CHAPTER 14

RANGE VEGETATION OF PAKISTAN - I

——— forage grasses ———

Grass plants constitute most extensive, much needed and familiar component of range vegetation especially in rather less extreme climates. Grasses in general are relatively more easily accessible, better in taste and quicker in digestion than shrubs and trees. Annual or ephemeral grasses are typical of most extreme climates. During short favourable season, these grasses quickly form a thin carpet of green foliage over extensive areas. The green carpet, however, suddenly disappears (gets consumed, dries & withers) with the onset of long unfavourable season (summer). Though available for a very short season, these grasses play very important role in these ecosystems (deserts) in supporting grazing animals and natural wildlife.

Ecosystems having rather less extreme climate have typical vegetation of perennial grasses. These grasses enjoy a special ecological feature of putting up vigorous quick resprouting as a result of strong reaction to moderate grazing and trampling. Grazed plants not only produce more tillers but also attain more height and develop more foliage and vigour than ungrazed ones. Non-grassy plants which generally do not resprout equally vigorously as a reaction to grazing, gradually get weakened and are ultimately replaced by grasses which are generally well known for drought tolerance and grazing tolerance. Like shrubs and trees, some of the perennial grasses, too, have a reasonably effective defensive system. The left over tillers of these grasses become very hardy and their clipped ends become very sharp. The grazing animals are content with fresh growth and stay away from close grazing or over grazing of old stubbles. Good examples of this type are *Panicum antidotale* and *Elionurus hirsutus*. Some are well known salt tolerant species such as *Diplachne fusca* and *Sporobolus helvolus*.

Pakistan's native flora does contain a few very good perennial forage grasses which need to be propagated through artificial seeding and stump planting. Most of these grasses are unfortunately summer grasses. Near absence of suitable winter growing grasses is a serious draw back of our vast sub-tropical range areas. Search for winter grasses is in progress.

Important perennial forage grasses of Pakistan are briefly described in the following pages.

Agropyron cristatum (Crested wheat grass)

It is perennial, large, winter growing, tufted, lush green, leafy grass. Flowering stems are upto about 1 meter high. This grass develops very dense root system which is upto about 2 m in depth. Spikes are 2-5 cm long and 0.7-2.0 mm wide. Each spikelet bears 3-8 flowers. Seeds are shed just after maturity. Seeds remain viable for longer period.

It is native of Central Asia, Eastern Europe extending to Siberia and is extensively cultivated in western Canada under the strain name "Fairway" and in the northern and western United States. In Pakistan it has been introduced in Islamabad, Peshawar, Mastung and in the Northern Areas. It also grows well in the mediterranean climate of Balochistan. Crested wheat grass is very resistant to drought and low temperatures. It is adapted to semi-arid steppe and a wide range of soils. It can grow where minimum annual rainfall is 125-300 mm and is found up to 2500 m elevation. The grass is hardy and frost tolerant. It likes light textured sandy soils and heavy clayey soils. It is sensitive to high watertable and salinity. It is best suited for pasture production. This grass can be grazed with heavy intensities without affecting its production level. It produces valuable early spring forage for grazing. It provides palatable leafy hay for cattle and sheep before flowering.

It can be combined with lucerne and sweet clover. It contains 14-17 percent crude protein during early stage but at maturity contains only 6 percent crude protein. Once established, crested wheat grass produces forage for longer period exceeding more than 30 years. Due to cross pollination this grass is quite variable in terms of seed size and germination.

Chemical composition is as under.

Component	Percent
Crude protein	5.31
Crude fibre	6.35
Ether extract	0.80
NFE	5.79
DM	21.70
Moisture	78.30

It is quite suitable for reseeding in the Northern Areas and high mountains of Balochistan. It also grows well in summer season (May-June) at high altitudes and produces forage during stress period when there is shortage of forage in the ranges.

Bothriochloa pertursa (Palwan)

It is stoloniferous sward forming perennial grass. Culms are erect geniculately ascending upto 60 cm high. Leaf-blades are 5-30 cm long, 2.5-5 mm wide; the lower ones are shorter than the upper ones and crowded at the base of the culm. The basal diameter is about 7 mm with 8-12 tillers. The flowering stems terminate in 6-10 radiating brownish seed spikes.

It is distributed in South East Asia, Arabian Peninsula and Tropical Africa. In Pakistan it is found in plains and hills. It grows well in sub-tropical sub-humid to humid ecological zones with annual average rainfall of 500-1300 mm. It can withstand constant grazing and moderate period of drought. Some varieties creep on the soil and root at the nodes. It grows on a variety of soils from moderately acidic to slightly alkaline soils. It is a good soil binder grass. Its seed is broadcast along contour trenches, in pits or on flat lands at the rate of 3 kg/ha. For quick results tufts are used in highly eroded hilly and watershed areas. If tufts are planted at an interval of 50-60 cm, it can cover soil surface within the same growing season. Planting is usually done before the onset of rainy season.

Chemical composition is as under.

Component	Percent
Crude protein	7.5
Crude lipids	2.5
Crude fibre	23.9
Carbohydrates	44.8
Ash	14.2

Palwan is very important grass of our rangelands. It is highly esteemed as a fodder grass and can also be made into hay. It is grazed by sheep, goats, cattle and buffaloes. Under natural conditions forage production upto 4-8 t DM/ha can be obtained.

Cenchrus ciliarus (Dhaman)

It is a tufted, tussock-forming perennial grass; 15 to 120 cm high and is some times rhizomatous. It produces branches from the base. Leaves are 10-25 cm long, 3-7 mm wide, glabrous or hairy, ligule narrow and ciliate membranous. The seeds are dimorphic and differ in size and weight.

Dhaman is native to tropical and sub-tropical Asia, Africa, Latin America, Pakistan, India and Indonesia. It is introduced and naturalized in Australia. In Pakistan, it is found in Pothowar range, salt range, Thal, Cholistan, D.G. Khan, Kohistan, Balochistan and Tharparkar Desert. It is adapted to tropical and sub-tropical summer rainfall areas with a long, dry season. It grows on a wide range of soils, especially on lighter and more sandy soils. It also grows on harder heavy textured soils. Dhaman is deep rooted; about more than 50 percent of the roots reach below 1 m. Its character of drought resistance is due to its extensive and deep root system. It grows well with annual rainfall of 350-800 mm and upto an altitude of 1000 m. Its seed is sown before the onset of monsoon season. Seed rate is 3.5 kg/ha. Broadcasting is very popular than drilling. After sowing, seeds are covered with 0.5 to 1.0 cm thick layer of soil. If the soil moisture is sufficient, seeds germinate within 10 days. Fresh seed shows very poor germination which can be improved to 70 percent by storing seed under dry conditions for two years. There are 90,000 to 200,000 seeds per kg. Tuft planting has also showed successful results in Thal and in Pothowar Plateau. In Pothowar, it is observed that under heavy grazing and after 4-5 years of its reseeding, it loses its vigor and ability to compete with other species and is invaded by *Heteropogon contortus* (Sariala). Dhaman stand requires one year complete protection after reseeding before light grazing can be allowed. With the application of N fertilizer at 100 kg/ha forage produced was 5.4 t DM/ha and without fertilizer production was only 3.3 t DM/ha.

Chemical composition is as under.

Component	Percent
Moisture	5.4
Dry matter	94.5
Crude protein	10.7
Either extract	1.8
Ash	10.0
Crude fibre	37.6
NFE	39.7

Dhaman is highly palatable and is relished by sheep, cattle and goats. It is excellent grazing grass for hot, dry areas in tropics and sub-tropics. It persists well under rather close grazing. It becomes less palatable if allowed to mature. It is one of the most important natural hay grass in Pakistan. It is intercropped with legumes to improve the forage quality.

Chloris gayana (Rhodes grass)

It is perennial, tuft-forming stoloniferous fine stemmed and leafy grass and is 60 to 150 cm high. Some times it behaves as an annual grass. It has a linear leaf blade 20-40 cm long and 3-9 mm wide. Its ligule forms hairy membranous ring.

Rhodes grass is native of S.E. Africa, extending to W. Africa. It is frequently found in Australia, Pakistan and India. It is widely adapted to tropical, sub-tropical and temperate areas with a rainfall of 600-1200 mm with an altitude up to 1500 m. It is adapted to variety of soils, from sand to heavy texture sandy loams and alkaline clays. It grows best on fertile soils of medium texture. Although it is moderately frost resistant but is unsuited to areas with more than occasional heavy frosts. It has been introduced as an important hay grass in Pakistan.

It is propagated by seeds and root shoot stubbles. Seed is sown before the onset of monsoon season in cultivated seedbeds. Line sowing showed better results than broadcasting. It needs 6 kg seed/ha. It is sown by drill 50-70 cm apart. Drilled seed should be mixed with a carrier such as rice husk or sieved saw dust becasue seed does not run easily, or may be mixed with fertilizer and sown with combine drill. It responds well to N fertilizer.

Chemical composition of its foliage is as under.

Components	Percent
Crude protein	4.8
Fat	0.91
Crude fibre	9.3
Calcium	0.69
Phosphorous	0.93
Mineral	4.63

It is one of the best species for rotation in grass lands of tropics and sub-tropics. It is palatable, warm-season pasture and hay grass which withstands heavy grazing and trampling well. It is easily established and forms a rapid cover so it is very effective grass in controlling soil erosion. It can, however, be easily eradicated and does not become a weed. As the plant matures and becomes old, its digestibility is lowered and its crude protein contents are decreased. Under rainfed conditions, it gives 7.5 t dry matter herbage yield/ha. It can be intercropped with a number of legumes and grasses which increase forage yield. It has good potential for reseeding over large areas in Pothowar and Himalayan foot hills.

Cynodon dactylon (Khabbal, Bermuda grass)

It is fine leaved perennial grass spreading by stolons and rhizomes and forming a dense turf. Its leaf blade is 5-16 mm long and 2.5 mm wide and ligule is 0.2-0.3 mm wide which is membranous in nature. It bears sessile flowers of 3-10 mm length. Flowering stems are from 10 to 70 cm high. Seeds are inconspicuous.

Bermuda grass is found throughout the world in tropics and subtropics extending into temperate zone along coasts. It is native to Pakistan and India. It is adapted to wide range of soils but grows best on moist,

well-drained medium to heavy soils. It is frequently found in cultivated lands, paths, along watercourses and roadsides. In more arid areas, it is found only along rivers or on irrigated lands. It grows well in areas where average annual rainfall is more than 600 mm and a mean daily temperature above 24°C. Application of Nitrogenous fertilizers greatly increases forage yield. Bermuda grass withstands flooding but grows poorly in water-logged areas. It is troublesome weed of arable land and unsuitable for rotation pasture as it is most difficult to eradicate. It is valuable for permanent pastures, very resistant to grazing and trampling. It is warm season grass with little growth during cold weather and is easily damaged by frost. It sprouts again in spring from under-ground buds on rhizomes. It can withstand long periods of drought but produces little growth during dry weather and is unproductive on poor dry soils. It is good soil binder and is used for soil conservation and as a lawn grass.

Chemical composition is as under.

Component	Percent
Crude protein	18.5
Crude lipids	0.06
Crude fibre	24.4
Carbohydrates	32.74
Ash	13.5

It is generally established by planting cuttings of stolons and rhizomes or by transplanting pieces of turf. Spacing of 3' x 3' is sufficient to give rapid cover. It is sown during spring or summer. A seeding rate of 9-11 kg/ha is recommended due to its low seed germination percentage. It can be intercropped with legumes such as vetches and clovers to assure year-round production. It is quite suitable for hay making. It should be cut for hay when 35 to 50 cm high. It gives large yield of palatable and nutritious forage under good management. Leaves contain 12-24 percent crude protein and digestibility of bermuda grass is 65 percent or higher.

Dactylis glomerata (Orcticivd grass)

It is coarsely tufted deep rooted, perennial grass which tends to form large tussocks. It is 15 to 140 cm high, erect or spreading, slender to stout, the vegetative shoots strongly compressed. Leaf blades are 10-45 cm long and 2-14 mm wide.

It is found in Punjab, N.W.F.P., Gilgit, Kashmir, temperate Europe and Asia;it was introduced in temperate areas throughout the world. It is drought resistant and withstands high temperatures. Local ecotypes in mediterranean region are adapted to long, hot, dry summer and may constitute one or more distinct species. It is adapted to wide range of soils but grows best on good loams and clays, but is also most productive on rather poor, dry soils. It starts growth early in spring and continues well into the summer. This grass can be sown in combination with rye grass, lucerne, meadow fescue etc, depending on purpose of ley. When sown as the only grass in association with clovers, seed rate of 5 to 11 kg/ha is suitable. It can be sown with lucerne separately in alternative rows 30 to 35 cm apart. Seeds per kg are 12,50,000.

It is the heaviest yielding temperate grass which provides excellent fodder for grazing. It is quite

suitable for silage and hay making. If cut for hay, it gives good aftermath even in dry periods. Leafy pasture strains remain winter-green and make some growth during spells of mild weather. It does not persist well under heavy continuous grazing. It becomes coarse and unpalatable if undergrazed and develops large tussocks. This grass is best suited to rotational grazing. In order to restrict tussock formation, it should generally be sown with other grasses and legumes.

Dichanthium annulatum (Murgha, Dab)

It is a perennial grass. The stems are 25-100 cm high, geniculately ascending. Leaf blades are 3-30 cm long and 2-7 mm wide. Leaves are linear upto about 8 to 30 cm, finely acuminate; glaucous, glabrous and more or less sparsely hairy above. The margins are scabrid with ligules nearly 0.3 cm long. The flowering stem bears 4-6 brownish seed spikes.

It is native to Pakistan (Sindh, Balochistan, Punjab, N.W.F.P. and Kashmir), India, Nepal, Bangladesh. It is also found in Kenya, Tanzania and Senegal. It has been introduced to southern Africa, Tropical America and Australia. It is very well adapted to tropical and sub tropical summer rainfall areas. It forms open turf under grazing and is good seed producer. It is difficult to distinguish from *D. caricosum*, but appears to be characteristically more tufted in habit. This grass grows well on fertile loams but also grows on rocky and stony soils with adequate moisture. Reseeding is done during summer and germination take place in a week or so. With irrigation, green forage yield up to 30 t/ha in six cuttings has been recorded. The forage crop reaches its climax stage (mature) within 60 days and is ready for grazing or hay making. The Indian strain 'Marvel-8' is quite suitable for protecting bunds and terraces. It is drought resistant. The roots reach up to 120 cm soil depth.

Chemical composition is as under.

Component	Percent
Crude protein	13.68
Crude lipids	5.33
Crude fibre	28.64
NFE	36.63
Ash	15.72

Murgha is excellent fodder grass. Its leaves contain 10.4 percent crude proteins. At maturity, protein decreases to only 2.7 percent. It is a recommended grass for reseeding in the subtropical humid rangelands of Pakistan.

Elionurus hirsutus (Gorkha, Karera)

It is a perennial grass with culms upto 60 cm height. Leaf blades are flat or rolled; ligules are short membranes or a lines of hairs. Inflorescence is a single raceme. It is a grass of sub-tropical semi-arid climate.

Gorkha grass is widely distributed in Arabia, South East Asia and in Pakistan. It is an excellent fodder grass of our range lands. This grass is self defensive and withstands moderate to constant grazing with increasing response. Its ungrazed or left over stubbles become sharp and woody and cause injury to animal's mouths. The animals are thus confined to consuming only current year's growth.

Elymus junceus (Russian wildrye)

It is a perennial grass which gives dark green appearance. Its stems are 1 m long. The spike is borne on a long leafless culm. Seedlings are small and very slow growing. It needs more protection and takes much time to establish. Higher germination percentage helps in getting good grass stand.

This grass is native to Russia and Siberia but later on was introduced to United States and Europe. It is very hardy species and is resistant to drought, salinity and frost. It can grow well where annual rainfall is only 125-300 mm. Its growth period is very prolonged which starts from early spring till late fall. It does well on fertile soils but can be grown on a variety of soils. Due to its extensive root system it can easily tolerate drought; its roots reach up to 3 m depth., This grass is self-defensive and can tolerate heavy grazing and its recovery process is very rapid. Russian wildrye grass can be intercropped with legumes for increased production and for better quality of forage. It can prove its worth if introduced as winter forage in Pothowar, Northern Areas and Balochistan.

It is highly palatable and nutritious grass which provides excellent forage during August to November. It is reported that with the application of N-fertilizers forage and seed yield increases tremendously. This grass is not suitable for hay. Forage production of 1.5 t dry matter/ha has been recorded in Mastung.

Lolium multiflorum (Italian ryegrass)

It is annual, biennial or short lived perennial grass and grows upto 30-130 cm height. Culms are tufted or solitary, erect or spreading and slender to rather stout. Leaf blades are 11-22 cm long, 3-8 mm wide, convolute when young, usually with auricles 1-4 mm long at the base. Spikes are straight or slightly curved and 15-33 cm long. Spikelets are sessile, each with 10-20 flowers.

Italian ryegrass is found in Pakistan (Balochistan and N.W.F.P.); Central and Southern Europe, Northwest Africa and Southwest Asia; it has been introduced in temperate and subtropical areas throughout the world. It is adapted to mild, humid, temperate or subtropical climate and to moist, well-drained, fertile soils. It grows well on irrigated lands and in areas where annual precipitation is 500-1000 mm. The grass is not drought resistant and is sensitive to frost and severe winters.

Its seed is either broadcast or drilled in rows at a seeding rate of 4-8 kg/ha. It needs double seed rate if planted for soil conservation. After maturity, seed shatters easily and falls on the soil surface. Intercropping with legumes or clover increases the quality and quantity of forage. It responds well to N-fertilizers; 30 kg N/ha significantly increases herbage yield. Due to fine stem and abundant leaves it is excellent for hay making. It should be cut for hay when the spikes are just formed. If the conditions are fovourable for plant growth, it may be grazed after hay cutting.

Italian ryegrass is excellent grass for forage, soil erosion and soil improvement. It is very palatable and nutritious grass which produces forage yield of 5-10 t/ha of hay or 25 t/ha of silage. It provide good grazing during the period of forage shortage in winter.

Lolium perenne (Perennial ryegrass)

It is loose to densely tufted perennial grass having 10-90 cm high tillers, forming dense turf when grazed. Leaf blades are 3-20 cm long and 2-6 mm wide and are linear, smooth but stiff. The membranous ligules are 1-2.5 mm long. Spikelets bear awnless flowers and spikelets contain 2-10 flowers.

It is native to temperate Europe, temperate Asia, and North Africa and has been later on introduced in North and South Americas, Australia, and New Zealand. It is adapted to mild, humid temperate climate. It is less drought resistant than *Dactylis glomerata* due to its shallow fibrous root system. It requires 750-1250 mm of annual rainfall. It is winter hardy grass which is grown for pasture all over the world. It grows best on rather heavy, rich, moist soils but it also does well on well manured, lighter soils with sufficient moisture. It is not adapted to areas with extremes of cold, heat or drought. It is vigorous, rapidly establishing grass, combining particularly well with white clover.

Perennial ryegrass is seeded in spring or fall but in severe cold localities spring sowing is quite suitable. It requires 12 to 28 kg/ha seed rate when intercropped with clovers. Seed beds are well prepared with a light disc plough before sowing.

Perennial ryegrass is an esteemed grazing grass of winter. It is very much liked by sheep for grazing. It give good response to N-fertilizers; 30-55 kg N/ha substantially increases forage production. Perennial ryegrass is quite suitable for making high quality hay due to its medium fine stems and leafiness. After hay cutting, the pasture can be grazed if conditions for plant growth are not hostile. It yields 1.6 t dry matter/ha.

Panicum antidotale (Blue panic, Malai)

It is coarse, vigorous, leafy, much branched perennial grass spreading by short stout rhizomes or stolons. Leaves are linear and blue green, leaf blades are 25-50 cm long and 5-12 mm wide. Flowering stems are up to 2 m in height. Spikelets are 2.5-3.5 cm long.

Blue panic is native to Pakistan, India, Nepal and Afghanistan. It is now extensively grown from Arabia in the west to Australia in the east. It is adapted to tropical and subtropical summer rainfall climates. It is resistant to drought, but is easily damaged by frost. It requires 500-800 mm annual precipatation and grows at an elevation up to 1000 m. It grows on a variety of soils but fertile sandy loam soils are best suited for good production.

This grass is propagated by seed, stem cutting and root suckers, planted 50 cm apart. It is seeded just before the onset of monsoon. Before sowing, proper seedbed preparation is necessary for reliable results. Normally broadcasting is being practiced but for uniform cultivation drilling is preferred. The seed should be lightly covered for higher germination. The seed response is very quick and it takes 8-10 days for germination. A full growing season is, however, required for plant establishment. The optimum seeding rate is 2.5 kg/ha which gives 1120 kg/ha of dry forage and 20 kg/ha of seed.

Its rapid growth produces large quantities of palatable but rather coarse herbage in good growing conditions. This grass is self defensive and can withstand heavy grazing. Its stem rapidly becomes hard and woody and injures animals mouths. Grazing is thus restricted to current year's growth only. Old stubbles and previous growth (plant capital) remains intact year after year. It should be grazed or cut for hay before flowering because at late flowering stage it accumulates oxalic acid which is responsible for the cause of kidney disorders. It can be used for the control of soil erosion and windbreak. It give good response to N-fertilizer, 100 kg/ha of urea can increase dry forage yields by 50 percent.

Chemical composition is as under.

Component	Percent
Dry matter	94.6
Crude protein	15.3
Either extract	3.4
Crude fibre	29.3
NFE	41.6
Ash	10.2
Moisture	5.3

It is reported that reseeding by blue panic increases the range productivity 12 times in northern area (Jamrud) of Pakistan. In Kohistan ranges, blue panic yields the second largest amount of forage after buffel grass. This grass is quite suited for large scale seeding on Murree foot hills, Pothowar Plateau, Salt Range, Khair-e-Murat, Thal and Kohistan ranges. According to forage production trials conducted at NARC, its forage production in Pabbi Hills, and Thal range area was 7.0 and 5.2 t dry matter/ha respectively.

Panicum maximum (Guinea grass)

It is a densely tufted perennial with 80-300 cm high erect or ascending, often branched culms. The nodes are usually bearded. It spreads slowly by rootstocks to form large stools. Leaf blades are linear and are 10-60 cm long and 4-20 mm wide. There are flat, glabrous, long and tapering to a fine point. There is considerable variation in growth habit.

Guinea grass is a native of Tropical Africa and has been introduced into most other warm countries. It is well established in Pakistan (Punjab and N.W.F.P.). It is drought resistant, but will not stand long periods of complete desication. It occurs naturally in areas with 1000 to 1750 mm rainfall with dry season not exceeding four months. It grows well on a wide variety of well drained soils, but not on black cracking clays or in areas liable to prolonged waterloggoing or flooding. It is not resistant to more than occasional light frosts. It is shade tolerant and grows well under trees.

This grass establishes readily by seed; but head ripens very unevenly and shatters early. Seed collection is by hand. Viability of fresh seed is generally low but may be increased by storing seed in dry conditions for six months or more. Seed is broadcast at 4 to 12 kg/ha. Small areas are often established vegetatively by planting stools. Rotational grazing is essential if continuous production of young leafy herbage is to be maintained. It dies rapidly under close continuous grazing.

It is an outstanding fodder grass readily grazed by cattle. This is quite suitable for green soiling, hay, and silage. It can give yields upto 50 to 60 tons of green fodder per acre under favourable conditions. Nutritive value is quite high at leafy and young stage (13 percent crude protein). In more humid areas, it combines well with tropical perennial legumes such as "Centro".

Paspalum dilatatum (Dallis grass)

It is a tufted perennial grass. Culms are robust and are 40-180 cm high. Leaf blades are linear and are 6-45 cm long and 3-12 mm wide. Spikelets are ovate, 2.8-3.8 mm long and of yellowish green colour.

This grass is distributed in Pakistan (Sindh, Balochistan) and has been introduced in South America, and is presently established in most tropical countries.It can be cultivated on every kind of soil except very sandy land. It can tolerate moderate drought conditions better than Bermuda grass. It can grow even in those areas from where disposal of water is delayed but grows luxuriantly on well irrigated fertile soils. It can withstand moderate and close grazing.

Chemical analysis is as under.

Component	Percent
Crude protein	13.67
Crude lipids	10.97
Crude fibre	36.07
NFE	31.51
Ash	7.78

It is variously known as golden crown grass or caterpiller grass. It is an esteemed pasture grass and is very much liked by cattle. The fodder is of high nutritive value. It is a clustered grass having many branches which are full of leaves. It remains green almost throughout the year. It yields up to 350-400 tons/ha/year.

Sorghum halepense (Baru)

It is a stout erect perennial grass spreading by long creeping rhizomes. Culms are simple or branched, slender to rather stout and 0.5-3 m high or more. Leaf blades are 20-90 cm long and 0.5-4 cm wide.

Baru is widely distributed in Pakistan (Sindh, Balochistan, Punjab, N.W.F.P., Gilgit and Kashmir) mediterranean coastal region and extending through Arabia to India. It was introduced in many subtropical and tropical countries. It is adapted to warm humid summmer rainfall areas in subtropics but not so well to more strictly tropical areas. It requires deep rich soils. It has earned a bad reputation as a weed of cultivated fields and is very difficult to eradicate. Worse than this, under certain circumstances its tissues contain hydrocyanic acid and are a positive danger to livestock.

It is established by seed broadcast drilled in spring or early summer at a seed rate of 20 to 35 kg/ha. Sometime it is sown in mixture with sweet clover. It gives good responses to nitrogen.

Chemical composition is as under.

Component	Percent
Crude protein	23.18
Crude lipids	9.13
Crude fibre	24.44
NFE	31.98
Ash	11.27

This grass provide palatable forage for sheep, goats and cattle. It is excellent grass for hay, and is cut for hay when flower heads are still in boot. Coarse stems dry slowly. Thorough curing is necessary for producing good hay. It tends to become sod-bound after two or three years and may be renovated by ploughing in spring and oversowing with soyabeans, cowpeas, or sweet clover. Frequent mowing or grazing at three to four week intervals through growing season exhausts root-stocks and is best means of its eradication.

Sporobolus helvolus (Khui)

It is a tufted perennial grass with long slender stolons. Culms are wiry and slender and 15-60 cm high. Leaf blades are flat 2-15 cm long and 2-4 mm wide. These are glaucous tapering to a filiform tip. Spikelets are 1.4-2 mm long and greenish brown in colour. Glumes are narrowly lanceolate to lanceolate, as long as the spikelet or a little shorter. Grains are ellipsoid and are 0.5 mm long.

Chemical composition is as under.

Component	Percent
Crude protein	8.46
Fat	3.00
Crude fibre	33.3
Calcium	0.368
Phosphorous	0.147
Minerals	11.04

Khui grass is distributed in Pakistan (Sindh, Punjab N.W.F.P.); tropicl Africa, Arabia and India. It is a desert grass making good fodder for camels. It responds very well to water spreading. It is known to be salt tolerant.

TEST QUESTIONS

1. What is the significance of forage grasses in Pakistan's rangelands?

2. Sudden reappearance of extensive green carpet of annual grasses in vast dead deserts after rains has been refered to by Quran as an evidence of life after-death. Explain.

3. Explain what is meant by self defensive grasses. Give examples.

4. Write a note on *Cenchrus ciliaris*.

5. Describe 2 grasses that are suitable for moist rangelands of Pakistan.

6. Discuss the problem of irregular supply of forage during the year. What is the role of winter grasses in this regard ?

7. Briefly describe *Elionurus hirsutus*, grass.

8. Write a note on grass that has particularly given good response to water spreading in Pakistan.

9. Briefly describe *Bothriochloa pertusa* and *Dicanthium annulatum* grasses.

10. What is the scope of *Chlorus gayana* in Pakistan's rangelands.