Sprinkler Head Testing Makes Dollars and Sense

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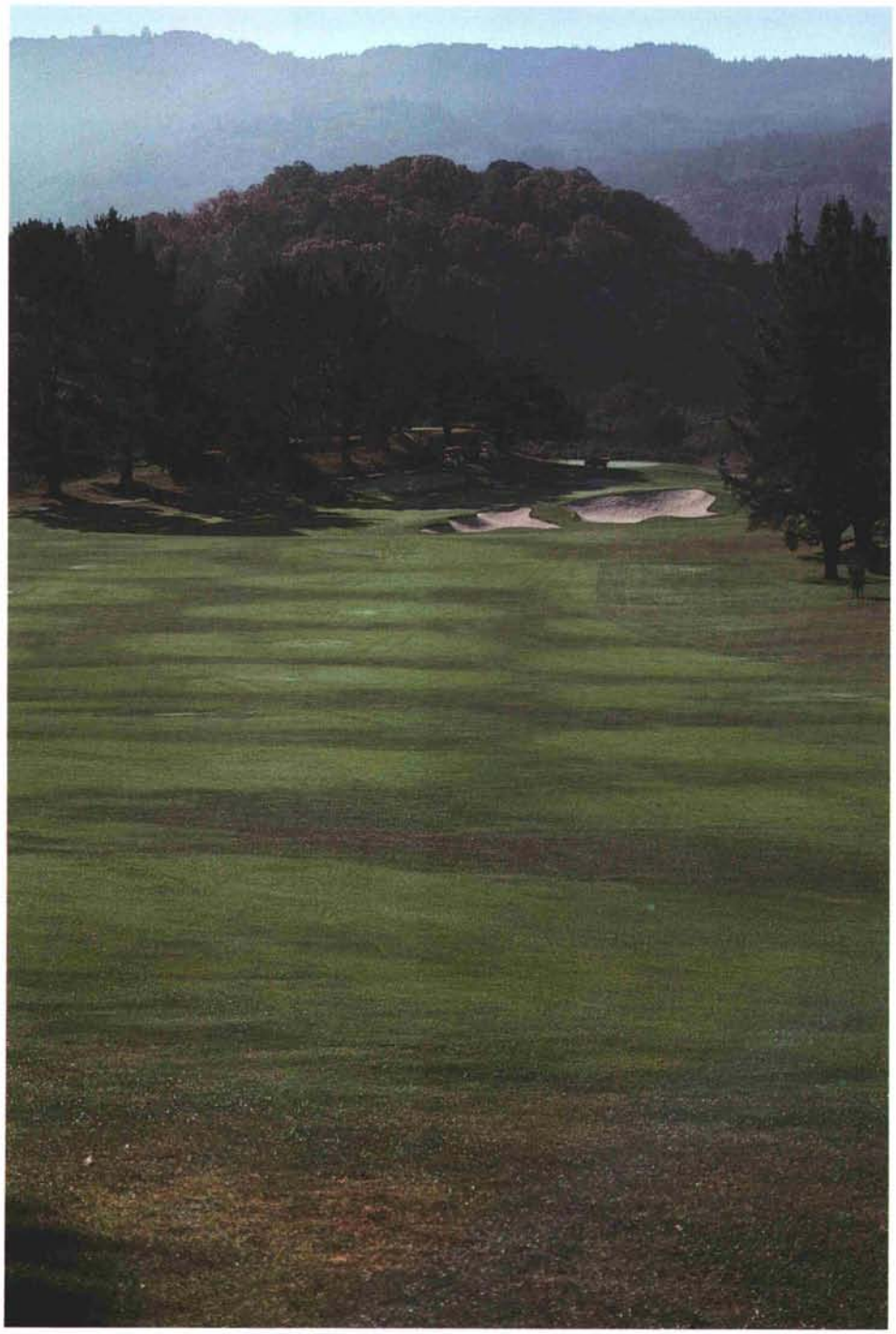
IN THE SOUTHWEST, where Mother Nature provides very little natural rainfall, uniform irrigation coverage is vital to maintaining both the health of the turf and the beauty of the course. Even in regions that receive more rainfall, where irrigation is only supplemental, uniform coverage should not be taken for granted, for it is nonetheless very important.

In addition to health and beauty, or what golfers directly see, golf course irrigation also represents a significant portion of the annual maintenance budget. More specifically, this cost includes capital improvement and/or system replacement, ongoing repair and maintenance, and water and energy usage. No matter what the specific costs, proper sprinkler head testing can be used to insure that every dollar will be spent wisely.

For new golf courses, sprinkler head testing can be used to select sprinkler head models and spacing combinations that produce optimum, uniform coverage. For existing irrigation systems, sprinkler head testing can be used to troubleshoot problems, identify deficiencies, and indicate the best means to make future capital improvements. To illustrate, this article will review what sprinkler head testing and analysis involve, discuss a measure of sprinkler head performance developed especially for turfgrass irrigation, termed Scheduling Coefficient, and consider the economics of improving the coverage of both new and existing irrigation systems.



Many golf courses are plagued by poor irrigation coverage by failing to take into account proper spacing of sprinkler heads. Sometimes these circumstances can be improved by testing alternative nozzle types and/or operating pressures.

Sprinkler Head Testing

During a test, the amount of water that falls at various distances from the sprinkler head (application rate) is measured with equally spaced containers. The resulting data then can be used to develop a "profile" that is representative of a particular sprinkler head model, nozzle combination, and operating pressure. Using special computer software called SPACE (Sprinkler Pattern And Coverage Evaluation), each individual profile can be "rotated" to simulate circular sprinkler head patterns, and then "overlapped" to simulate the irrigation

coverage of multiple sprinkler heads positioned as they would be on the golf course.

Uniformity Measures

Unfortunately, no irrigation system, or even Mother Nature, applies water in a "perfectly" uniform manner, so there will always be a number of both wet and dry spots. The mainstream agricultural industry has long used a calculated Coefficient of Uniformity (CU) to measure such non-uniformity in water application for a given sprinkler head, nozzle type, operating pressure, and spacing combination. Turf irrigation professionals generally agree, however, that the interpretation of CU for turfgrass irrigation is difficult at best, and often misleading. A high CU, for instance, is no guarantee that dry spots will not develop on the golf course. To deal with these circumstances, the Center for Irrigation Technology (CIT), in Fresno, California, has developed another measure of uniformity called Scheduling Coefficient. Except in cases when a golf course has extremely poor drainage, underwatering of specific areas is the most significant problem. The Scheduling Coefficient, therefore, looks at the water application rate of the critical dry areas and compares it to the average water application rate over the entire golf course.

For example, suppose the average water application rate from the sprinkler system is 0.5 inch per hour. If the turfgrass needs 2 inches of water per week, then each sprinkler needs to run four hours per week to meet those needs. In the critical dry areas, the actual application rate is less, say only 0.25 inch per hour. If the sprinkler heads are run four hours per week, then this area will receive only one inch of water, or half the amount of water required by the turf-grass. As one would expect, the critical dry areas are the first to discolor and then deteriorate from lack of water.

To compensate, the golf course irrigator is forced to program longer irrigation cycles. In order to apply the needed 2 inches per week in the critical dry areas, the irrigator will have to run the sprinkler heads eight hours per week, or twice as long as the irrigation cycles needed for the rest of the golf course.

The Scheduling Coefficient is, more precisely, a run time multiplier, and is calculated by dividing the water application rate in the critical dry areas into the average water application rate. The Scheduling Coefficient for our example, then, is $0.5 \div 0.25 = 2.0$.

Scheduling Coefficients are, by definition, greater than 1.0 and ideally below 1.5. Good irrigation systems have Scheduling Coefficients of approximately 1.1. Unfortunately, many golf courses are currently being irrigated by systems with Scheduling Coefficients that measure as high as 2.2 or more!

TABLE 1

Sprinkler Spacing and Coverage Analysis

Actual Test Results for Three Golf Course Sprinklers

Sprinkler*	Equilateral Triangular Spacing % of Diameter	Coefficient of Uniformity	Scheduling Coefficient
Brand A	50	92	1.77
	60	72	2.15
	70	62	2.05
Brand B	50	89	1.40
	60	73	2.11
	70	71	1.77
Brand C	50	84	1.35
	60	83	1.65
	70	84	1.32

*All three sprinklers deliver approximately 27 gallons per minute at a pressure of 70 PSI, and have a 74-foot radius of throw.

Improved Efficiencies Save Money

Local utility rates and the golf course size, in terms of acres under irrigation, dictate the water and energy costs for each course. In the arid Southwest, annual water and energy costs may amount to $1,500 per acre. For a large course, the total bill can easily be $150,000 to $250,000 per year. Even in areas where less irrigation is required, the cost for water and energy can be substantial.

Consider the case of a course spending $100,000 per year on water and energy. By testing the sprinkler heads, operating pressure, and spacing combination, it is determined that the Scheduling Coefficient is 2.1. Although not unusual, 2.1 is not very good, to say the least. If the course could adjust its irrigation system to achieve a Scheduling Coefficient of 1.3, the water and energy bills could be reduced to $61,900 [$(1.3 \div 2.1) \times \$100{,}000 = \$61{,}900$], or a savings of over $38,000 per year. If the Scheduling Coefficient could be reduced to 1.1, the water and energy bills could be cut nearly in half. Recognizing that these are annual figures, the long-term savings could be very substantial.

Under these circumstances, the course could afford to spend $70,000 on capital improvements of the irrigation system, and the investment would be paid back in less than two years. Indeed, investing in a lower Scheduling Coefficient can be a wise investment.

Next, consider the case of a course planning to install a new irrigation system. The irrigation designer commissioned to engineer a new system has a choice of many sprinkler head makes, models, and spacing combinations. Testing the sprinkler heads in advance can provide guidance as to the best design choice.

For example, consider the sprinkler head test data in Table 1. These results are from tests run at CIT on three actual golf course sprinkler heads. All three sprinkler heads have the same flow rate and distance of throw. In fact, if you looked them up in the manufacturer's catalogs, you might conclude that these sprinklers are "equal" and could be substituted for one another.

After further examination, however, the Scheduling Coefficients for these three sprinklers are NOT the same. Even when spaced to throw "head-to-head" (spacing equals 50% of the wetted diameter, these sprinkler heads' Scheduling Coefficients range from 1.32 to 2.15. Furthermore, note that the sprinkler head with the best Coefficient of Uniformity is not the one with the lowest Scheduling Coefficient.

Even with head-to-head coverage, these similar sprinkler heads do not have the same

(Top) Through proper testing of existing irrigation systems, their performance can, in many cases, be significantly improved. By doing so, the course not only looks better, but water and energy bills are also reduced.

(Above) For those golf courses with poor irrigation coverage, the irrigator is forced to program long irrigation cycles to compensate for critical dry areas. To the golfers' disappointment, wet areas then develop.

performance or Scheduling Coefficients. As in the case of improving existing irrigation systems, the difference between 1.32 and 2.15 can mean thousands of dollars per year in future water and energy costs. Buyer beware; it's much better to test the sprinkler head and make the right choice before the system goes in the ground.

Testing sprinkler heads and analyzing the results can be of great benefit, either for new or existing golf course irrigation systems. Sprinkler head testing can guide selection or renovation decisions, resulting in higher irrigation efficiencies and lower Scheduling Coefficients. Such guidance also can lead to large savings in the form of reduced water and energy bills.

To contact the Center for Irrigation Technology for more information, readers can call (209) 278-2066, or write to: Center for Irrigation Technology, 5370 North Chestnut Avenue, Fresno, CA 93711-0018.