptable cultivars for specific conditions should be recommended for proper regions (Altinok and Karakaya, 2002; Abusuwar and Bakri, 2009; Saruhan and Kusvuran, 2011; Cinar and Hatipoglu, 2014) [3, 1, 21, 8].

Scope in organic farming

Ladakh is going towards organic farming till 2025 and Changthang by default is organic in nature. The initiative of Ladakh being organic can be also be achieved by growing alfalfa. The species enriches the soil with nitrogen, and a good predecessor for various other crops, it is a good green-manure and nectar producing crop and reduces effect of water and wind erosion with its soil binding property. The well-developed root system produces 80 to 120 quintals per hectare of root mass and stubble in the arable layer of soil, equivalent to the application of 40-60 t of manure in terms of content of nitrogen, phosphorus, potash and other elements (Ivanov, 1988) [14]. Nitrogen stored in subterranean organs and residues of alfalfa becomes available to companion crops after biomass degradation. Cultivation of alfalfa in the Changthang region during crop rotation in agriculture fields improves the fertility of the soil, and simultaneously increases the yield of following crops. These characters make alfalfa an essential for organic agriculture (Torricelli, 2006) [24]. Alfalfa is one of the few cultivated plants which produce high level of biomass with lowest inputs. Annicchiarico *et al.*, 2006 [4] also reports sustainability of farming system under organic management increase by the introduction of alfalfa in crop rotation. The cultivation of alfalfa was also done without the use of any fertilizer making it organic. However, the yield is very low compared to the other regions. The yield of alfalfa is purely from fallow degraded lands kept as barren land for years.

Storage and Utilization

Alfalfa for livestock nutrition in Changthang region is most frequently used as hay, but also dehydrated form of haylage for grazing. Alfalfa is harvested and stored primarily as hay for use among the nomadic communities. These collected and dried under the sun on the roofs of traditional Ladakhi houses. The feeding value of harvested alfalfa may be changed by post-harvested factors as much as by precutting environment and history of plant. Conservation and storage system are designed to minimize the loss and deterioration of nutrients (Table 5).

Table 5: Effect of utilization way on dry matter lost

Harvesting method	Harvesting loss (%)
Drying in field	30-50
Dehydrate	20-30

The most adopted method of alfalfa harvesting is preparation of hay but this is usually associated with high losses of nutritive substances. The greater loss in digestible energy of hay was associated with increased leaf loss in snow-damaged hay, which is very often seen in first alfalfa cut which is a more productive. This can be used in making silage but in eastern Ladakh people are not interested in making silage compare to the other parts of the world. The reason can be harsh winter climates with sub zero temperatures.

Impact of Alfalfa cultivation

Impact of the technology: This is with respect to the direct output of the activity.

- **Production impact:** The Yield and productivity of the alfalfa was seen by the farmers in their own farms and farmers were satisfied with the yield and more people were interested in growing alfalfa in their fallow field. The technology has spread horizontally across all the villages.
- **Economic impact:** Income and rate of return of farmers in cluster I and Cluster III have also increased. Alfalfa is sold at the rate of 1300-1700 per quintal. The land which was kept fallow was utilized by the farmers and they have started earning good amount with minimum input.
- **Environmental impact:** The utilization of alfalfa as the fodder crop has not only raised the income of the farmers but also helps in controlling degradation of land and erosion of land.

Conclusion and Recommendation

Alfalfa is an important perennial forage crops species of Ladakh. It is a remarkable crop in comparison with others with widely adapted agronomic properties. It is important and the cheapest source of protein rich forages of excellent amino acid composition and high digestibility, which is so valuable in economical animal husbandry. Moreover this species is important for improving soil, by biological nitrogen fixation and it has important place in crop rotation. It produces high level of biomass with minimum inputs. This is the reason why alfalfa, besides important role in conventional husbandry is getting great role in sustainable agriculture and organic production. Alfalfa is sustainable fodder legumes which can address the scarcity of fodder in eastern Ladakh because being perennial in nature and this legume have the potential to produce higher yield with better herbage quality through suppressing weed growth and improving soil fertility.

According to the study result *Medicago sativa* being the herbaceous perennial legume has significant advantage than growing oats solely in the fallow lands increasing the yield harvested. Among the tested legume alfalfa was found to be the best forage in lower regions of the eastern Ladakh Epecially, Liktsey, Tukla, Nee, Kumdok, till Nidder. But the germination percent was very low in the upper villages of Hanley, Demchok and Kuyul especially above 4600m elevations. Therefore, from this study we recommend that *Medicago sativa* was found to be the best forage species both in terms of storage and adaptability with low benefit cost ratio in regions between 3200-4200m. However, in other higher regions species of Oats can be cultivated in Eastern Ladakh.

In future recommendation identification of sites for seed production and development of suitable cultural practices for maximum yield should be done. In addition to these, enhancing on-farm alfalfa seed production at selected pocket sites will help to ease the management. Moreover, through development and/or adoption of mechanized systems for alfalfa seed production, it could be possible to foster the involvement of private investors in longer term.

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References

1. Abusuwar AO, Bakri E. Effect of water quality and weeding on yield and quality of three alfalfa (*Medicago sativa* L.) cultivars. Australian Journal of Crop Science. 2009;3(6):315-321.
2. Alemayehu Mengistu. Forage Production in Ethiopia: A case study with Implications for livestock production. ESAP, Addis Ababa, 2002, 87p.
3. Altinok SA, Karakaya. Forage yield of different alfalfa cultivars under Ankara conditions. Turkish Journal of Agriculture and Forestry. 2002;26:11-16.
4. Annicchiarico P, Pecetti L, De Rosa L, Piano E. Lucerne variety evaluation for organic farming in Nothern Italy. Proceedings 26th EUCARPIA Fodder Crops and Amenity Grasses Section Meeting, 2006, 65-71.
5. Brink GE, Sanderson MA, Casler MD. Grass and legume effects on nutritive value of complex forage mixtures. Crop Sci. 2015;55(3):1329-1337.
6. Caporali F, Onnis A. Validity of rotation as an effective agroecological principle for a sustainable agriculture. Agric. Ecosyst. Environ. 1992;41:101-113.
7. Cheng, JM, Wan HE, Wang J. Alfalfa growth and its relation with soil water status in loess hilly and gully region. Chin. J Appl. Ecol. 2005;16:435-438 (in Chinese with English abstract).
8. Cinar S, Hatipoglu R. Forage yield and botanical composition of mixtures of some perennial warm season grasses with alfalfa (*Medicago sativa* L.) under Mediterranean conditions. Turkish Journal of Field Crops. 2014;19(1):13-18.
9. Crop Protection Compendium, CD-Rom, CABI, Willingford, Oxen, UK, 2003.
10. FAO, Medicago sativa L. In: Farmers Their Animals and the Environment. FAO/ILRI CD-ROM Forbes, J.C. and R.D. Watson. 1992. Plants in agriculture. Cambridge University Pres., Cambridge, 1999, 355p.
11. Geng HZ, Huang WH, Cao ZZ. China Alfalfa. China Agriculture Press, (in Chinese), 1995.
12. Hobbs JA. Yields and protein contents of crop in various rotations. Agron. J. 1987; 79:832-836.
13. Hu JH, Han QF, Ma L, Jia ZK. Analysis on the industrialized production of alfalfa in the mountains in South Ningxia. Agric. Res. Arid Areas, (in Chinese with English abstract), 2002;20(2):116-119.
14. Ivanov AI. Alfalfa. Published by Oxonian Press Pvt., New Delhi, 1988.
15. Jacob MJ, Mary B, Aaron R, Craig CS. Identifying Base Temperature for Alfalfa Germination: Implications for Frost Seeding. Crop science, 2016, 56.

https://doi.org/10.2135/cropsci2016.02.0109.
16. Katić S, Genetičke I Fenotipske Korelacije Proizvodnih Osobina Lucerke (*Medicago sativa* L.). Doktorska disertacija, Poljoprivredni fakultet, Novi Sad, 2000.
17. Kunzes A, Sonam S, Yogesh K, Hanuman LV, Jigmet L, Kunzang L *et al*. Adoption and knowledge level of farmers about alfalfa scientific cultivation practices in Eastern Ladakh (UT), India. International Journal of Agricultural Sciences. 2021; 17(AAEBSSD 2021):98-104.
18. Lamm FR, Harmoney KR, Aboukheneira AA, Johnson SK. Alfalfa production with subsurface drip irrigation in the Central Great Plains. Trans. ASABE. 2012;55:1203–1212.
19. Nešić Z, Tomić Z, Žujović M, Krnjaja V. Production characteristics of domestic alfalfa (*Medicago sativa* L.) cultivars in agroecological conditions of Srem district. Biotechnology in Animal Husbandry. 2005;21:5-6, 169-173.
20. Saruhan V, Kusvuran A. Determination of yield performances of some lucerne (*Medicago sativa* L) cultivars and genotypes under the Southeastern Anatolian region conditions. Journal of the Faculty of Agriculture, Izmir, (in Turkish). 2011;48(2):133-140.
21. Stanisavljević R, Đukić D, Milenković J, Radović J, Lugić Z, Stevović V. Effect of cultivars and cuts on production and quality of alfalfa (*Medicago sativa* L.). Biotechnology in Animal Husbandry. 2006;22:781-790.
22. Tan CX, Li JY. The cultivation and rotation of alfalfa in south of Shanxi. Acta Agric. Sin, (in Chinese with English abstract). 1957;8(3):314-327.
23. Torricelli R. Evaluation of lucerne varieties for organic agriculture. Proceedings 26th EUCARPIA Fodder Crops and Amenity Grasses Section Meeting, 2006, 141-144.
24. Yasar TK, Riza A. Yield and Quality Performances of Various Alfalfa (*Medicago sativa* L.) Cultivars In Different Soil Textures in A Mediterranean Environment. Turkish Journal of Field Crops. 2015;20(1):65-71.