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NITROGEN FERTILIZER TRIALS ON IRRIGATED NAVY BEANS

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SUMMARY

Irrigated trials conducted for 3 years on a low fertility recent alluvial indicated that the most economic rate of nitrogen side-dressing of navy beans (*Phaseolus vulgaris*), following basal application of 35 lb N/ac, was 75-90 lb N/ac.

There were responses to nitrogen side-dressings in the range 0-184 lb N/ac, with yield increases of 600-1,100 lb/ac, 1,000 grain weight increases of 148-173 g and grain nitrogen increases of 4·63–5·58%. It appears likely that the yield increases were due to increases in both pods per foot of row and grain weight.

I. INTRODUCTION

The evaluation of irrigation crops has assumed importance in agronomic research in the benefited area of the recently constructed Coolmunda Dam in southern Queensland. The inherently low nitrogen status of these soils and double cropping have placed emphasis on nitrogen responses. Though navy bean rhizobium strains are available in Queensland, the contribution of nitrogen from this source is limited by the short growing season of the crop and therefore applied nitrogen is required. Planting techniques in the Inglewood area are unsuitable for applying high rates of nitrogen at planting and side-dressing is the most suitable alternative. Trials were carried out to investigate the requirements of nitrogen as a side-dressing.

II. MATERIALS AND METHODS

The investigation comprised three field trials set down as randomized blocks with four replications in 1969 and 1970 and five replications in 1971. Rows were planted 28 in. apart. Four rows of 60 ft comprised a plot in 1969, two rows of 60 ft in 1970 and two rows of 40 ft in 1971. Treatments were six rates of N (nil, 46, 69, 92, 138 and 184 lb/ac) applied as urea (46% N).

The trials were established on a recent alluvial silty clay loam on the Department of Primary Industries' field station at Whetstone. The soil was sampled for analysis in January 1969 and the results are shown in Table 1. The 1969 trial was preceded by 2 years of wheat, and barley was grown as a double crop during the trial period.

TABLE 1

SOIL ANALYSIS RESULTS

—	0–6 in.	6 in.–12 in.
pH	6·5	6·5
NO_3 nitrogen	Medium	Low
NH_4 nitrogen	Very low	Very low
Available P	91	83
K (m-equiv. %)	1·33	2·09

Stubble was disced in December following harvesting of the grain crop and the area was tined and harrowed prior to planting. Dates of subsequent operations are given in Table 2. Trifluralin for weed control was applied at 1·125 lb a.i./ac in 1970 and at 0·75 lb a.i./ac in 1971. Some root pruning occurred with the heavier rate. Seed of the variety Selection 46 (Sanilac x Actopan) treated with captan was planted at 35 lb, and 220 lb of a complete fertilizer mixture (16% N, 6·5% P, 6% K) was band-applied at planting.

The trials were hand-pulled on maturity and hand-threshed in 1969 and 1970. A portable rasp drum thresher was used in 1971. Plant counts were made in 1970 and 1971 and 2 ft of row per plot was pulled in 1971 for pod counts. In 1971, 1,000 grain weights, grain nitrogen and phosphorus levels were measured from samples obtained from bulked treatments.

TABLE 2

DATES OF OPERATIONS

Year	Planted	Side-dressing (days later)	Irrigated	Harvested
1969	Jan. 31	32	Mar. 3, 24† Apr. 11, 21	May 19 (109 days)
1970	Jan. 28*	33	Feb. 16‡ Mar. 2, 24 Apr. 7	June 3 (126 days)
1971	Feb. 15*	15	Mar. 2‡ Apr. 6, 16	July 5 (140 days)

* Planting delayed by wet weather.
† Furrow irrigation.
‡ Spray irrigation.

III. RESULTS

Yield increases of between 600 and 1,100 lb/ac from nitrogen side-dressing were obtained (Table 3 and Figure 1). Base yields indicated the variability of seasonal conditions.

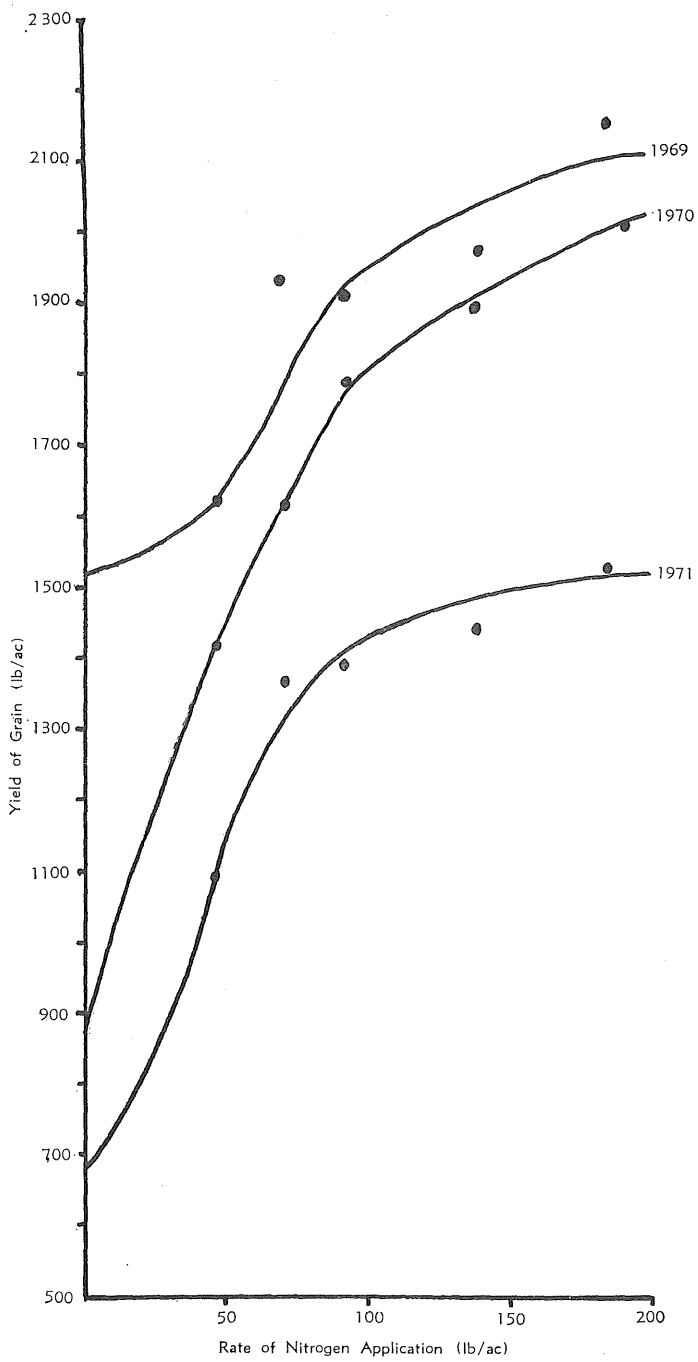

Fig. 1.—Yields from Trials

Grain weights and nitrogen levels from the 1971 trials (Table 4 and Figures 2 and 3) showed increases up to the 138 lb N/ac level.

Pod counts were made in 1971 (Table 5). There was a significant rise in pod numbers with increasing level of nitrogen.

TABLE 3

YIELD (lb/ac)

Rate of N (lb/ac)	1969 Yield	1970 Yield	1971 Yield
Nil (control)	1,510	866·1	684·9
46	1,615·9	1,410·9	1,082·4
69	1,936·4	1,619·0	1,357·0
92	1,900·4	1,780·0	1,384·9
138	1,965·3	1,888·1	1,441·3
184	2,149·9	1,958·1	1,522·0
L.S.D. 5%	289·6	342·8	104·6
L.S.D. 1%	400·3	473·9	142·7

TABLE 4

1,000 GRAIN WEIGHT AND NITROGEN AND PHOSPHORUS CONTENT OF GRAIN—1971

Rate of N (lb/ac)	1,000 Grain Weight (g)	Nitrogen (%)	Phosphorus (%)
Nil (control) ..	148	4·63	0·87
46	165	4·79	0·83
69	165	4·71	0·84
92	175	5·38	0·81
138	183	5·58	0·78
184	173	5·30	0·78

TABLE 5

POD COUNTS PER FOOT OF ROW—1971

Rate of N (lb/ac)	No. of Mature Pods	No. of Barren or Frosted Pods	Total No. of Pods
Nil	20·9	49·8	70·7
46	35·3	52·2	87·5
69	35·7	49·0	84·7
92	38·5	46·1	84·6
138	41·3	60·6	101·9
184	44·8	56·3	101·1

F test was not significant at the 5% level.

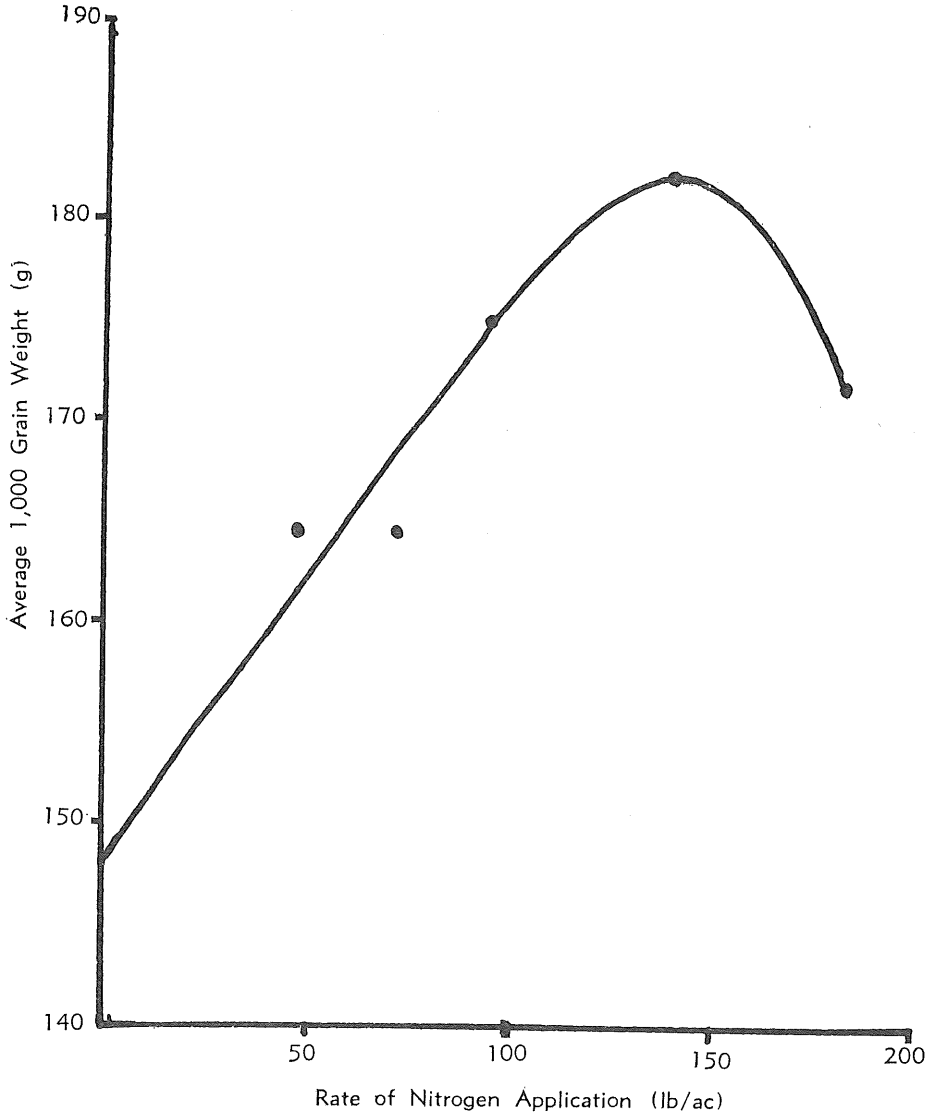

Fig. 2.—Effect of Nitrogen on Grain Weight

IV. DISCUSSION

The aim of the trials was to determine the effects of nitrogen side-dressing of navy beans following a planting application of 35 lb N/ac. Results indicated that seasonal variability determined potential yields at all levels of nitrogen, base yields varying from 687 lb to 1,510 lb/ac. Yield increases of between 400 and 800 lb of beans per acre were obtained at the inflection points of 75-90 lb

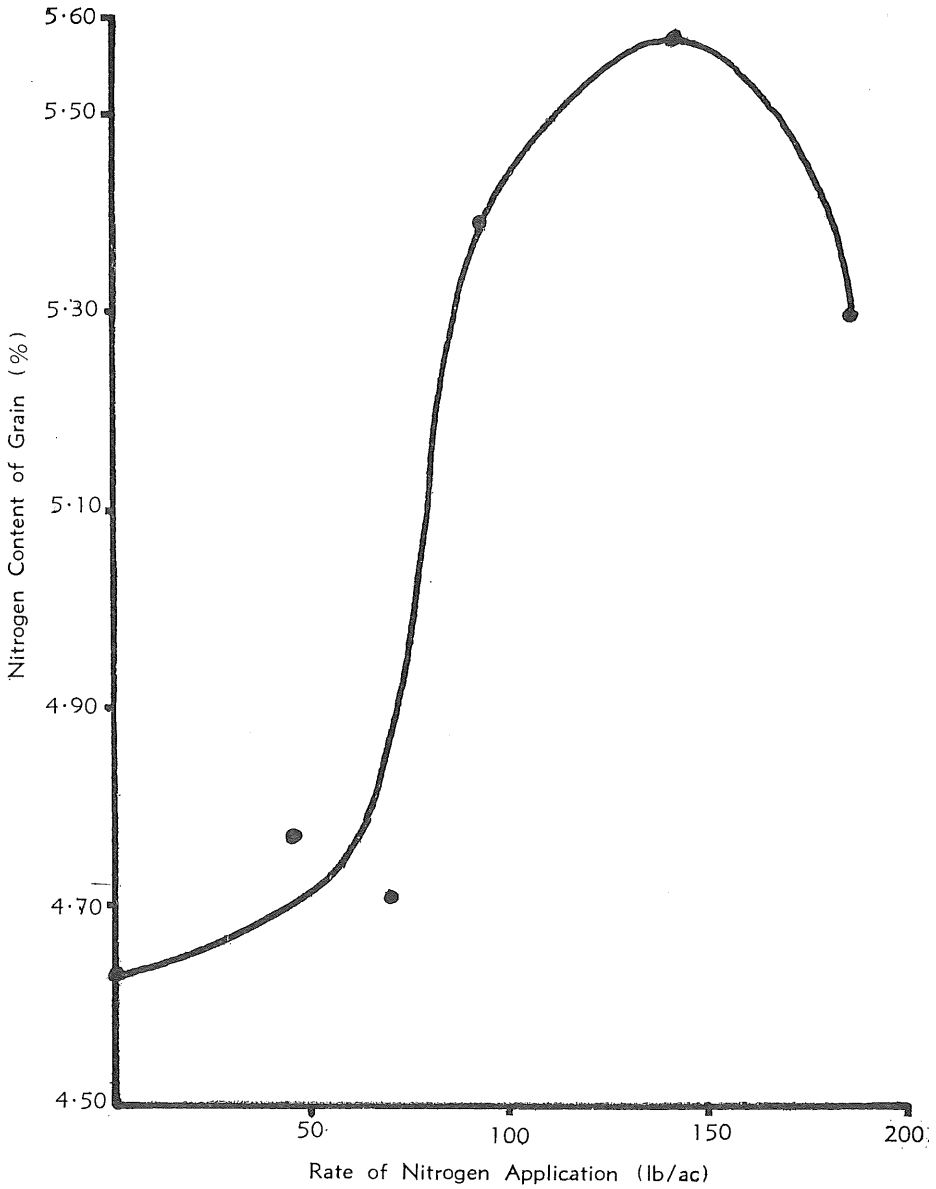

Fig. 3.—Effect of Nitrogen on Nitrogen Content of Grain

N/ac over the 3 years of trial. Yields continued to increase up to the ceiling level of 184 lb but increases were neither significant nor economic. The similarity of the inflection points is significant because of the range of seasonal conditions experienced over the 3 years of trials. (In 1969, there were several effective falls of rain betwen irrigations; in 1970 such falls were somewhat lower, while 1971 was a dry season. Mean daily temperatures throughout the growing period were generally higher in 1969 and 1970 than in 1971).

Results from 1,000-grain weights in the 1971 trial showed that increases were obtained in grain weight up to the 138 lb level. The fall above this figure may be due to frost damage, which was visibly more severe in plots with higher levels of nitrogen.

While pod count differences showed no statistical significance, the number of mature pods and the total number of pods showed a tendency to increase with higher rates of nitrogen. The number of barren pods and frosted pods did not indicate higher losses at the high rates of nitrogen.

The figures suggest that yield increases are related to increases in both number of pods per foot of row and grain weight.

Grain nitrogen levels increased with higher rates of nitrogen up to 138 lb/ac. The fall in nitrogen content above this figure may also be due to the higher visible frost injury to plants on the higher levels of nitrogen.

At current prices (navy beans at 11 cents per lb and nitrogen at 9 cents per lb), yield increases above 90 lb of nitrogen barely equal fertilizer costs involved.

No indication of the correct time to side-dress was obtained. The value of the 35 lb/ac supplied at planting has also not been determined.

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