IMPROVEMENT OF SUB-ALPINE AND ALPINE HIMALAYAN PASTURES

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1. INTRODUCTION

Pastures situated in sub-alpine and alpine regions of the Himalaya are an important forage resource for the livestock of the area. These pastures are used for grazing during March-April to September-October and for rest of the time these remain under snow. Generally, these pastures are grazed by sheep and goats but in some cases buffaloes and cattle have been observed at the upper reaches of sub-alpine pastures.

There is no strict altitudinal limit to delineate sub-alpine and alpine regions. However, it is maintained that an altitude of 2,900 m though cautiously, be kept as a starting point of an alpine zone. The areas adjoining the alpine zone on its lower altitudes between 2,200-2,900m may be designated as subalpine.Plant indicators are, however, the best source for the indentification of these zones. Presence of Betula indicates the sub-alpine regions while Rhododendron–Betula– Juniperus association is indicative of an alpine region.

Due to an ever-increasing demand of livestock products, the grazing pressure on the sub-alpine and alpine pastures is increasing unabated. Grazing area available to one ACU (Adult Cattle unit) in Kashmir sub–alpines and alpines was 0.143 ha during 1977 and the same decreased to 0.103 ha in 1982 and it is continuously decreasing thereafter.

The overgrazing of these pastures has resulted in destruction of palatable grass and legume species. The plant emergence in these areas starts with the melting of snow and at the same time grazing starts. As a result, the plants do not get enough time to grow, set seed and proliferate. Besides, close grazing results in reduction of root growth as such the carbohydrate concentration in perennating organs declines and the plants gradually die. Under such conditions the light penetration in the sward is maximum thereby permitting the invasion of rosette forming plants. Besides, the grazing animals are stocked at very high rates in these pastures. All these factors have lead to very poor availability of herbage from these pastures.

In order to achieve optimum levels of herbage production, these pastures need immediate improvement by way of resowing of palatable, nutritious and quick growing grass and legume species. Subsequent management interventions like protection, fertilizer application, maintaining proper stocking rates, rotational grazing etc will have to be imposed for achieving best results.

Various methodologies for improvement and management of sub alpine and alpine pastures have been standardized at the Indian Grassland and fodder research Institute. These methodologies are presented in this paper.

2. IMPROVEMENT

The first step towards improvement and its subsequent management is the provision of protection to the improved site. Unless it is done, the resown or re-transplanted plants will not grow. Once the protection of the site is assured, sowing or transplantation needs to be done in
supplementation with fertilization. Methodologies for various improvement processes are described below:

2.1 Protection

The biggest impediments in carrying out improvement of the subalpine and alpine pastures are the terrain and accessibility. These areas are undulating, sloppy and highly inaccessible. There are no motorable roads, hence all the materials have to be carried on horses/mules or hauled manually.

Three types of fencing can be erected for protection from grazing:

- Barbed wire fence on wooden poles.
- Barbed wire fence on steel angle irons embedded in cement-concrete bases
- Cattle proof trenching.

In case of barbed wire fence the wooden poles or steel angle iron rods should be at least 6 feet tall. One foot of the length is to be embedded in the soil/cement concrete base. Poles should be fixed at a distance of 6 ft from each other. Three strings of a barbed wire at a distance of 1.5 ft may be fixed on the supports. In order to provide strength to the fence a cross of barbed wire needs to be fixed between two poles.

Wooden poles get decayed during snowfall and generally break or bend due to the load of snow. At least 30 percent of the poles are to be replaced each year. However, it is easiest and cheapest to get these poles in subalpine and alpine regions. Steel angle irons though durable are expensive, require heavy transportation charges and the cost is further increased due to the requirement of cement-concrete. However, the choice can be made keeping into consideration the resources available and the location.

Cattle proof trenching requires digging of a 5 ft wide and 4 ft deep trench around the site. This method is most sustainable and is not very expensive. Live hedge fencing is the most economic method of providing protection but there are no suitable plant species available for subalpine and alpine regions.

2.2 Sowing

The situation in subalpine and alpine pastures is unique. Being inaccessible, it is impossible to carry the machinery for mechanised sowing of these. Being situated on steep slopes, it is not advisable to remove the ground cover lest it leads to massive soil erosion. However, removal of thick and tough sward and a little soil working is very essential for sowing. The experiments conducted on the performance of seed broadcast on the existing sward indicated that not even a single seed germinated. The best methods of seed sowing are:

2.2.1 Pit method

The pits of 30×30-cm size are scratched from the existing sward. First the sward is uprooted, then the soil is dug up to a depth of 10-15 cm. The below ground portion of the sward is taken out and the soil is worked. Such pits are dug in a staggered manner, in lines at a distance of 1 m from each other. Alternate pits are sown with grass and legumes seeds the seeds should not be deep sown. The depth should not be more than 2 cm. The seeds need to be covered with soil. Since these areas have enough underground as well as above ground moisture, there is no need of putting a mulch. Each pit should be sown with 6-8 grains of seed.

2.2.2 Strip method

Under this method a 20-cm wide strip is scratched against the slope. The strip has to be a continuous one. This method can be adopted only at the places where the slope is unbroken into
gullies or contours and the areas are large. After removing the sward, the soil is dug upto 10-15 cm and is cleaned of the below ground parts of the sward. Depending upon the grade of slope these strips are scratched at a distance of 2-4 m. on gentle slopes (upto 30%) the strip –strip distance should be 2m. with the increase in the grade of slope, the distance between the strips needs to be increased. The alternate strips are then sown under grass and legume seeds. Each running meter of the strip should be sown with 8-10 grains of seed.

2.2.3 Suitable species

2.2.3.1 Grasses

*Lolium perenne*, *Festuca pratense, F. rubra, Phleum pratense*. For sub–alpine areas *Festuca arundinacea*, *Phalaris arundinacea* and *P. tuberosa* are also suitable.

2.2.3.2 Legumes

*Trifolium repens, T.pratense*. For subalpine areas, *Trifolium sub–Terraneum, Lotus corniculatus, Medicago sativa* and *Onobrychis viciaefolia* are also suitable. In the context of the pastures, it is very important to create a mixed vegetation so that the herbage availability is assured the season round. Depending upon the availability of seeds, it is recommended that the seeds of grasses and legumes should be sown in equal proportions.

2.2.4 Seed rate

The optimum seed rate for sowing of grasses is 5 kg/ha excepting *Festuca arundinacea*. In this case the recommended seed rate is 6 kg/ha. Incase of legumes the optimum seed rate is 5 kg/ha excepting *Lotus corniculatus* and *Onobrychis* for which a seed rate of 7 and 15 kg/ha, respectively may be applied.

2.3 Transplantation

It has been found in subalpine and alpine area of the Himalaya that grasses can be raised in a nursery and the seedlings may be transplanted in pits or strips. However, the survival rate of legume seedlings was very low (27%). Hence it is recommended that legumes should be raised by sowing the seeds. The transplantation of seedlings, though more labour intensive is a quicker and more sure method of resowing of pastures. It may be comparatively difficult to apply this method in alpine areas because of distances and other logistical problems but it can very well be applied in sub – alpine areas where irrigated land for raising nurseries are available at short distances.

Nurseries of grass seedling can be raised in well drained, elevated soils. Farm yard Manure @ 100 kg/ha should be added to the finely ploughed and broken soil. Beds should not be very large. An ideal bed will be 4 x 2-m size. The bunds of the bed should be raised. Seed should be evenly spread on the soil and a thin layer of soil should be spread over. The depth of seed should not be more than 2 cm. After sowing, a light shower with a sprinkler should be provided. Thereafter the bed should be covered with mulch. Out of dry grass, tree branches, old news papers and polythene, the last one i.e; polythene sheet was found to be best mulch. The soil of the nursery bed should be moist, not flooded, all the times. When the seedlings reach two leaf stage, the mulch should be removed and the bed should be regularly irrigated. When the seedlings reach a height of 20 cm these can be transplanted in the pits or strips.

For transporting the seedlings to the site of transplantation the bed should be flood irrigated about 2 hrs in advance. The seedlings after uprooting should be tied in small bundles and transported.

At the site the upper portion of the seedlings should be chopped off. Only a length of 10 cm from the base should be maintained for the seedling. A minimum of two seedlings should be transplanted at one spot. These spots should be atleast 10 cm apart from each other.

The nursery sowing needs to be made atleast 45 days in advance to the date of transplantation.
2.3.1 Time of sowing/transplantation

From October to April all the alpine pastures are under snow while for sub-alpine pastures this period can be November–March. Therefore, for alpines 5 months of May-September and for sub-alpines 7 months of April–October are available for sowing/transplantation. Experiments conducted by IGFRI have revealed that sowing made in fall (autumn) during the months of September–October had a germination rate of 13.3% in spring (March–May). Only 23.4 percent of these seedlings survived during coming summer. While on the other hand sowings made during spring, (March–April) in sub-alpine and April–May in alpines exhibited an average germination rate of 87.45% and out of these 92.80% seedlings survived. These findings may vary in different Himalayan eco-systems because of the Himalayan diversity and the niche effect. However, spring is the best time for sowing.

As far as transplantation is concerned, obviously, spring is the best time. The exact time can be determined after taking into account the factors like time of melting of snow, availability of clear pasture area and the weather conditions. In Indian Himalaya, March 15–April 15 and April 30 – May 30 are the best periods for transplantation in sub-alpine and alpine pastures respectively.

2.4 Fertilizer application

Experiments conducted on the effect of fertilization on the herbage production of grasses and legumes have revealed that excepting Lolium perenne, all grasses produce maximum upto an application of 90 kg N/ha. Lolium perenne, however, would produce best at nitrogen application of 120 kg/ha. Incase of legumes best response was found at the application of 60 kg/ P₂O₅.

Since Lolium perenne forms only one component of the new swards, it is recommend that 90 kg N+ 60 kg P₂O₅ may be applied to the resown pastures in three splits. The first split should be a basal application; the second split should be applied after the optimum growth of seedlings (say average height of 30 cm) and the third application should be provided at initiation of boot stage of the grasses.

2.5 Post sowing/transplantation activities

During next year of the operations, it should be ensured that similar operations, as described above, would be carried out between pits/strips laid last year. The interspaces of the strips/pits should be replanted the same way to ensure greater spread of the desired species composition.

All the newly resown/transplanted areas would require atleast one year for establishment. Hence it is recommended that the entire area should not be sown/transplanted in one go. Half of the area should be improved and protected from grazing for one year. Next year it may be opened for grazing and rest of the area may be resown/transplanted.

Only improvement of the pasture is not enough to achieve maximum production. Subsequent management like regular fertilization and fixing of appropriate stocking rates is a must. Even the grazing has to be regulated. The rotational system of grazing has been found to be the best.