On-farm Dynamics of Wheat Genetic Resources in Nainital District of Uttarakhand

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Current status of wheat genetic resources and their management was studied in eight blocks of Nainital district of Uttarakhand. A total of 13 wheat varieties comprising of six traditional types and seven improved high yielding types (HYVs) were found under cultivation. Over four decades, 66.43% of the area of traditional varieties has been replaced by HYVs. Rye (*Secale cereale*) locally known as *Russi gehun* is also under sporadic cultivation. The selection of varieties was varied depending upon the topography, agro-climatic niches and resources of the area. Two traditional varieties *viz*. *Naulia* and *Daulatkhani* were found to have rare distribution. Significant variability for some characteristics between and among the traditional varieties were observed. Assured grain yield, good straw quantity, drought tolerance, grain quality, taste and resistance to birds and animal damage were some of the farmers' criteria for selection of the varieties.

Key Words: Genetic resources, Wheat, Uttarakhand

District Nainital is situated in Central Himalayan region between 80º14' East longitude and 29º5' North latitude. The region is a well known centre of crop diversity (Arora 1990; Khushoo 1992). The total geographical area of district is 3422 km^2. Geographically, it is divided in to two zones viz. hilly and the plains. The conservation of crop diversity is the major concern of today. After green revolution, many high yielding varieties (HYVs) particularly of wheat and rice were introduced in this region for increasing of production. The introduction of high yielding varieties, initially free of cost, has encouraged the farmers to adopt them. Consequently farmers abandoned their old traditional varieties, which were locally adapted and catering to farmers' needs. As a result, many traditional crop varieties were disappeared. A particular worry is about the substitution of diverse set of genetically variable crop landraces by a few genetically uniform modern varieties (Brush 1991; Harlan 1992; National Research Council, 1993). In contrast to modern agriculture, traditional farming system not only serves to preserve the diversity of local varieties, but also the human knowledge and behaviour practices that have shaped this diversity (Bellon, 1996). The present study aimed to understand the on-farm dynamics of traditional and high yielding varieties of wheat (*Triticum aestivum* L.) in district Nainital of Uttarakhand.

Materials and Methods

Data of wheat (*Triticum aestivum* L.) genetic resources under cultivation in district Nainital were collected from primary sources by using a structured questionnaire accompanied with interview schedule at individual farm household level during *rabi* 2008-09. Sample villages were randomly selected from all eight blocks of the district. All the regions representing distinct agro-climatic niches were covered for the study. A total of 32 villages and 109 households were randomly selected as respondent farmers for documentation of wheat varieties under cultivation in their villages. A non participant observation method was also employed while recording the information.

The information on erosion, shift in varietal diversity and changes were obtained by using participatory rural appraisal (PRA) technique. Current status was validated by recording observations in the fields for wheat cultivars diversity. All possible care was taken to determine the consistency in farmers naming and describing wheat cultivars by comparing information from farm households, different social groups etc. Information obtained was authenticated with the help of knowledgeable farmers and agricultural extension and development workers engaged in the region.

Results and Discussion

The present study revealed that six traditional varieties (TVs) are being grown by the local farmers of which

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Munda, Naulia and *Daulatkhani* are the awnless (*Munda*) varieties while *Ryat, Syat* and *Chanosi* are awned (*Jhusia*). High yielding varieties viz. RR 21, S 227, VL 616, VL 738, VL 829, UP 2382, UP 2554 and PBW 343 are also under cultivation. *Chanosi* is dominant in all blocks except in Ramnagar, where none of the TV is under cultivation as land is irrigated and well connected to National highway.

Local farmers informed that before 1970s they used to grow TVs only, none of the HYVs were present in the region. Presently HYVs have occupied a large area (66.43%) of wheat cultivation. It is evident that the erosion of the TVs is a result of state sponsored 'Green Revolution', which pushed the HYVs, chemical fertilizers, pesticides etc. free of cost (Maikhuri *et al.*, 2004). The present study revealed that replacement of TVs in different development blocks varies from 24 to 100%. The least replacement is observed in Betalghat and Kotabagh blocks as these are not well connected with high ways. In Bhimtal, Dhari, Haldwani, Okhalkanda and Ramgarh blocks most of the TVs have been replaced. Haldwani development block is also well connected with road networks. Consequently TVs of crops including wheat have been replaced under the onslaught of developments and mushrooming of construction works. Development block Okhalkanda is backward in agriculture hence government agencies have provided input resources in the form of fertilizer, HYVs etc. to the farmers for agricultural development. As a result 63.74% of the TVs' area have been occupied by HYVs.

Among the TVs, *Naulia* and *Daulatkhani* are the worst affected and almost disappeared from the farmers' fields. Their presence in the study area is mere 2.78% of each. Among TVs *Ryat gehun* occupies the highest area (25.0%) followed by *Munda* (22.23%), *Chanosi, Syat gehun* (19.42% each) and *Russi gehun* (*Secale cereale*) (8.34%). The reduction of area under traditional varieties is also evident in other regions and countries. In terms of genetic diversity, the introduction of HYVs has increased the diversity of wheat genetic resource in the region as most of the high yielding varieties have diverse germplasm from various sources in their pedigree.

Grain yield, straw yield, drought tolerance, grain quality, taste and resistance to birds and animal damage (because of presence of awns) are the major criteria adopted by farmers for selection of wheat varieties and their area share of cultivation. Assured yield is the most important feature of the variety. Awned TVs, *Chanosi, Ryat* and *Syat* are ranked first in view point of assured yield followed by HYVs and awnless TVs. Traditional awnless varieties are found suitable for drought conditions, reported the farmers. A study conducted in district Almora of Uttarakhand by Tiwari and Das (1996) also revealed the same trend. The grain quality and taste of *Chapati* are also very important criteria for adopting a variety in the region. Awnless TVs are good in grain quality and *chapatti* taste particularly *Daulatkhani*, once a very popular cultivar in Kumaon hills as reported by farmers. Similar findings were also reported by Mehta *et al.* (2009).

In Central Himalayas the traditional agro-biodiverstiy is complex with strong linkage between crop plants, animals and forests (Palni *et al.*, 1998) and straw a byproduct of crops is an important source of fodder for the domestic animals. The farmers normally prefer TVs which have good quality straw alongwith grain yield. The study revealed that in spite of possessing all the desirable traits, the awnless TVs have been replaced by the farmers because they were very prone to birds and animal damage. Consequently the overall area share of the awnless TVs has been reduced to the lowest rank (Table 1). Jarvis *et al.* (2000) also reported that for selection of variety, it is important to understand how farmers make use of their crops and agro morphological characteristics in different capacities particularly selecting among the plants in the crop populations to maintain the desirable traits and to increase the prevalence of other valued traits in the population overtime.

Variations in size, shape and colour of grains were observed among and within the local cultivars

Table 1. Replacement of traditional varieties by HYVs in different development blocks of district Nainital

Development block	Area (%) of wheat varieties under cultivation	
	TVs	HYVs
Betalghat	76.00	24.00
Bhimtal	51.20	48.80
Dhari	10.00	90.00
Haldwani	4.00	96.00
Kotabagh	71.00	29.00
Okhalkanda	36.26	63.74
Ramgarh	20.12	79.88
Ramnagar	0.00	100.00
Total	33.57	66.43

Table 2. Grain character of traditional varieties grown in district Nainital

Name of traditional varieties	Grain length (mm)	Grain width (mm)	100-seed weight (gm)	Grain colour	Remarks
Naulia	5.9	3.30	4.02	Amber	Awnless, tall
Ryat gehun	5.81	2.98	2.71	Red	Awned, tall, drought tolerant
Syat gehun	5.98	3.11	3.04	Amber	Two variants: awned and awnleted
Munda	6.22	2.83	3.47	Variants white, amber and red	Awnless, bold grains
Daulatkhani	5.77	3.02	3.67	Amber	Awnless, bold grains
Chanosi	6.25	3.30	4.17	Amber	Awned, plant height medium, bold grain

(Table 2). In *Syat gehun* two variants – amber and reddish grain colour with awned and awnleted spikes were recorded. *Ryat gehun* grains are of medium size and red (light to dark red) in colour. There were two variants in *Chanosi* long and bold with white grain and medium size with amber grain. In *Munda*, three variants – red, amber and white grain colour were recorded. *Naulia* a bold grain wheat, two colour variants amber and white were found under cultivation in some pockets of Bhimtal block. Three variants of grain colour in *Daulatkhani* were collected during the study and collection mission. The intra cultivar diversity observed in on-farm managed populations could be explained by size in the number of landraces cultivated during the last 2-3 decades. In the North-western Himalayas, farmers plant several landraces in the same or in nearby fields (Bisht *et al.*, 2007). Further, at local level there is frequent exchange of landraces among farmers. The seed selection is normally very uncommon and the size of the population is relatively large which avoid substantial loss of intra-varietal diversity from generation to generation through genetic drift. Increase in intra-varietal diversity over continuous cultivation has also been reported in other studies as well (Benzancan *et al.*, 2008; Bary *et al.*, 2008).

The overall diversity of traditional wheat cultivars are of paramount importance to cater the subsistence requirement of the local farmers in rainfed agro-ecosystems of the Himalayas. The traditional wheat cultivars were giving better yields under low input rainfed conditions. The abandoning of TVs and adopting of HYVs without considering any pros and cons in the Himalayan region particularly in rainfed marginal farming systems has negative impact on agricultural production. Before developing of HYVs, it is very essential to study and understand the topography, micro climate, pedology and resource conditions of the target region. The traits of traditional cultivars, for which they are popular among the local farmers must be incorporated in the new improved varieties. It is also important to take care of the traditional cultivars and those should be collected and conserved for the future generations while introducing the improved high yielding varieties in traditional agro-ecosystems, so that the process of sustainable development may also be continued.

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