Effect of Cultivar, Irrigation, and Soil Calcium on Runner Peanut Response to Gypsum


ABSTRACT

Calcium is often limiting to peanut (Arachis hypogaea L.) yield, grade, and germination in the southeastern United States. The response of large-seeded (Georgia-06G) and small-seeded (Georgia Green) runner peanuts to gypsum applications was evaluated in 14 tests in southern Alabama and Georgia. Experiments were conducted in a randomized complete block design with four replications of gypsum applications as main treatments (0, 560, 1120, and 1680 kg ha⁻¹) in soils with a range of soil Ca (178–498 mg kg⁻¹) in both irrigated and non-irrigated tests. Increases in yield, grade, seed Ca, and germination were significant with increased gypsum application for non-irrigated tests when data were combined. In the non-irrigated tests, yield increases ranged from 500 to 1000 kg ha⁻¹ and grade indicated by sound mature kernels (SMK) increased 3.4 to 5%. Critical pegging zone soil Ca values of 150 and 250 mg kg⁻¹ were evaluated and found appropriate for irrigated and non-irrigated peanuts, respectively. Georgia-06G had lower seed Ca concentrations and slightly lower germination than Georgia Green. More than 95% germination of Georgia-06G and Georgia Green was observed when seed Ca concentrations were >600 mg kg⁻¹. Analysis of Ca concentrations in nearly mature seeds pre-harvest may provide an indication of seed germination quality as seed Ca concentration increased at approximately the same rate as seed size from immature white to mature black peanut maturity classes using the hull-scrape method.

Peanut requires an adequate Ca supply to develop properly. Application of Ca to low Ca soils has been shown to increase yield (Adams et al., 1993), pod dry weight (Smal et al., 1989), and germination rate (Adams et al., 1993; Sorenson and Butts, 2008). In addition, elevated seed Ca has been correlated with improved grade (Hallock and Allison, 1980; Hartzog and Adams, 1988; Adams et al., 1993) and decreased number of underdeveloped kernels or “pops” (Smal et al., 1988). Calcium has been directly linked to seed quality through its requirement for plumule development (Cox and Reid, 1964; Harris and Brolmann, 1966; Sullivan et al., 1974).

The sandy Coastal Plain soils of southern Alabama and Georgia are texturally favorable for growing peanuts, but are naturally low in Ca (Adams and Hartzog, 1979). Lime (CaCO₃) that is used to increase soil pH also provides Ca to peanuts. However, lime is not always required and may not have sufficient carryover from year to year to provide enough Ca to developing peanuts. When Ca is limiting and lime is not required, gypsum (CaSO₄) is often used to increase Ca without increasing soil pH.

It is important that Ca be present in the zone of peanut development, or pegging zone, which is the top 7 to 9 cm (2.8–3.5 in) of surface soil. Calcium in the pod is obtained directly from the soil and is not supplied from the leaves via translocation from the plant root system (Wiersum, 1951; Sleaton and Shear, 1971; Kiesling and Walker, 1982). Because Ca is obtained by diffusion to both the pod and the root system, competition with other cations such as K and Mg may affect seed Ca as well as overall plant health.

Soil-test recommendations for Ca vary by state. Current Ca recommendations for peanut production in Alabama state that when soil-test Ca is >150 mg kg⁻¹ (300 lb Ca acre⁻¹) supplemental Ca is not needed. This value was established by Hartzog and Adams (1973) and has been confirmed by subsequent studies (Adams and Hartzog, 1980; Hartzog and Adams, 1988; Adams et al., 1993, 1994). In Georgia, current recommendations state that soils with Ca in the pegging zone >250 mg kg⁻¹ (500 lb acre⁻¹) and a Ca/K ratio >3:1 do not need supplemental Ca (Kissel and Sonon, 2008). These recommendations are based on numerous studies that were conducted primarily on research stations in Georgia between 1980 and 1990 using irrigation (Hodges et al., 1994). Several studies have found that peanuts do not respond to gypsum when soil Ca >250 mg kg⁻¹ (Hartzog and Adams, 1973; Alva et al., 1989; Sorensen and Butts, 2008; Tillman et al., 2010). However, seed producers typically apply additional Ca to ensure quality seed regardless of soil Ca and liming practices (Kissel and Sonon, 2008). This practice is recommended by Georgia and the Southern Seed Certification Association.

The three most recent evaluations of Ca requirements for peanuts in the Southeast United States were performed in 1987 to 1989 (Adams et al., 1993), in 2004 to 2005 (Sorensen and Butts, 2008), and in 2005 to 2007 (Tillman et al., 2010). Except

Abbreviations: ABAC, Abraham Baldwin Agricultural College; CPES, Coastal Plain Experiment Station; ICP, inductively coupled plasma; SMK, sound mature kernels; WREC, Wiregrass Research and Extension Center.