Table 1. Basic Germplasm introduced from other countries (No. of clones given in brackets)

Species	Country
Saccharum officinarum	Indonesia, Papua New Guinea, Fiji, New Caledonia, etc. (773)
Saccharum robustum	Papua New Guinea (77), Indonesia (49)
Saccharum edule	Papua New Guinea (9), Indonesia (7)
Saccharum spontaneum	Bangladesh, Burma, China, Congo, Algeria, Egypt, Fiji, Guam, Indonesia, Kenya, Nepal, Uganda, SriLanka, Phillipines, Singapore, Vietnam, Israel, Mauritius, New Guinea, Thailand, Japan, Malaysia, Russia, Taiwan. (138)
Saccharum sinense	China (7), Japan (1)
Erianthus spp	Indonesia (86), Thailand (6), Burma (4), Nepal (4) Fiji (4), Papua New Guinea (5), Vietnam (2)

1947 to 1956. Only one clone collected from Java appear in the pedigree of most varieties.

During 1966-1973, under US PL480 project, attempt to introduce disease resistance and hardiness from Indian "Spontaneums" into foreign commercial varieties was made. Commercial varieties from Hawaii and Puerto Rico were crossed with selected *S. spontaneum* clones and 150 hybrids were selected from the derived population. These were designated as (IA) Indo-American clones. Some of these clones are found in the pedigree of commercial varieties Co 7908 and Co 8318. 130 Indo-American clones and 585 Foreign hybrids are being maintained at Kannur centre of SBI.

Many foreign clones, especially POJ varieties, have been utilized in sugarcane improvement programmes. A list of foreign clones that have entered into the pedigree of Indian commercial varieties is given in Table 2. POJ 2878 is the only introduced variety from Indonesia that has ever been successful in this country as a cultivated commercial variety.

Table 2. Foreign germplasm introgressed into Indian varieties

No	Country (source)	List of varieties/clones
1	Indonesia	EK 28, POJ 100, POJ 181, POJ 213, POJ 385, POJ 1410, POJ 1499, POJ 2364, POJ 2725, POJ 2878, POJ 3247, Kassoer, *S. spontaneum* (Java).
2	USA	CP 670, CP 1165, CP 34120, CP 29-116, CP 34-120
3	Mauritius	M 2, M 4000
4	Australia	Q 63, Q 116
5	West Indies	B 3412, B 3747

Table 3. Recently introduced Sugarcane germplasm

	Year	Country	EC nos.	No of clones
1	1999	Thailand	432420-432570	150
2	2000	China	453250-453252	3
3	2000	USA	453405-453417	13
4	2003	Mauritius	516236-516240	5

Recently, sugarcane germplasm, both wild and cultivated, have been imported from the following countries (Table 3).

Efforts are being made to introduce *Erianthus kanashiroi* from Japan, China; *E. hostii* from Iran, Iraq; *E .rufipilus* & *E. sikkimensis* from Bhutan and *E. longisetosus, E.hookerii, E. filifolius, E. giganteus, E. brevibarbis, E. strictus, E. alopecuroidus, E. coarctatus, E. contortus, E. maximus* from USA.

Utilization of Gene Pool in Genetic Improvement in Forage Oats – Achievements and Future Prospects

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Plant genetic resources are vital inputs for sustaining genetic improvement programme. For an efficient breeding programme, a large collection of cultivars, landraces and wild relatives of the species need to be assembled has to be made, both from exotic and indigenous sources.

Oat (*Avena sativa* L.) is an important cultivated cereal for both fodder and feed purpose. It ranks sixth in world cereal production following wheat, maize, rice, barley and sorghum. It is an important winter forage crop. It has wide adaptability in northern and north western regions of the country because of its excellent growth habit, quick regrowth and highly nutritive value for both milch as well as draft animals.

The species which make up the genus *Avena* are from a polyploid series with a basic chromosome number of n = 7. Three naturally occurring ploidy levels are known within the genus, diploids (2n =2x=14), tetraploids (2n= 4x =28) and hexaploids (2n=6x= 42).

Keeping in view the ever-increasing pressure on land resources, IGFRI, Jhansi has tailored its oat genetic improvement programme to develop cultivars, which can fit into existing cropping systems. The programme is being followed with the objective of developing non-lodging, erect, multicut, dual purpose, late flowering types.

Utilization of Exotic Germplasm in Cultivar Development

Oat breeding research in India is of recent origin. Kent, Algerian, Brunker-10, FOS 1/29 varieties were introduced long back and produced good fodder and grain yields. Among these the Kent notified in 1975 has been one of the most successful introduced varieties and it is still under cultivation with wide adaptation.

At IGFRI, Jhansi, wide range of germplasm has been introduced from various external agencies such as USDA, National Gene Bank, Sweden; Maryland University; IGER (UK); Brazil, Japan etc. The evaluation and utilization of these germplasm has resulted in development of many promising cultivars, which have high potential for biomass and quality. Many parental stocks such as Cuahtemaoc, Veli, Pennline, Diadem, Akiyutaka have shown high combining ability. Some of the promising strains procured from exotic sources are: Black Mesdag, Saturn, Diadem, Veli, Hankinjan Valco, Rodney, Orbit, Benson, Montezuma, PI 497888, PI 497819, CI 9313, CI 9370. etc. Many such lines have been identified as donors for desirable agronomic traits and have been utilized in crossing programme so as to develop suitable lines for different agro-ecological situations in the country.

Selection from Japanese oat "Hiugo Karyokuro" has resulted in development of a superior variety JHO -851 which has been released for cultivation in entire India. It is multicut variety with high protein and regeneration ability. Similarly cultivars like JHO 822, JHO 810, JHO 829 have been developed utilizing the exotic germplasm as one of the parent.

Utilization of Secondary Gene Pool

The gene transfer from wild relatives is of great importance for improvement of oat, because the cultivated germplasm pools of this crop are quite restricted and the cultivated types have remained isolated from their wild relatives for several thousand years.

In the improvement programme, other species from secondary genepool of oats have also been exploited involving back crossing and colchiploidy techniques to develop superior strains with many desirable traits from both the parents. The hybridization of *A. sativa* (2n=6x=42) with *A. maroccana* (2n=4x=28) has resulted in development of F1 sterile hybrid with chromosomal constitution of 2n=5x=35). The subsequent cholchiploidization of the F1 hybrid has resulted in fertile amphidecaploid lines (2n=10x=70). The gradual stabilization of these lines through generations has resulted in polysomic lines (2n = 42, 44, 46, 50, 52, 58, 66, 70). These lines combine the traits of both the parents in various combinations.

This has resulted into creation of an array of genetic material to be exploited for development of superior forage oats with respect to yield and quality. Many improved lines combining desirable traits of wild types are being tested under All India Coordinated trial. Vast potential exists to introduce novel genes into cultivated *A. sativa* background. The desirable progenies from these lines have been identified and are in advanced stages of multilocational trials under the aegies of AICRP (FC).

Utilization of Wild Relatives from Primary Genepool

Among the wild gene pools *A. sterilis* (hexaploid) contain a number of valuable genes for growth rate, higher biomass, tillering ability, protein content and resistance to pests. Such genes may be introgressed in cultivated *A. sativa* background through interspecific hybridization .At IGFRI, Jhansi interspecific hybridization with *A. sterilis* and subsequent backcrossing with *A. sativa* have given rise to many progenies combining the traits of both the parents and many desirable lines have been selected for high biomass under both single cut and multicut system.

Utilization of Exotic Germplasm for Breeding of Dual Purpose Varieties

Oat is the most ideal cereal crop both for fodder and animal feed. Keeping this in view breeding efforts must be made to tailor dual-purpose genotypes (forage-cum-seed). Enough scope exists for identification of genetic stocks from world oat germplasm combining forage productivity in first cut followed by grain productivity. Efforts in this direction have been initiated at IGFRI, Jhansi. Several genotypes have been identified as dual purpose and are being tested in trials for their performance.

Future Prospects

- Developing dual purpose oat varieties.
- Breeding oat for diverse cropping systems.
- Exploiting tertiary gene pool for introducing desirable traits.
- Developing multicut types for sustained fodder availability for longer duration.
- High tillering and high protein.