Indian J. Agron. **40** (3) : 450–453 (September 1995)

Effect of sand application on rainfed groundnut (*Arachis hypogaea*) in arid tropics

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Received: May 1994

ABSTRACT

The field experiment as well as verification trial were conducted to study the direct and cumulative effect of sand application to Alfisols on soil physical properties and productivity of groundnut (*Arachis hypogaea* L.) in arid tropics. The treatments for the field experiement were 5 levels of sand, viz. 0, 10, 20, 30 and 40 tonnes/ha, and for verification trial 3 doses of sand (0, 20 and 40 tonnes/ha) and continuous application for 2, 3 and 4 years of above doses. Sand was applied at the time of preparatory cultivation. The soil infiltration rate increased by 77.8% with sand @ 30 tonnes/ha over the control (25.1 mm/hr). Crust strength of top 2–5 cm layer decreased by 17.7–39.65% during first year of sand application (40 tonnes/ha) over no sand application. Higher percentage of mature pods to total pods was observed with sand application due to less soil mechanical resistance in the pod zone (top 2–5 cm of soil). Pod yield increased with increase in sand application over the control, which ranged from 13.2 to 57.1% over years. The cumulative effect of sand application was also observed up to 4 years. Harvest index was improved by 5.7% with sand application compared with no sand application.

Sand application to red chalka soils to an extent of 30% by weight of soil had improves the germination of pearlmillet [*Pennisetum glaucum* (L.) R. Br. emend. Stuntz.] due to reduction in crust strength (Subbarami Reddy *et al.*, 1985). Chittapur and Angadi (1989) reported that application of sand @ 2 tonnes/ha to a black soil did not increase the pod yield of groundnut (*Arachis hypogaea* L.) when applied as amendment. Farmers of Anantapur district apply sand to Alfisols @ 20 to 40 tonnes/ha with a belief that it increases pod yield of groundnut. The advantages if any of sand application in a sandy-loam soil need to be examined. A field experiment and a verification trial were conducted to study the influence of sand on soil physical characteristics and yield of groundnut under rainfed conditions.

MATERIALS AND METHODS

The field experiment was conducted at the Agricultural Research Station, Anantapur, during rainy season of 1987 and 1988. Based on the results of the field experiment, a verification trial was conducted during the rainy season of 1989, 1990, 1991 and 1992 to study the direct and cumulative effects of sand application on soil physical properties and yield of groundnut. The experiment was laid out with 5 treatments, viz. 0, 10, 20, 30 and 40 tonnes/ha, of sand and with 4 replications in randomized block design. The plot size was 6 m x 10 m. Verification trial was conducted on large-sized plots of 30 m x 6 m without

replication. The treatments included 3 doses of sand (0, 20, and 40 tonnes/ha) and continuous application for 2, 3 and 4 years of above doses. The soil of the experimental site was sandy loam with a water-holding capacity of 40 mm. The subsoil had a compacted *murrum* with clay illuviation. The field capacity and permanent wilting point of soil were 13 and 4.5% respectively. The soil was low in organic carbon (0.2%), high in available P (20.7 kg/ha) and medium in available K (197.5 kg/ha). The climate of the region is arid tropics with an annual rainfall of 521 mm.

Sand was applied before field preparation as per treatments and ploughed. The sand used was found to contain 93.6% sand and 6.2% silt. Groundnut was sown in July or August when a rainfall of more than 20 mm was received during the season. The test variety was 'TMV 2' in all the seasons and was sown with a spacing of 30 cm x 10 cm using a bullock-drawn seed-cum-fertilizer drill. The fertilizer dose was 20, 17 and 33 kg/ha of N, P and K was applied at the time of sowing. All the recommended management practices were followed for raising the crop.

Infiltration rates under different treatments were measured with double-ring infiltrometer (Black *et al.*, 1965) immediately after harvest of each crop. Crust strength was measured at the time of pegging with pocket penetrometer at 10 sites in each plot and the mean values were expressed as kg/cm^2. The soil moisture was estimated up to 30 cm depth by gravimetric method and expressed as mm/30 depth of soil.

RESULTS AND DISCUSSION

Infiltration rate

Soil infiltration rate was found 26.1 mm/hr with no sand application, while it was 46.4 mm/hr with 30 tonnes/ha of sand application (Table 1). The increase in infiltration rate with increasing dose of sand

Table 1. Influence of sand on infiltration and pod yield of groundnut

Sand (tonnes/ha)	Infiltration rate (mm/hr)	Pod yield (kg/ha)	
		1987	1988
0	26.1	1,661	2,337
10	29.6	1,744	2,297
20	31.3	1,775	2,546
30	46.4	1,759	2,957
40	38.7	1,848	2,756
CD (P = 0.05)		NS	432

NS, Non-significant

Table 2. Direct and cumulative effects of sand application on crust strength (kg/cm^2)

Particular	Dose of sand (tonnes/ha)		
	0	20	40
Direct effect			
1990	0.63	0.46	0.38
1991	0.79	0.70	0.65
Mean	0.71	0.58	0.51
Cumulative effect after 2 years			
1990	0.63	0.42	0.37
1991	0.78	0.55	0.61
1992	1.30	1.20	1.05
Mean	0.90	0.76	0.68
Cumulative effect after 3 years			
1991	0.78	0.62	0.58
1992	1.70	1.40	1.20
Mean	1.24	1.01	0.89
Cumulative effect after 4 years			
1992	1.70	1.00	0.75

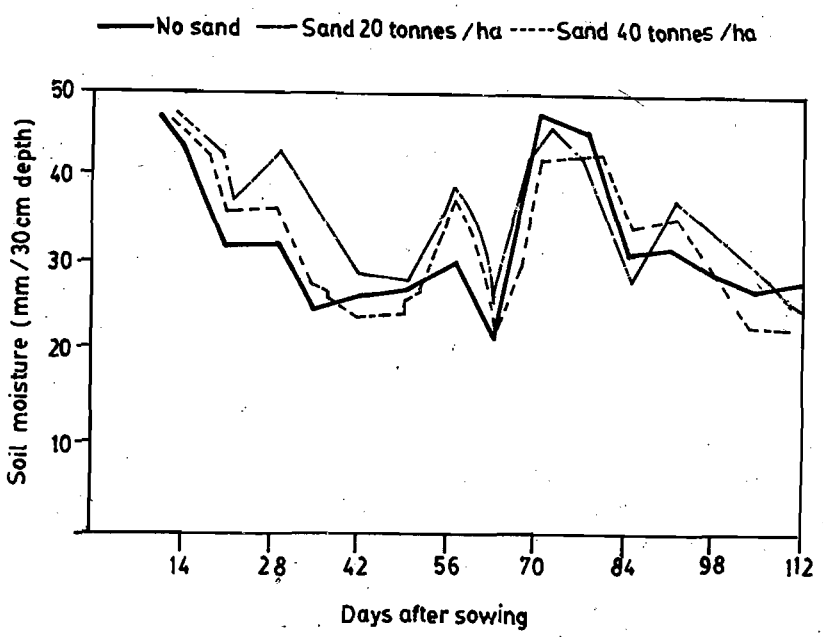

Fig 1. Effect of sand application on soil moisture

Table 3. Cumulative effect of sand on per cent mature pods and harvest index

Treatment	Mature pods (%)	Harvest index (%)
Sand @ 20 tonnes/ha		
2 years	73.5	59.8
3 years	77.3	60.1
4 years	74.4	52.0
Sand @ 40 tonnes/ha		
2 years	74.0	51.4
3 years	82.1	57.3
4 years	74.2	53.3
Control	67.0	45.7

might be due to increased macropores present in the soil.

Crust strength

Rainfall causes the finer particles to form into suspension which either causes clogging of macropores on surface or enter into the soil. Sometimes these finer particles resettle on surface and cause surface crust (Ghildyal and Gupta, 1991). The crust thus formed on surface of loamy sand soil offers greater resistance to the peg penetration. Crust strength in the top 2–5 cm layer decreased with increased level of sand (Table 2). The decrease in crust strength over the control with sand at 20 tonnes/ha was 26.8% and with 40 tonnes/ha was 39.7% in 1990. Similar trend was observed in different years. Sand @ 40 tonnes/ha continuously for 4 years had a crust strength of 0.75 kg/cm^2 which was 55.9% less than no sand application (1.70 kg/cm^2). The decrease in surface-crust strength was due to higher sand fractions present in the top layers. Subbarami Reddy *et al.* (1985) reported improved emergence in pearlmillet with sand application by decreasing crust strength.

Soil moisture

The trend of the soil moisture graph indicated that soil moisture in 0–30 cm

layer was lower up to 60 days after sowing in no sand application (Fig.1) than that with 20 tonnes/ha of sand. The subsequent decrease in soil moisture during grand growth period of crop with sand application could be attributed to increased crop growth compared to no sand application.

Crop yield

Application of sand increased the percentage of mature pods to total pods over the control (Table 3). The percentage of mature pods to total pods was 67.0 with no sand application, while it was 74.0–82.1% with different doses of sand and its cummulative effect. The higher percentage of mature pods was due to decrease in crust strength and less soil resistance for the young growing pods. Harvest index was lower with the control (45.7%) compared to that observed with sand application, where it was 51.4–60.1%. The pod yield was significantly higher with 30 tonnes/ha than the control in 1988 (Table 1). The higher pod yield with sand application was due to better infiltration, less crust strength and favourable soil moisture during dry spells.

Table 4. Direct and cumulative effects of sand application on pod yield (kg/ha) of groundnut

Effect	Dose of sand (tonnes/ha)		
	0	20	40
Direct effect			
1989	992	1,139	1,380
1990	993	1,264	1,125
1991	126	158	198
Cumulative effect after 2 years			
1990	993	1,326	1,576
1991	126	242	311
1992	1,093	1,146	1,226
Cumulative effect after 3 years			
1991	126	231	336
1992	1,093	1,300	1,310
Cumulative effect after 4 years			
1992	1,093	1,346	1,400

In the verification trial pod yield of groundnut increased with sand application at 20 tonnes/ha from 14.8 to 27.3% over no sand application in different years (Table 4). Similarly, pod yield increased with sand application at 40 tonnes/ha which ranged from 13.2 to 57.1% in different years. It indicates the advantage of sand application. The cumulative effect of sand at both the doses was observed in verification trial. The increase in yield with 20 tonnes/ha of sand for 2 consequetive years varied very widely from 4.8% during favourable years to 92% during unfavourable years. The cumulative effective of sand application was observed up to 4 years with sand @ 20 tonnes/ha. Similar trend was observed with sand application @ 40 tonnes/ha.

It can be concluded that sand application even on sandy-loam soil is beneficial to groundnut when applied @ 20 to 40 tonnes/ha.

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