Performance of two wheats with differing row configurations, and nitrogen and sowing rates

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Abstract

As part of a study monitoring water and nitrogen use in wheat-legume intercropping systems, field experiments (2004-05) were undertaken at Roseworthy (SA) to evaluate the yield performance with different row configurations, seeding rates and nitrogen inputs of two wheat cultivars differing in vegetative structure and maturation time (Frame and Wyalkatchem). Row configurations were based on standard 0.175 m spacings and included double skip (DSA) and single skip (SSA) arrangements, as well as sole crop configuration (Sole). SSA provided the higher yields in both the 2004 and 2005 compared with DSA, consecutively receiving only 10% and 14% yield reductions when compared to the sole arrangement, whereas the DSA treatment showed 20% and 21% penalties. The interaction between row configuration and seeding rate was significant in 2005 ($P<0.05$) and evidently associated with improved resource use by SSA plants at the highest seeding rate. Nitrogen inputs x cultivar interactions were also significant ($P<0.05$) with Wyalkatchem showing a greater response to the application of nitrogen. While measuring soil moisture, the significant interaction ($P<0.05$) between cultivar and row configuration illustrated that Wyalkatchem had reduced uptake in the DSA arrangement. The lower yields and conservation of soil moisture within the DSA treatment suggest a reduction in the horizontal accessibility of resources, therefore improving their availability for summer active forage legumes grown as an inter-row crop.

Keywords

Intercropping, winter cereals, summer legumes, spatial arrangement

Introduction

Crop production depends on the ability of plants to capture resources. On an annual basis, farming systems centred on single crops waste large proportions of key inputs (Caviglia, 2004). Therefore increased interest into cropping systems involving multiple crops per year to improve resource capture and productivity is evident. Although not widely explored within southern Australia, winter cereal / summer forage intercropping is one example of a system that does this. Complementarity between the different species of an intercrop is one of the most important factors to its success, with the crops involved collecting resources from different zones (spatial dimension) and/or at different times (temporal dimension) (Francis, 1986). So far the research in this area has taken advantage of the temporal complementarity available by using crops of differing seasonal activity. However, it is only now with the advent of guidance technology that intercrops can effectively be separated spatially on a large scale. The following study looked at the effects of alternative spatial configurations, and seeding and N rates, on two wheat cultivars differing in vegetative structure and maturity.

Materials and Methods

Two experiments took place during the winter growing seasons of 2004 and 2005 at the Roseworthy Campus, the University of Adelaide (mean 330 mm rainfall April - October). Two varieties of wheat Frame (mid to late season maturity) and Wyalkatchem (early to mid) were sown mechanically at a row spacing of 0.175 m. Blocking certain rows allowed different spatial seed placement configurations. These configurations were: double skip (DSA), single skip (SSA) and sole crop (Sole). Sowing rates for each configuration were 40 and 80 kg. Fertilisation rates of 0, 30 and 60 kg N/ha (as urea) were evaluated only in 2005. All treatments were replicated 4 times. Soil moisture data within and between rows were taken using 15 cm TDR probes at two-week intervals from anthesis to senescence.

Results and Discussion

In both seasons wheat yield responses were of similar magnitude and row configuration had the most significant effect ($P<0.001$) (Figure 1.). SSA yielded on average 9% more than DSA. Yield penalties compared with the Sole treatment were 10 and 14% for SSA and 20 and 22% for DSA in 2004 and 2005, respectively.

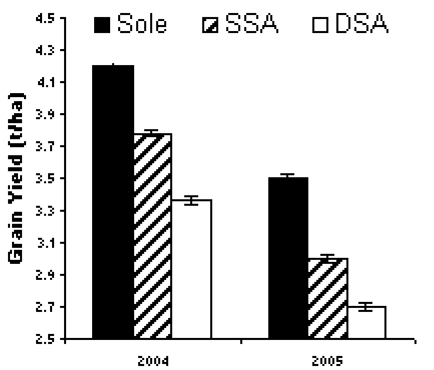

Figure 1. Grain yield of the varying row configurations

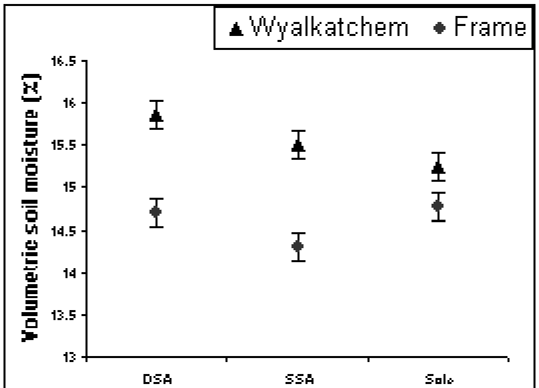

Figure 2. The relationship between mean Vol. soil moisture (%) and cultivar

There was also a significant nitrogen x cultivar interaction (lsd = 0.11, $P<0.05$). At 60 kg N/ha, grain yield increased from 2.95 to 3.31 t/ha in Wyalkatchem and from 2.60 to 2.79 t/ha in Frame.

Figure 2 shows the cultivar*row arrangement mean moisture contents ($P<0.05$), where the earlier maturing Wyalkatchem retained more soil moisture than Frame in the DSA than Sole crop.

Table 1. Row arrangement and seeding rate on yield (t/ha) (interaction lsd= 0.14)

Row arrangement	Seeding rate (40 kg/ha)	Seeding rate (80 kg/ha)
DSA	2.511	2.687
SSA	2.637	3.016
Sole	3.236	3.375

The significant relationship ($P>0.001$) between row arrangement and seeding rate on yield is shown in Table 1. The interaction of greatest significance was associated with the SSA plants at the highest seeding rate. Also evident in these data is the marginal difference of yield between seeding rates for the DSA arrangement, suggesting that a lower seeding rate may be found to achieve similar yields.

Conclusion

The lower yields of the DSA sowing treatment suggest a reduced use of resources. This, coupled with the variation in water use between cultivars suggests that a preferred system is possible that conserves resources for an adjacent sown rain fed summer forage (temporal dimension). As yield penalties for the DSA treatment were only 20-22%, the prospects for producing a greater land equivalence ratio through intercropping with summer active forage crops in south-east Australia is promising.

References

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