Drought tolerance characteristics of Brazilian soybean cultivars

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Objectives

Soybean production in South America is highly productive but severely diminished if drought occurs during the reproductive growth stages of soybean crops. In order to illuminate the physiological and morphological characteristics associated with drought tolerance as measured by a yield index, scientists artificially measured drought stress during the reproductive growth stage of soybean cultivars from southern Brazil using rainout shelter treatment from 1999 to 2000.

Results

Researchers determined that yield ranking among cultivars in the rainout shelter (RS) plots was stable across the two-year period with a correlation coefficient for yield ranking significant at the 1% level (r=0.78). Although the irrigated plot showed the yield rankings in a different order, there was a significant correlation between the rankings for two seasons, suggesting that drought tolerance should be detectable using rainout treatment.

On the basis the RS plot yield figures, cultivar BRS 183 displayed high drought tolerance, while BR-16, Embrapa 59, and BRS 134 showed low drought tolerance (Table 1). The results of growth analysis (Table 2) in the RS plots during the rainout treatment period illustrated that the BRS 183 had a high relative growth rate (RGR), and thus, a high drought tolerance. BR-16, Embrapa 59, and BRS 134 displayed low RGRs and low drought tolerance. RGR differences reflected a difference in net assimilation rate (NAR), but the leaf area ratio (LAR) did not differ among cultivars. BRS 183 had large root dry weight during the drought period compared with the low drought tolerance cultivars, namely BR-16, Embrapa 59, and BRS 134 (Fig. 1).

Based on these results, it was concluded that relative growth rate during drought conditions for a one-month period following flowering can serve as a good index for analyzing how drought tolerance differs among cultivars. However, if drought occurs during other periods, drought response may not necessarily be the same as reported in this study.

Table 1. Seed yield of ten Brazilian soybean cultivars under drought conditions using rainout shelters.

No.	Cultivar	Seed yield (t ha^{-1})	
		1999/2000	2000/2001
1	BR-16	1.01	1.38
2	BR-37	1.24	1.76
3	Embrapa 48	1.07	1.72
4	Embrapa 59	0.86	1.34
5	BRS 132	1.05	1.68
6	BRS 133	1.08	2.02
7	BRS 134	1.06	1.20
8	BRS 183	1.23	2.38
9	BRS 184	1.10	1.99
10	BRS 185	0.88	1.57
	LSD (5%)	0.70	0.84

After first flowering soybeans received no rains for one month under rain-out shelters. Cultivars with high drought tolerance are represented in blue and those with low tolerance in red.

Table 2. Growth parameters of soybean cultivars in rainout-treated (RS) plots during the drought stress period (1999/2000).

No.	Cultivar	RGR g g^{-1}d^{-1}	NAR g m^{-2}d^{-1}	LAR m^2 g^{-1}
1	BR-16	0.015	1.3	0.012
2	BR-37	0.035	3.1	0.012
3	Embrapa 48	0.006	0.6	0.010
4	Embrapa 59	0.010	0.8	0.012
5	BRS 132	0.030	2.8	0.011
6	BRS 133	0.034	2.9	0.012
7	BRS 134	0.019	1.6	0.012
8	BRS 183	0.046	3.9	0.012
9	BRS 184	0.031	2.7	0.011
10	BRS 185	0.031	3.0	0.011

After first flowering soybeans received no rains for one month under rain-out shelters. RGR=NAR × LAR. Cultivars with high drought tolerance are represented in blue and those with low tolerance in red.

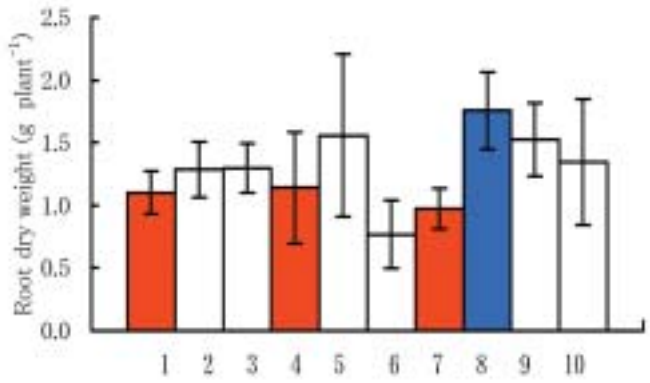

Fig. 1. Root dry weight of soybean plants 20 days after first flowering (2000/2001). Means ± SD of 3 replicates. Cultivars with high drought tolerance are represented in blue and those with low tolerance in red.

References

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