Chapter IV
Fodder oat germplasm: a world scenario

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Summary

Cultivation of fodder oats is growing in popularity with farmers in many areas of the HHK. Oat cultivars as part of new crop management technologies have been effective in increasing winter fodder production and improving animal condition, fertility and milk yields. The *ad hoc* supply of cultivars to the HHK region is of immediate concern. There is an urgent need to co-ordinate the supply of fodder oat germplasm and to develop cultivars that focus specifically on the needs of farmers. This germplasm cannot easily be acquired, introduced and circulated in the absence of appropriate mechanisms, financing and networks mandated to work in the targeted areas.

The vegetative portion of oat (*Avena sativa* L.) is valuable to many livestock farmers as a source of pasture for grazing and fodder. Many farmers grow oat crops for this purpose because of their value for milk and meat production. Oats are also used for hay, haylage, chaff, straw bedding materials for animals, and grain.

Fodder cultivars must be capable of producing large amounts of highly digestible green fodder for animals, have high regrowth capability following cutting, and be resistant to potential plant diseases that may limit fodder yield in the production areas.

Dual purpose cultivars are often used. They are commonly autumn-sown, produce green fodder over winter, then may be left to grow for silage, hay, straw, or to produce grain for animal food, or seed for sale. Oats are generally more productive in cut-and-carry systems than for grazing, especially in colder environments. Oats have an advantage over other small grain cereals because of their early and fast capability to produce biomass from autumn or winter sowings. Their disadvantage includes the lack of cultivars developed specifically for intensive multiple grazing situations in cooler regions where grazing is the preferred feeding practice.

'Germplasm' can be defined as a part of the germ cell that contains hereditary materials, the chromosomes and genes. This paper briefly discusses scenarios for accessing oat germplasm internationally for fodder cultivar selection and distribution; the role of fodder oats in the Himalaya-Hindu Kush (HHK) zone; and explores farmer participatory cultivar selection, testing and seed distribution systems.

Fodder oats in the Himalaya – Hindu Kush

Fodder oats have become a major crop along the HHK zone. Oat and other cultivated cereal fodders, including fodder legumes, are being used to facilitate zero and tethered animal grazing. This is a more efficient use of fodder; it reduces waste and prevents overgrazing and soil erosion.

In many areas of the HHK cultivated oat fodder provides for better utilisation of the fallow between grain crops, when land is bare, thus improving the availability of green fodder for commercial dairy and dry livestock at the village level. Extension projects have encouraged greater intensification of oat growing by farmers, such as in the Kashmir where much of the land once remained bare over winter. Fodder oats are frequently grown as mixes with forage legumes, such as vetch (*Vicia* spp.) and berseem (*Trifolium alexandrinum*) for example.

The cultivation of fodder oat is growing in popularity with farmers. Areas sown in Nepal, Pakistan and India and the warmer regions of China are increasing substantially. Oat is easy to cultivate, grows well over winter and has adequate cold and drought tolerance for these regions. It has been effective in improving animal condition, animal health and milk yields.

December to April (winter to early spring) is the oat fodder producing period for many parts of the HHK zone. It is also the period of greatest fodder need, although this varies according to altitude. In most of the regions bordering on to the HHK there are shortages of quality fodder all year.

Oat fodder cultivation has the potential to extend the availability of green winter fodder from the low to high altitudes around 2 500 metres, but for higher altitude areas new dual purpose fodder and grain producing cultivar types are required. In Nepal oat fodder is currently concentrated below 1 600 m altitude (Pariyar 2004).

Farmers along the HHK mostly use cut-and-carry systems. This system provides for greater control over the timing of fodder harvests and enables farmer to control cutting height above the ground, therefore maximising crop recovery potential. Consequently, very high dry matter yields are often achieved.

Extension programmes have trained and encouraged farmers to adopt new fodder crop management and animal feeding technologies to improve the revenue earning capability of their land-holdings, in a sustainable manner. These programmes help farmers optimise soil conditions and fertility and promote cropping rotations that utilise improved fodder cultivars and quality seeds. Introducing genetic improvement programmes, especially for higher value livestock, will also need greater attention in future.

Oat cultivars for winter fodder production

According to Pariyar (2004), the introduction of new multi-cut cultivars to Nepal along with new crop management technologies have increased the green matter yield potential of fodder oat from 15 − 20 tons/ha to 50 – 93 tons/ha (Pariyar 2004).

The adoption of cultivated oat fodder technologies along with new cultivars selected specifically for forage use has significantly improved on-farm fodder yields. New cultivars with improved traits are critical components of these fodder technology packages because they provide farmers with greater flexibility when managing crop rotations. For example, cultivars with a longer winter vegetative growing phase and rapid growth capabilities from vegetative to grain maturation will enable farmers, particularly in higher altitudes, to leave part of their fodder crop to produce a successful seed harvest, in time for late spring cultivation and sowing of the following summer crop.

Background to fodder cultivar introductions

Finished oat cultivars originating from New Zealand, Canada, Europe, Pakistan and India form the basis of the fodder oat improvement programmes across the HHK and many areas of South Asia. New Zealand's involvement with fodder improvement in Nepal started during the 1950s with the successful introduction of Grasslands Huia white clover (*Trifolium repens*), Grasslands Maku lotus (*Lotus pedunculatus*), Whero field pea (*Pisum sativum*) and various New Zealand ryegrass, clover and fescue cultivars.

Grasslands and Crop Research Divisions of the New Zealand Department of Scientific and Industrial Research (DSIR) were major suppliers of donated research samples until these organisations were disestablished in 1992. Commercial importations were also made by the Food and Agriculture Organisation of the United Nations (FAO-UN), the Asian Development Bank and various other projects. Support for this research and extension has been provided by the Nepal Agricultural Research Council, Department of Livestock Services, and HMG Ministry of Agriculture as the implementing partners (Stevens *et al.* 2000).

More recent introductions of finished oat cultivars to Nepal came from Crop and Food Research in New Zealand, sponsored by the FAO-UN under project TCP/NEP/2901(A), which is due to terminate in April 2005. The cultivars supplied were a mix of older and recently developed fodder types developed using parental materials selected in New Zealand and from USA, Canada, Australia and Europe. Cultivars supplied were mostly the common or domestic oat (*Avena sativa* L.).

Fodder oat cultivar development

Breeding adapted cultivars suitable for commercial production requires continuing access to genetically diverse germplasm to overcome potential challenges from new pests and diseases, and to provide consistent yields of good quality fodder across different environments.

Cultivar development involves the acquisition and selection of parental materials, hybridisation among the materials, possible inbreeding and selection among the resulting progeny, replicated testing for yield and other important quantitative traits, and finally seed multiplication, possible cultivar registration, cultivar seed maintenance and distribution. This developmental process can take ten years - more or less.

There are also ongoing cultivar maintenance costs while registered cultivars remain in commerce. Registered cultivars can be protected for up to 20 years in some western economies. Royalties for seed sales or end point levies are collected. These royalties or levies help fund breeding programmes. Royalty collection along the HHK, however, is not a practical option.

Successful plant improvement programmes are difficult and expensive to replicate. Set-up costs can be high and success is not guaranteed. As the total international investment from public funds for plant improvement programmes diminishes, accessing germplasm becomes slightly more difficult. Programmes formerly funded from public sources are increasingly operating inside commercial partnerships with the logical outcome that germplasm now has an identifiable monetary and/or strategic value. Consequently, accessing germplasm today from formerly public sources is on a much more commercial basis. Germplasm exchange agreements are frequently part of the process and, like any contract, usually involve conditions that the recipient is expected to uphold.

Nevertheless, for the HHK region oat germplasm is available from both commercial and public systems, including a number of working *Avena* collections around the world. What is urgently required is an oat fodder network that has a mandate to develop cultivars for the HHK region.

Oat fodder cultivar network for the HHK zone

Special purpose fodder cultivars are needed for the HHK region. There are no international agencies responsible for generating and co-ordinating fodder oat germplasm enhancement and cultivar development programmes specifically for the varying altitudinal and agricultural regions in the HHK. Researchers and farmers along the HHK stations need modern oat fodder cultivars with resistance to potential pest and disease threats of the future. Official cultivar release programmes for other cereal crops are already in place so cultivar integrity and seed quality mechanisms to ensure continuity of supply of fresh seed to the rural markets along with farmer traded seed is not an issue. Such dual processes provide very rapid and cost-effective routes to market for new cultivar seeds. The missing link is a mechanism for developing and supplying modern fodder cultivars targeted for on-farm use in the HHK region. Possible solutions need to be canvassed and could include a combination or variations of any of the following:

- establishing an oat fodder network with recognised United Nations, governments, CGIAR network and/or other agencies such as the International Oat Committee (IOC), and organisations that have a mandate to work within targeted areas for humanitarian relief, rehabilitation and development;
- endowing the network with a portfolio of oat breeding materials, finished cultivars and guidelines from existing plant breeding organisations, keeping in mind that plant variety rights and other contractual arrangements to forgo royalty payments would have to be negotiated by the network as an integral part of cultivar releases;
- establishing a small oat fodder unit in Nepal to test and distribute finished cultivars supplied by the network within the NARC and DLS system alongside the existing wheat and barley plant improvement programmes;
- attracting a cash or in-kind sponsor;
- continue as at present, with periodic funding.

Cultivar testing and farmer participation

Cultivars have been successfully and periodically introduced to the region. Cultivars are generally tested in the first instance on established research sites where conditions are as similar as possible to the potential target production areas. This process is useful for eliminating poorest performers and identifying 'best bet' cultivars prior to on-farm evaluation. An example is the Nepal project TCP/NEP/2901(A). Thirty-member farmer clusters were provided with the ten 'best bet' fodder oat cultivars selected from a large number of cultivars trialled on irrigated and rain-fed research sites. This participatory practice provided farmers with an opportunity to select cultivars appropriate to their needs, in consultation with project staff.

Farmers made astute observational comparisons with control cultivars, Kent and Swan, which are widely used in Nepal and sown alongside all individual 'best bets'. Their ability suggests that, at least in the initial stages of crop and cultivar improvement programmes of this nature, cultivar selections by farmers are a cost-effective method of choosing the final tier of cultivars from which commercial releases can be made. This simple farm-based methodology introduces these farmers to facets of crop improvement programmes that generally take place on research sites with minimal farmer involvement.

In project TCP/NEP/2901(A) fodder yield was only one of several parameters that the farmers judged. Plant appearance, tillering capability, leaf to stem ratio, lodging resistance on highly fertile soil, and cultivar maturity when crops are required for seed production were also evaluated. In future, field reactions to plant diseases are factors these farmers may also consider when choosing their fodder cultivars.

Experiences from project TCP/NEP/2901

For project TCP/NEP/2901(A) a considerable quantity of cultivar plot data was also collected. The data were used to develop training packages for farmers, extension officers and researchers involved in the field experimental process. There was considerable on-site interaction with all parties observing and comparing cultivars against control cultivars. Sound judgements were made on cultivar performance using these observational skills and measured data. This project highlighted the limitations of relying solely on established statistical processes for determining best performers because the newly adopted crop management systems applied on farms improved crop yields more than did cultivars, masking the smaller yield differences that one could expect between cultivars and that is more difficult to determine statistically. In these situations farmers are likely to make the best judgements on cultivars they believe are most appropriate for their use.

As the standard of on-farm management improves, 'best bet' cultivars selected on research stations could be tested using conventional experimental processes (modified to cope with terrain) on the top performing farms if the objective is to accurately compare cultivars for on-farm yield performances. These farms could then become the demonstration sites from which the better performing cultivar seeds are distributed to neighbouring farmers.

Conclusion

The *ad hoc* supply of cultivars to the HHK region is of immediate concern. There is greater urgency to co-ordinate a supply of fodder oat germplasm and to develop cultivars that focus on the needs of the HHK. Landraces and inferior fodder oat cultivars bred and released decades ago continue to be grown. New and improved materials with better disease resistance are required. However, they cannot easily be acquired, introduced or circulated without mechanisms such as the CGIAR network, which caters for other major world crops such as wheat, barley, maize, pulses, and vegetables.

Most of the breeding effort worldwide is directed at increased grain production. In the HHK cropping systems, oats are used mostly for fodder. There is likely to be genetic variability among these genotypes in their suitability for cultivated fodder production in this region. Investment in oat breeding is diminishing worldwide. However, with the help of organisations with a mandate to work within targeted areas and with access to working *Avena* collections in many countries, including the HHK region, progress may be made. Information on the entries in many of the collections can be accessed electronically. The Germplasm Resources Information Network (GRIN) established by the USDA, ARS is such an example.

Official cultivar release programmes for other cereal crops in this region are already in place. Farmers will continue to need training and some encouragement to adopt sustainable land management systems. New crop management technologies, greater access to genetic improvement programmes for higher value livestock, and genetically superior fodder cultivars contribute to these systems. The missing links are the absence of appropriate mechanisms, financing and networks, especially in small nations and/or minority areas that lack resources to develop their own breeding programmes.

There remains an urgent need to launch and develop a globally co-ordinated forage and fodder oat programme for resource-poor regions of the world. Suitable oat cultivars should be identified and distributed through the CGIAR and other networks, as they are for wheat, barley, maize, pulses, selected vegetables and other cash crops.

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