QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES
DIVISION OF PLANT INDUSTRY BULLETIN No. 455

SOME EFFECTS OF PLANT SPACING AND NUTRITION ON THE YIELD AND NUT QUALITY OF VIRGINIA BUNCH PEANUTS

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SUMMARY

In years of adequate rainfall, yield increases were obtained by doubling the normal number of 14,520 plants per acre in 3-ft rows. The increases were not obtained economically.

Yield response to fertilizer indicated that the usual rate of application could be increased with an economic benefit.

No significant effect of plant spacing or fertilizer application on nut quality was shown.

I. INTRODUCTION

The Queensland peanut industry is centred mainly on Kingaroy, in the Burnett district, where 80% of the crop is grown on red loams which have been farmed for up to 70 years. Available phosphate is low and potash deficiency often occurs on land which has been cultivated for longer than 20 years. Superphosphate is now applied over most of the area and PK and NPK fertiliser mixtures are also widely used.

The current planting recommendation for Virginia Bunch peanuts is single rows 36 in. apart, with individual plants 12-15 in. apart in the row, giving plant populations of 12,000 to 14,000 per acre. Overseas, closer row spacings and closer plant spacings within the row are often used (Oram 1958).

Commercial fertilizer application rates for peanuts were variable at the time of commencing the trials. Rates ranged from nil to 3 cwt/ac and the materials used varied from superphosphate alone to complete mixtures. The present commercial usage is 1–3 cwt superphosphate per acre in 1·75:19:10 or 1·5:14·75:20 mixtures. (The proportions are expressed as percentages of nitrogen, P_2O_5 and K_2O).

This series of trials was initiated to determine the effects on the yield of Virginia Bunch peanuts of doubling the plant population per acre by (a) doubling the number of rows by having four 12 in. inter-row spaced rows instead of two 36 in. inter-row spaced rows, (b) doubling the number of rows by having four rows with 12 in., 14 in., 12 in. inter-row spaces, or (c) doubling the number of plants within the row. The effects on growth and yield of substantially increasing the normal fertilizer application were also studied.

Plant height measurements were made because of the contention that mechanical peanut cutter-pullers would not work efficiently on short plants. However, it was demonstrated that pullers worked well on very small plants after simple adjustments were made, so the observations on plant height and spread have little applied interest.

The effect of plant number and fertilizer application on nut size was also examined.

II. MATERIALS AND METHODS

The trial site was typical of the red "forest" areas. It had been cleared some 40 years previously and thereafter was cropped intermittently for 25 years without fertilizer additions. More recently, the site was cropped rotationally and fertilized, with a peanut crop every third season.

Soil analytical data and rainfall figures are given in Tables 1 and 2 respectively. The long-term mean rainfall for the period October-April is 22·39 in., so except in the first season the rainfall during the growing period was well below average. It should be stated that in most seasons peanut plants suffer moisture stress at some time during the growing period.

The trials were carried out in the 1962-63, 1963-64 and 1964-65 seasons on a farm 6 miles south of Kingaroy.

A randomized block design was used for all trials. Treatments are set out in Table 3.

TABLE 1

ANALYTICAL DATA FOR RED FOREST SOIL, KINGAROY

Portion 88V Boonenne

Season	Depth of Sample (in.)	pH	Available P_2O_5 (p.p.m.)	Avail K+ (m-equiv. %)	NH_4 Nitrogen	NO_3 Nitrogen
1962–63 ..	0–6	5·8	47	0·16	Medium	Low
	6–12	6·7	16	..	..	..
1963–64 ..	0–8	5·9	36	0·24	Medium	Very low
1964–65 ..	0–8	6·0	43	0·20	Low	Low

TABLE 2

RAINFALL (IN.) DURING TRIAL SERIES

Month	1962–63 Season	1963–64 Season	1964–65 Season
October ..	·50	·65	1·72
November ..	4·08	1·05	1·40
December ..	4·39	2·65	3·80
January ..	4·90	1·29	2·32
February ..	1·95	1·75	·04
March ..	5·93	6·10	·70
April	·19	1·88	2·67
Total ..	21·95	15·37	12·65

TABLE 3

DETAILS OF TREATMENTS

Treatment	Plants Per Acre	Fertilizer Application Rate (lb/ac)		
		1962–63	1963–64	1964–65
Single planting, 6 in. spacing	29,040	300	255	176
Single planting, 12 in. spacing	14,520	300	255	176
Double planting, 12 in. spacing	29,040	300	242	176
Single planting, 6 in. spacing	29,040	620	517	348·5
Single planting, 12 in. spacing	14,520	620	517	348·5
Double planting, 12 in. spacing	29,040	600	510	352
Bed planting with 4 rows 12, 14 and 12 in. apart with 34 in. inter-bed spacing ..	29,040	..	242	..
Bed planting (as above)	29,040	..	510	..
Double planting, 12 in. spacing	29,040	..	..	697

The fertilizer mixtures used were, for the three seasons respectively, of the composition 5·25:12·6:14·5, 0:14:20, and 1:14:20. They were determined on the basis of soil analysis. All fertilizer was applied in bands at seed depth and 3 in. to the side of the seed lines; in the case of double rows the fertilizer was applied at seed depth between the rows. The variations in rates of application were due to the equipment used. Gypsum at the rate of 220 lb/ac was applied over all plots at flowering to eliminate the incidence of "pops" (pods without kernels).

Plots were planted thickly and hand-thinned to appropriate spacings as soon as emergence was complete. Weeds were removed by hoe-chipping. Plots were cut, then pulled and threshed by a stationary thresher. Samples (500 g) of nuts in shell were graded for size, using commercial machinery available at the Peanut Marketing Board's premises, for assessing the value of commercial samples.

III. RESULTS

Yields for the various treatments for the three seasons are given in Table 4, data for mean plant height and mean plant spread in Table 5, and data on nut quality in Table 6.

TABLE 4

MEAN YIELD DATA FOR THE THREE TRIALS

Nut-in-shell per acre (lb)

Treatment	1962–63	1963–64	1964–65
Single planting, 6 in. spacing; fertilizer low	1,584	1,886	462
Single planting, 12 in. spacing; fertilizer low	1,496	1,730	484
Double planting, 12 in. spacing; fertilizer low	1,749	1,900	363
Single planting, 6 in. spacing; fertilizer high	1,771	2,104	495
Single planting, 12 in. spacing; fertilizer high	1,672	1,757	495
Double planting, 12 in. spacing; fertilizer high ..	2,046	2,073	385
Bed planting, 12–14–12 in. spacing; fertilizer low ..	..	2,128	..
Bed planting, 12–14–12 in. spacing; fertilizer high ..	..	2,165	..
Double planting, 12 in. spacing; fertilizer very high ..	..	..	407
S.E.	51·7	56	27·9
Necessary differences for significance 5%	156	166	82·9
Necessary differences for significance 1%	216	226	113·6

IV. DISCUSSION

(a) Spacing Responses

Yield of nut-in-shell.—Clear evidence exists of a yield response to double plant populations, but the type of response differs from season to season.

In trial 1, a period of near-normal rainfall, there was a highly significant response to spacing between the double-planted, high-fertilizer plots and the single-planted, high-fertilizer plots. This response occurred even when the treatments had the same plant population. With the low-fertilizer treatments, an increase approaching significance occurred in the double-planted plots compared with the single-planted 6 in. intra-row plots with the same plant populations. A highly significant increase occurred with the double-planted plots compared with single-planted plots with 12 in. intra-row spaces. No significant difference occurred between single-planted, low-fertilizer plots with 6 in. and 12 in. intra-row spaces.

In trial 2, with rainfall 68% of average, bed-planted plots with high and low fertilizer were not significantly different from other plots with the same plant populations with high fertilizer. The bed-planted plots gave a highly significant yield increase over double-planted 12 in. intra-row spaced low-fertilizer plots and single-planted 6 in. intra-row spaced low-fertilizer plots as well as single-planted 12 in. intra-row spaced plots with both high and low fertilizer. A

TABLE 5

PLANT HEIGHT AND PLANT SPREAD IN RELATION TO TREATMENT

Treatment	1962–63		1963–64		1964–65	
	Plant Height (in.)	Plant Spread (in.)	Plant Height (in.)	Plant Spread (in.)	Plant Height (in.)	Plant Spread (in.)
Single planting, 6 in. spacing; fertilizer low	8·8	17·6	7·5	15·0	4·88	12·13
Single planting, 12 in. spacing; fertilizer low	7·9	18·0	7·4	15·5	5·13	12·63
Double planting, 12 in. spacing; fertilizer low	7·0	23·6	6·4	12·5	4·00	10·00
Single planting, 6 in. spacing; fertilizer high	8·9	19·2	8·1	16·4	5·63	12·50
Single planting, 12 in. spacing; fertilizer high	8·0	18·1	7·6	16·4	5·38	13·00
Double planting, 12 in. spacing; fertilizer high	7·5	25·1	6·3	12·4	4·50	10·38
Bed planting, 12–14–12 in. spacing; fertilizer low	..	..	6·5	13·3	..	..
Bed planting, 12–14–12 in. spacing; fertilizer high	..	..	6·6	13·3	..	..
Double planting, 12 in. spacing; fertilizer very high	..	..	..	..	4·75	10·25
S.E.	0·2	0·7	0·3	0·5	0·17	0·58
Necessary differences for signifiance 5%	0·6	2·2	0·8	1·4	0·50	1·73
Necessary differences for signifiance 1%	0·8	3·0	1·1	1·9	0·68	2·37

TABLE 6

PERCENTAGE LARGE PODS IN RELATION TO TREATMENT

Treatment	1963–64	1964–65
Single planting, 6 in. spacing; fertilizer low	51·22	56·1
Single planting, 12 in. spacing; fertilizer low	45·52	70·3
Double planting, 12 in. spacing; fertilizer low	43·90	59·6
Single planting, 6 in. spacing; fertilizer high	50·54	59·9
Single planting, 12 in. spacing; fertilizer high	50·43	73·4
Double planting, 12 in. spacing; fertilizer high	50·80	59·2
Bed planting, 12–14–12 in. spacing; fertilizer low	51·06	..
Bed planting, 12–14–12 in. spacing; fertilizer high	42·24	..
Double planting, 12 in. spacing; fertilizer very high	..	60·5
S.E.	3·03	5·8
Necessary differences for significance 5%	6·30	12·1
Necessary differences for significance 1%	8·57	16·6

highly significant yield increase occurred in this trial due to doubling plant populations by halving intra-row spaces in 3 ft rows under high-fertilizer; this did not occur under low-fertilizer conditions.

In trial 3, with rainfall 56% of average, no significant differences occurred between any plots with 3 ft row spacings. Single-planted, high-fertilizer plots with both 6 in. and 12 in. intra-row spacings gave the same yield. They gave significant increases over double-planted, very high-fertilizer plots, and double-planted, high-fertilizer plots and they gave highly significant increases over double-planted, low-fertilizer plots. The reversal of behaviour in the third trial as compared with the previous trials is considered to be due to the extreme moisture stress during the last trial.

Plant height and spread.—In all trials, the treatment 6 in. spacing and single 3 ft rows gave the tallest plants. In trial 1, double plantings gave more spreading plants, but in trials 2 and 3 the position was reversed. Apparently moisture stress has a big effect on plant spread.

(b) Responses to Fertilizer

Yield of nut-in-shell.—In every instance in this series of trials, high-fertilizer plots gave more peanuts than their equivalent low-fertilizer counterparts but increases were not always significant.

In trial 1, equivalent spacings all gave significant or highly significant responses to fertilizer.

In trial 2, only the single and double plantings with 12 in. intra-row spacings gave significant responses to fertilizer.

In trial 3, no significant fertilizer responses occurred.

Plant height and spread.—The only significant response in height or spread due to increased fertilizer alone was achieved in relation to plant height in trial 3, where low-fertilizer treatments were of a lower order than in previous trials.

(c) Quality of Peanuts

Equipment to determine pod size as a quality indicator became available in 1964; hence this determination is for 2 years only. For trial 2 (Table 5), although significant differences occur there are no consistent tendencies in relation to either fertilizer or spacing.

In trial 3 it would appear that the effect of extreme moisture stress was to increase the percentage weight of large pods over trial 2. This was caused by small pods not having developed kernels; hence they weighed less. All plots with high plant populations were significantly inferior to the single-planting, 12 in. intra-row spacing, high-fertilizer plots.

(d) Economic Considerations

Theoretically, 25 lb of Virginia Bunch peanut seed of the size (VK2) supplied by the Peanut Marketing Board is sufficient to give 1 acre of peanuts planted in 3 ft rows and spaced 12 in. apart in the row, i.e. 14,520 plants per acre. In practice, it is usual to plant 40–45 lb seed to obtain such a plant stand, because seed frequently gives only 70% emergence, germination percentage being less than 100% and damage occurring to seed as it passes through planters; there is irregular dropping of seed by planters.

To double plant populations it would therefore be necessary to plant an extra 40–45 lb seed per acre, at a cost of 22c/lb, an extra $9.99/ac. To cover this cost a yield increase of 125 lb at 8c/lb would be necessary. Yield increases of 258 and 266 lb/ac were the largest increases obtained at any time in these trials due to close spacing alone. The average of all trials was 143·1 lb, which would pay the increased cost of seed but leave nothing for added costs of growing, including such items as extra planting and fertilizer equipment, more powerful tractors and the use of specialized weed control equipment which would not be suitable for other district crops.

For the three trials, the average yield increase from doubling fertilizer application was 166·8 lb nuts-in-shell per acre, worth approximately $14, which is the cost of 5 cwt of the fertilizer mixture used. Thus, the difference in returns from increasing the fertilizers applied was sufficient to cover the entire cost of fertilizer at the heavy rate. This is apart from the fact that residual fertilizer effects are observed in trial areas 2 years after heavy fertilizer application.

(e) Conclusions

Since in the first two trials yield increases were obtained by increasing plant populations of Virginia Bunch peanuts beyond the usual commercial planting figure of 14,500 plants per acre in 3 ft rows, and in the third trial, which was grown under drought conditions, there was no significant yield difference between any treatments grown in 3 ft rows and double planting reduced yields, it may be concluded that yield increases could be anticipated from high plant populations in years of adequate rainfall but the reverse could occur in drought years.

Soil moisture measurements suggest that better soil moisture utilization may possibly be achieved by reducing inter-row spaces below 3 ft.

Yield increases occurred through using higher fertilizer applications.

V. ACKNOWLEDGEMENTS

Land preparation was carried out by the owner of the experimental site, Mr. R. J. Hunwick, who also provided assistance in harvesting the first two trials. Labour and the use of machinery were provided by the Peanut Marketing Board for the third trial. All statistical analyses in connection with this investigation were carried out by the Biometrics Branch.

REFERENCE

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(Received for publication October 16, 1967)

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