# INTERCROPPING WHEAT, OATS AND BARLEY INTO LUCERNE IN VICTORIA

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*Summary*. Five field trials were conducted in North-central Victoria from 1992 to 1994 to evaluate a cereal-lucerne intercropping system. Intercropping caused cereal yield reductions of 6% to 60% of the yield of conventionally sown cereals.

## INTRODUCTION

Dryland lucerne (*Medicago sativa*) has a significant role in the predominantly mixed cropping/grazing farming area of north-central Victoria as a way of increasing the productivity and profitability of grazing enterprises (1). Lucerne is also valued in dryland salinity management because of its potential to reduce groundwater recharge.

On mixed farms approximately 30% of the farm area is cropped each year. The remainder is either in an annual or lucerne and annual pasture mix. The area of lucerne grown in the region has doubled to 8.5% of the region's farming area from 1984 to 1991. However, it is still perceived as being difficult to successfully establish and to integrate into a cropping/grazing farming system (2). In order to combine the two enterprises and allow an easier transfer between each phase, farmers have been sowing cereals and to a lesser extent grain legume crops into established lucerne stands. Sowing cereal crops into lucerne established the previous year has been the most commonly practiced form of intercropping, although intercropping into older lucerne stands also occurs in an effort to utilise added legume nitrogen. In either case lucerne is available for grazing after the cereal crop is stripped.

This paper reports on cereal-lucerne intercropping experiments designed to assess the suitability of different cereals for intercropping and the effect of intercropping on cereal growth and yield.

## MATERIALS AND METHOD

Field cereal-lucerne intercropping experiments were conducted from 1992 to 1994 at locations 25 to 50kms north of Bendigo in north-central Victoria. Sites were located at Elmore and Raywood in 1992, Elmore in 1993 and Bears Lagoon in 1994 on red brown earth soils. Sites were selected from lucerne stands of densities of between 12-15 plants/m$^2$ established one year before the cereal crop was sown. In each experiment two standard wheat and oat and one standard barley variety were direct drilled into lucerne in a randomised block design with four replicates. Cereals were sown at 100 kg/ha in 1992 and 70 kg/ha in 1993 and 1994. Control cereal plots containing no lucerne were also sown. Prior to sowing the lucerne was grazed. After a three to four week period Sprayseed$^R$ (paraquat+diquat) was applied at 2 L/ha to control weeds and temporarily suppress the lucerne. Lucerne production was measured from dry matter cuts of non-intercropped lucerne every six weeks from when the cereal was sown to harvest.

In 1992 an additional experiment was conducted to determine the effect of lucerne density on intercropped wheat and oat yields. Cereals were direct drilled into lucerne densities of 0, 5, 10, and 15 plants/m$^2$.

## RESULTS AND DISCUSSION

Growing season rainfall (Table 1) in 1992 and 1993 was well above average. In 1993, there was a dry start but both years had wet spring periods. In 1994 no effective rainfall occurred in winter and spring.

Table 1. Site, growing season rainfall (April-October), cereal sowing date and lucerne cultivar for field intercropping experiments.

| | Elmore 1992 | Raywood 1992 | Elmore 1993 | Bears Lagoon 1994 |
|---|---|---|---|---|
| Growing season rainfall (mm) | 485 | 380 | 320 | 133 |
| Mean growing season rainfall (mm) | 360 | 292 | 360 | 309 |
| Sowing date | 19 May | 25 May | 16 June | 25 June |
| Lucerne cultivar | Trifecta | WL451 | Trifecta | Siriver |

Intercrop and sole (lucerne-free) cereal grain crop yields (t/ha) are shown for each site (Table 2). Intercropping resulted in reductions in grain yield apart from the yield of Mortlock oats at Elmore in 1992. Yield reductions ranged from 6% for barley at Elmore in 1992 to 62% for barley at Elmore in 1993. Both wheat varieties and Echidna oats were the highest yielding crops in 1992 and 1993. Differences in intercrop yields between years could be attributed to lucerne vigour, seasonal conditions and sowing dates. Wheat crops in 1992 were able to gain a height advantage over the lucerne in early spring which may have reduced the competitiveness of lucerne for light. The ability of the cereal to achieve light dominance over the legume may be an important factor in determining the cereal yield (3).

However, yields of the semi-dwarf Echidna oat were not unduly affected by lucerne plants gaining a height advantage. In 1993, the failure to adequately suppress the lucerne at sowing and the greater competitiveness of the lucerne in spring resulted in the largest yield reductions of the trials. Yields for all cereals at Elmore in 1993 were approximately half of sole cereal crop yields. Apart from the 1994 experiment, intercropped cereal dry matter yields taken at cereal anthesis were similar to sole cereal yields. This suggests that it is in the post cereal anthesis period when competition in the intercrop is at its most intense. Intercropped cereal protein content was similar to that of sole crops.

Table 2. Sole crop and intercrop yields (t/ha).

| Site | Elmore 1992 | Raywood 1992 | Elmore 1993 | Bears Lagoon 1994 |
|---|---|---|---|---|
| Wheat:Rosella | 5.66 | 5.38 | 3.29 | 0.70 |
| Wheat:Rosella+L[a] | 4.11 | 4.04 | 1.74 | 0.40 |
| Wheat:Meering | 5.59 | 5.77 | 3.33 | 1.04 |
| Wheat:Meering+L[a] | 4.33 | 3.78 | 1.84 | 0.64 |
| Oats:Mortlock | 2.30 | 2.76 | 2.73 | 0.33 |
| Oats:Mortlock+L[a] | 2.36 | 1.86 | 1.35 | 0.30 |

| | | | | |
|---|---|---|---|---|
| Oats:Echidna | 5.60 | 5.86 | 3.79 | 0.79 |
| Oats:Echidna+L[a] | 5.01 | 4.43 | 1.83 | 0.66 |
| Barley:Schooner | 4.23 | 4.39 | 2.91 | 1.67 |
| Barley:Schooner+L[a] | 3.97 | 3.33 | 1.10 | 1.41 |
| Sig. of effects and errors: Crop l.s.d$_{5\%}$ Lucerne Wheat Oats Error M.S. | 0.24 P<0.001 P=0.29 P<0.001 0.15 | 0.26 P<0.001 P=0.25 P<0.001 0.19 | 0.33 P<0.001 P<0.001 P<0.001 0.07 | 0.28 P=0.13 P<0.001 P<0.001 0.07 |

[a]+L denotes lucerne intercrop

The effect of lucerne density on wheat and oat yields is shown in Fig 1. Increasing lucerne density reduced wheat and oat yields differently (P=0.07). Wheat yields were largely unchanged in lucerne densities of 0, 5 and 10 plants/m but were significantly reduced in a lucerne density of 15 plants/m$^2$. This indicates that wheat intercropped into lucerne densities of 5-10 plants/m$^2$ are less affected by competition from lucerne than intercropping into higher lucerne densities. In north-central Victoria lucerne densities in this order are considered by farmers to be acceptable for pasture production. In a less favourable season than 1992, intercropping into lucerne densities greater than 15 plants/m$^2$ would most likely severely reduce intercrop cereal yields. Intercropping did not affect lucerne stand density (plants/m$^2$) after the cereal component was harvested (data not shown).

Figure 1. The effect of lucerne density on grain yield.

Lucerne production measured from non-intercropped lucerne plots at Elmore was 5200 kg/ha and 4800 kg/ha in 1992 and 1993 respectively. Lucerne production in these experiments was higher than production from mixed pastures containing dryland lucerne growing in a similar environment. This was due to weed and annual pasture competition being removed by the application of Sprayseed prior to sowing. Normal pasture yields in the area are 4500 kg/ha of annual pasture in a growing season from April to November. With dryland lucerne, an additional production of 800 to 2000 kg/ha is produced from November to April. In this situation lucerne pastures are capable of increasing stocking rates from 4-5 DSE's/ha (dry sheep equivalents) to 8-10 DSE's/ha (1). With long term gross margins of $18 DSE, lucerne pastures are capable of gross margins of $160/ha compared to $80/ha for annual pastures. In 1992 gross margins for intercropped Meering wheat were $149/ha compared to $220/ha for a sole Meering wheat crop (based on feed wheat prices). A fuller economic appraisal of a cereal-lucerne intercropping system is needed to include benefits such as the flexibility of the system, the elimination of the need to re-establish lucerne after cropping, the ability to produce a opportunity crop and retainment of a productive perennial pasture.

## CONCLUSIONS

Factors such as lucerne vigour, density and seasonal factors determine the success of intercropped cereal yields. Further research is required to determine appropriate methods to minimise the competitive effect of lucerne on cereal growth.

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