4.2.2 INFLUENCE OF PLANT POPULATION AND NITROGEN TIMING ON CANOPY STRUCTURE, YIELD POTENTIAL AND QUALITY ON MALTING BARLEY CV GAIRDNER (INVERLEIGH, VIC)

Abstract:

1. Effect of plant population and nitrogen management on canopy structure and yield

With 3 different populations (93, 171 and 233 plants/m^2) on a site of low fertility (2nd cereal situation), the plant was unable to compensate in terms of yield and quality from the population below 100 plants/m^2. In season with very dry periods during stem elongation and grain fill, the low plant populations produced inferior yield and quality characteristics. This is in contrast to the 2003 results on heavier ground (1st cereal after canola) where with greater soil nitrogen reserves compensation from a low plant population (120 plants/m^2), lead to equal yields and better quality characteristics. In that case lower plant populations were producing 450-650 ears/m^2 (550-850 tillers/m^2) compared to 200-350 ears/m^2 (350-650 tillers/m^2) in 2004.

The highest margin was produced from 170 plants/m^2 fertilised with nitrogen at GS33 (third node).

2. Interaction between plant population and nitrogen management

There was a significant interaction between plant population and subsequent nitrogen management, since whilst seedbed timed nitrogen was the lowest yielding fertiliser treatment with all 3 plant populations, the significant advantage of higher plant populations was only apparent with later timed nitrogen applications. Thus with thinner canopies resulting from lower plant populations (below 100 plants/m^2), there was less disadvantage to earlier timed nitrogen (upfront measures). Conversely to secure the benefits of higher plant populations 170 plants/m^2 and 230 plants/m^2, it was necessary to adopt early stem elongation timings (GS30-33) for nitrogen application.

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Location: Inverleigh,Geelong, Victoria
Growing Season Rainfall (April-Nov): 388mm

Background/Objectives:
Under high rainfall zone (HRZ) conditions barley crops can easily become too vegetative, this creates problems with disease due to the higher humidity in the canopy and weakens the stem leading to lodging. Under similar conditions overseas, growers have adopted lower plant populations and later nitrogen timings that aim to reduce canopy density. This manipulation of the crop canopy has been termed canopy management. Canopy management has been very successful in countries such as New Zealand, particularly in winter wheat.

This trial is part of larger GRDC funded project, which examines whether lower plant populations and later timed nitrogen approaches are suited to the HRZ in Australia, it also examines whether these techniques which were principally established for wheat can be used in malting barley, where high protein can be undesirable.

Methodology:
Gairdner barley was established at Inverleigh (Geelong) on 22nd June 2004 in a 2nd cereal situation following wheat. The crop was planted at three plant populations (93, 171 and 233 plants/m^2) and treated with applied nitrogen at three different timings (Table 1). The site had a low soil mineral N level (24 mg/Kg N) at sowing, based on 0-60cm profile. A fully randomized and replicated (4 reps) trial design was used.

Table 1: Fertiliser Treatments

Trt	Fertiliser regime
1	Control untreated
2	100 kg/ha N GS00 (seedbed) on 22nd June
3	100 kg/ha N GS30 (pseudo stem erect) on 8th September
4	100 kg/ha N GS33 (third node) on 27th September
5	50 kg/ha N GS00 (seedbed) plus 50 kg/ha N GS30 (pseudo stem erect)
6	50 kg/ha N GS30 (pseudo stem erect) plus 50 kg/ha N GS33 (third node)

Results and Discussion:

There were significantly more tillers/m^2 with each successive increase in plant population (Table 2). All nitrogen application timings increased tiller number (Table 3.) with the greatest effects as might be expected from earlier application.

Table 2: Influence of Plant Population on Tiller Numbers/m^2 Assessed at GS31 (Mean of 6 N Treatments)

Plant Pop.m^2	Tillers/m^2
P1 (93 p/m^2)	498
P2 (171 p/m^2)	576
P3 (233 p/m^2)	643
LSD	**66**

Table 3: Influence of Nitrogen Timing on Tiller Numbers/m^2 Assessed at GS31 (Mean of 3 Plant Populations)

Fertiliser treatment	Tillers/m^2
1. Zero N	432
2. 100% N seedbed	664
3. 100% N GS30	746
4. 100% N GS33	555
5. 50% N seedbed + 50% N GS30	505
6. 50% N GS30 + 50% N GS33	530
LSD	**93**

In terms of ear numbers, there were significantly more ears/m^2 with the higher plant populations than there was with the 93 plants/m^2 population (Table 4).

Table 4: Influence of Plant Population on Ear Numbers/m^2 Assessed at Harvest (Mean of 6 Nitrogen Timings)

Plant Pop.m^2	Ears/m^2
P1 (93 p/m^2)	306
P2 (171 p/m^2)	364
P3 (233 p/m^2)	402
LSD	**41**

Table 5: Influence of Nitrogen Timing on Ear Numbers/m^2 Assessed at Harvest (Mean of 3 Populations)

Fertiliser Treatment	Ears/m^2
1. Zero N	262
2. 100% N seedbed	390
3. 100% N GS30	375
4. 100% N GS33	398
5. 50% N seedbed + 50% N GS30	355
6. 50% N GS30 + 50% N GS33	364
LSD	**58**

There were no significant differences in ear numbers at harvest when nitrogen timings were averaged over the 3 seed rates, with the exception of the zero N plots, which had significantly less ears/m^2.

The plant population below 100 plants/m^2 reduced yield and grain test weight and significantly increased screenings (2.5mm) and protein. There were no significant differences in yield or quality parameters between the two higher populations (Table 6.)

Table 6: Influence of Plant Population on Yield and Quality (Average of 6 Nitrogen Treatments) – Inverleigh

Plants Population (pl./m^2)	Yield t/ha	Test Weight kg/hl	Screen%	%Protein
93	3.44	61.5	3.5	11.2
171	3.68	63.8	2.5	10.7
233	3.75	64.5	2.5	10.7
LSD (5%)	**0.21**	**1.0**	**0.4**	**0.4**
Significance of linear trend	*	***	**	*

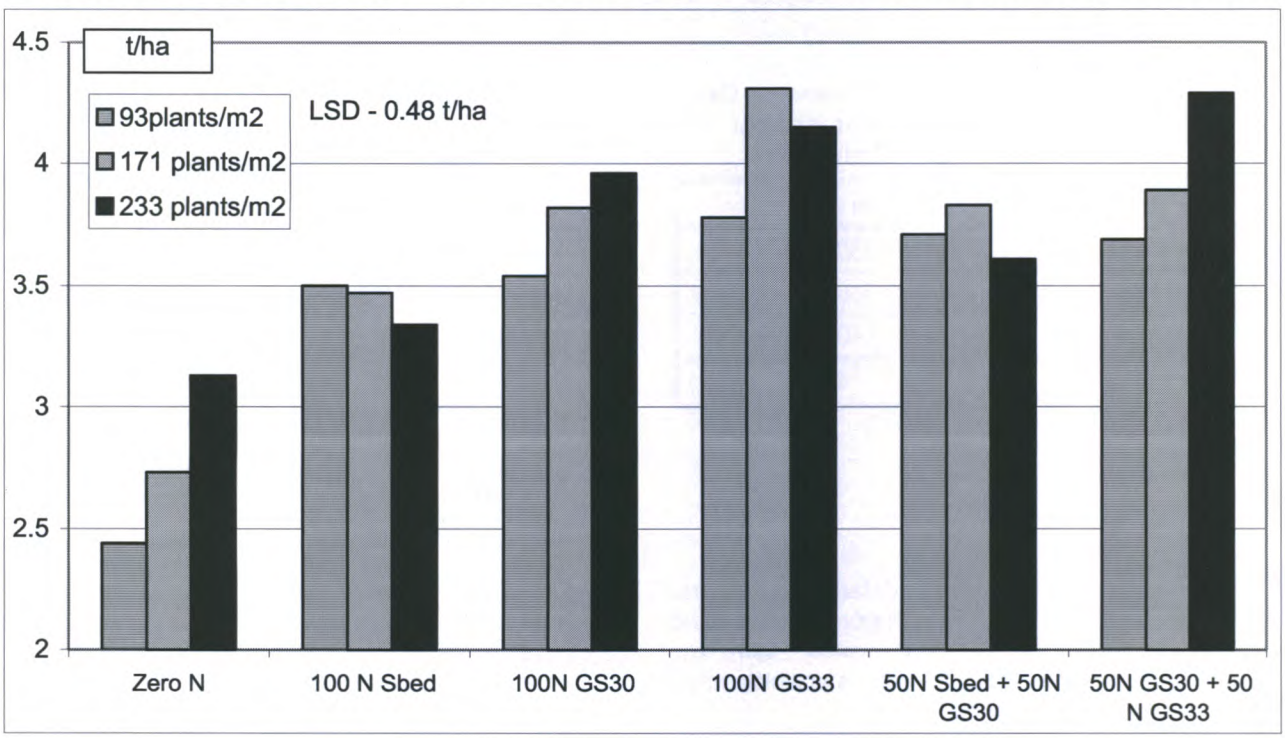
*=5% sig; **=1% sig; ***=0.1% sig.

All nitrogen treatments (based on 100kg/ha N) significantly increased yield with a significant yield advantage to later applied nitrogen when applied as a single timing. Seedbed nitrogen produced the poorest quality characteristics, higher screenings and lower grain test weight. All protein levels were within the malting guidelines, but the latest nitrogen timing produced the highest protein in line with findings in wheat.

Table 7: Influence of Nitrogen Timing on Yield and Quality (Average of 3 Plant Populations) - Inverleigh

Main Effect of Nitrogen	Yield t/ha	Test Wt kg/hl	Screen %	% Protein
1. Zero N	2.77	63.9	1.7	9.2
2. 100% N seedbed	3.43	60.8	4.7	11.5
3. 100% N GS30	3.77	63.1	2.8	10.9
4. 100% N GS33	4.08	64.3	2.5	11.7
5. 50% N seedbed + 50% N GS30	3.72	63.8	2.7	11.2
6. 50% N GS30 + 50% N GS33	3.96	63.6	2.6	10.8
LSD (5%)	**0.28**	**1.5**	**0.8**	**0.5**

Table 8: Influence of Nitrogen Timing and Plant Population on Malting Barley Yield (t/ha) cv Gairdner



Conclusions:

The work illustrated that in low fertility situations, which are more ideal for malting barley (2nd cereal low soil N reserves), there was no disadvantage to applying nitrogen applications at stem elongation (GS30-33). In fact there was a significant advantage to these later timings compared to applications in the seedbed. The work illustrated that plant populations below 100 plants/m^2 were unable to compensate in this situation and gave inferior quality and yield results compared to the economic optimum in this trial of 170 plants/m^2.

Whilst GS33 applications produced proteins below 12%, there is a risk with malting barley that these very late timings may produce proteins that are too high, particularly if the rate of applied N is excessive. Thus for malting barley in the southern Victorian HRZ it may still be more appropriate to time the majority of nitrogen in the GS30-32 window. For feed barley crops it should give more confidence that if nitrogen is delayed as late as GS33, it can still create yield responses.