

632.116 : 634.58 : 631.559

EFFECT OF DRY AND WET SPELLS ON THE YIELD OF GROUNDNUT CROP ON VERTISOLS

Groundnuts (*Arachis Hypogaea* L.) are one of the most important legumes of the Semi Arid Tropics (SAT). Of the world's total production about two third is produced in SAT, but with lower and unassured yields averaging only 500 to 800 kg/ha. In India the crop is grown extensively under rainfed conditions during monsoon and partly under irrigated conditions in summer. In Maharashtra State though the cultivation of the crop is increasing every year, still sizable acreage (92%) of the crop depends on the rains only whereas irrigated groundnut (summer) constitutes only 8% of the total acreage.

Seshadri (1964) reported that the main reason for the lower yield of groundnut in India was due to limitation of moisture. In groundnut, flowering, pod-formation and harvest stages have been identified as critical stages (Sindagi 1958) during which light moisture level must be maintained. Any long dryspell duration or monsoon break during these stages is very effective in reducing the yields. Likewise heavy rains spoil and reduce the yields. Thus, excessive or deficient rains and the dry spell duration especially coinciding with critical stages play significant role in deciding yield of groundnut. Therefore, the present investigation was carried out with an intention to quantify and equate the relationship between yield and dry spell durations. It is the aim to assess the effect of deficient and excessive rains, uneven and problematic rainfall distribution and the erratic nature of monsoon during the life phase of groundnut on the yield performance of the crops.

Thirteen years rainfall and yield data of groundnut recorded at the Agrometeorologica Observatory, Agric. College, Nagpur (21°09' N, 79° 21' E, 321 m) was utilized in the investigation. The crop was grown in the farm situated in the vicinity of the observatory and the place has rolling relief. The normal annual rainfall is 1225 mm. The normal onset date of monsoon in the region is 12 June and withdrawal date is 1 October. The groundnut crop is normally sown in the last week of June or in the first week of July after receiving good rains. Thereafter the crop is not sown. The variety SB-XI with 100-105 days duration was grown on the vertisols. Normal agronomic practices, viz., gap filling, field operations like interculture operations, plant protection schedules etc were followed. Yield was measured in dry pods (kg/ha). Variations in the yield were compared with corresponding variations in the rainfall. The critical stages were identified at 50% level. The monthly rainfall and the yield are recorded in the Table 1. The coincidence of dry spell durations with the various critical stages is exhibited yearwise in Table 1. The rainfall distribution and the yield were plotted and are shown in the Fig. 1. The regression equation for the yield on dry spell duration was worked out.

Groundnut is a thermosensitive plant requiring 25° to 35° C optimum temperature but with somewhat day-neutral character (Ghadekar 1987). During kharif season these weather parameters do not form limiting factors in the region. The growth, development and yield is, therefore, totally, determined by the available soil

moisture in the Nagpur region. The groundnut, in general, always requires moderate soil moisture. Over moistening and drought during the fruiting are very undesirable (Ustimenko-Bokumovsky 1983). A well distributed rainfall of 500 to 700 mm is generally adequate for short season varieties (Kakade 1985). The crop needs dry conditions for harvesting and only moist soil during intensive flowering for the pegging and pod formation.

The total normal rainfall during June to October growing season is 861.5 mm which is virtually well above the minimum requirement of 500-700 mm. However, the monsoon is much erratic, characterised with heavy and prolong wet spells and long dry spells and, therefore, the distribution of the rains in the region totally governs the yield and not its total. The frequency of dry spells computed from 70 years data (1901 to 1970) less than 10 days is very high (66%) but these do not affect the crop. The frequency of the dry spells more than 10 days (11-20 days) is 31% and > 20 days only 3% and these spells affect the crop yield.

From the Table 1, it is seen that during the period of last 13 years, the highest rainfall (1278.5 mm) was received in 1981 with lowest yield (401 kg/ha), however, during 1982 lowest (635.5 mm) rainfall was received but it fetched highest yield (954.0 kg/ha). There appears to be little and insignificant relationship between yield and the total seasonal rainfall. It is also observed that early sowing (last week of June) or late sowing (first week of July) has also little and insignificant relationship with the yield. In 1981 though the sowing was early, lowest yield (401 kg/ha) was recorded while in 1980 the sowing was much delayed (8 July) but the deviation in yield was only - 3.04%.

In Fig. 1, the distribution of the weekly rainfall during the year 1976, 1981 and 1982 is shown. The total rainfall during the growing season, i.e., from the last week of June to mid-October (27 to 42 Met. week in all 16 weeks) was 871.6 mm in 1976, 1073.20 mm in 1981 and only 570.4 mm in 1982. From these figures, it is clearly seen that in the year of 1976, there was even distribution of rainfall up to first week of September (36 Met. week) but subsequently there was no rainfall at all as the monsoon withdrew by 10 Sep. In the year 1981 there were heavy rains in each week (with a mean total weekly value as 82.55 mm except 33rd and 34th Met. week) up to 39th week, i.e., September end and thereafter the rains ceased. In the year of 1982, the total rainfall was the lowest but almost in every week an average rainfall was 35.5 mm till 42 Met. week, i.e., mid-October. Thus, one finds that the monsoon in the year 1982 was very much regular and even, giving light rains (35.5 mm in each week) throughout the growing season. As a result of the well distributed light rains, the highest yield (954 kg/ha) was recorded in 1982. Perhaps, this distribution of rains seems to be favourable and ideal one, and can be fixed as criteria for the minimum favourable rains (i.e., total rainfall equal to 570.5 mm with at least 35.5 mm in each week till mid-October) for the groundnut in the region. The year 1981 with highest rainfall (1278.5 mm) presented the worst climatic conditions with the lowest yield and, therefore, a weekly rainfall distribution of 82.55 mm can be taken as unfavourable distribution. Thus, these observations made it clear that not the total rainfall but the even distribution of rainfall is necessary for the good crop.

TABLE 1

Sowing date, monthly rainfall, total rainfall for wet season, yield and interspell durations coinciding with various phenophases of the groundnut crop

Sowing date	Stress monthly rains (mm)					Total stress (days)	Total rains (mm)	Yield (kg/ha)
	Emergence (Jun 26 week)	Veg. growth (Jul 27-30 week)	Flowering (Aug 31-35 week)	Pod formation (Sep 36-39 week)	Harvest (Oct 40-43 week)			
26 June 1974	170.2	280.80	239.20	38.0	—32 days— 229.80	32	956.0	669.0
27 June 1975	208.4	320.40	184.06	216.80	79.60	Nil	1009.80	913.0
2 July 1976	73.4	330.80	252.40	264.00	0.00	35	920.6	448.0
25 June 1977	194.4	252.6	304.6	103.00	10.00	14	864.9	882.0
25 June 1978	182.05	269.0	335.6	87.9	0.00	43	873.5	451.0
26 June 1979	202.00	252.4	330.9	99.8	0.00	21	885.1	789.0
8 July 1980	218.4	177.2	339.2	133.5	0.00	26	868.3	643.0
30 June 1981	210.0	349.1	284.7	398.1	36.6	Nil	1278.5	401.0
27 June 1982	79.7	263.9	106.7	145.1	40.2	20	635.5	954.4
27 June 1983	152.6	345.1	221.5	284.8	52.6	Nil	1056.6	704.0
3 July 1984	114.8	599.2	276.0	24.4	70.8	27	1085.0	461.0
26 June 1985	228.3	425.4	164.0	45.8	209.50	20	1073.0	637.0
25 June 1986	215.6	178.2	300.2	97.7	13.4	27	805.3	608.0

The year of 1976 presented another distinct situation than that in 1981 or 1982. The rainfall was moderate (871.6 mm) during the growing season of groundnut but no rainfall after first week of September causing stress or drought conditions. Weekly rainfall was heavy (79.22 mm) up to 35 week but thereafter there was no rainfall till harvest. The stress caused has severely influenced the yield.

Throughout the entire growing period of groundnut light rainfall is required except at harvest. From the Table 1, it is observed that during 1975, 1981, 1983 there was no stress at all and the corresponding yields were 913.0 kg/ha, 401 kg/ha and 704 kg/ha. In the years 1981

and 1983, the yields were poor and moderate as the heavy and continuous rains prevailed during the critical stages, viz., flowering, pod-formation and harvest, spoiled the growth and hence the yield. The light and timely rains in 1975 during flowering, pegging and pod formation facilitated the crop growth recording maximum yields. In the year 1983, the rainfall was (1056.6 mm) less than the normal rainfall (1225.0 mm) without stress but the continuous rains during the harvest reduced the yield to 704.0 kg/ha. In Table 1, the moisture stresses more than 10 days encountered by crop during the important phytophases, viz., intensive flowering for pegging, pod formation and harvest etc, are clearly indicated. Longest stress of 35 days in 1974 fetched a poor yield of only

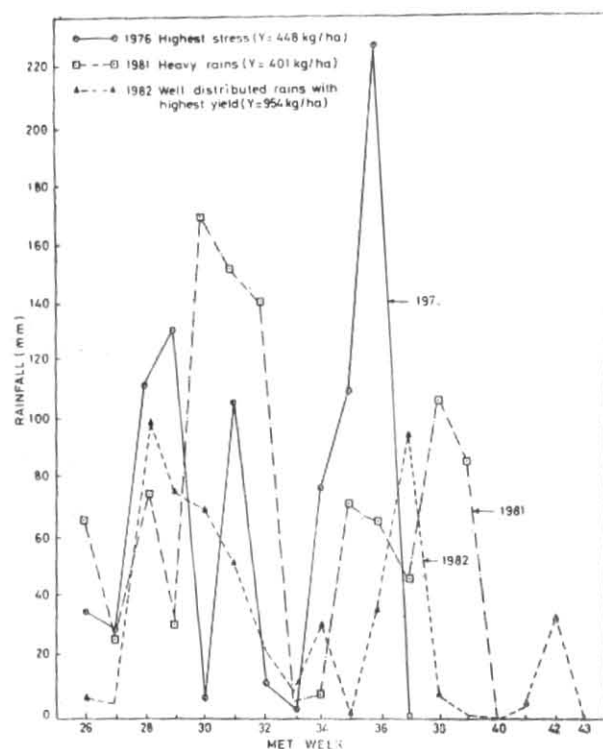


Fig. 1. Distribution of rainfall during growing season of groundnut

448.0 kg/ha while the shortest stress of 14 days in 1977, fetched a good yield of 882.0 kg/ha. Rains during 1983 harvest or heavy rains with continuous wet spells during harvest and previous (1981) phytophases badly reduced the yield. From 13 years data one finds that longer the stress period during flowering for pegging and pod formation, lower is the yield. Stress less years definitely yield more.

The statistical analysis of the data clearly showed that there is "high degree negative correlation" between the yield of groundnut and the stress period or dry spell duration. The relationship between the yield as dependent variable (Y) and the dryspell duration as independent variable (X) is worked out and is well represented through the regression equation:

$$Y = 913.47 - 10.54 X \quad (1)$$

The linear relationship between the yield and the stress period is shown in Fig. 2.

Yield and rainfall data of 13 years has clearly shown that dry spell durations more than 10 days are more influential in deciding the yield of groundnut. Long dry spell durations especially coinciding with the critical stages caused stress reducing the yields. Similarly the rainspells during harvest were also found unfavourable. These studies indicated that the rainfall even less as much as only 570.5 mm is sufficient for the crop in the

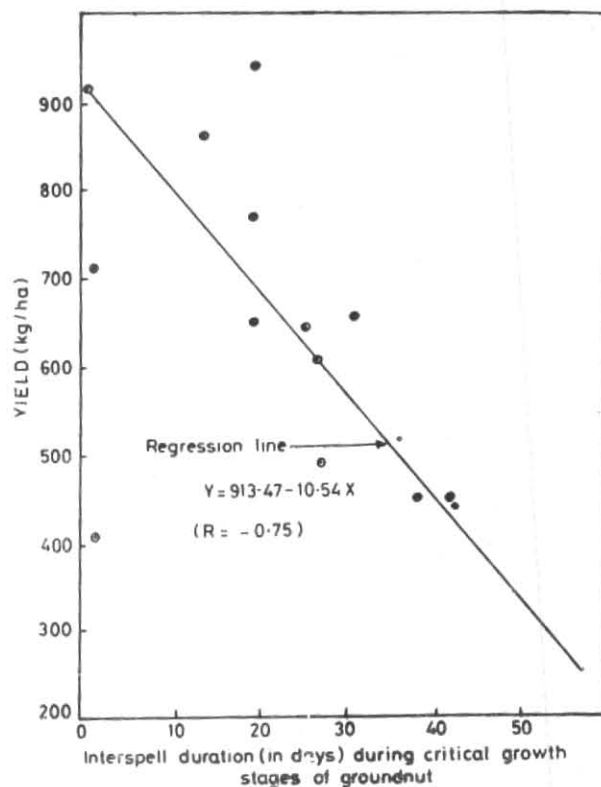


Fig. 2. Effect of interspell durations on yield of groundnut

region provided it is evenly distributed (35.5 mm per week) during the growing season. The heavy rainfall with more than 85.0 mm per week, uneven distribution, continuous rains during harvest or total life phase of the crop found to set unfavourable conditions for groundnut strongly reducing the yields.

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