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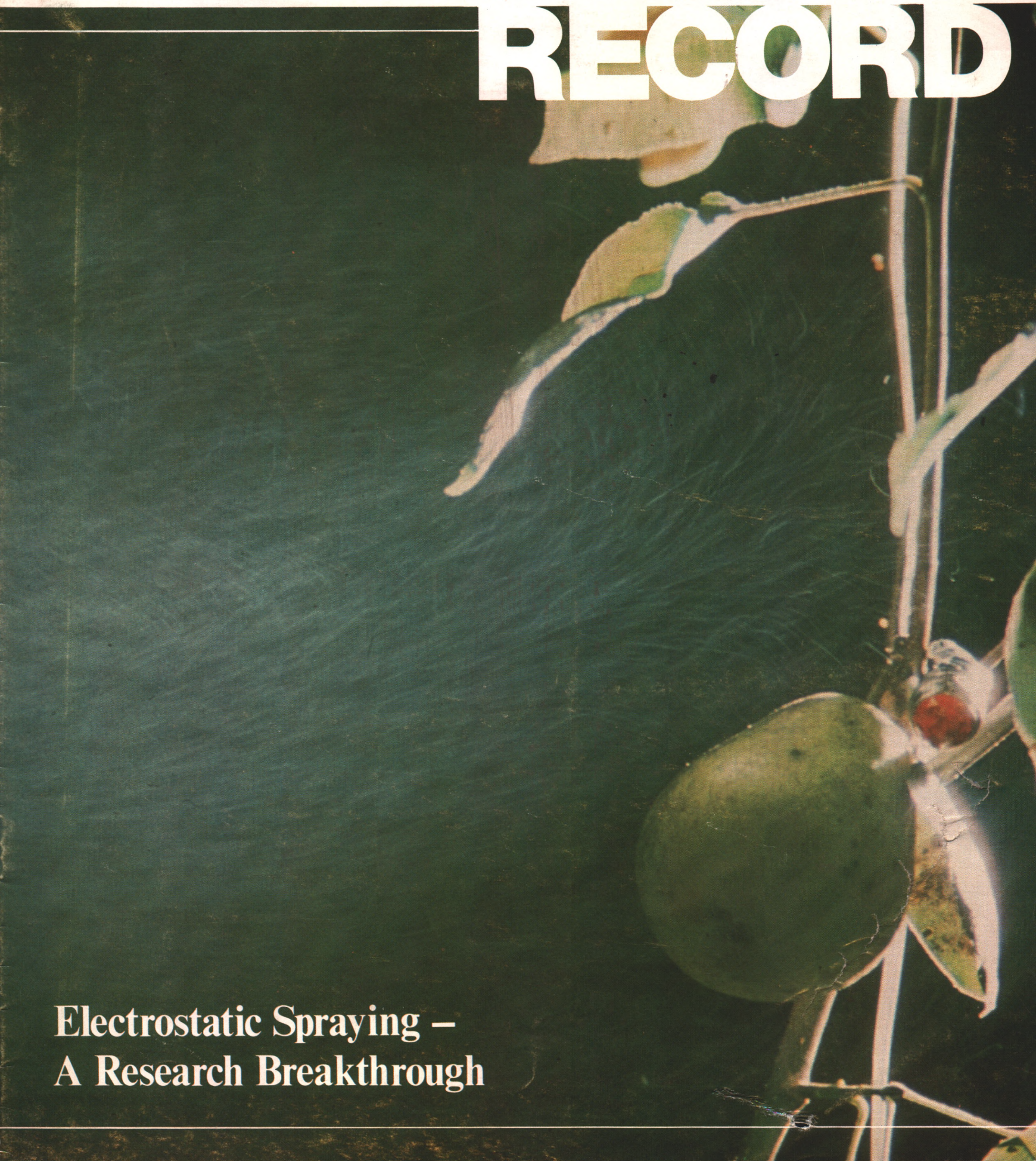

Electrostatic Spraying – A Research Breakthrough

USGA

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Cover Photo:
The negatively charged spray cloud is drawn to the positively charged plant.

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A GREEN SECTION RESEARCH PROJECT

Funded by the Carolinas Golf Association

An example of the electrostatic precipitation spray technique. Note total cover as compared to conventional spray on the left.

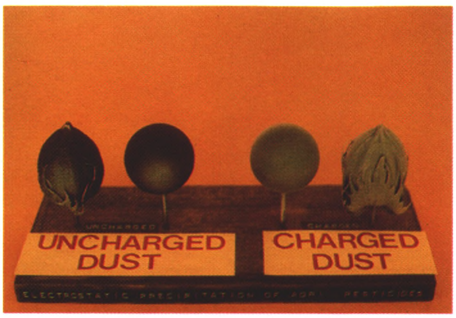


Figure 1. Research prototype machine for evaluating electrostatic pesticide spraying.

Electrostatic Spraying of Turfgrass

by **R. C. ANANTHESWARAN**, Graduate Research Assistant,
and S. EDWARD LAW, Associate Professor,
Department of Agricultural Engineering,
University of Georgia, Athens, Georgia

INTRODUCTION

GOLF, UNLIKE OTHER sports, has, as an intrinsic feature, a close relationship with nature. And yet, excessive and incorrect applications of the pesticide chemicals which provide economical control of insect, disease and weed pests can cause acute setbacks in the surrounding environment. The conventional methods of turfgrass management using pesticide sprays are not always effective; sometimes as much as 80 percent of the spray drifts away to adjacent plots and contaminates the wildlife and water supplies.

To improve this situation, electric forces have been incorporated into spray application. In electrostatic spraying, the finely atomized spray droplets are given a negative charge. The charged spray cloud then induces a positive charge onto the nearby plant material, which is at ground potential. Because of the attraction between opposite charges, the negatively charged spray cloud is drawn to the positively charged plant. This results in a more uniform spray deposit and less airborne drift of the spray particles.

Electrostatic spraying offers as much as 50 percent reduction in the amount of pesticide used and a deposition efficiency as high as seven times that obtained with conventional methods of spraying in row crops (Figure 2). The resulting economic advantages and better control of pests achieved by using electrostatic spraying also offer potential benefits in the field of turfgrass management.

It was hypothesized that the addition of an electrostatic precipitator above the charged spray cloud would introduce additional forces on the charged droplets, forcing them to be deposited even faster onto flat grass targets. Since the drift of airborne droplets is directly proportional to the time the droplets remain in the atmosphere, an electrostatic precipitator might aid in reducing drift. Thus, the objective of this study was to investigate the degree of improvement in spray deposition onto turfgrass-type targets achieved with charged sprays applied under various type electrostatic precipitators (Figures 1 and 3).

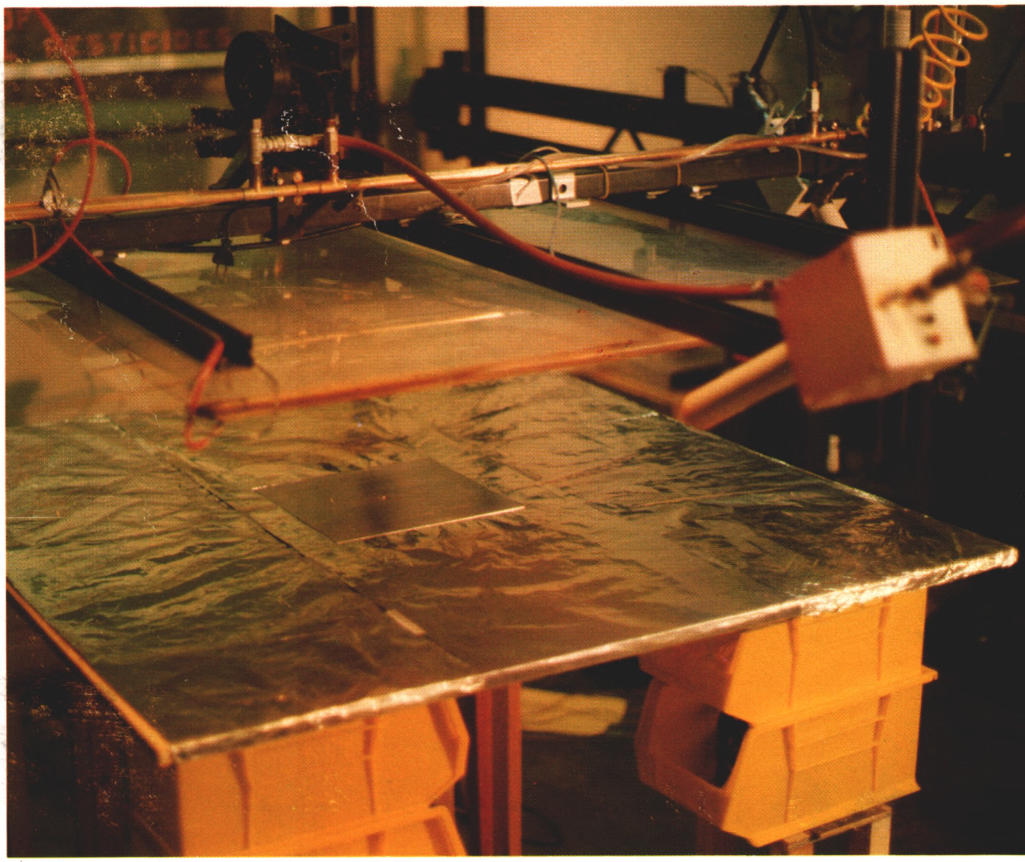


Figure 2. Experimental setup of spray-charging nozzle at 45° inclination angle above flat deposition surface.

EXPERIMENTAL ANALYSIS

An electrostatic spraying nozzle specifically suited for charging pesticide droplets has been developed within the agricultural engineering department at the University of Georgia (Figures 4 and 5). The nozzle uses the principle of electrostatic induction to charge the liquid droplets and is powered by a transistorized supply energized with a 12 volt d.c. battery of the type found in tractors. This charging nozzle system has been designed onto the self-propelled vehicle shown in Figure 1 in order to evaluate the performance of electrostatic pesticide spraying onto various living-plant targets, including turfgrass. The nozzle itself was evaluated for its use in turfgrass spraying in conjunction with the added electrostatic precipitators.

Two types of electrostatic precipitators were studied. First, a high-voltage metal plate was maintained above the charged cloud to act as an electrostatic precipitator. The potential on the high-voltage plate was varied from 0 kilovolts to -30 kilovolts in steps of 10 kilovolts. The second type was a dielectric-barrier

Figure 3. Spray-charging nozzle oriented at 0° inclination angle over turfgrass target.

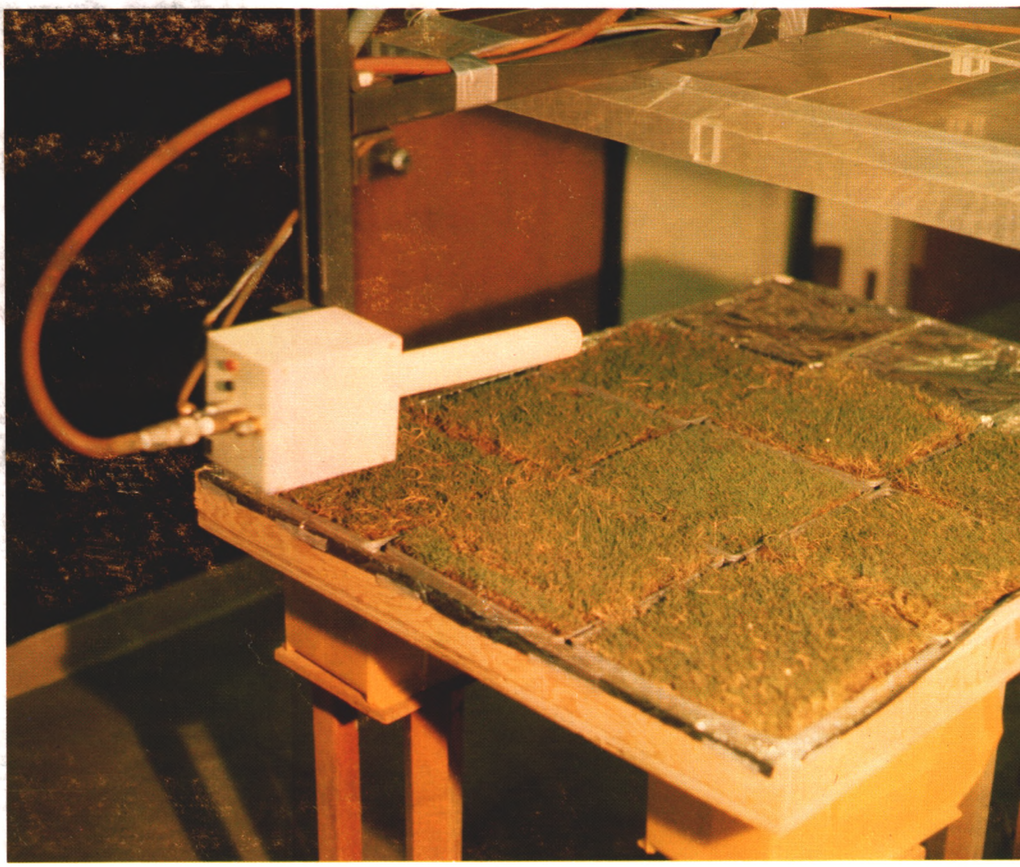


Figure 4. Electrostatic spraying of turfgrass under dielectric-barrier precipitator.

electrostatic precipitator made of a polyethylene sheet stretched over a square plexiglas frame. Initially the polyethylene sheet would accumulate negative charges on its surface through the impingement of charged spray from below. Later, these accumulated charges would repel further spray droplets downward toward the turfgrass.

Quantitative analysis of spray deposition with charged and with uncharged sprays was done on a flat aluminum target simulating turfgrass. A fluorometric technique was used to quantify the amount of spray deposition onto the aluminum target resulting from the different treatments.

The spray experiments, conducted in the laboratory with a sprayer simulator, tested the charging nozzle at 0-degree, 15-degree, 30-degree and 45-degree inclination angles. The nozzle trailed 0.15 m (6 inches) behind the electrostatic precipitator in its travel. The target surface was placed 0.3 m (12 inches) below the nozzle, which as aligned coplanar with the precipitator for 15-degree, 30-degree and 45-degree inclination angles (Figure 2). For the tests with 0-degree nozzle inclination angle the nozzle was maintained 0.15 m (6 inches) below the precipitator (Figures 3 and 4).

The spray cloud current, which is a measure of the degree of spray charging, was varied from 0 μA (uncharged) to -8 μA in steps of 2 μA.

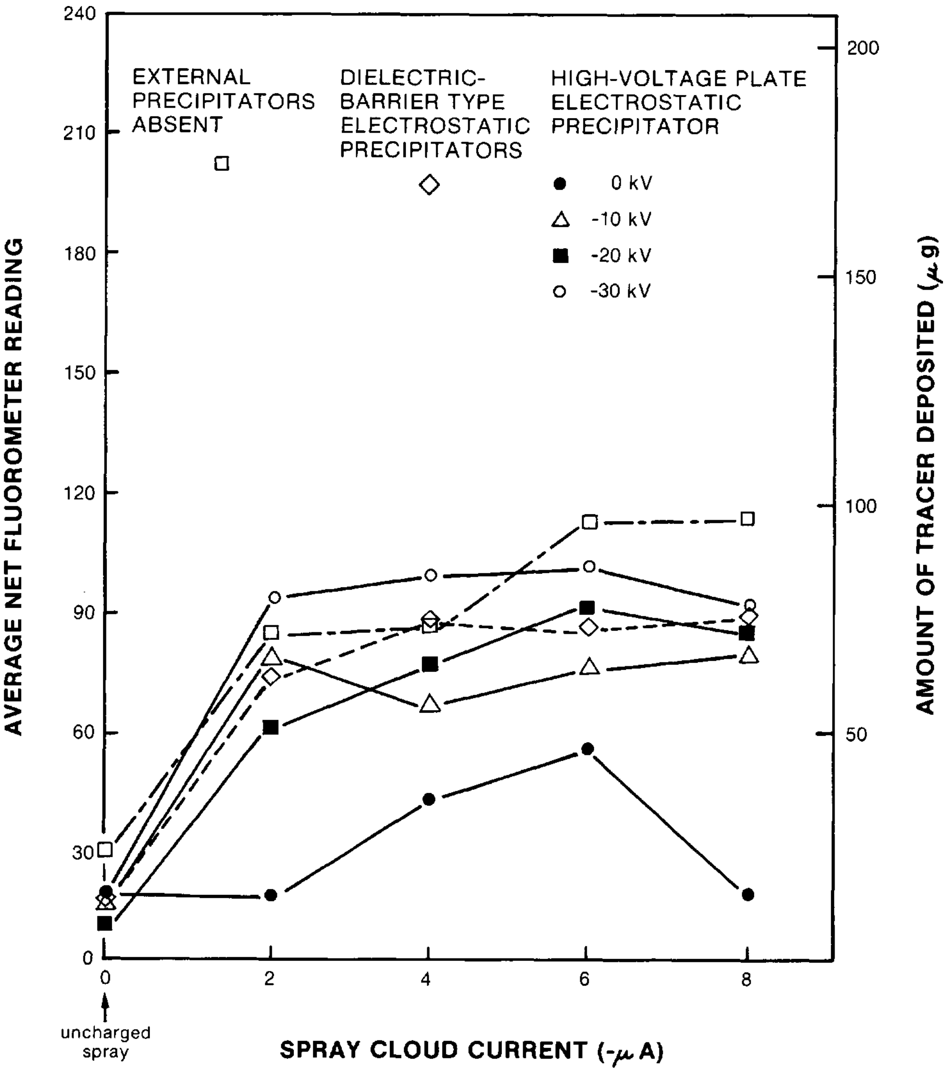
RESULTS AND DISCUSSIONS

The deposition was found to increase significantly on increasing the nozzle inclination angle. The different forces aiding the deposition of the charged spray droplets were: (a) the gravitational force, (b) the vertical component of the inertial force due to velocity of the spray, and (c) the electrical force due to the spray's space charge and the presence of the electrostatic precipitators. Since a 0-degree nozzle inclination angle would correspond to a minimum of inertial force component, it would give a better comparison of the other variables of primary interest in this experiment. Figure 5, therefore, shows the deposition with 0-degree nozzle inclination angle for charged and for uncharged conditions of the spray under the influence of the two types of electrostatic precipitators. Deposition achieved solely by the charged spray cloud without any added precipitators is also shown.

It is seen that the deposition increases on charging the spray up to typically 4 to 6 μA. Application of increasingly higher voltages to the precipitator plate can also be seen to enhance the movement of charged spray droplets downward for deposition. However, the presence of a grounded electrostatic-precipitator plate actually reduces target deposition. This is because the resultant electric field acting on the charged droplets then drives a portion of the spray upward to the grounded plate instead of downward to the target. It is also shown that maximum electrostatic deposition occurred purely as a result of the charged spray cloud's own self-generated space-charge electric field driving the charged droplets downward to the grounded surface. Nevertheless, in actual turfgrass applications the presence of crosswinds would likely favor use of some appropriate type of an electrostatic precipitator merely to enclose and protect the charged spray.

The dielectric-barrier type electrostatic precipitator appears to satisfy this need. At the higher levels of spray charging, it is seen to be practically as efficient as the high-voltage plate type electrostatic precipitator (even at -30 kV) for depositing charged spray onto planar targets like turfgrass. Moreover, the ease in its construction and the absence of those hazards associated with the high-voltage plate electrostatic precipitator make the dielectric-barrier type electrostatic precipitator the desirable approach in the design of electrostatic turfgrass sprayers.

Figure 5. Deposition of spray onto planar targets under charged and uncharged conditions for 0° nozzle inclination angle and for various electrostatic precipitator conditions.



CONCLUSIONS

It has been verified that electrostatic spraying can be successfully used to improve droplet deposition onto turfgrass-type planar targets. The deposition achieved onto the flat targets utilizing charged spray at -6 μA in conjunction with the dielectric-barrier type electrostatic precipitator was improved 3.6 times as compared with uncharged spray.

The presence of an electrostatic precipitator in the form of a polyethylene sheet above the spray cloud also acts as a protection for the charged spray cloud from the effects of crosswinds.

The above concepts of electrostatic spraying can be successfully incorporated in the design of turfgrass sprayers for more efficient and economical golf course management.

ACKNOWLEDGMENT

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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!

by DONALD D. HOOS
Director, Western Region, USGA Green Section

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.

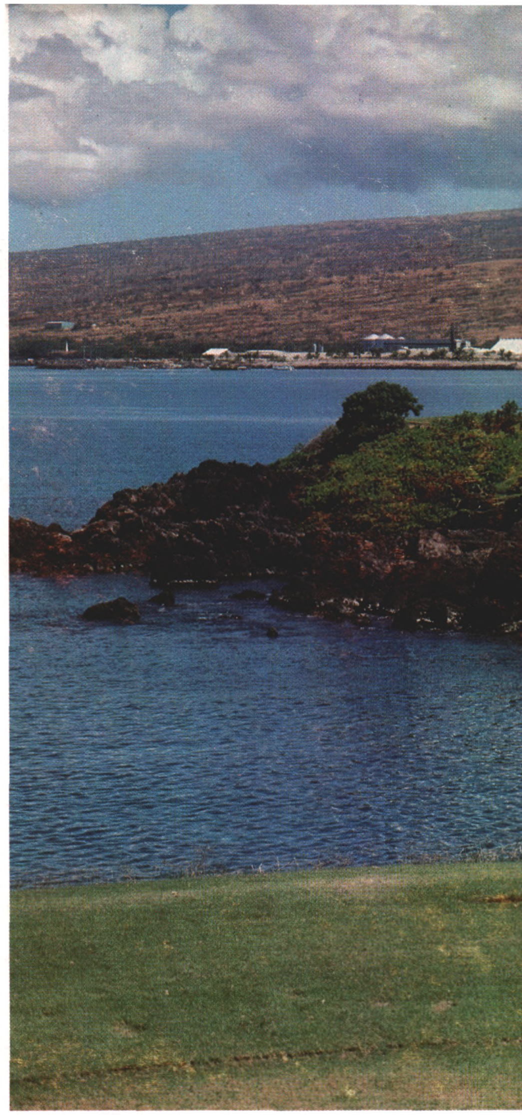
Perhaps one of the greatest paradoxes relating to turfgrass management in Hawaii is the lack of sand. The sand available in Hawaii is beach sand, essentially all calcium carbonate. The high carbonate content makes the sand, in most people's judgement, unfit for green construction. However, this is the 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 postemergence goosegrass control have been MSMA and DSMA.

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

An effort should be made to keep all of a golf course's greens consistent and firm enough to force the player to put spin on the ball. 1979 U.S. Amateur Public Links Champion Dennis Walsh in his semi-final match with Jodie Mudd at the West Delta golf course.

A Golfer's View of Maintenance

by **TIM BERG,** Director of Golf, West Delta Golf Club, Portland, Oregon

EVEN THOUGH maintenance is important to the golfer, I don't believe any golfer walks to the first tee with the attitude that he's going to look for all the things wrong with the course. He's excited about playing golf. His thoughts are on his swing, who his partner will be, how many strokes he will get, and what the stakes are going to be.

A golfer's feelings about the course and its maintenance develop while he is playing, and they are summed up in his comments during and after the round. The way a player plays and the condition of the golf course affect the attitude the golfer has when he leaves the course. How a player plays can also affect his attitude toward maintenance on the golf course. Those who play well usually have less to say about conditions.

You all know that you can't satisfy all the golfers who play your golf course. They all have certain preferences in greens (speed, firmness), mowing heights of fairways and roughs, and the length of the holes, among other things. Different types of facilities have different types of players, and, therefore, different maintenance practices. For instance, a public course may have a little slower greens and less rough than a private course.

Generally speaking, a golf course should be maintained as near as possible to what your players want, while keeping in mind the health of the turf plant.

For the sake of organization, I have separated the rest of my remarks into three areas which affect the view of a golfer toward maintenance. These are:

1. Consistency
2. Definition
3. Challenge

No matter how you maintain a golf course, the program should be consistent. All of the mowing schedules should remain the same throughout the season. For example, if greens are mowed five or six times a week, the days the greens are not mowed should remain the same. That way a golfer knows what to expect when he comes to play.

AN EFFORT should be made to make all of a golf course's greens consistent. The greens should putt at approximately the same speed and receive a well-struck ball with the same action. Golfers become very frustrated when one green is slow and another fast, or when a ball bites on one green but bounces off another. Also, this isn't fair to the players. The USGA's Stimpmeter can help improve the consistency of speed of your greens. Longer rough on one hole compared to the rough on another hole is unfair to the player who hits a bad shot on one hole and is confronted with a more difficult shot than a player hitting a similar shot on a different hole. Comparative bad shots should result in the same difficulty when the circumstances are the same.

Bunkers should have sand of a consistency that will eliminate plugged or bare lies. All bunkers should have adequate rakes!

Try to do major maintenance activities (aerifying, topdressing) at the same time of year (weather permitting). Post your activity schedule far enough in advance so that the golfer can be prepared for the inconvenience.

Grooming a golf course beyond normal conditions for a tournament can be upsetting to the players. You might hear, "Why can't the course be like this for us?" If a consistent maintenance program includes good grooming practices, the golf course will always be well received by the players and will appear to be in tournament condition.

The second area that affects the golfer's view of maintenance, which I called "definition," answers the questions: Where does the player go? How does my ball lie? How do I proceed? Am

I or am I not out of bounds, or in a hazard or a bunker?

When a player stands on the tee, can he tell the direction he is going? Do the tee markers point the golfer at the fairway, or are they aimed toward the rough or bunkers or water? Is the mowing pattern in the correct direction? Does the hole have rough, bunkers, water, or trees to show where the hole plays? Even a light rough gives a hole definition. A few trees planted in strategic places can give a plain hole direction.

All hazards, bunkers and out of bounds should be well defined. Poorly edged bunkers and poorly marked hazards and out of bounds frustrate the golfer if he cannot tell where he is. Poor definition can also lead to cheating. Many players will play the ball without taking a penalty, with or without the approval of their playing partners. (A reason for having good definition during normal play as well as for tournament play.) Stakes should be visible from one to the other and close enough so the player can tell how his ball lies. Cart paths that are paved or graveled should be well defined so that the player knows he is either on or off the path. Any drop areas should be well marked.

DEFINITION is an important part of every hole, and it enhances the beauty and playability of any course.

The third and last area is challenge. I believe challenge puts the greatest demand on the golf course superintendent. How should the course play? Hard? Easy? What is hard, easy, fair?

Should the course be firm and fast, soft and lush (dark green) or somewhere

Do tee markers point the golfer at the fairway? A view of hole 16 east tee in the process of being correctly aligned at Winged Foot Golf Club.

What about the bad shot? Conditions have also improved for the shot that is poorly hit. Consistent height of rough, raked bunkers and smooth surfaces throughout the course have given better playing conditions throughout the golf course.

IN MODERN maintenance, the golf course superintendent can provide the challenge with his grooming methods.

The golfer should be challenged to hit good shots at all levels of play. Rough should border the fairways. Height of rough would depend upon the facility and type of player who uses it. Normally, courses being groomed for major competitions would have rough 4 to 6 inches high, but even a public course should have some rough to penalize the bad shot. Private clubs would have a little higher rough because, overall, they have far less play than most public courses.

Greens should be firm enough to demand some spin be put on a ball hit from the fairway if it is to hold. A thinly hit 3-iron that screams along five feet off the ground should not land on the green and stop within a few feet. Of course, if the fairway grass were long and the green hard, too much would be demanded. A player couldn't put the clubface on the ball to apply spin for proper stopping action.

Slow, soft greens don't offer a challenge. Despite what some players feel about soft greens for holding shots, there are negative aspects to this condition. Soft putting surface cannot remain true with the continual foot traffic. Soft greens vary in speed and cause short shots to react inconsistently.

Greens should be firm and fast enough to require some touch in putting. The sledge hammer approach requires little skill or finesse and is very uninteresting. Greens that are too fast cause play to be slow.

Thought should go into tee and hole placements so that the golfer receives as much variety as possible within the capabilities of your course. On each hole, develop a relationship between the forward, regular, and championship tees and move them together as you vary the distance of the holes.

Remember that the USGA Handicapping System helps equalize the players. A handicap will allow the players to put as much into their game as they wish and still remain competitive.

The golfer who doesn't wish to improve his game shouldn't dictate how

in between? Some golfers feel dark green is good. I know the neighbors who live around the City of Portland courses feel dark green is best. Every year when the unwatered areas start browning out, our office receives calls complaining about the condition of the golf course, or the park across the street. I am not arguing the pros or cons of dark green, but I feel what is best for the turf is also best for playability and challenge.

Golf played at every level should demand something of the player's skills. These demands can be made through the design of the course and the maintenance of the course. This is how I believe maintenance can provide this challenge.

Originally golf was played in an area with no maintenance. In those days, you teed up within a few feet of the hole on dirt taken from that hole. Imagine what that putting surface looked like and the condition of the edge of that hole.

Visualize yourself playing under these conditions: No mowed grass, unkempt hazards, the hole cut in the ground (and remains unchanged), and you tee off within a few feet of that hole.

Now bring in modern maintenance techniques and equipment (mowers, aerifiers, topdressers, chemicals, fertilizers). Mow the fairways, greens, tees, and roughs. Smooth out the putting surfaces.

Now visualize yourself playing this modern course. I believe we now have a golf course that rewards the good shots. A premium has been put on accuracy. You've said to the player, "Improve your skills and you can play from better lies. You will be rewarded for playing better. Your score will reflect the time and effort you put into your game."

A golfer should know what to expect when he comes out to play.

the course is maintained. If a golfer wishes to have no hazards or rough, wants sponge greens, and doesn't want to think about the game, he should go to the city park or the beach for his walk, because a walk is all that he would be getting from his experience.

When a golfer walks onto the course, he should expect to be challenged by that course and to be rewarded for his good shots.

I remember a golf course superintendent saying in jest, "If it weren't for the golfer, I would have a real nice golf course." With a golf course that is consistently maintained, has good definition, and provides a challenge for the golfer, you would be very happy to have the golfer around. He is going to be your best friend.

Your maintenance program can challenge the golfer to make good shots. It can put a lot of excitement and interest into the player's game and force the player to put some thought into his play. In short, you can help develop a dedicated, enthusiastic golfer who can hardly wait to work on his game and get back on the golf course.

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

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	Average No. Copies Each Issue During Preceding 12 Months	Single Issue Nearest to Filing Date
A. Total No. Copies Printed (Net Press Run)	12,216	11,800
B. Paid Circulation		
1. Sales through Dealers and Carriers, Street Vendors and Counter Sales	none	none
2. Mail Subscriptions	11,308	10,865
C. Total Paid Circulation	11,308	10,865
D. Free Distribution (including samples) by Mail, Carrier or other means	573	382
E. Total Distribution (Sum of C and D)	11,881	11,247
F. Office Use, Left Over, Unaccounted, Spoiled after Printing	335	553
G. Total (Sum of E and F)	12,216	11,800

I certify that the statements made by me are correct and complete.

Robert Sommers, Managing Editor

Index to the GREEN SECTION RECORD for 1979

The appropriate article is listed and followed with the name of the author, year, volume, number and page.

TURF TWISTERS

IT IS GOOD PRACTICE

Question: Can the winter heave/thaw cycle kill grass plants? (New Jersey)

Answer: Yes, especially young ones. During normal freeze/thaw winter cycles the grass plant can literally be pushed from the soil by the expansion and contraction of the ground. This action can sever roots or elevate the plant, making it more susceptible to desiccation. When this condition is apparent, it is good practice early in the spring to roll the ground lightly to force the grass crown back into contact with the soil.

TO CLOSE ONE COURSE

Question: We have a 36-hole facility. Is it common practice to keep all 36 holes open to play during winter or is it best to keep only 18 of our 36 holes open? (Delaware)

Answer: Much depends upon the amount of play each course receives. If winter play is minimal, then very definitely it would pay to center all play on one course. When this is done, our experience indicates that the grass on the course that is closed for the winter becomes denser, undamaged roots are deeper, weeds and diseases are less troublesome and the putting surfaces are smoother the following year than the course that was played all winter. Obviously, it would pay to alternate courses for winter play annually at a 36-hole facility.

TO PREVENT WINTER DAMAGE

Question: Our golf course superintendent prohibits play when there is frost on the ground. Is this good practice and if so, why? (Ohio)

Answer: When turfgrass plants with a frost cover experience foot or vehicular traffic, permanent damage frequently occurs because walls of plant cells are ruptured. Also, it is possible that the crown of the plant may be damaged, which could result in permanent turf loss. A weakened plant provides an ideal opportunity for weed and disease invasion and a decrease in plant density for the summer stress months. The golf course superintendent has the interest of the majority of players in mind, and he is interested in the maximum use of the course for all seasons when he faces the decision to close the course because of inclement weather.