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SEEDLING EMERGENCE OF GROUNDNUT AS INFLUENCED BY CULTIVAR, SOWING DEPTH AND SEED SIZE IN A DRYING SOIL

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A growth chamber experiment was carried out to determine the influence of cultivar, sowing depth and seed size on the emergence of groundnut in a drying soil. Seeds of four cultivars (Kadiri-3, Kadiri 71-1, Gangapuri and TMV-2) classified into three size grades were sown at four depths (2,4,6 and 8 cm) in soil at field capacity and no water was added subsequently. Result indicated that there were considerable differences among cultivars for rate and fractional emergence. Gangapuri showed the greatest fractional emergence, while, TMV-2 had the fastest rate of emergence than all other cultivars. Sowing depth had a significant influence on the rate and fractional emergence and as expected, seedling emergence decreased with increased depth of sowing. In general, the rate and fractional emergence of small seeds were better than those of large seeds at all sowing depths.

Key words: Groundnut cultivar, Fractional emergence, Rate of emergence.

Introduction

Groundnut is cultivated predominantly in the developing countries of the Semi-Arid Tropics (SAT). But the yields are low in comparison to the average yields of the developed countries. A major factor limiting the productivity of many crops including groundnut in the SAT is poor establishment of seedlings. Thus, it is essential to obtain the desired number of plants per unit area to achieve optimum yield. In practice, it is difficult to obtain a good stand in the field. Failure of seeds to germinate, emerge and establish leads to a poor crop stand. Among a number of factors that affect the emergence of seedlings, seed size, sowing depth of seeds and moisture content of soil are important. Several investigators have studied the influence of seed size on the germination and emergence of crops. Response of groundnut to seed size has been found to be variable. Results showed higher germination and emergence from large seeds rather than small seeds [2,7,10]. Ponnuswamy and Ramakrishnan [6] reported that the fractional emergence of smaller seeds was greater than that of larger seeds. The rate of field emergence decreased with the increase of seed size.

Farmers in the SAT frequently sow seeds deeply to overcome the adverse effects of dry surface soil on germination and emergence and to make better use of the moisture at greater depths. Results for various crops including groundnut have shown a reduction in fractional emergence of seedlings and rate of emergence with increasing sowing depth [5,8,9]. The optimum depth of sowing of different crops depends on many factors, such as; seed size, soil moisture content, soil structure, soil temperature, season of growing etc. Under insufficient and uncertain rainfall environment, selection of correct seed size and sowing depth is critical for growers. Varietal response to seed size and sowing depth on the germination and emergence in drying soil conditions are important criteria for selecting the right cultivars for large scale production. Therefore, the present study was undertaken to determine the influence of cultivar, sowing depth and seed size on the emergence of groundnut in a drying soil.

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Materials and Methods

The experiment was conducted in growth chamber at the Department of Agriculture and Horticulture, University of Nottingham, UK in 1988. The cultivars (cv.) used in the experiment were Kadiri-3 (V_1), Kadiri 71-1(V_2), Gangapuri (V_3) and TMV-2 (V_4). The seeds were graded by hand sieving with round hole screens into large (L), medium (M) and small

Table 1. Details of Seed Size Used.

Cultivar	Seed size	Range of seed diameters (mm)	Mean seed weight (g)
Kadiri-3	Large	10.31 - 9.52	0.616 + 0.095
	Medium	9.52 - 7.93	0.448 + 0.038
	Small	<7.93	0.344 + 0.042
Kadiri 71-1	Large	9.52 - 8.72	0.601 + 0.066
	Medium	8.72 - 7.93	0.393 + 0.046
	Small	<7.93	0.292 + 0.027
Gangapuri	Large	9.52 - 7.93	0.446 + 0.044
	Medium	7.93 - 6.35	0.350 + 0.033
	Small	<6.35	0.239 + 0.030
TMV-2	Large	9.52 - 7.93	0.398 + 0.036
	Medium	7.93 - 6.35	0.296 + 0.028
	Small	<6.35	0.237 + 0.024

(S) sizes. Details of the seed sizes used are presented in Table1. The seeds were sown at four depths, viz. 2,4,6 and 8 cm. The experiment was laid out in a split-split plot design with two replications. Each plastic pot was filled with 4.7 kg soil, maintaining a bulk density of 1.5 g cm^{-3}. The soil in each pot was initially irrigated with 1200 ml of water and left for three days in the glass house to drain any excess water through the holes at the bottom of each pot. Glass rods were marked and used for making holes of desired depths. One seed was sown in each hole. The seeds were then covered with dry soil and 100 ml of water was applied to the surface to ensure seed contact with the soil. Light was provided by HLRG mercury vapour lamps supplying a radiation of about 70 Watts m^{-2}. The day length was adjusted to a photoperiod of 12hrs from 0800 to 2000 hrs at a constant temperature of 28°. In this experiment, there was no further application of water from sowing.

A seedling was considered to have emerged when the cotyledon was visible at the soil surface [4]. The rate of emergence was calculated as the reciprocal of time (d) to 50% emergence (E=0.5). In this study, the E=0.5 criterion for emergence was calculated on the basis of the number of seedlings that had emerged.

Data on fractional emergence and rate of emergence were analyzed with a computer using the "Genstat" programme. Tests of significance were made at the 0.01 and 0.05 levels of probability.

Results and Discussion

Fractional emergence. Cultivars showed no significant difference in fractional emergence but all cultivars showed a reduction in emergence. Results of fractional emergence showed that there were differences in cultivars in the same growing conditions irrespective of sowing depth and seed size (Fig. 1a). Cultivar TMV-2 had the greatest fractional emergence. Cultivar Kadiri-3 and Kadiri 71-1 had similar emergence but lower than cv. Gangapuri. The differences in fractional emergence may be associated with the genetic potential of cultivars and differential mechanical resistance offered by the soil to the emerging seedlings of different cotyledonary areas. As there was no subsequent irrigation after sowing, the surface soil became dry quickly due to evaporation and formed soil crust which may have reduced the emergence considerably. The result is in agreement with that reported by Tiwari *et al.* [11].

In spite of the insignificant differences between cultivars, depth of sowing had a considerable influence on fractional emergence for all cultivars (Fig. 1b). Emergence reduced with the increase of sowing depths. At 8 cm sowing depth, only about 40% emergence was recorded.

The effect of seed size was insignificant (Fig. 1c). However, small seeds appeared to have a better emergence than large seeds. This might be due to their smaller cotyledonary area which consequently had less soil resistance during emergence. Ponnuswamy and Ramakrishnan [6] and Hopper *et al.* [3] reported better emergence from small seeds of groundnut and soybean respectively.

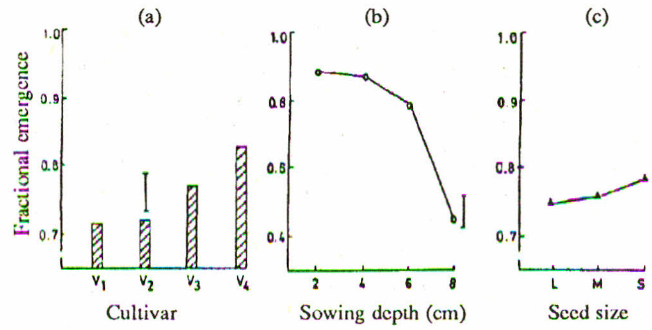

Fig. 1. Fractional emergence as influenced by (a) cultivars (b) sowing depths and (c) seed sizes in a drying soil. Bars represent SED.

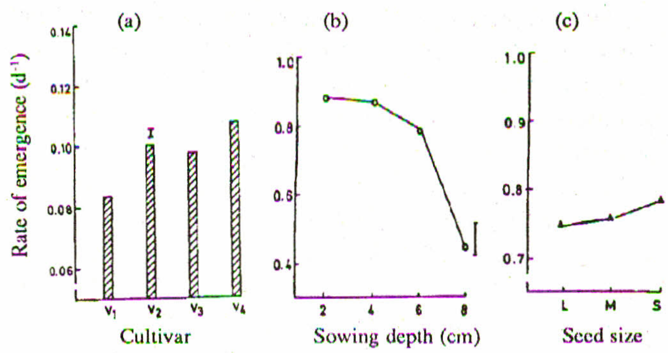

Fig. 2. Rate of emergence as influenced by (a) cultivars (b) seed sizes in a drying soil. Bars represent SED.

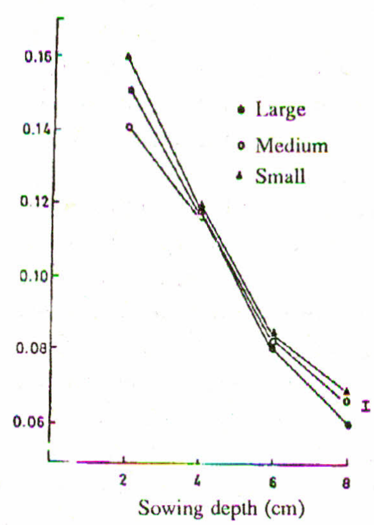

Fig. 3. Rate of emergence as influenced by sowing depths and seed sizes in a drying soil. Bar represent SED.

Rate of emergence. Significant cultivar differences were observed in the rates of emergence (Fig. 2a). Cultivar TMV-2 emerged significantly faster than all other cultivars. Cultivar Kadiri-3 emerged most slowly. The faster emergence of TMV-2 might be either due to its genetic potential or small seed size in comparison to other cultivars. Babu *et al.* [1] reported retarded growth of radicle and hypocotyls in all cultivars of groundnut studied under moisture stress which in turn reduced the emergence rate. The effect of seed size on rate of emergence was significant ($P<0.05$). Small seeds emerged faster than medium and large seeds. The emergence rate increased linearly with the decrease in seed size (Fig. 2b). The reasons for faster emergence of small seeds might be due to rapid activation of physiological processes and reduced mechanical resistance encountered during emergence of seeds.

None of the interactions between cultivar, sowing depth and seed size was found to be significant except sowing depth and seed size. Emergence rate differed significantly at 2 cm sowing depth due to seed size but showed a similar effect at 4 cm and 6 cm depths (Fig. 3). At 8 cm sowing depth, medium and small seeds showed a similar but significantly faster emergence rate than large seeds.

From the results of the study, it can be concluded that earlier emergence can be achieved by sowing the cultivar TMV-2 and by sowing small seeds at shallow depths (4-6 cm) in conditions where there are limited soil moisture and possible formation of soil crusts due to rapid evaporation.

References

1. V.R. Babu, P.S.S. Murthy and D.N. Reddy, Seed Res., **13** (1), 141(1985).
2. C.Dharmalingam and V. Ramakrishnan, Seed Res., **9** (1), 57 (1981).
3. N.W. Hooper, J.R. Overholt and J.R. Martins, Ann. Bot., **44**, 301 (1979).
4. H.A. Mohamed, Ph.D. Thesis, Deptt. of Agriculture and Horticulture, University of Nottingham, UK (1984).
5. P.T.C. Nambier and B.V. Rao, Exptl. Agric., **23** (3), 283 (1987).
6. A.S. Ponnuswamy and V. Ramakrishnan, Madras Agric. J., **72** (1), 53(1985).
7. A. S. Ponnuswamy, Madras Agric. J., **72** (6), 352 (1985).
8. A. B. G. Rao and R.K. Gupta, Seed Res., **4** (1), 124(1976).
9. S.K. Saini and J.N. Singh, Seed Res., **8** (2), 127 (1980).
10. S. Sivasubramanian and V. Ramakrishnan, Seed Sci. Tech., **2**, 453 (1974).
11. J. P. Tiwari, S.K. Shrivastava and U. R. Pandey, Seed Res., **4** (2), 174(1976).