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Effect of seed size on yield of two groundnut genotypes

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Abstract *Small, medium and large seed sizes of the groundnut genotypes Spancross (a released variety) and 2/91 (a breeding line) were assessed for growth and yield under field conditions in 1996 and 1997. In 1997, there were significant effects of cultivar and seed size on shoot and root biomass. The shoot dry matter for large seeds was 36% and 24% greater than for small seeds of Spancross and 2/91 respectively. Large seeds of 2/91 showed a significant increase of 26% in root biomass but Spancross recorded a decline of 8% over small seeds. Generally, productivity increased with seed size. In 1996, rainfall was low and varietal differences were significant, with 2/91 giving significantly higher kernel yields (2082 kg/ha) than Spancross (1498 kg/ha) when averaged across seed size.*

Keywords: groundnut, nodulation, rainfall, seed size, yield.

Introduction

For groundnut, larger seeds show high germination rates, vigorous growth and high yield (Knauft et al. 1990). Vindhavarmaan et al. (1990) and Detroja et al. (1993) reported that groundnut plants from large seeds outyielded plants from smaller seeds due to an increased proportion of effective pods and consequently pod yield. However, Sahoo et al. (1988) and Sedano et al. (1988) recorded no such advantages in yield with large seeds, while Detroja et al. (1993) also reported that differences in seed size did not influence plant height, number of branches per plant, number of pods or shelling percentage. These variable results imply that the growth and yield response to seed size at planting cannot be generalized and specific recommendations are required for different genotypes and environments. Farmers are often advised to select large and well-filled seeds for planting, but in many developing countries seed supplies are limited and farmers often have to use seed of lower quality. This study assessed the influence of seed size on the growth, nodulation and yield of two groundnut genotypes under rain-fed conditions.

Materials and methods

A field experiment was established at the University farm (525 m asl) on a loamy–sandy soil during the 1996 and 1997 rainy seasons. The area used had been planted with groundnut in the two previous seasons, so presumably there were enough *Bradyrhizobium*

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species to facilitate effective nodulation (Duke 1981). The soil had a pH of 7.3 (H_2O), total nitrogen 0.11%, phosphorus 3.2 mg%, potassium 4.5 mg%, calcium 0.7 mg% and magnesium 0.3 mg%.

The two genotypes were upright bunch types: Spancross, a certified cultivar; and 2/91, a breeding line. Marketable-quality seed of both types were separated into small, medium and large sizes whose 100-seed weights were 28, 36 and 44 g for Spancross and 29, 35 and 44 g for 2/91 respectively. The experiment was a split plot with cultivars as main plots and seed size as subplots (2.8 (1.4 m) laid out in a randomized complete block design with three replications. At planting, triple super phosphate was applied at the rate of 40 kg P_2O_5/ha. Seeds were sown one per hill 10 cm apart in rows 35 cm apart, a plant population of 286 000 plants/ha. Rainfall is summarized in Table 1.

At 35 days after emergence (DAE) three plants were randomly sampled from rows adjacent to the outer guard rows, and outside the four rows used later for harvest in each subplot, to determine shoot and root biomass and nodule counts. Plants were carefully dug out and washed in water. Nodules were removed and roots and top growth were separated and oven dried at 80°C for 72 h. Yield and yield components were recorded at harvest. Data were analysed using the MSTATC package and significant differences between means were determined using the LSD test at 5%.

Results

In 1996, January was too dry and February too wet for ploughing, so sowing was delayed to 1 March, but in 1997, sowing was on 25 January. The crop received 500.4 mm of rainfall in 1997 compared to 470.4 mm in 1996 (Table 1). In 1996, the soil was extremely wet at planting and nearly one-third of the rainfall was in the first month after sowing. The total in both seasons is above the minimum of 300–400 mm for non-commercial groundnut production (Weiss 2000).

Shoot biomass at 35 DAE for both cultivars increased with seed size but differences were significant ($P \leq 0.05$) only in 1997 (Figure 1). Shoot biomass was generally higher in 1997 than in 1996 for both cultivars and seed sizes. Cultivar × seed size interactions for root biomass were significant ($P \leq 0.05$) in both seasons, but differences were greater in 1997, particularly for 2/91.

Table 1. Rainfall (mm) at Sokoine University farm

	1996	1997
January	–	13.4
February	151.5	71.5
March	127.9	177.2
April	208.5	216.1
May	132.0	35.7
June	2.0	18.9
Sowing date	1 March	25 January
Harvesting date	18 June	10 May

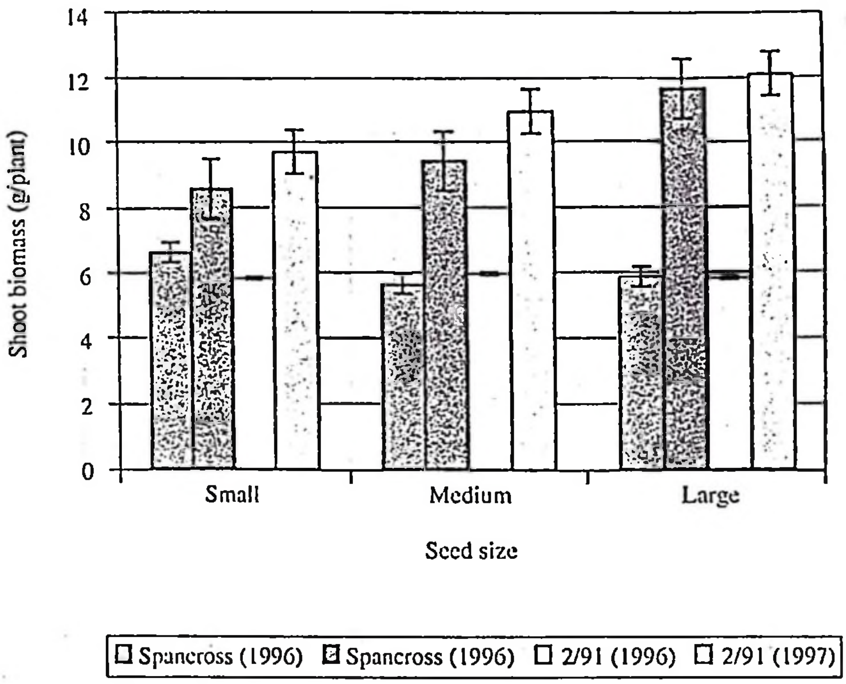

Figure 1. Shoot biomass at 35 DAE. Bars = × 1 SE.

In 1997, root biomass for 2/91 increased significantly ($P \leq 0.05$) with seed size (Figure 2), while that of Spancross decreased. This suggests different genotypic responses to seed size in relation to root growth. For Spancross, shoot:root (S:R) ratios were the lowest (16.05) for small seeds in 1996 and highest (18.90) for medium seeds in 1997, and the differences were significant (Figure.3). For 2/91, the differences in S:R were not significant. There was no significant difference in numbers of nodules per plant, filled pods per plant or shelling percentage in either year.

In 1996, pod yields were significantly different ($P \leq 0.05$) between cultivars and in this season significant differences were recorded for marketable kernel yields between cultivars and between seed sizes (Table 2). Kernel yield was significantly higher for large seeds than small for each genotype, but the differences between medium and large seeds were not significant. In 1997, pod and kernel yields were relatively higher for Spancross, but neither genotype nor seed size, or their interaction, had significant influences on yield or yield components. Genotype 2/91 gave relatively higher kernel yields in the drier year, 1996.

Discussion

The increase in shoot biomass with seed size agrees with the work of Knauft et al. (1990), who reported increased plant vigour and yield of groundnut with large seeds. The increased dry matter production and improved pod formation and pod fill with the better distributed

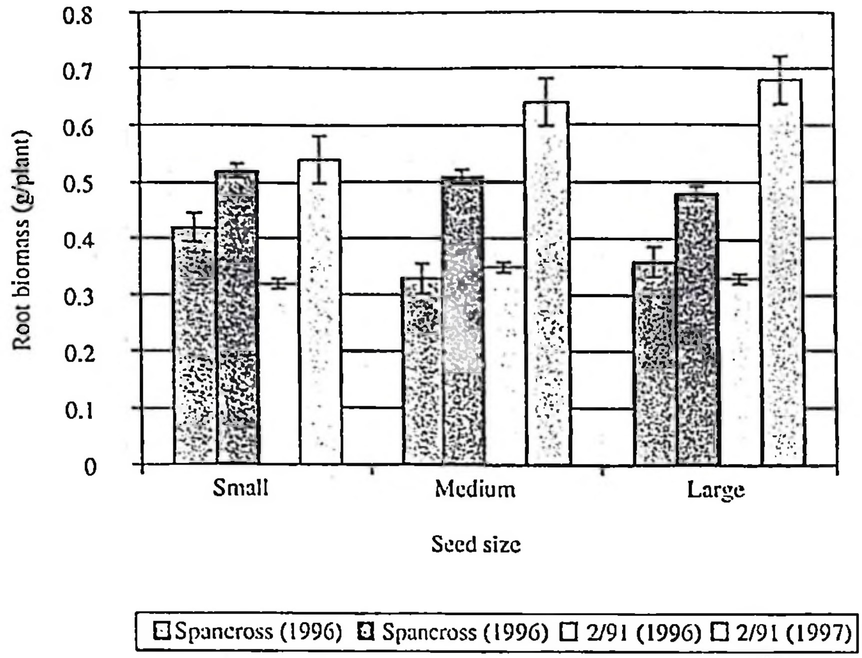

Figure 2. Root biomass at 35 DAE. Bars = x 1 SE.

rainfall in 1997 is similar to the results of Patel and Golayinka (1988). Genotype 2/91 showed a much higher potential for dry matter accumulation in the roots, especially with medium and large seeds, which suggests a differential genotypic response of root growth to seed size. Differential growth in response to environmental changes is common in plants (Leopold and Kriedemann 1975). Genotype 2/91 seems better able to tolerate intermittent drought than Spancross. The lack of significant differences in marketable yields in 1997 indicates that seed size did not play a significant role when rainfall was evenly distributed. Vindhavarmaan et al. (1990) reported positive correlations between seed size and groundnut yields, although Sahoo et al. (1988) and Sedano et al. (1988) found no such correlations. Seed size was important when rainfall was low, as in 1996, when kernel yield was low when small seeds were used at planting. At that time, 2/91 showed more moisture stress resilience than Spancross, as it had better pod and kernel yields.

Acknowledgements

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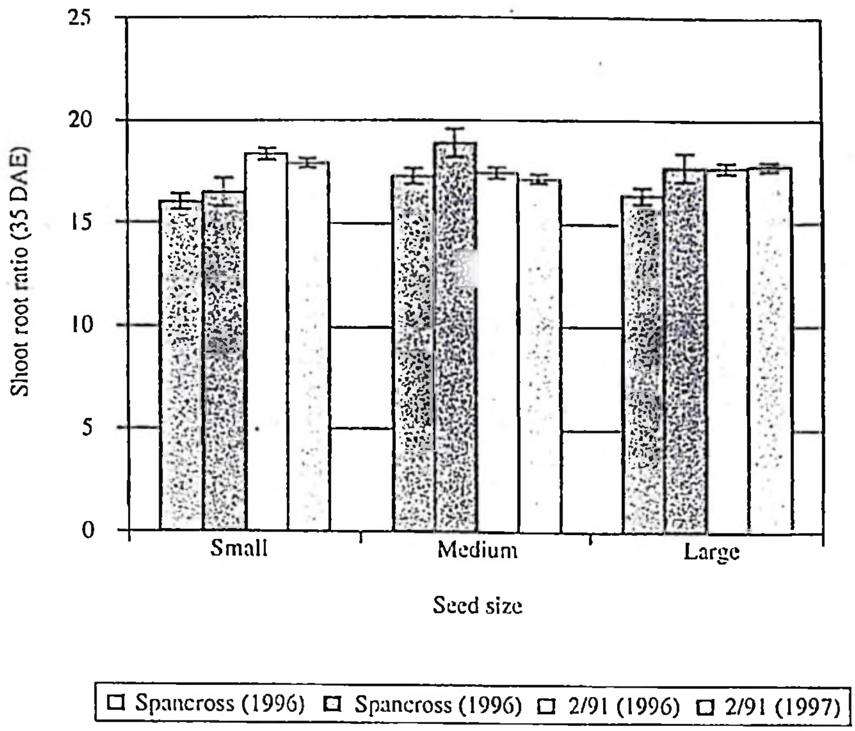

Figure 3. Shoot:root ratio at 35 DAE. Bars = × 1 SE.

Table 2 Mean values for yield of groundnut

	1996 Pod yield (kg/ha)	1996 Marketable kernels (kg/ha)	1996 100-seed weight (g)	1997 Pod yield (kg/ha)	1997 Marketable kernels (kg/ha)	1997 100-seed weight (g)
Spancross						
Small	2302	1107	30.8	2701	1728	31.6
Medium	2853	1668	28.7	3033	2120	29.2
Large	2940	1718	31.9	3532	2260	37.1
Mean	2698	1498	30.4	3688	2036	29.3
Line 2/91						
Small	3267	1703	35.8	2685	1491	25.7
Medium	3449	1909	38.7	3414	1731	32.9
Large	3925	2635	38.1	3354	2001	42.7
Mean	3547	2082	37.5	3151	1717	33.7
LSD, Cultivar (C)	756.7	571.5	6.2	NS	NS	NS
LSD, Seed size (S)	NS	736.1	NS	NS	NS	NS
LSD (C × S)	NS	NS	NS	NS	NS	NS
CV (%)	18.00	21.25	5.89	23.45	33.74	29.20

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