BREEDING OBJECTIVES

Good Qualities of Forages

- Forage should be highly productive
- Could be used as fodder, pasture, hay or silage
- Should have good seed production
- Sod-bound problems should be minimum (barren patches)
- Seedling vigorous enough to produce early sod
- Should not be thinned out under heavy grazing
- Should have multiple cuttings and long lasting stand
- Should produce good aftermath (grass growing after mowing or harvest)
- It should maintain its palatability
- All types of livestock could relish it

Breeding Objectives in Forage Grasses

SEED YIELD COMPONENTS

- Shortage of seed
- Negative correlation with herbage yield & quality
- Seed system to be established
- Pockets of seed production
- Dual purpose crops
- General components
  - Grains per culm/plant
  - Seed index ?
  - Plant population per unit area
  - Seed viability & dormancy
  - No.,Viability & dormancy of buds on stolons / rhizomes

Import of Fodder Seed

Crops	2000-01		2001-02		2003-04	
	Quantity Imported (mt)	Value (Rs. Millions)	Quantity Imported (mt)	Value (Rs. Millions)	Quantity Imported (mt)	Value (Rs. Millions)
Sorghum	805	38.627	1367	53.17	1123	57.00
Berseem	5118	221.119	9929	453	4348	178.00
Alfalfa	4.8	0.867	87	6.03	5.00	1.00

Source: Pakistan Agricultural Statistics

Overcoming Seed Shortage

- Breed for dual purpose fodder crops which could be accomplished through breeding for:
  - Indeterminate growth habit
  - Prolonged senescing of leaves, keeping the leaves on the plants still green after the inflorescence consisting of matured seed has been harvested.
- Pockets need to be identified for exclusively seed production in Pakistan.
- Both Government and private sectors must mark priority to contribute in this sector for development and research.

Herbage Yield Components

- No. of nodes/plant
- Inter-nodal length
- No. of leaves
- Leaf area/plant
- Plant height
- Leaf/stem ratio
- Dry matter %age
- Growth rate

Summary of Breeding objectives

- **Seed yield**
- **Herbage yield**
- **Quality Components**
  - Palatability
  - Digestibility
  - Nutritive value
  - Anti-nutritive components
- **Environmental and physiological stresses**
  - Lodging resistance and fertiliser responsiveness
  - Leaf and seed shattering resistance
  - Salt, drought and water logging resistance
- **Biotic stresses**
  - Disease and insect resistance
  - Trampling resistance
  - Early sod formation: Stolon number, weight, length and diameter.
  - Sod-binding tendency

Strategies To Improve Fodder

- Seasonal Feed Shortage
- Seed Production
- Legume inoculants
- Variety/Hybrid development
- Fodder trees and shrubs
- Training and information exchange
- Training of the Farmers / Herdsmen
- Preservation of Surplus Fodder as Hay or Silage
- Enrichment of Crop Residues
- Molecular genetic approaches for:
  - ❖to enhance fodder quality through improved digestibility and palatability.
  - ❖To minimize the level of anti-nutritional compounds.

Breeding Objectives In Legume Fodders

SEED YIELD:

- Number of florets per cluster,
- Number of flower clusters per plant,
- Number of pods per plant and
- Number of seeds per pod.
- Seed viability, seedling vigour and growth rate

HERBAGE YIELD:

- Dry matter
- Number of leaves per plant.
- Number of sprouts per plant (basal stem node that produces branches)
- Sprouts can further re-sprout.
- The degree of sprouting depends upon
  - Planting time
  - Planting density
  - Nutrition level in soil
  - Frost and temperature
  - Genetic capacity of plant species

Breeding Objectives In Legume Fodders

QUALITY OF FORAGE:

- High nutritive value
- Palatability
- Digestibility
- Exclusion of toxic substances

LODGING RESISTANCE:

- Breakage of the stem from node or internode
- Partial uprooting of the plants
- Week nodes or inter nodes on long stems, unable to support plant, is a genetic drawback.
- Shallow week roots are unable to anchor the plants during winds.
- Breeding for thick, stiff stem and deep rooting could resolve the problem

Resistance To Diseases

- Forage legumes are attacked by several serious viral and fungal diseases.
- Among them one or a few genes control the most.
- Anthracnose caused by *Kabatiella caulivora* has been bred to red clovers. Resistance to anthracnose in red clover is controlled by single recessive gene.
- Powdery mildew caused by *Erysiphe polygoni*. Resistance is dominant and monogenic in five races of the fungus.
- Yellow mosaic virus
- Crown or stem rot caused by *Sclerotinia trifoliorum*
- Root-knot nematode caused by *Meloidogyne spp*.

Resistance To Insects

- Yellow clover aphid (*Theriophis trifolii*), pea aphid (*Acyrthosiphon pisum*) and stem nematodes are serious pests in some instances.
- Resistance to both types of aphids has been combined in red clovers by recurrent phenotypic selection.
- Two dominant genes have been found governing resistance against nematodes.

Breeding Objectives In Fodder Legumes

Drought Tolerance:

- Berseem is absolutely not drought tolerant.
- Sweet clover, and lucerne are good tolerant rather excessive water is harmful to sweet clover.
- Lucerne tolerates heat, cold and drought but not salinity.

Tolerance To Mineral Deficiency:

- Plants require large amounts of essential macro elements.
- Essentiality of an element depends on the genotype of a plant.
- Crop plants differ in sensitivities to mineral deficiencies.

Frost Tolerance:

- Optimum temperature for berseem is 10-25 °C, whereas berseem is killed at –2 °C.
- That's why berseem is only confined to the areas without frost.

Increasing Nitrogen Fixation

- Simply inherited genes prevent nitrogen fixation in red and crimson clover.
- Cobalt stimulates growth of legumes such as beans, clovers, and alfalfa.
- Cobalt is used by nitrogen fixing bacteria; just 1 µg of cobalt per litre of nutrient solution stimulates growth dramatically.
- Rhizobium bacteria create nodules on roots.
- Rhizobium injection is available or soil could be used where berseem has been growing last year and produced nodules in their roots.
- Berseem seed should be inoculated with *Rhizobium trifolii*.
- Berseem needs relatively large amounts of phosphate and potash.
- A pH of 6-7 is required for efficient N_2-fixation.

Berseem Inoculation

- Berseem typically gets enough nitrogen from its symbiotic relationship with nitrogen-fixing Rhizobium bacteria and from soil organic matter, which releases nitrogen as it decomposes.
- But in some cases, such as where poor soil is used light doses of urea help seedling develop healthy roots.
- Adequate phosphorous is important for successful establishment and good root development.
- Farmers start planting berseem roughly from mid September till end of November.
- Berseem planting before mid September results in poor stand as well as poor forage quality.

Special Features of Lucerne

- Deep rooting enable alfalfa tolerates drought conditions.
- It thrives well in low rainfall and high sunshine areas, and dry climate.
- Can tolerate extreme heat and cold and long periods of drought.
- It is not good for acidic, alkaline and water logged conditions.
- The young lucerne plants are very sensitive to salinity.
- It is a rich source of protein, vitamins and minerals.
- Provide fodder both in rabi and khrif seasons.
- It provides 6-8 cuttings in a year with 15-20 tons of fodder per hectare in each cutting
- Varieties Type-8, Type 9,
- Jassid and armyworm cause damage during February-march.