Annals of Arid Zone 31(4) 273–276 1992

Yield, Reproductive Efficiency and Quality of Groundnut as Influenced by Water Stress at Different Growth Stages

B B Garara and B S Yadav*
Department of Agricultural Chemistry and Soil Science, GAU, Junagadh – 362 001 India

Abstract Groundnut was subjected to water stress during flowering, pegging, pod formation and pod development stages corresponding to 23-47, 33-55, 57-79 and 73-95 DAS at individual, any two and three growth stages alongwith control of no water stress. Water stress to the crop significantly reduced dry matter yield, number of flowers, total and effective pegs, pod : peg ratio, pod : haulm yield ratio, pod yield and shelling percentage. These parameters decreased with increase in the cycle/period of water stress. The magnitude of reduction in pod yield due to single, double and triple cycle of water stress over that of unstressed plants was 48.2, 58.1 and 69.7%, respectively. Pod development stage along or in combination with any other stage (s) with water stress was found most sensitive for pod yield, reproductive efficiency and shelling percentage whereas pegging stage alone or in combination with any other stage (s) was sensitive to haulm yield.

Key words Cyclic water stress, Growth stages, Groundnut reproductive efficiency, Quality

Growing groundnut (*Arachis hypogaea* L.) as rainfed is one of the main reasons of low yield. Dry spells of different duration and at plant growth stages further enhance the unstability in the yield and oil content. Hence, information on crop response to water stress at different growth stages is needed to optimise the returns from limited water available for irrigation.

Materials and Methods

A field experiment was conducted in summer 1989 on a medium black soil (Vertic Inceptisol) with 15 levels of cyclic water stress treatments (Table 1). The experimental soil (0-30 cm) was clayey (66.9% clay with field capacity 41.8%, permanent wilting point 19.3%, bulk density 1.5 Mg m^{-3}, pH (1:2.5) 8.2, EC (1:2.5) 0.36 dSm^{-1}, $CaCO_3$ 2.6%, CEC 34.5 c mol (p+) kg^{-1}, OC 0.79%, Olsen's P_2O_5 31 kg ha^{-1} and NH_4OAc extractable K_2O 340 kg ha^{-1}. The entire dose of 25 kg N ha^{-1} as urea and 50 kg P_2O_5 ha^{-1} as single superphosphate as drilled in rows 30 cm apart. The crop was subjected to water stress during flowering, pegging, pod formation and pod development stages corresponding to 23-47, 33- 55, 57-79 and 73-95 days after sowing (DAS) by withhelding irrigation (Table 1). Oil content in kernels was determined by NMR.

Plant samples were taken in each plot from an area of one square meter at 30, 46, 62 and 78 DAS. These samples were dried under sun and dry matter yield was recorded. Treatmentwise observations on flower count at 35 and 45 DAS, number of effective and total pegs, mature and immature pods and pops were recorded at harvesting from five randomly selected and tagged plants. Pod and haulm yields were recorded. Reproductive efficiency of groundnut was worked out in terms of pod : peg ratio and pod : haulm yield ratio. The percentage proportion of kernels to pods was determined for shelling percentage.

Results and Discussion

Grwoth attributes and yield : Dry matter yield at 46, 62 and 78 DAS, flower count, total and effective pegs and mature pods were significantly reduced due to water stress over their respective values at no water stress (Table 1, Fig. 1). At 30 DAS no waterstress was imposed, therefore, dry matter yield was not influenced. At 46, 62 and 78 DAS, some of the treatments received no and others partial or full water stress. Among single and

*Agricultural Research Station, Sriganganagar – 335 001

Table 1 *Yield and quality of groundnut as influenced by water stress*

Treatment	DAS*	Dry matter yield (kg ha^{-1})				Yield (kg ha^{-1})		Shelling %	Oil content %
		30	46	62	78	Pod	Haulm		
No water stress	–	459	1193	2570	3903	2251	4902	71.4	48.9
Single cycle water stress									
At flowering	23–47	453	672	1540	2420	1427	3011	67.7	48.9
At pegging	33–55	460	887	1245	1990	1179	2570	65.7	48.8
At pod formation	57–79	450	1201	2501	2540	1068	3214	64.3	48.8
At pod development	73–95	462	1191	2575	3893	996	3437	61.5	49.1
Double cycle water stress									
At flowering and pegging	23–55	459	681	1096	1876	1004	2520	64.5	49.2
At flowering and pod formation	23–47 57–79	457	678	1614	2243	1020	2969	63.5	49.4
At flowering and pod development	23–47 73–95	452	675	1549	2412	926	3048	61.3	48.8
At pegging and pod formation	33–79	460	894	1242	1954	903	2539	61.1	49.0
At pod formation and pod development	33–55 73–95	449	898	1237	1991	913	2549	61.2	48.9
At pod formation and pod development	57–95	461	1198	2520	2553	886	3134	60.5	49.0
Triple cycle water stress									
At flowering, pegging and pod formation	23–79	453	668	1096	1750	575	2227	59.1	48.6
At flowering, pegging and pod development	23–55 73–95	456	672	1105	1870	785	2934	60.1	49.0
At flowering, pod formation and pod development	23–47 57–95	458	678	1530	2243	808	2492	60.2	49.0
At pegging, pod formation and pod development	33–95	464	895	1234	1946	559	2231	59.0	48.9
CD 5%	–	NS	127	224	287	149	396	1.0	NS

* Period in days after sowing during which irrigation was not applied

double cycle water stress treatments, pod development stage alone or in combination with any other stage (s) with water stress caused the maximum reduction in mature pods and increse in immature pods and pops (Fig.1). Water stress at pegging alone or in combination with other stage (s) produced the maximum adverse effect on dry matter yield at 62 and 78 DAS and number of total and effective pegs. The effect of triple cycle water stress treatments was evident only at maturity. Water stress during any three stages caused higher reduction in dry matter yield and yield components than that imposed during any one or two stages.

The magnitude of reduction in pod yield (Table 1) due to single, double and triple cycles of water stress over that of unstressed plants was 48.2, 58.1 and 69.7%,respectively. The corresponding values for haulm yield were 37.8, 43.0 and 49.5%. The adverse effect of increase in the period of water strss on yield is ascribed to less availability of water (Slatyer 1967) to plants and reduced vegetative and reproductive growth. Pod development stage found to be most sensitive to water stress in reducting pod

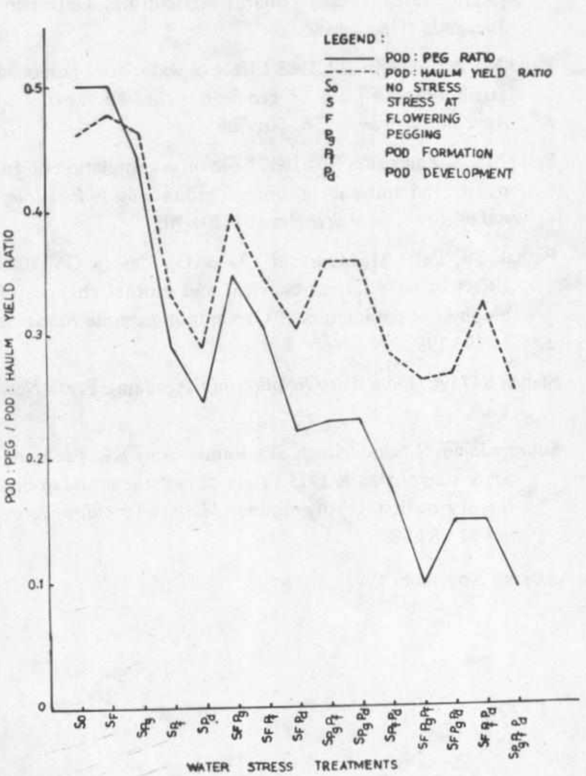

Fig 1 Yield attributing characters of groundnut as influenced by water stress

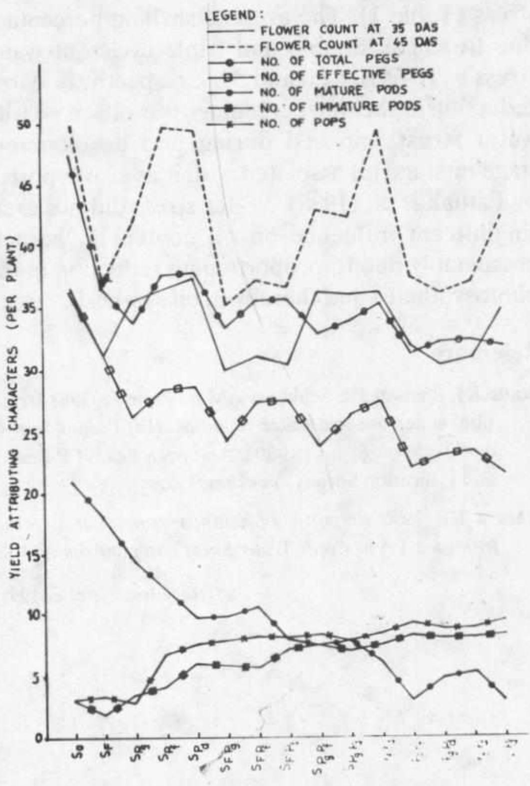

Fig 2 Reproductive efficiency of groundnut as influenced by water stress

yield (55.7%), followed by pod formation (52.5%), pegging (47.6%) and flowering (36.6%) stages. However, haulm yield was reduced to the maximum extent (47.6%) when stress was imposed during pegging followed by that during flowering (38.6%), pod formation (34.4%) and pod development (29.9%) stages. The pod development stage along or in combination with any other stage (s) with water stress was most sensitive for pod yield whereas at pegging stage along or in combination with any other stage(s) was sensitive to haulm yield. The adverse effect of water stress during pegging and stages associated with it on crop growth and yield could be due to drastic reduction in growth rate (Patel & Zalawadia 1982) and production of pegs (Patel & Golakiya 1988) whereas during pod development stage and its associated stage (s) due to increased growth, high temperature and period of fruit set (Boote *et al.* 1982).

Reproductive efficiency : Different water stress treatments significantly influenced both pod peg ratio and pod : haulm yield ratio which decreased with increase in the cycle/period of water stress (Fig. 2). The highest values of these ratios were recorded with water stress during flowering stage which were statistically at par with the respective ratios at no water stress. Water stress during pod development stage decreased the reproductive efficiency of groundnut to the maximum extent among single cycle of water stress treatments. The decrease in pod : peg ratio at this stage was due to reduction in number of matue pods (Garars 1990) and in pod : haulm yield ratio due to reduction in pod yield (Table 1). Subramaniam *et al.* (1975) reported pod formation and pod addition period as most sensitive to water deficit.

Quality : The significantly highest shelling percentage (71.4) was obtianed with no water stress and it deceased with increase in the duration of water stress (Table 1). The average shelling percentage due to single, double and triple cycles of water stress were 64.8, 62.0 and 59.6, respectively. More reduction in shelling percentage was observed with water stress imposed during pod development stage or stage (s) assoiated with it as also reported by Pathak *et al*. (1988). Water stress did not exert singinficant influence on oil content in kernels presumably due to proportionate reduction in the photosynthates and thereby in oil synthesis.

Reference

Boote KJ, Stansell JR, Schubert AM & Stone JR 1982 Irrigation, water use and water relations. (In) *Peanut Science and Technology,* pp 163-203. American Peanut Research and Education Society, Yeakum, Texas

Garara BB 1990 *Response of summer groundnut (Arachis hypogaea L.) to Cyclic Water Stress and potassium*. M.Sc. (Agriculture) Thesis, Gujarat Agricultural University, Junagadh (Unpublished)

Patel MS & Golakiya BA 1988 Effect of water stress on yield attributes and yield of groundnut. *Indian Journal of Agricultural Science* **58** 701-706

Patel MS & Zalawadia NM 1982 Note on accumulation of dry matter and nutrients in summer groundnut. *Indian Journal of Agricultural Sciences* **52** 704-705

Pathak SR, Patel MS, Qureshi AU & Ghodasara GV 1988 Effect of water stress on yield and diurnal changes of biophysical parameters of Groundnut. *Legume Research* **11** 193-195

Slatyer RO 1967 *Plant Water Relationship.* Academic Press, New York

Subramaniam S, Sundersingh SD, Ramaswamy KR, Packiaraj SP & Rajgopalan K 1975 Effect of moistue stress at different growth stages of groudnut. *Madras Agricultrue Journal* **62** 587-588

(Received October 1991 Accepted November 1992)