The effect of nitrogen and plant population on seed quality of desi and kabuli chickpeas

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Introduction

Chickpeas (*Cicer arietinum* L.) are a relatively new crop in the Canterbury region. Experimental work as early as 1981 showed that the crop could yield in excess of 2 t seed/ha (Hernandez, 1986). The seed has a high value and has sold for up to NZ$2200/t (Farnsworth, 1985). The value of the seed, particularly for export can be affected by both seed size and protein content (Williams and Nakkoul, 1985). Kabuli chickpeas need to be at least 8 mm in diameter for export. Seed size is less important for desi chickpeas. Protein levels are lower than for most grain legumes and usually average about 20% (Hernandez, 1986).

Methods

A randomized complete block design consisting of a factorial combination of 2 varieties (Kabuli and Desi), 2 nitrogen applications (0 and 50 kg nitrogen/ha and 4 plant populations (15, 30, 45, and 60 plants/m^2) was sown on 6 November, 1990. The trial site was a Templeton silt loam at Lincoln University Henley Block. Plots of 23.1 m^2 were sown with treated seed (Apron 70 sd at 200 g/100 kg seed). Weeds were controlled with trifluralin at 3 l/ha applied pre-emergence. Calcium ammonium nitrate (28% nitrogen) was applied to plots on 17 December at 50 kg nitrogen/ha.

Seed protein content was determined using a Kjeldahl digestion and a steam distillation titration.

Results and Discussion

During the growing season, sequential dry matter (DM) sampling showed no response to nitrogen (data not shown). However, by the final harvest there was a highly significant response of both DM production and seed yield to nitrogen (Table 1).

This experiment showed that desi is capable of outyielding kabuli chickpeas with respect to seed yield, by 14%. The addition of 50 kg N/ha resulted in an increase of 16 and 17% for DM and seed yield respectively. Population affected both DM and seed yield with 15 plants/m^2 giving 3740 kg seed/ha and 60 plants/m^2 only 3070 kg/ha.

There were significant treatment effects on both seed weight and protein content (Table 1). As expected, desi

Table 1. The effect of varying plant population and applied nitrogen on yield and quality of desi and kabuli chickpeas. Combined treatment means are shown.

	Dry Matter (kg/ha)	Seed (kg/ha)	Seed wt. (mg)	Protein (%)
Variety				
desi	6480	3680	154	14.6
kabuli	5850	3220	271	15.7
s.e.m.	187	100	2.6	0.21
signif.	*	**	**	***
Nitrogen (kgN/ha)				
0	5710	3190	208	14.6
50	6630	3720	218	15.8
s.e.m.	187	100	2.16	0.21
signif.	***	***	**	***
Population (plants/m^2)				
15	6770	3740	216	15.1
30	6430	3670	216	14.7
45	6010	3330	207	15.4
60	5460	3070	212	15.6
s.e.m.	265	142	3.6	0.31
signif.	**	**	ns	ns
CV (%)	17.2	16.4	6.8	8.0

seeds were only about half the size of kabuli seeds at 154 mg and 271 mg respectively. Nitrogen fertilizer application resulted in a 4.8% increase in seed size. However, the nitrogen effect varied with variety, kabuli seed size increased 6.5% while desi increased only 3%.

Protein content was affected by both variety and nitrogen application. Kabuli chickpeas were 15.7% protein while desi were only 14.6% protein. Nitrogen application resulted in an 8% increase in protein content (Table 1).

As widely reported in the literature, legumes which are not nodulated usually respond to nitrogen. Saxena (1980) reported highly significant yield responses of chickpeas to nitrogen in the absence of *Cicer* rhizobium. Although this present study was carried out on a site which contained nodulated chickpeas 8 years previously there was no apparent nodulation. While there was no nitrogen effect on DM production at any of the sequential samplings, plot colour clearly indicated a lack of nitrogen late in the season in the zero nitrogen plots. This lack resulted in a lower final yield (Table 1).

Hernandez (1986) in Canterbury also reported yield responses to additional N both with nodulated and non-nodulated chickpeas. In all instances inoculated plants outyielded uninoculated plants. Interestingly, he also reported that while nitrogen added at sowing reduced nodule numbers, nitrogen added 30 days after sowing (DAS) did not affect nodule number and increased TDM per plant. Andrews *et al.* (1986) reported that with 4 nodulated cultivars of *Vicia faba*, 200 kg/ha added nitrogen as either nitrate, ammonium or urea gave increased seed yields and increased nitrogen content of seeds.

Response to population was similar to reports by Hernandez (1986) who found an optimum population for chickpeas of between 30 - 60 plants/m^2. Overseas reports have shown little positive reponse to population.

As expected, variety had a significant effect on both seed size and protein content. Clearly, although desi outyielded kabuli, kabuli is the more valuable commodity as seed size is suitable for export and protein content is higher.

Nitrogen increased both seed size and protein content and yield. This contradicts reports by many other authors. Most authors report a negative correlation between yield and protein content (Bressani and Elias, 1980; Williams and Nakkoul, 1985). However, there is no reason why this should be so. Andrews *et al.* (1986) found that even in nodulated *V. faba* additional nitrogen gave increases in seed yield and seed N content regardless of form of nitrogen applied.

Conclusion

The relationship between legumes and response to nitrogen needs more study. An experiment on chickpeas being conducted at the present time has shown that even with inoculation by a suitable Rhizobium strain, there has been no nodulation of chickpeas during this past winter (Stokes, 1991, unpublished data).

It is concluded that:

1. Additional nitrogen can give increased seed yields.
2. With chickpeas, added nitrogen can boost both yield and protein content.
3. Further work is necessary to determine the relationships between yield, nodulation, seed quality and soil fertility.

References

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