



Flowering, pod-formation and grain-yield of groundnut (*Arachis hypogaea* L.) in response to nitrogen fertilization in Jos-Plateau, North-Central Nigeria

L L Garba, O A T Namo

Department of Biology, Kaduna State College of Education Gidan-Waya, P.M.B, Kafanchan, Kaduna State, Nigeria

Abstract

A two-year experiment was carried out at the Potato Research farm in Kuru, near Jos, to study the response of flowering, pod-formation and total grain yield of groundnut (*Arachis hypogaea* L.) to nitrogen fertilisation in the Jos-Plateau environment (09°44'N, 08°47'E; 1,293.2m above mean sea-level). The treatment combinations, comprising three N-rates (0, 50 and 100 kg ha⁻¹), two dates of N-application (10 and 31 days after sowing) and two local varieties of groundnut (Yar-Bajju and Yar-Kubacha), were arranged in the plots using the randomised complete block design with three replications. The results showed that mean number of days to flower-onset and 50% flowering as well as mean number of pods and pops per plant, pod length, pod yield per plant, total pod yield and total grain yields did not differ significantly with the rate and time of N-application in both years. The variety Yar-Bajju flowered earlier than Yar-Kubacha in both 2002 and 2003. Mean number of pods and pops as well as pod yield per plant and total pod yield were higher in variety Yar-Kubacha than Yar-Bajju in both years. Variety Yar-Bajju exceeded variety Yar-Kubacha in pod length. Total grain yield was higher in variety Yar-Kubacha than in Yar-Bajju in 2003. The interaction effects of N-rate and variety on mean number of pods per plant and pod yield per plant were significant in 2003. The study revealed that groundnut could be cultivated in the Jos-Plateau environment without the application of nitrogen fertilizer.

Keywords: Flowering, pod, yield, groundnut

Introduction

Groundnut (*Arachis hypogaea* L.) was an important cash crop and a major foreign exchange- earner in Nigeria before the oil- boom. Then, there was a shift in the agricultural policy in favour of oil exploration. With the dwindling fortunes of the oil revenue, efforts are being made to revamp the agricultural sector, including the commercial production of groundnut in the different agro-ecologies.

Like any other legume, groundnut is able to absorb the atmospheric nitrogen through the *Rhizobium* sp in its root nodules. The amount fixed is, however, dependent on the number of nodules per hectare, the size, longevity and the bacterial strain in them (Russell, 1973) [6].

It has been observed (Russell, 1973; Purseglove, 1988) [5, 6] that due to late or poor nodule-formation, it might be necessary to give a basal application of nitrogen fertilizer to get a leguminous plant established. Brevadan *et al.* (1978) reported that applying 168 kg ha⁻¹ of nitrogen to soybean plants during the initial bloom period increased the number of pods per plant by 26%, while the application of 40 kg ha⁻¹ of nitrogen 25, 50 and 75 days after planting increased grain yield and shoot fresh weight of plants. Amadi (1993) [1] reported that cultivars of soybean responded differently to the split application of nitrogen fertilizer at different growth and developmental stages.

In the Jos-Plateau agro-ecology, especially in the highland areas, groundnut is cultivated only as a marginal crop. There is a need to explore the possibility of cultivating the crop on commercial scale. The present study was aimed at establishing whether this feat could be achieved without the use of the nitrogen fertilizer.

Materials and Methods

The experiment was conducted in 2002 and 2003, at the potato research farm of the National Root Crops Research

Institute (NRCRI), Kuru, in Plateau State, north-central Nigeria (09°44'N, 08°47'E; 1,293.2m above mean sea-level).

In each year, the gross plot size measured 19.2m x 13.0m while each net plot (4m x 1.6m) consisted of two 0.8m rows each measuring 4 metres long. Three rates of nitrogen (0, 50 and 100 kg ha⁻¹) were combined with two local varieties of groundnut, namely 'Yar-Bajju' (the erect or bunch type) and 'Yar-Kubacha' (the runner or spreading type) and two dates of fertilizer application (10 and 31 days after sowing) in a randomized complete block design with three replications.

The seeds were treated with 25 g of thioral (20% Lindane plus 25% TMTD) before sowing on May 11 in 2002 and on May 25 in 2003. Seeds were sown one per hill at 0.8m between rows and 0.2m within rows, giving a total population of 62,500 plants per hectare.

The plots were supplied with a blanket application of 80 kg P₂O₅ ha⁻¹, equivalent of 355.6 g of single super-phosphate at planting. Ten (10) days after sowing (10 DAS), 40 kg KCl ha⁻¹, which was equivalent to 103.2 g of muriate of potash, was applied blanket to all the plots. Three rates of nitrogen fertilizer (0, 50 and 100 kg ha⁻¹), which were equivalent to 0, 69.5 and 139 g of urea per plot, were applied at 10 DAS (at germination) and at 31 DAS (at flowering). Weeds were controlled by hoeing and thereafter by hand-weeding to prevent injury to the plants.

Field Observation and Data Collection

Mean Number of Days to Onset of Flowering: This was recorded as the number of days from sowing to when plants have started flowering in each plot.

Mean Number of Days to 50% flowering: This was recorded as the number of days from sowing to when at least 50% of the plants had flowered in each plot.

Mean Number of Pods per Plant: This was recorded as the mean number of filled pods produced by five (5) randomly sampled plants in each plot.

Mean Number of Pops per Plant: The late-formed pods that did not reach maturity at the time of harvest were recorded as pops. The mean number of pops produced by the five sampled plants in each plot was used in the analysis. **Pod Length:** This was based on the mean length of twenty (20) randomly selected pods in each plot.

Pod Yield per Plant: Five (5) plants were sampled from each plot, the pod yield of each of which was recorded. The mean was used in the analysis.

Total Pod Yield: After harvesting, the pods were sun-dried for seven (7) days. Thereafter, the pods were weighed and the weight was converted to kilogrammes per hectare.

Total Grain Yield: Seven (7) days after sun-drying the pods, they were shelled and the seeds were weighed. The moisture content of the seeds was determined by drying 20 g of pulverized seed-samples from each plot in a ventilated oven at 100°C for 48 hours (AOAC, 1975). Total grain yield was thereafter computed at 7% moisture content and converted to the equivalent in kilogrammes per hectare.

Data Analysis: Data collected in both years were subjected to a two-way analysis of variance (ANOVA) test and the means were compared by using the least significant difference (LSD).

Results

Mean Number of Days to Onset of Flowering: The mean number of days to onset of flowering was similar across the

rate and time of N-application in both 2002 and 2003. In both years, the variety Yar-Bajju flowered earlier than Yar-Kubacha (Table 1).

Mean Number of Days to 50% flowering: Like the onset of flowering, the mean number of days to 50% flowering did not differ significantly with the rate and time of nitrogen fertilization in the two years. Similarly, the variety Yar-Bajju attained mid-flowering earlier than Yar-Kubacha. Irrespective of variety, rate and time of N-application, plants took a longer period to attain mid-flowering in 2003 than in 2002 (Table 1).

Mean Number of Pods per Plant: The mean number of pods per plant was similar across the rate and time of N-fertilization in the two years of experimentation. The number of pods produced by each plant was generally higher in 2002 than in 2003. The variety Yar-Kubacha produced a significantly higher number of pods than Yar-Bajju in both 2002 and 2003 (Table 1).

Whereas the mean number of pods increased with increasing N-rate in the variety Yar-Bajju, the reverse was the case in variety Yar-Kubacha in 2003 (Table 3).

Mean Number of Pops per Plant: Like the number of pods per plant, the mean number of pops per plant was similar irrespective of the rate and time of N-application in the two years. The variety Yar-Kubacha produced a higher number of pops than Yar-Bajju in both 2002 and 2003. The number of pops produced in 2003 was generally higher than in 2002 (Table 1).

Pod Length: The pod length was similar across the rate and time of N-application in 2002 and 2003. The variety Yar-Bajju produced significantly longer pods than Yar-Kubacha in the two years (Table 2).

Table 1: Main effects of variety, rate and time of Nitrogen application on mean number of days to onset of flowering, mean number of days to 50% flowering, mean number of pods per plant and mean number of pops per plant in groundnut in 2002 and 2003

S/N	Variety	Days to Onset of flowering plant		Days to 50% flowering		Pod No per plant		Pop No per plant	
		2002	2003	2002	2003	2002	2003	2002	2003
1	Yar Bajju	28.00	31.00	31.30	33.67	24.95	13.43	17.70	16.63
2	Yar Kubacha	30.92	35.83	34.20	38.33	57.05	31.47	29.42	36.15
3	LSD (0.05)	0.16	1.19	1.15	0.94	5.91	5.06	7.31	5.36
	kgN ha ⁻¹								
1	0	29.50	33.75	32.30	36.25	39.08	23.60	22.75	26.13
2	50	29.25	33.38	32.50	35.75	41.80	22.03	23.40	23.48
3	100	29.63	33.13	33.50	36.00	42.13	21.73	24.53	29.58
4	LSD (0.05)	0.90	1.46		1.15	7.22	6.19	8.96	6.57
	Time (DAS)								
1	10	29.42	33.08	32.50	36.00	40.68	24.57	23.02	28.43
2	31	29.50	33.75	33.00	36.00	41.32	20.33	24.01	24.35
3	LSD (0.05)	0.16	1.19	1.15	0.94	5.91	5.06	7.31	5.36
4	CV (%)	2.75	3.97	3.89	.90	16.02	25.07	34.53	22.63

Pod Yield per Plant: In both 2002 and 2003, pod yield per plant did not differ significantly with the rate of nitrogen application. The pod yield per plant was generally higher in 2002 than in 2003. The variety Yar-Kubacha produced more pods than variety Yar-Bajju and the difference (P>0.05) was significant (Table 2).

A significant interaction of N-rate and variety on pod yield per plant was observed in 2003. The pods produced by each

plant increased as the rate of nitrogen fertilizer was increased in the variety Yar-Bajju. This trend was, however, reversed in variety Yar-Kubacha (Table 4).

Total Pod Yield: Like pod yield per plant, total pod yield did not significantly respond to the rate and time of N-fertilization in both 2002 and 2003. Generally, more pods were produced in 2002 than in 2003. The total pod yield in

variety Yar-Kubacha differed significantly ($P>0.05$) from that of variety Yar-Bajju in the two years (Table 2).

Total Grain Yield: Irrespective of the variety, rate and time of N-application, total grain yield in 2002 was generally higher than in 2003. Grain yield varied from 866.25 kg ha⁻¹

at 0 KgN ha⁻¹ to 1,107.50 Kg ha⁻¹ at 50 KgN ha⁻¹ in 2002, and from 461.25 Kg ha⁻¹ at 50 KgN ha⁻¹ to 482.50 Kg ha⁻¹ at 0 KgN ha⁻¹ in 2003. In both years, grain yield did not differ significantly with the rate or time of N-application (Table 2). The variety Yar-Kubacha exceeded variety Yar-Bajju in total grain yield in 2003.

Table 2: Main Effects of variety, time and rate of Nitrogen application on pod length, pod yield per plant, total pod yield and total grain yield in groundnut in 2002 and 2003

S/N	Variety	Pod Length (cm)		Pod Yield per Plant(g)		Total Pod Yield (Kg ha ⁻¹)		Total Grain Yield (Kg ha ⁻¹)	
		2002	2003	2002	2003	2002	2003	2002	2003
1	Yar Bajju	3.91	3.68	105.67	42.00	1565.00	665.00	990.00	310.83
2	Yar Kubacha	3.39	3.15	181.83	65.33	2610.83	1382.50	1000.33	638.33
3	LSD (0.05)	0.22	0.24	23.90	15.40	570.67	370.66	257.20	219.53
	kgN ha ⁻¹								
1	0	3.69	3.43	134.75	55.75	2232.50	1090.00	866.25	482.50
2	50	3.60	3.40	156.00	52.50	2052.50	988.80	1107.50	461.25
3	100	3.67	3.43	140.50	52.75	1978.75	992.50	1012.50	480.00
4	LSD(0.05)	0.28	0.29	29.25	18.86	698.93	453.76	315.01	268.87
	Time (DAS)								
1	10	3.62	3.46	139.33	59.00	2164.17	1059.20	951.67	473.33
2	31	3.69	3.38	148.17	48.33	2011.67	988.30	1039.17	475.83
3	LSD (0.05)	0.22	0.24	23.90	15.40	570.67	370.66	257.20	219.53
4	CV (%)	6.60	7.74	18.50	31.94	30.42	40.30	28.76	51.49

Table 3: Effects of Nitrogen and Variety on Mean Number of Pods per Plant in Groundnut in 2003 KgN ha⁻¹

Variety	0	50	100	mean
Yar-Bajju	44.4	45.0	71.8	13.43
Yar-Kubacha	144.4	131.2	102.0	31.47
Mean	23.60	22.03	21.73	

LSD (0.05): Nitrogen (N) = 6.19
Variety (V) = 5.06
N x V = 8.76

Table 4: Effects of Nitrogen and Variety on Pod Yield per Plant in Groundnut in 2003 kgN ha⁻¹

Variety	0	50	100	Mean
Yar -Bajju	136	140	228	42.00
Yar-Kubacha	310	280	194	65.33
Mean	55.75	52.50	52.75	

LSD (0.05): Nitrogen (N) = 18.86, Variety (V) = 15.40, N x V = 26.67

Discussion and Conclusion

Although there was no significant response of flower-onset to the application of nitrogen fertilizer, the variety Yar-Bajju flowered earlier than variety Yar-Kubacha, indicating that variety Yar-Bajju matures earlier than variety Yar-Kubacha. A similar observation has been made by Emery and Gupta (1968)^[4].

Although Arnon (1972)^[3] reported that fertilisation increased the rate and duration of flowering, in the present study the response was not significant. Although more pods could be formed as a result of increased fertilisation, the percentage that attains maturity prior to harvest might be low compared to when fertilizer is not used (Arnon, 1972)^[3]. Differences exist in the varietal response of pod number and pod yield per plant to the application of nitrogen fertilizer. In variety Yar-Bajju, for example, the number of pods and pod yield per plant increased with increasing N-

rate, but decreased as the N-rate was increased in variety Yar-Kubacha.

The non-significant response of the yield and yield components to nitrogen fertilisation in this study shows that groundnut, especially the spreading type, could be cultivated in the Jos-Plateau environment without the use of fertilizer nitrogen.

References

1. Amadi CO. The effects of nitrogen on some morphological traits as yield determinants among soybean [*Glycine max* (L.) Merr] varieties in Saminaka, Nigeria. Unpublished M.Sc. Thesis. University of Jos, Jos, Nigeria, 1993, 132.
2. A.O.A.C. Official Methods of Analysis. 12th Edition. Association of Analytical Chemists, Washington, D.C, 1975.
3. Arnon I. Crop Production in dry regions: Systematic treatment of principal crops. Leonard Hill Books, London, 1972:2:344-420.
4. Emery DA, Gupta CL. Reproductive efficiency of Virginia type peanuts. II The influence of variety and seasonal growth period upon fruit and kernel maturation. Oleagineux, 1968:23:99-104.
5. Purseglove JW. Tropical Crops: Dicotyledons. 1st Edition. Longman Singapore Publishers Limited, 1988, 225-234.
6. Russell EW. Soil conditions and growth. Longman Group Limited, London, 1973, 849.