NAS 941

THE INFLUENCE OF SEEDRATE ON THE YIELD OF WHITE FLOWERED SPRING BEANS, 1992-95

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Summary

An experiment to determine the optimum seedrate for Caspar, a semi-determinate, white flowered spring field bean, showed that the response to increasing plant population was generally similar to that expected for other semi-determinate and indeterminate bean varieties. Maximum yield was given by a population of 40 plants/m² which translates into an optimum seedrate of 40 to 50 seeds/m², equivalent to 200 to 250 kg/ha depending on seed size and expected field establishment level.

Introduction

Field beans (*Vicia faba*) are typically grown in the UK to provide a protein-rich ingredient for animal feed products and act as a useful nitrogen-fixing break crop. Their current popularity largely reflects the substantial support through area payments allowed under the EU Common Agricultural Policy. Because of relatively low and uncertain market prices and this system of support, there is every incentive to adopt low cost production methods. Seed forms a high proportion of the variable costs of growing spring beans so that choice of seedrate is a potentially critical decision.

Previous attempts (Ingram & Hepplethwaite, 1976; Cleal, 1991) to determine optimum seedrates have focused on conventional indeterminate and semi-determinate coloured flower and high tannin seed varieties. These resulted in the general recommendation for a target plant population of 40 plants/m² (Anon., 1986). The introduction of new high yielding semi-determinate varieties with white flowers and low tannin seed prompted renewed questioning of the accuracy of this advice on plant populations and led to the series of trials described in this report.

Method

The white flowered, low tannin spring bean variety Caspar was sown at a range of seedrates on a sandy clay loam soil (Beccles series) at Little Stonham, Suffolk, in each year from 1992 to 1994. In 1995 the experiment was sited at Morley Research Centre in Norfolk on a sandy loam soil (Ashley series). The aim was to establish six plant densities of 10, 15, 20, 30, 40 and 50 plants/m² by sowing sufficient numbers of seed and allowing for a nominal field loss of 20%. Accordingly, a standard Nordsten farm drill fitted with Suffolk coulters was calibrated each year using fresh seed and used to sow plots 1.8 m wide by 24 m long, with rows 12 or 24 cm apart. The drilling dates ranged from 21 February in 1992 to 22 March in 1995. Treatments were arranged in a randomised block design with four replicates.

Established plant populations were assessed in April or May after emergence was judged to be complete. Components of crop structure were assessed, in 1992 and 1993 only, at crop maturity in August prior to harvest. Plot yields were determined at harvest using a Claas Compact combine modified for plot work and fitted with a Novatech M864 weigh meter. The harvest dates ranged from 18 August in 1995 to 5 September in 1994.

Results

Plant population

The level of crop establishment varied between years, being close to that anticipated in 1993 (86%), but was generally below the target in the other years (ranging from 46% in 1994 to 61 and 62% in 1995 and 1992 respectively). However, the range of plant populations achieved was adequate for the purposes of the experiment in all years except 1994.

Because of the relatively poor plant establishment in 1994 and the development of a competitive population of volunteer oilseed rape in the lowest bean population plots, the results from 1994 have been excluded from this report.

Crop structure and yield

The assessments carried out in 1992 and 1993 (Table 1) showed that increasing plant density produced a taller crop with less branches. At the lower populations the number of pods per plant appeared to decrease while the number of pods per m^2 increased significantly with increasing plant density. Seed yield only increased significantly with increasing plant density up to 28 plants per m^2, which suggests that there were marked reductions in pod size (number of seeds per pod and/or seed size) at plant densities above this level.

Another parameter of practical importance is the height of the first pod which governs the height of the cutter-bar at harvest. Although increasing plant density increased this distance from just over 25 cm to over 30 cm on average in 1992 and 1993, most of the height gain was achieved by the initial increases in plant density at the lowest plant populations tested.

There was no significant difference in crop structure or yield between the two row widths tested.

In 1995, yields were curtailed by drought and bean rust. However, since the overall trends were similar to those observed in 1992 and 1993 the yield data is included in the means shown in Table 2. Over the three years the maximum yield was given by an average plant population of $40/m^2$.

Discussion

Estimation of the economic optimum seedrate for Caspar from these results involves a degree of subjectivity with regard to the level of field establishment which might be achieved. For the purposes of this discussion the authors have taken 70% establishment, which was the average level achieved in this experiment, to calculate seed costs. Using a product value of £150/t and a typical seed : product price ratio of 2.33 : 1, the optimum seedrate in terms of *seed density in this experiment* appeared to be 40 to 50 seeds/m² depending on seed size (Table 2). The larger seeds gave an optimum seedrate at the lower end of this range while smaller seed gave a higher one. The resulting plant populations would be expected to lie between 30 and 40/m².

The response by Caspar to increasing plant population agrees well with the results of other workers using different varieties of spring field bean. The ranges of optimum seedrate proposed for other semi-determinate varieties, ie 46 to 66 seeds/m² (Cleal, 1991), and indeterminate varieties, ie 62 seeds/m² (Ingram & Hepplethwaite, 1976), using similar cost assumptions suggested that Caspar was not dissimilar in its requirements.

On the basis of these results the authors recommend a seedrate of between 200 and 250 kg/ha depending on seed size and probable level of establishment. This weight of seed per hectare should result in established populations of 30 to 40 plants/m².

Table 1. *Plant population, crop structure and yield, two year means 1992-93*

Seedrate (no./m²)	Plant population (no./m²)	Crop height (cm)	Height of 1st pod (cm)	Number of branches per plant	Number of pods per plant	Yield (t/ha @ 85% dm)
12.5	9.96	97.3	25.6	3.14	32.1	3.77
18.8	14.21	102.3	29.6	2.73	25.7	4.81
25.0	19.29	103.9	31.0	2.89	25.0	5.28
37.5	28.29	105.1	32.5	2.62	23.2	6.20
50.0	37.75	107.3	33.3	2.49	19.8	6.35
62.5	43.54	109.4	30.2	2.72	23.4	6.37
LSD	3.206	3.50	3.50	NS	6.12	0.318
Row width						
12 cm	25.74	104.4	30.8	2.70	23.7	5.45
24 cm	25.28	104.0	29.9	2.83	26.1	5.48
LSD	NS	NS	NS	NS	NS	NS

LSD = least significant difference at 95% probability level
NS = no significant difference

Table 2. *Yields and estimated margins over seed cost for two theoretical seed lots based on mean yield, 1992-95*

Seedrate (no./m^2)	Seedrate (kg/ha)	Seed cost* (£/ha)	Yield (t/ha)	Gross return* (£/ha)	Margin over seed (£/ha)
Light seed (TGW = 460 g)					
12.5	57.5	20.1	2.75	412.5	392.4
18.8	86.5	30.3	3.50	525.0	494.7
25.0	115.0	40.3	3.86	579.0	538.8
37.5	173.0	60.6	4.59	688.5	628.0
50.0	230.0	80.5	4.74	711.0	630.5
62.5	288.0	100.8	4.83	724.5	623.7
Heavy seed (TGW = 540 g)					
12.5	67.5	23.6	2.75	412.5	388.9
18.8	101.5	35.5	3.50	525.0	489.5
25.0	135.0	47.3	3.86	579.0	531.8
37.5	202.5	70.9	4.59	688.5	617.6
50.0	270.0	94.5	4.74	711.0	616.5
62.5	338.0	118.1	4.83	724.5	606.4

TGW = 1000 grain weight
*Seed cost £350/t; Produce valued at £150/t

Acknowledgements

The provision of the site and expert supervision of the crop by Mr W R Hamilton & Son is gratefully acknowledged. We also thank colleagues at Morley for their help. This work was funded by Morley Research Centre.

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