New Mauna Loa golf course, on the island of Hawaii, is being constructed on a base of 100-year-old lava.

Play A Round On A Volcano!

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GRASS GROWN on rocks. A golf course on a volcano. Five inches of rainfall per year. Two hundred fifty inches of rainfall per year. Man-made sand. Someone might wonder what all these things have in common. These are simply a few of the sentences one might use in describing golf courses in Hawaii.

Someone visiting golf courses in this tropical paradise is immediately struck by the great variety of climatic and edaphic conditions — truly unexpected if one considers the small land mass that comprises the Hawaiian Islands and their close proximity to each other. Most people would not expect climates that vary from tropical rain forests with hundreds of inches of rainfall per year to semi-arid or arid conditions existing a few miles apart. These are just some of the paradoxes faced by golf course superintendents in Hawaii.

Additionally, the golf course superintendent in Hawaii contends with the same weeds, insects and diseases as superintendents on the mainland. Interestingly, however, when Hawaiian superintendents were asked their biggest problem, the responses were much the same as you would expect to hear anywhere. The answers ranged from communicating with the green committee to the need for improved drainage, weed control, thatch control and other common problems.

Agronomic problems are numerous. The lack of a good quality topsoil on fairways and tees is a major problem on

the majority of courses, coupled with a lack of good quality sand for green construction. These factors combine with a 12-month growing season that makes weed and insect control a continuous process. The most troublesome weed encountered is goosegrass (*Eleusine indica*), but not to be overlooked are knotweed, nutsedge and crabgrass. The 12-month growing season also necessitates a continual program of thatch control which must be scheduled so as not to prevent too much interruption to the busy golfing schedule, especially at resort courses.

In earlier years, to overcome these problems, the superintendents had to rely on a great deal of their own ingenuity and basic hard work. Being over 2,000 miles from major turfgrass equipment and chemical suppliers made the job sometimes perplexing and often frustrating. Having the knowledge to solve a problem often wasn't enough to get the job done when equipment or materials were not available. With the increasing number of courses on the Islands and the creation of a potentially larger market, many, but not all, of the equipment and chemical supply problems have been solved.

Soil Conditions

Unfortunately, many of the golf courses in Hawaii are built on land that was not suitable for agricultural purposes or housing development. Several courses, in fact, are built on old lava flows; they were actually carved right through the lava rock,and grass was planted directly into the small particle-size rock created by movement of heavy equipment. In a few cases, a shallow layer of topsoil was transported onto the course. That grass would grow under these conditions is remarkable, let alone withstand mowing at ½ inch and support golfing traffic all year.

Perhaps the most extreme example of soil conditions is the Honolulu International Country Club, just outside Honolulu, at a location many of the native Hawaiians still refer to as "Salt Lake." The golf course was created by draining what at one time was a salt water lake. Needless to say, initial establishment of grass was extremely difficult because of the accumulation of soluble salts in the soils. With the addition of many additional drainage lines to allow flushing away of the salts, bermudagrass was established throughout most of the course. Some of the areas of highest salt accumulation were too much even for bermudagrass, and an even more salt-tolerant grass, *Paspalum vaginatum*, was successfully planted in these areas.

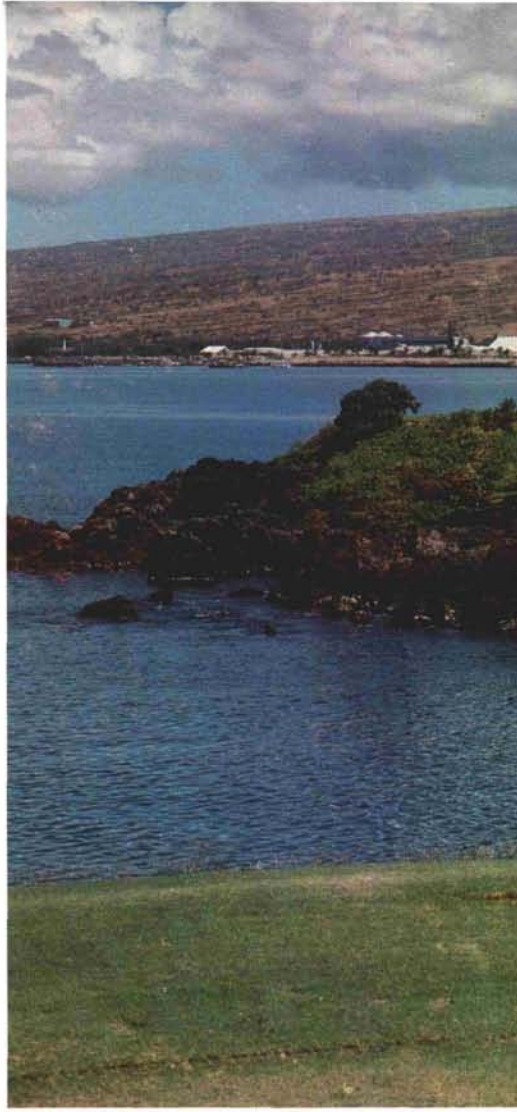
Perhaps one of the greatest paradoxes relating to turfgrass management in Hawaii is the lack of sand. The sand available in Hawaii is beach sand, essentially all calcium carbonate. The high carbonate content makes the sand, in most people's judgement, unfit for green construction. However, this is the sand material from which most greens in Hawaii are built and topdressed. The calcium carbonate is constantly being decomposed by normal soil chemical processes, as well as the addition of fertilizers. It is common to find a concrete-like barrier 10 to 20 inches below most older greens, formed by the breakdown and subsequent chemical reactions of the beach sand.

To overcome this problem, research is currently being performed at the University of Hawaii by Dr. Charles Murdoch, research and extension turf specialist, to examine the use of a man-made sand for green construction. The man-made sand is made by crushing basaltic rock. If this or similar materials meet the requirements for green construction, it would certainly aid turfgrass management operations.

Thatch Control

The primary turfgrasses used on Hawaii's golf courses are bermudagrasses. The majority of courses have common bermudagrass fairways and either Tifgreen or Tifdwarf bermudagrass greens. The climate is ideal for these grasses because of the relatively constant temperature throughout the year. On putting greens, this requires a constant program to keep thatch accumulations from becoming excessive and to prevent grain development in the bermudagrass greens. Many different techniques have been developed to accomplish this. Since the development of the triplex putting green mower with its verticutting attachments, almost all courses lightly verticut greens weekly. Many courses have even found it necessary to do this operation twice a week to provide the best possible playing surfaces for its membership. The regular vertical mowing in combination with aerification and topdressing as needed have done much to reduce thatch accumulations and improve playing conditions in recent years. Because of the lack of good quality sand and topdressing material, programs of light and frequent topdressings have not been developed.

One problem not unique to Hawaiian golf courses is the development of color and texture changes in the bermudagrass greens after the greens have matured. This phenomenon has also been reported on many courses in the southeastern United States. Several explanations have been suggested for this occurrence, but at the present time, no conclusive scientific data has been found to fully explain or solve the problem. Ways of making the discoloration



(Above) The third hole at Mauna Kea Beach Hotel golf course constructed on a base of old lava flow extending into the ocean.

(Opposite page) Salt accumulations are even too much for the bermudagrasses.

disappear have ranged from additional fertilizer applications to insecticide or fungicide applications. Hawaiian turf managers can take consolation in the fact that researchers at the Coastal Plains Experiment Station, Tifton, Georgia, (developers of Tifgreen and Tifdwarf) have as yet not been able to solve the problem, either.

Weed, Insect, and Disease Problems

Next to thatch control on greens, the development of an effective weed control program is the major problem on many of Hawaii's finest golf courses. The 12-month growing season is also ideal for growth of weeds. When weeds are germinating twelve months, it makes weed control programs a continual process. The number one weed enemy is goosegrass. Until recently, the most effective labeled materials for post-emergence goosegrass control have been MSMA and DSMA.

To be effective, repeated applications of these materials must be made at the highest recommended rates. Preemer-

gence controls are difficult because for most materials, at least four applications per year would be needed over the entire course. The economics of such a program would be staggering, not to mention the possibility of turfgrass damage from continual herbicide applications.

The University of Hawaii Turfgrass Research Program has devoted a great deal of time to the goosegrass problem both at the University Research Station plots and on experimental plots at several golf courses throughout the Islands. Good results have been achieved using MSMA in combination with simazine or metribuzin. The chance of obtaining special use labels for these materials may be possible.

The turfgrass diseases affecting bermudagrass greens in Hawaii are primarily active between November and April during the rainy season. The incidence of disease would not be considered to be in epidemic proportions and the amount of fungicides needed is minimal. However, the main problem is that the disease period is also a period of increased tourist activity and increased golfing activity. The additional rounds of golf during this period put additional stress on the turfgrass and can amplify disease and other stress conditions. Although several turfgrass diseases are common in Hawaii, probably the most active disease is Helminthosporium Leaf Blotch and Melting Out.

In Hawaii, as in other areas of the United States, insect control has become increasingly more difficult in the last few years because of restrictions by the Environmental Protection Administration on the use of insecticides with long residual activity from use on turfgrasses. A closer check on number of insects and damage levels as well as proper timing to achieve maximum benefit from insecticide applications are now practiced. The most common and perhaps most destructive insect pests are lawn caterpillars, such as the lawn armyworm (*Spodoptera mauritia anonyctordes*) and the grass webworm (*Herpetogramma livarsisalis*). Just as with weed control, insect control is a year-round activity because of the favorable conditions for continual growth and activity of the insects.

Another insect problem is Rhodesgrass scale. These tiny insects with their white scale formation are sometimes easily overlooked. In many instances, a sure sign of their activity is increased activity of ants in the area of infestation. The ants are feeding on the sugary secretions of the Rhodesgrass scale.

The turfgrass manager in Hawaii definitely has some unusual situations to deal with in the course of his work, but where else in the world could one have such sweeping panoramas of ocean and islands? Fairways that contain ancient stone walls, unusual lava formations, exotic native foliage bordering the golf course, with scenic views of the ocean all combine to make Hawaii's golf courses pleasurable places to work. The uniqueness of the Islands presents unusual problems, but the continual effort to achieve better turf for better golf promises even better golfing conditions for the future.

Ancient Hawaiian stone walls had to be preserved during construction of the orange course of the Wailea golf course.