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INFLUENCE OF CULTIVAR, SOWING DEPTH AND SEED SIZE ON THE EARLY SEEDLING GROWTH OF GROUNDNUT

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Growth chamber experiments were carried out to determine the influence of cultivar, sowing depth and seed size on the early seedling growth of groundnut (*Arachis hypogaea* L.) There were four cultivars: Kadiri-3, Kadiri 71-1, Gangapuri and TMV-2; four sowing depths: 2,4,6,8 cm and three seed size: Large, medium and small. Experiments were conducted in a controlled environment growth room at 28° and with a 12th day length. Results showed that the differences between cultivars in early seeding growth were variable. However, Kadiri-3 produced more vigorous seedlings compared with the other cultivars. Sowing depth had a profound effect on seedling growth. Seeds sown at 4 and 6 cm depths produced more vigorous seedlings. Seed size had a significant influence on the early growth of seedlings. For each cultivar, large seeds produced the most vigorous seedlings at any particular sowing depth.

Key words: Groundnut, Cultivar, Growth, Seed size, Sowing depth.

Introduction

Rapid and uniform stand establishment with vigorous seedlings is fundamental to subsequent plant performance. Thus, it is important to obtain the desired number of plants per unit area to achieve optimum yield. Among a number of factors that affect the establishment of seedlings, seed size is an important factor for many crops. Several investigators have studied the influence of seed size on the emergence and growth of crops [1-4,6,7].

Another factor which determine the emergence and growth of crops in the field is sowing depth. Growers in the Semi Arid Tropics (SAT) frequently sow seeds at greater depths to over come the effects of a dry soil surface on germination and emergence and to make better use of the moisture at greater depths. Results of groundnut experiments have shown a reduction in fractional emergence of seedlings and rate of emergence with increasing depth of sowing [5,7]. Varietal responses to seed size and sowing depth on the seedling growth are important criteria for selecting the right cultivars for large scale production. Therefore, pot experiments were conducted with groundnut cultivars in controlled environments with the following objectives:

(i) To study the influence of cultivars, sowing depth and seed size on the early growth of seedlings.

(ii) To establish the ideal combinations of the these factors for the commercial production of groundnut in adequate soil moisture conditions.

Materials and Methods

One experiment was carried out in controlled environment at the Department of Agriculture and Horticulture University of Nottingham, U.K., during 1987 to study the influence of cufltivar, sowing depth and seed size on the growth of seedlings of groundnut. The four cultivars used in the experiment were Kadiri-3, Kadiri-71-1, Gangapuri and TMV–2 designated as V_1, V_2, V_3 and V_4 respectively. Seeds of each cultivar were graded into large (L), medium (M) and small (S) sizes. The seeds were sorted by hand sieving with round hole screens. Seeds of each cultivar were sown at four sowing depths, *viz.* 2,4,6 and 8 cm. The experiment was laidout in a split-split plot design with cultivar in the main plot, sowing depth in the sub-plot and seed size in the sub-plot. There were two replications.

Seeds were sown in plastic containers. Soil was collected and air dried and passed through a 4mm sieve. Each pot was filled with a total of 4.7kg soil maintaining a bulk density of 1.5g cm^{-3}. Seeds, not visibly damaged, were selected from each size of each cultivar for sowing at different depths.

The pots were arranged in a growth chamber according to the plan. Light was provided by nine HLRG mercury vapour lamps supplying a radiation of about 70 watts m^{-2}. The day length was set to a photoperiod of 12hr at a constant temperature of 28°.

Each pot was watered with 200ml tap water every five days to keep the soil moist during the growth of seedlings. Nine randomly selected plants were harvested from each pot after 30 days of sowing. Leaves were separated from the stems and the area of leaves were determined using a planimeter (LI-COR, Model 3100) and the length of the stem was measured. The stem and leaves were dried in an air ventilated oven a 80 ±5° for 48hr. The dry weights of the samples were taken using an electrical balance.

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Data were statistically analysed with a computer using the "Genstat" programme. Tests of significance were made at the 0.01 and 0.05 levels of significance.

Results and Discussion

Stem length. No significant cultivar differences were observed for stem length. Kadiri 71-1 produced the tallest plants and this was followed by Kadiri-3, TMV-2 and Gangapuri (Table 1). The influence of sowing depth on stem length was clear. Seed sown at 4 and 6cm sowing depths produced taller plants compared with 2 and 8cm depths, but their advantage over the 2cm depth was not significant. At a sowing depth of more than 6cm, plant height was reduced significantly (Table 1). Reduction in plant height at shallow depths may be due to the shortage of soil moisture and unavailability of nutrients in the surfacesurface soil, because this was more liable to dry out quickly due to evaporation. Reduction in stem length was also observed for seeds sown at a greater depth. This might be due to the fact that the seedlings used most of their assimilate reserves and energy at the time of emergence and before they had established the autotrophic stage.

A significant effect of seed size on stem length was observed. Large seeds produced taller plants than small seeds. The length of the stem was reduced with a reduction in the seed size (Table 1). The results of seed size are in agreement with those of ponnuswamy [6] and Gorbet [4]. The increased height of seedlings from larger seeds was probably due to relatively more growth as influenced by the presence of larger amounts of assimilates in the larger cotyledons.

TABLE 1. INFLUENCE OF CULTIVAR, SOWING DEPTH AND SEED SIZE ON THE EARLY SEEDLING GROWTH OF GROUNDNUT.

Characters treatments	Stem length (cm)	Leaf area (cm)	Stem dry weight(g)	Leaf dry weight(g)
Cultivar				
Kadiri-3	8.8	50.2	0.164	0.157
Kadiri 71-1	9.5	46.0	0.160	0.146
Gangapuri	8.5	51.5	0.148	0.150
TMV-2	8.7	46.2	0.126	0.144
SED (df=3)	0.25	2.5	0.006	0.004
Sowing depth				
2 cm	8.9	50.5	0.145	0.145
4 cm	9.3	54.3	0.148	0.161
6 cm	9.1	50.8	0.152	0.153
8 cm	8.0	47.5	0.140	0.136
SED (df=3)	0.21	1.0	0.004	0.005
Seed size				
Large	9.6	56.8	0.174	0.170
Medium	8.8	49.0	0.148	0.146
Small	8.1	43.5	0.120	0.128
SED (df=2)	0.19	1.5	0.003	0.008

An interaction between sowing depth and seed size was observed (P<0.05). Results indicated that large seeds produced the tallest plants at all sowing depths. Large seeds performed better at 6 cm sowing depth and small seeds in shallow depths, but all seed size showed reduced stem length at 8cm depth and the reduction was significantly greater in small seeds (Fig. 1a).

Leaf area. There was no significant difference between cultivars in leaf area production. However, Gangapuri produced more leaf area than the other cultivars. Sowing depths had a significant effect on leaf area production (P<0.01). Leaf area increased from 2cm sowing depth to 4cm depth and then decreased gradually with further increases in sowing depths (Table 1). The largest leaf area was recorded at 4cm sowing depth. The decreased leaf area at shallow sowing depths may be partially due to the shortage of water and available nutri-

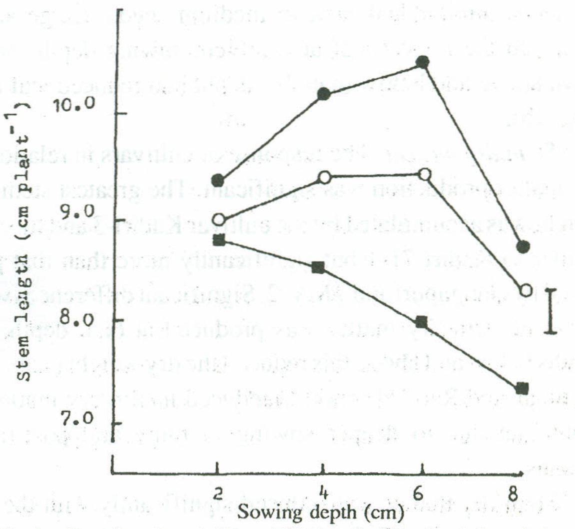

Fig. 1a. Stem length as influenced by sowing depths and seed sizes.
• Large ▫ Medium ▪ Small
Bar represents SED (df = 6)

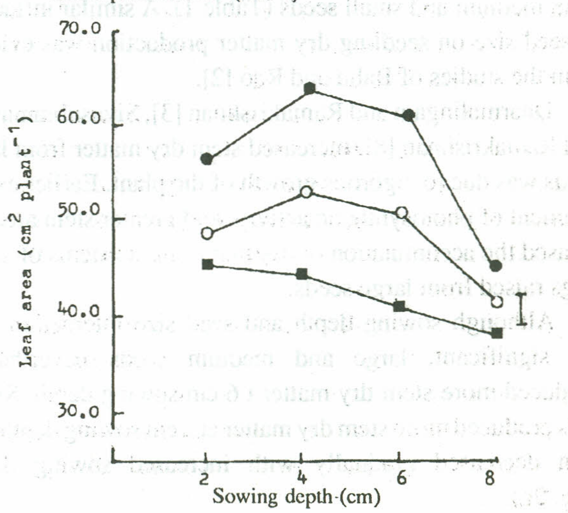

Fig. 1b. Leaf area in relation to sowing depths and seed sizes.
• Large ▫ Medium ▪ Small
Bar represents SED (df = 6)

ents. The soil surface was frequently dry due to evaporation, hence making nutrients unavailable to plants. Delayed emergence and use of more food reserves during emergence of seeds sown at a greater depth caused a delay in the establishment of the autotrophic stage, which in turn reduced plant height and leaf expansion.

The effect of seed size on leaf area was significant. Leaf area decreased linearly with the decrease in seed size. Large seeds produced significantly more area than small (Table 1). This is in agreement with the results of Ponnuswamy [6]. He reported largest leaflet sufaces from the largest seed.

Sowing depth and seed size interaction was found to be significant. Large seeds produced significantly greater leaf area at all sowing depths than small seeds. Small and medium seeds produced similar leaf area at 2 and 8cm sowing depths. Large seeds had a remarkable effect at 8cm sowing depth and produced similar leaf area to medium seeds. Large seeds produced the largest leaf area at 4cm sowing depth. Seeds sown above and below than this depth had reduced leaf area (Fig. 1b).

Stem dry weight. The response of cultivars in relation to dry matter production was significant. The greatest stem dry weight was accumulated by the cultivar Kadiri-3 and this was similar to Kadiri 71-1 but significantly more than that produced by Gangapuri and TMV-2. Significant differences were found in stem dry matter was produced at 6cm depth and depths below and above this reduced the dry weight (Table 1). Nambiar and Rao [5] reported reduced haulm dry matter in groundnut due to deeper sowing in rainy and post-rainy seasons.

Stem dry matter was reduced significantly with the decrease in seed size ($P<0.01$). The dry matter of plants raised from large seeds was significantly more than for plants raised from medium and small seeds (Table 1). A similar influence of seed size on seedling dry matter production was evident from the studies of Babu and Rao [2].

Dharmalingam and Ramakrishnan [3], Sivasubramanian and Ramakrishnan [8]. Increased stem dry matter from large seeds was due to vigorous growth of the plant. Earlier establishment of photosynthetic activity and greater stem area increased the accumulation of dry matter in the stems of seedlings raised from large seeds.

Although sowing depth and seed size interaction was not significant, large and medium seeds nevertheless produced more stem dry matter t 6 cm sowing depth. Small seds produced more stem dry matter at 2 cm sowing depth and then decreased gradually with increased sowing depth (Fig. 2a).

Leaf dry weight. The influence of cultivars on leaf dry matter accumulation was found to be insignificant. However, Kadiri-3 produced the largest amount of leaf dry matter and TMV-2 the smallest (Table 1). The effect of sowing depth on leaf dry matter production was highly significant ($P<0.01$). Leaf dry weight increased as the sowing depth increased from 2 cm to 4 cm but further increase in sowing depth reduced dry weight significantly.

Seed sie had a profound effect on the leaf dry weight. Leaf seeds produced greater leaf dry matter than medium and small seeds. Sowing depth and seed size interaction was significant. Large seeds produced significantly more leaf dry matter at 2,4 and 6 cm sowing depth compared with medium and small seeds Fig. 2b). All seed sizes produced more leaf dry matter at 4 cm sowing depth.

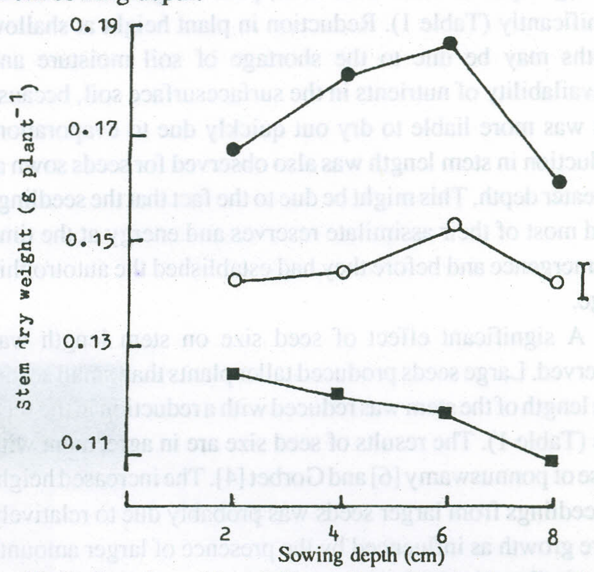

Fig. 2a. Stem dry weight as influenced by sowing depths and seed sizes.
• Large ○ Medium ▪ Small
Bar represents SED (df = 6)

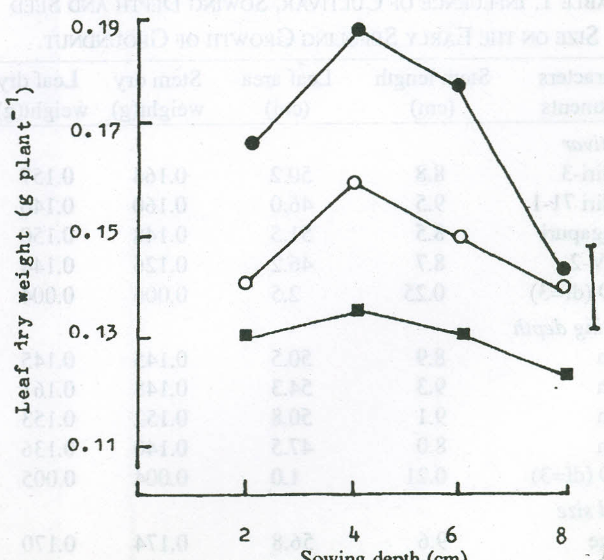

Fig. 2b. Leaf dry weight as influenced by sowing depths and seed sizes.
• Large ○ Medium ▪ Small
Bar represents SED (df = 6)

From the results of the study, the following conclusions can be drawn (i) sowing seeds at a depth of 4-6 cm would give the most vigorous young plants; (ii) within any one cultivar at any particular sowing depth, large seeds had a clear advantage over small seeds during the early growth of the crop.

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