Three Grasses' Struggle for Supremacy on the Island of Molokai

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IN leafing through history books, we read of races of people replacing other races and in turn being replaced by a still more vigorous group. The history of plants is often similar to the history of people. The story of grasses may not be so grim as the story of the rise and fall of peoples, but it can be a fascinating study. The native plant can be displaced by a vigorous foreigner, that in turn can be forced from a dominant place by a more aggressive plant. Life it seems for people, animals, or plants is seldom static.

Here is the story of three grasses that grow on the arid lands of the Island of Molokai, Territory of Hawaii. One of the grasses, pili grass (*Heteropogon contortus*), has lived here so long that if it is not actually indigenous, it is considered a native. A second grass, fuzzytop (*Andropogon barbinodis*), came in a little after the turn of this century. The third grass, African foxtail (*Pennisetum ciliare*) was introduced about fifteen years ago. The third grass is a true malihini (a rank newcomer). It came directly from South Africa.

This study of grasses was made on the arid section of the Island of Molokai. The island is located at 21 degrees N. latitude. The long axis lies almost due east and west. The island is about 36 miles long and 7 miles wide. The highest point on Molokai is a little under 5000 feet. The struggle of the grasses described here is confined, however, to the arid lands under 1000 feet elevation on the west end of the island, and to the limited low lying fringe lands along the southeast coastline.

Geologically, Molokai island is of volcanic origin. Parts of the island have in the past risen from the sea. Some low areas along the coast have developed from soil washed from higher slopes. Red, medium textured soils dominate. Some of the rangelands have rocks on the surface. Much of the area is severely eroded and gullied. An extreme degree of erosion is indicated by the fact that in places rocks protectively cap pedestals of soil.

The temperature on arid Molokai is warm yearlong, averaging about 74 degrees F. It never freezes. Winds blow through most days. Yearly rainfall averages a little under 20 inches, though the average means little in this section. A large part of the total yearly rainfall might, and has, occurred in a single week.

Pili Grass

Pili grass, as it grows in the Hawaiian Islands, is a weak-rooted perennial that greens up briefly after rainstorms. In India pili grass is called "spear grass," in the southwestern part of the United States, "tanglehead." Both names describe the appearance of the seed heads at different stages of maturity. Pili grass is also indigenous in other parts of the sub-tropics and to some extent in the tropics.

It is a perennial grass growing from one to three feet high in a compact, upright bunch. The leaves are a bright green after

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each rain and slowly turn brown in drying weather. The seed heads as they emerge from the sheath resemble a single tier of overlapping shingles that produce long, crooked awns, which become tangled when dry. Spear grass and tanglehead aptly describe the seed head first in the green and later in the dry stage. Pili has a shallow, limited root structure so that cattle will often pull up the plant when grazing. The shallow roots are unable to seek the deeper moisture in the soil, consequently, the plants stay green for only short periods.

Hawaiians believe that pili grass is native because they thatched their huts with the grass for centuries. Records state that where the weather was dry, the thatched huts lasted 10 or 12 years. Where the precipitation was high the thatch of pili soon rotted and had to be replaced frequently.

The ravines and draws of the arid sections of Molokai once dominantly covered with pili grass had a scattered overstory of dryland trees. Drought periods doubtless occurred in the early days, as they do today. However, the native vegetal cover under non-grazing use permitted the soil to absorb moisture rapidly. As a result, the grass stayed greener longer than it now does.

Pigs were brought to the islands by the early Polynesians and have been here for hundreds of years. The first cows, horses, sheep, and goats, however, were brought to the Territory of Hawaii by Vancouver late in the 1700's and early 1800's.

The first cattle brought to the Island of Molokai in 1830 were put ashore on the grassy plain at the village of Paalau. A "tabu" by the island chief against killing cattle shortly after their arrival prevented all slaughter. Sheep and goats were introduced a few years later and were also protected by a "tabu." Springs near the village of Paalau supplied the only livestock water for the large arid area. Under a favorable environment all livestock multiplied rapidly. As numbers increased, they grazed all the grass within several miles of the springs, with the result that for several miles above Paalau a dry, eroded, barren area developed as the pili grass was destroyed. Deep gullies developed and fertile topsoil washed away. For example, an artificial 500-acre saltwater fishpond maintained by the natives along the low lying coastline immediately below Paalau was filled to a depth of 4 feet with a part of the fertile topsoil from the 20 square miles tributary area.

About the turn of the century the increasing numbers of cattle, sheep, and goats reached such numbers that the plant complex was markedly deteriorated. Under the impact of the uncontrolled grazing and increasing numbers of animals even the trees in sheltered spots and ravines died, and for a long time no plants replaced them. A corollary development was the introduction of kiawe (*Prosopis chilensis*) that first covered the coastal lowlands, and later spread to the uplands. Seeds of other plants were introduced with imported livestock feeds. In this way a number of annual grasses and weeds gained a foothold, furnishing some seasonal feed, but they failed to protect the soil even as well as the weak rooted pili grass. Erosion increased, and good range feed became scarce. The plant cover deteriorated though pili grass was still the most abundant species, particularly in spots where it was not excessively overgrazed.

Many new plants have been introduced during the past century. They came from all parts of the world—Australia, South Africa, California, Southwestern United States, and the Mediterranean. Some of the introductions were tested in local

grass gardens where most of them proved to be ill adapted. Oddly enough, today many species once tried have been forgotten and are being tried again. Among plants being tried are yellow bluestem and African sandbur, which show promise. Other grasses that will adapt themselves to this dry site will doubtless be found.

Fuzzytop

About 1905, George Munro introduced a new bunchgrass to Molokai. He received the seed from Jared Smith, agronomist for the Department of Agriculture. Locally the grass is called "fuzzytop." In the United States it is called cane beardgrass or plume beardgrass.

Fig. 1. Fuzzytop successfully invading the original pili grass stand.

Fuzzytop is a strong-rooted perennial that greens up after each rainstorm. Fuzzytop is a native to the southwestern part of the United States and the northern part of Mexico. This perennial bunchgrass usually has a basal rosette of leaves shorter than pili grass leaves. The leaves emerge from the base of the rosette and on the older plants, leaves clothe the stems. The stems often 3 feet high are topped by a silvery appearing head of fuzzy-like seeds. When the seeds ripen and shatter they may be carried some distance by the wind. The root structure of fuzzytop, in contrast with pili, develops a mass of fibrous roots that reach from one to four feet into the ground on all sides. Grazing cattle do not pull this plant from the ground after it is once established. Furthermore, its greater root system enables the plant to utilize moisture deeper in the soil. Fuzzytop stays greener longer than pili grass and greens up as readily after rains. It is liked by cattle even more than pili.

For a long time fuzzytop was regarded as a stranger and was little appreciated as a forage plant. It was first established in a localized area near the center of Molokai called the Hoolehua plains. More seed was imported, some of which appears to have produced a strain that seems even better adapted to the Molokai climate than the original introduction.

Fuzzytop is now well established in the west central section of Molokai, and it is spreading to the drier sections of the island, but not fast enough to halt the erosion on a number of potential grazing areas. The Molokai Ranch, which owns most of the arid part of Molokai, plans to harvest fuzzytop seed with a seed stripper adapted from plans received from the Soil Conservation Service nursery in Texas. With increased seed supplies more of the dry land areas will be seeded in an effort to halt as rapidly as possible the terrific erosion caused by heavy rains on the depleted range lands.

FIG. 2. AFRICAN FOXTAIL. A. Becoming established on a heavily used stock trail. B. A group of Hawaiian cattle ranchers inspect a good stand.

It may be that fuzzytop will eventually displace the pili grass, as it seems to be doing in certain sections now (Fig. 1). The two grasses grow together but the pili is overtopped by the fuzzytop.

AFRICAN FOXTAIL

In 1935 a third range plant was commercially introduced from South Africa. African foxtail is the Hawaiian name. In South Africa it is called bufflehead, in India it is called Anjan dhaman. The species also occurs in Sicily and the Canary Islands.

African foxtail is a semi-prostrate perennial bunchgrass. It forms large, round clumps, sometimes 6 feet in circumference, one to three feet high. It is pale green in color, with soft drooping leaves. Many cylindric dense seedstalks bend outward and slightly downward as a canopy over the basal leaves. The grass is aptly called bufflehead. The length of the seed head varies from 3 inches to nine inches. The seeds in the head circle the stem, and are enclosed in a bristly chaff, easily carried by wind of even moderate velocities. The roots are strong, heavy and numerous, and reach 2 to 6 feet into the ground. A few short rhizomes are produced. On good soil and with adequate moisture, African foxtail plants reach good size the first year of planting. The plant enlarges rapidly and produces large amounts of seed. The plants green up and produce more seed heads after each rain of 1/2 inch or more.

African foxtail with a large number of other grass species was tested in rod rows some 15 years ago in a grass garden near the Molokai Ranch slaughterhouse located in central Molokai. This is an extremely dry part of the island. Indication of the hardiness of the 3 grasses discussed here is the fact that today in this

grass nursery, only African foxtail, pili grass, and fuzzytop remain. African foxtail dominates the old nursery site, now abandoned.

An area of open range with deep but hard, exposed subsoil, long overgrazed and depleted of organic matter, lies adjacent to the old nursery. African foxtail is also slowly invading this site, and where it has gained a foothold covers it sufficiently to stop erosion. It gives much promise of being a species adapted to these tough, dry sites (Fig. 2).

The foxtail was also observed invading a moderately thick stand of tree size kiawe. The grass in this instance is growing vigorously 2 to 3 feet high, lush and green after the other grasses are dry, while the soil underneath the grass clumps is soft and mellow—a decided contrast to the condition of the soils generally over the dry area.

The palatability of foxtail has been questioned by some of the people of the islands. Reports from other countries show that in India this grass is considered excellent forage for cattle and horses. In Africa it is considered a good forage plant. In Australia, when extremely dry conditions prevail, it is said to be eaten to the ground by the livestock even when dry. On Molokai some cattlemen who have watched the cattle graze believe cattle prefer it to pili grass. It probably is not the most palatable of forage plants, but for the arid sites on Molokai Island its palatability compares favorably with other forage plants growing there.

Summary

This is the story of three grases on the Island of Molokai—pili grass, fuzzytop, and African foxtail—that currently seem best adapted to the dry, depleted range lands of Molokai Island.

Pili grass, the native or a very old introduction, appears to be giving way to the two newer grasses. The reasons for this are (1) the superior root system of the newer plants, (2) superior seed producing habits, and (3) cattlemen actively reseeding selected areas of the depleted range to fuzzytop and African foxtail.

Other plants are also being tried and some may prove superior. Examples are yellow bluestem and African sandbur, two plants tried this year that show promise. Others adapted to this dry site doubtless will be found.

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