

Can't Stop Your Ball on the Green?

Are the greens to blame or is it your game?

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In preparation for any USGA National Championship, especially the U.S. Open, Senior Open, Women's Open, and U.S. Amateur, putting greens are managed to provide firm and fast conditions. Firm surfaces encourage players to approach greens from strategic angles based on the shape of the green, hole location, and surrounding topography and hazards. Firm putting surfaces emphasize the skills of players hitting well-executed golf shots and reward them accordingly. In other words, firm putting surfaces help distinguish golfers playing the best amongst their peers. Soft greens, on the other hand, allow players to "throw darts," and such conditions negate

much of the intended course strategy and setup. Daily-play golf is much different. Whether at a municipal golf course, a high-end daily-fee facility, resort course, or an elite private club, most golfers prefer soft greens. Why? Because softer conditions make golf easier. Soft putting greens allow inaccurate and loose approach play to suddenly become acceptable or even well-played golf shots. But when golfers cannot stop their ball, suddenly the greens themselves are the scapegoat.

Every golfer seems to have an opinion as to why he or she is unable to stop and spin an approach shot just as the professionals do on TV. But

what is the real reason? To answer this, we must first investigate what factors influence ball reaction on a putting green. The following are primary surface characteristics of a putting green that may influence an inbound golf shot:

- Green firmness
- Turf variety
- Green speed
- Grain
- Slope or pitch of the green
- Surface moisture
- Putting surface irregularities
- Recent cultural practices (e.g., core or solid tine aeration, sand topdressing)

What about the golfer? How do golfer ability and equipment influence

the physics of an approach shot? Golfers are able to influence the following characteristics of an approaching golf shot:

- Inbound angle
- Ball speed
- Spin

Golfers influence such factors through clubhead speed, loft of the golf club, quality of impact (a function of the ball lie, angle of attack, and squareness of impact), condition of grooves on the clubface, and the ball itself. Which of these factors affects ball reaction the most? In other words, what aspect has the largest influence on a golfer's ability to stop a ball on the putting green?

inches on both impact sites over both days. Contrary to what one might expect, the non-overseeded portion yielded a marginally softer average TruFirm® value of 0.464 inches. The range of firmness values found in this study is representative of what golfers will find on bermudagrass putting greens in the desert Southwest.

A modified baseball pitching machine was used to fire golf balls into the turf with a range of speed, spin, and angles. Four different combinations were tested after firing 857 "shots" over the two-day study period. Each turf (overseeded and non-overseeded) was tested in two directions (one uphill

RESULTS

Which factors are important predictors of ball reaction?

The most important factors controlled by the golf course were:

The slope or pitch of the green. At the Paradise Valley CC nursery green, the surface is sloped approximately 1.5 percent in the southbound direction. When shots were fired in this direction, or with the slope, the average bounce plus roll for both surfaces was 32.5 feet. Conversely, when in the uphill direction, or against the slope, the average was only 13.5 feet, a statistically significant difference. Two factors are at play here. First, shots in the uphill direction approach the green at a steeper angle (because the green is tilted into the shot). Secondly, the roll is uphill, with gravity helping to stop it.

The firmer the surface, the greater the bounce and roll. In fact, the effect surface firmness has on ball reaction ranks equal to backspin. There was appreciable difference in TruFirm® values on the uphill impact sites to analyze the effect of firmness. For example, on day 1, the TruFirm® value on the uphill portion of the overseeded area was measured at 0.398 inches. By comparison, the firmness of the uphill segment of the non-overseeded area was 0.478 inches, a difference of 0.08 inches. On day 2, the difference was again 0.08 inches between the two uphill impact sites. The firmness range between the two downhill impact sites was nominal; therefore, this portion of the data set was not used for the purposes of identifying the effect of firmness on ball reaction. When comparing bounce and roll for the two uphill impact sites, it was found that the firmness had a statistically significant impact on golf ball bounce and roll. For example, on day 1, the bounce and roll increased by 9 feet on the firmer site. On day 2, the ball bounced and rolled out nearly 12 feet further on the firmer impact site.

The most important factors controlled by the golfer were:

The inbound angle and ball speed (velocity) of the golf ball. As expected, the steeper inbound angle and slower ball speed (representative of a sand

Table 1

Landing conditions of various iron shots from a fairway or rough

Club	Landing Conditions (Fairway)			Landing Conditions (Rough)		
	Speed (mph)	Angle (deg)	Spin (RPM)	Speed (mph)	Angle (deg)	Spin (RPM)
3	57	44	4,300	58	35	3,300
5	56	44	4,400	58	36	3,000
7	55	46	5,100	58	39	2,800
9	53	48	6,200	57	43	2,800
SW	49	51	9,100	52	49	3,500

THE SCIENCE BEHIND BALL REACTION

In search of an answer to this question, a study was performed in March 2011 at Paradise Valley Country Club in Paradise Valley, Arizona. A Champion bermudagrass nursery green was used for testing. The nursery is slightly pitched at 1.5 percent from north to south and measures approximately 60 yards long (running north and south) by 12 yards wide. Half of the nursery was overseeded with *Poa trivialis*, a commonly used turfgrass for overseeding in the desert Southwest. The greens were mowed and rolled to produce ball roll distance of approximately 12 feet as measured by a USGA Stimpmeter®. The USGA TruFirm® was used to measure surface firmness. The TruFirm® value on the overseeded portion of the green averaged 0.432

and one downhill), and the entire test was repeated a second day. The inbound speed, spin, and angle were measured with a camera-based launch monitor mounted to the output of the pitching machine. The distance to the first bounce and the total bounce and roll were recorded. The settings for the tests were intended to bracket the expected speed, spin, and angles that would result from different iron shots landing on a green (3-iron down to a sand wedge). For example, a 3-iron golf shot played from a fairway will impact a green at about 57 mph at an angle of 44 degrees and spinning at a rate of 4,300 rpm (Table 1). By comparison, a sand wedge shot played from a fairway will land at only 49 mph, at a much steeper angle (51 degrees), and with higher backspin (about 9,000 rpm).

wedge shot) resulted in the ball stopping the shortest distance from its initial impact. In some cases, this distance was negative (representative of a golf ball impacting the green and spinning backward, behind its impact point). Conversely, shallower angle and faster speed resulted in the golf ball rolling out a great distance (over 100 feet on several occasions), which is representative of a long iron golf shot. The backspin on the golf ball was the next most influential factor. As one would expect, the higher the backspin, the faster the ball stopped.

Some factors turned out to not be very important to the bounce and roll:

On day 1, green speed was measured at 11 feet 3 inches on the overseeded portion and 12 feet 3 inches on the non-overseeded area of the green. Despite this difference, bounce and roll distance were unaffected. Green speed on day 2 did not vary appreciably between any of the impact sites and, as a result, did not impact bounce and roll.

Other factors such as turf variety (bermudagrass versus bermudagrass overseeded with *Poa trivialis*), grain, and surface moisture did not affect ball reaction.

CONCLUSIONS

In order to stop the ball within a shorter distance from impact, the golfer must hit shots with steeper inbound angles and with greater spin. This may be achieved by hitting higher approach shots from the fairway. Consequently, golfers may want to [“Tee it Forward”](#) and consider playing from a set of tees that matches their ability and offers an opportunity to hit higher lofted clubs into greens. The pitch of the green also affected the bounce and roll. Older courses tend to have greens that slope back to front, and consistent with the results from this study, it will be easier to stop the ball on those greens compared to a flat surface or a green sloping away from the player. Putting green firmness affected the distance golf balls bounced and rolled, but only when the surface firmness was significantly different between the two impact sites, in this case a difference of 0.08



*A Champion bermudagrass nursery green was used for testing. The nursery is slightly pitched at 1.5 percent from north to south (photo was taken looking south) and measures approximately 60 yards long by 12 yards wide. Half of the nursery was overseeded with *Poa trivialis* (foreground).*

inches as measured by the USGA TruFirm®. With such a difference in firmness, the impact on ball reaction was of equal importance to backspin. Under conditions where the firmness was only marginally different at 0.03 inches, the ball reaction was unaffected.

In summary, golfers striving to hit a golf shot that impacts the green and spins backwards will be best served by focusing on the factors they can control, hitting shots with high spin and steep angles. This can be helped by playing from tees that put you in position on fairways to hit approach shots into greens using high lofted clubs. Golfers should also recognize that regardless of putting green firmness, when playing from the rough or hitting a low-trajectory shot into a green, or if the shot is not struck well, the golf ball is likely to roll out a considerable distance. Putting green design and surrounding terrain should also be considered. Some greens are constructed without approachable fronts, which requires the golfer to land

the ball on the putting green. If those greens are pitched away from the player, the ball will tend to bounce and roll away from its impact position. The next time you enjoy a round of golf and the ball bounds over the green, take it in stride and consider a lesson or two to learn how to hit a high-trajectory, spinning golf shot that stops on a dime.

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