

Leaf Area Development and Growth of Two Irrigated Brassica Forage Crops

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ABSTRACT

The growth and leaf area development of two brassica forage crops was studied under four levels of irrigation over a period of 90 days during spring and summer. Turnips (*Brassica rapa var. rapa*), and rape (*Brassica napus var. napus*) were grown without irrigation, and at 20%, 50% and 100% irrigation to maintain field capacity. Dry matter (DM) yield of both species responded linearly to total water (including rainfall and applied irrigation). Rape required 5% less water than turnips to produce each unit of net leaf area index (LAI). Turnips out yielded rape under all irrigation treatments and under dryland conditions. The increased production appears to be due to better conversion of leaf area into utilisable dry matter. Turnips produced more than twice the dry matter yield of rape for the same level of net leaf area developed.

KEY WORDS

Leaf area index, brassica, irrigation, turnips, rape.

INTRODUCTION

Summer is a limiting period for the production of milk in South East Australia. A reduction in available pasture caused by the onset of moisture stress under rainfed conditions occurs in most years, causing reduced milk production and an increased need for supplementary feeding after mid-December until late March. In Tasmania, 60% of dairy farms irrigate pasture to maintain production during this period. Typical growth rates of perennial ryegrass/white clover pastures in North West Tasmania under full irrigation are about 50 kg DM/ha.day⁻¹ (1) whereas, turnips produce ca. 137 kg DM/ha/day (A.A. Salardini, *pers. comm.*) when near fully irrigated over a similar period. Therefore, irrigated turnips appear to be an attractive potential alternative to irrigated pasture.

An experiment was conducted to investigate the effect of optimal and sub optimal irrigation on leaf area development and dry matter yield in turnips (*Brassica rapa var. rapa*) and rape (*Brassica napus var. napus*) over spring and summer.

MATERIALS AND METHODS

The experiment was conducted at the Elliott Research and Demonstration Station in North West Tasmania (41°5'S, 45°46'E) on a krasnozem soil [Gn4.11; (3)] from October 1999 to January 2000. Turnips (cv Barkant) and rape (cv Bonar) were sown at 1.4 and 6.8 kg/ha, respectively, on 13 of October 1999.

Irrigation sprinklers (as a point source) were modified to deliver varying levels of water across each species plot. The consequent water treatments were equivalent to no irrigation and 20%, 50% and 100% of irrigation to maintain field capacity. Over the period of the experiment rainfall was 205mm and the applied irrigation was 166mm in the fully irrigated (100%) treatment. Total water is the sum of irrigation and rainfall. Leaf area and yield samples were collected every 10 to 14 days.

RESULTS AND DISCUSSION

Net LAI (Ratio of live leaf area to ground area) of turnip and rape responded linearly to total water. There was negligible difference in intercepts and the slopes differed by only 5 %; Rape net LAI = $1.21X - 148.6$ ($R^2 = 0.74$), turnip net LAI = $1.16X - 157.5$ ($R^2 = 0.86$) where X = total water.

The efficiency of development of net LAI was not the critical factor in overall dry matter production, as turnip produced 46 kg DM per unit of net LAI compared to rape which produced only 22 kg DM (Figure 1).

This increased yield could be due to a number of factors including greater contribution of photosynthetic products to the development of the storage organs (swollen root), greater efficiency in photosynthesis, and/or photosynthate may be more efficiently stored as available dry matter by turnips.

Given the linear relationship between total water and net LAI; and net LAI and dry matter yield, it is not surprising there was a strong linear relationship between the dry matter yield of both species and the total amount of water. This is consistent with the finding of Neilsen *et al* (2) that for each millimetre of total water turnips produced 54 kg DM/ha ($R^2 = .85$) and rape produced 29 kg DM/ha ($R^2 = .77$).

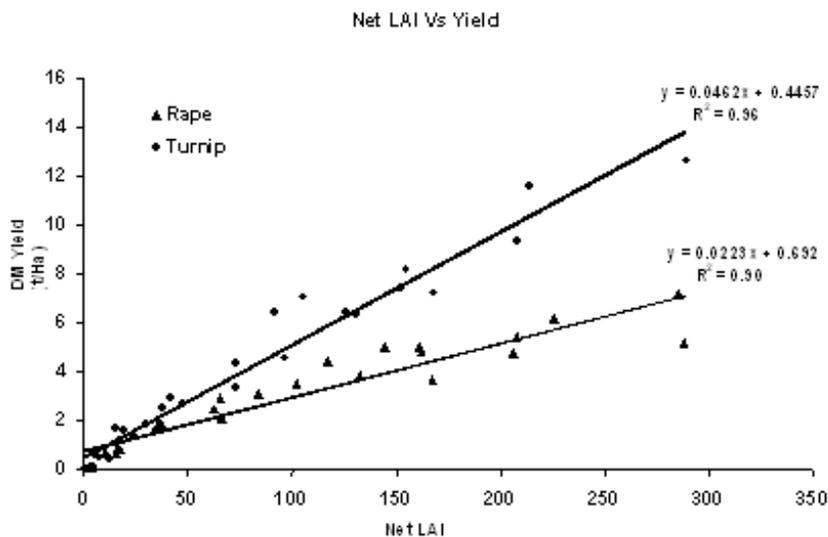


Figure 1. Net leaf area index versus dry matter yield of turnips and rape.

CONCLUSION

The accumulation of DM was higher in turnips than rape at any given net LAI, indicating greater partitioning to storage reserves and structural materials. While turnips have slightly higher irrigation demands than rape to produce similar net LAI's the increased efficiency in DM conversion in turnips compensates for the higher water use requirements

Investigating the physiological reasons for the water efficiency advantage of turnips appears to be an important step in optimising productivity and water use efficiency for this important summer forage crop.

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