GROWTH ANALYSIS OF SHORT AND LONG SEASON COTTON CULTIVARS?

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Abstract

According to the nutritional hypothesis, the timing of crop maturity in cotton is affected by when the fruit that are already growing monopolise resources and prevent the crop from producing new fruiting sites. Maturity can therefore be influenced by either the supply of resources to the fruit or the level of demand generated by the fruit. Growth analysis was used to examine the supply of resources, in terms of the production and partitioning of dry matter, of an early and a late maturing cultivar grown in two fully irrigated field experiments. The two cultivars did not differ in peak leaf area index, above ground dry matter production or in allometric partitioning between the fruit and the rest of the shoot. Differences were however, found in light interception, canopy light extinction coefficient and radiation use efficiency in one experiment but not in a way that explain the differences in maturity.

Key words allocation, extinction coefficient, Gossypium hirsutum, light interception, partitioning, RUE

Cotton is an indeterminate species. The timing of crop maturity is not governed directly by temperature and photoperiod. Rather, according to the nutritional hypothesis, the timing of crop maturity is determined by when the fruit that are already growing monopolise resources and prevent the crop from producing new fruiting sites (1). Usually, the crop then finishes maturing the fruit that are already set. Crop maturity can therefore be affected by either the supply of resources to the fruit or the demand the fruit are generating in terms of their number or growth rate. In this paper we use growth analysis to examine the supply of resources in terms of the production and partitioning of dry matter, of an early and a late maturing cultivar.

Methods

An early maturing (Siokra S324) and late maturing (Siokra L22) cotton cultivar were studied in two field experiments grown on a uniform grey clay at Narrabri, NSW. The crops were sown on a 1m row spacing with 10 plants m-2. Full irrigation and commercial insect control were used and N was applied as anhydrous ammonia six to eight weeks prior to sowing. Exp 1 was sown on 10 Oct 1995 and received 150 kg ha-1 of N. Plots were 175m by 4 rows and a completely randomised design was used with three replicates. Exp 2 was sown on 11 Oct 1996 and received 113 kg ha-1. A randomised complete block design and four replicates were used. Plots were 75m by 4 rows. Starting just before first square, 1m2 samples were taken on a fortnightly basis and leaf area index (LAI) and dry weight of fruit, leaf and stem determined. The proportion of photosynthetically active radiation intercepted (PAR) by the canopies was measured weekly.

Results and discussion

The aim of this experiment was to determine whether differences in the dry matter production or partitioning could have contributed to the differences in crop maturity of a late and an early cotton cultivar. Differences were found between S324 and L22 in Exp 1 in terms of accumulated light interception and radiation use efficiency (RUE) as measured over the whole period of measurement but not in a way that explained their maturity (Table 1). No differences were measured in Exp 2. The difference in light intercepted between cultivars in Exp 1 was due to a higher light extinction coefficient (k) and not greater canopy size (Table 1).

According to the nutritional hypothesis, a greater assimilate supply for the production of fruiting sites should result in prolonged fruit production and delayed maturity. The combination of the higher cumulative light interception and the higher RUE of S324 might suggest that S324, the early cultivar, would have the greater supply of photosynthate for the production of new fruiting sites. However, since the allometric partitioning (2) of the resources did not differ between the cultivars the greater supply of dry matter should lead merely to a larger plant in S324 (Figure 1). In either case, the differences do not explain why it is the earlier cultivar. Further studies are considering within season variation of growth and partitioning, demand for resources by fruit, and are including a greater range of growth conditions.

Variable	Experiment	Cultivar S324	Cultivar L22	Pooled SE	Significance
LAI	1	3.02	2.52	0.30	n.s.d.
?	2	1.70	1.82	0.27	n.s.d.
PAR (MJ m-2)	1	1024	976	12	*($P < 0.05$)
?	2	626	599	20	n.s.d.
k?	1	0.64	0.77	0.03	* ($P < 0.05$)
?	2	0.62	0.65	0.03	n.s.d.
TDM (g m-2)	1	870	811	47	n.s.d.
?	2	621	582	22	n.s.d.
RUE (g MJ-1)	1	1.07	0.89	0.03	* ($P < 0.05$)
?	2	1.03	1.00	0.03	n.s.d.

Table 1: Comparison of peak LAI, cumulative PAR, k, total dry matter (TDM) and RUE for the two cultivars in the two field experiments. (n.s.d. - no significant difference).

Conclusions

The late and early cultivars did not differ in peak leaf area index, above ground dry matter production or in allometric partitioning between the fruit and the rest of the shoot. In one season differences were however, found in light interception and canopy light extinction coefficient. The short season cultivar also had a significantly higher radiation use efficiency, but this does not explain why it matures earlier.

Acknowledgments

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References

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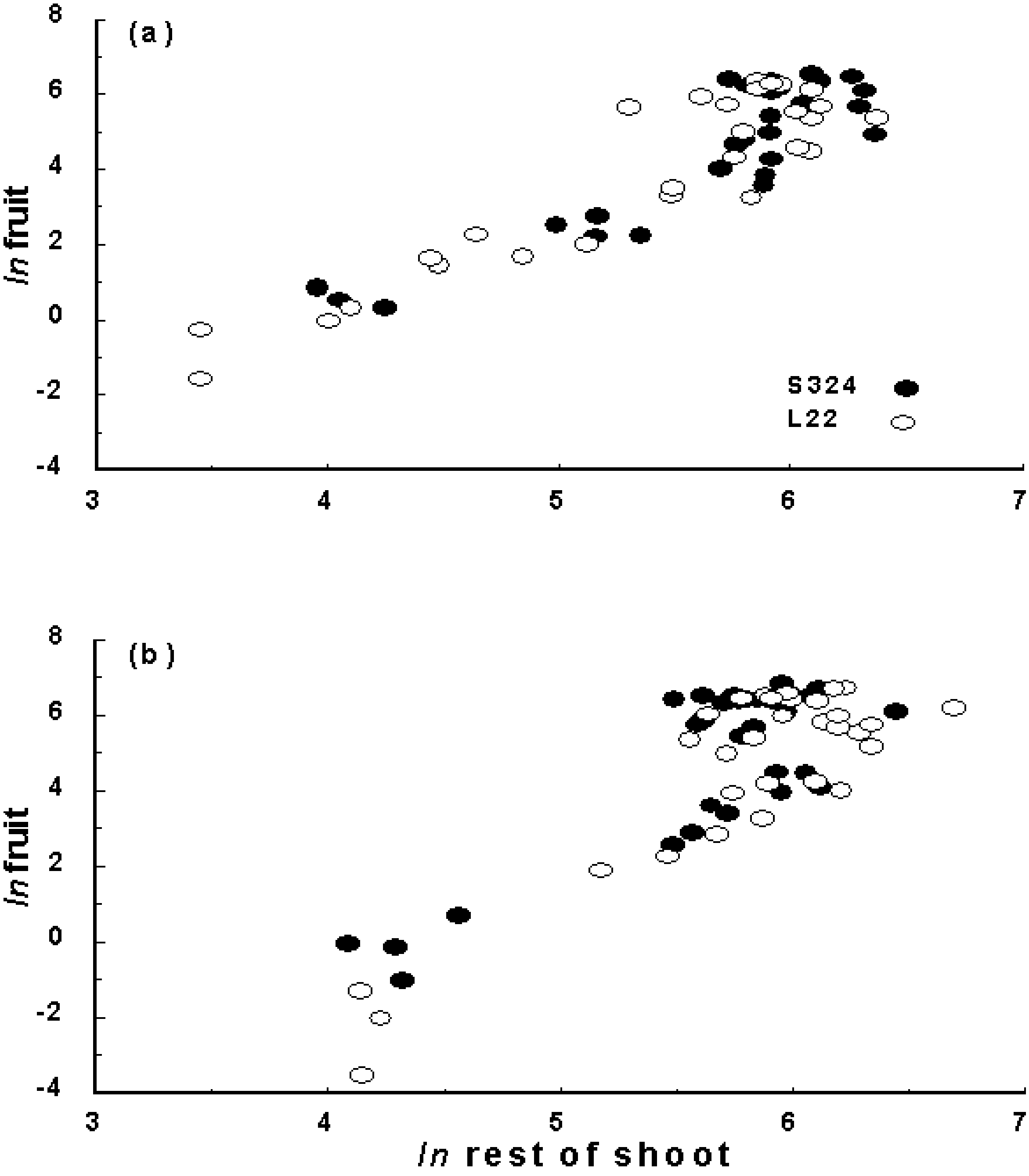

Figure 1: Comparison of the allometric partitioning of the two cultivars in the two field experiments.