Auburn University
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Cooperative

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THE MORPHOLOGY OF SWEETGUM SEEDLINGS

by
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INTRODUCTION

Sweetgum is often used for plantation management in the South with nurseries producing the 1-0 bareroot planting stock typically used for plantation establishment. Similar to many hardwoods, there has been a limited amount of research on the morphological aspects of sweetgum planting stock. In this study, the morphological characteristics of sweetgum seedlings are plotted by seedling root collar diameter. These measurements were part of a larger study looking at sweetgum seedling quality and plantation establishment and growth.

METHODS

A total of 600 large (12.0 - 15.9 mm RCD) and 600 small (4 - 7.9 mm RCD) bareroot 1-0 sweetgum seedlings were hand-lifted from a nursery in the lower Coastal Plain of Alabama in late January. Twenty-five seedlings were taken randomly from both the small and large seedling samples. These fifty seedlings were taken to Auburn for analysis and the following morphological characteristics recorded: height, root collar diameter, the number of first order lateral roots (defined as any root coming directly off the taproot that was 1 mm in diameter or larger), the fresh and dry weight of the lateral roots on each seedling, the fresh and dry weight of the taproot, the fresh and dry weight of all branches on each seedling, and the fresh and dry weight of the seedling stem (without branches). Regression analyses were then used to explore the relationships among these parameters, concentrating on diameter and height (which are relatively easy to obtain) with other morphological characteristics.

RESULTS

Table one presents the result of regression analyses of RCD and height with various morphological characteristics. Selected relationships are graphed in Figures 1 through 4. Most of the regressions using RCD resulted in strong correlations and high R^2 values. There is a strong relationship between root collar diameter and first order lateral roots. In other words, sweetgum RCD can accurately pre-

Table 1. Regressions of various sweetgum morphological characteristics against diameter at root collar (RCD) and seedling height. (Units: RCD in mm, height in cm, and weight in grams.)

Parameter	Model	R^2
	Ht = 22.6 + 6.98(RCD) - .21 (RCD)^2	.66
	No. = 2.0(RCD) - 7.0	.76
	Wt. = .88 - .91(RCD) + .15(RCD)^2	.88
	Wt. = .09(RCD) - .37	.61
	Wt. = 1.17(RCD) - 4.05	.87
	Wt. = .5(RCD) + .14(RCD)^2 - 4.19	.94
	Wt. = 2.55 - .87(RCD) + .07(RCD)^2	.90
	Wt. = 1.81(RCD) - 7,86	.93
	Wt. = 0.12(RCD)^2 - .05(RCD) - 1.18	.95
	Wt. = 0.45(RCD) + .26(RCD)^2 - 5.36	.96
% of seedling weight in lateral roots	% = 2.68(RCD) - 3.61	.72
% of seedling dry weight in top root	% = 53.2 - 2.09(RCD)	.58
% of seedling dry weight in roots	% = 49.6 + .59(RCD)	.08
% of seedling weight in branches	% = .94(RCD) - 4.32	.81
% of seedling weight in stem	% = 54.8 - 1.53(RCD)	.39
% of seedling weight in shoot	% = 50.4 - .59(RCD)	.08
Height regressed against:		
Diameter	RCD = 0.21(Ht) - 4.9	.63
No. of first order lateral roots	No. = .43(Ht) - 17.17	.50
Total dry weight of laterals†	Wt. = .40 - 18.83(Ht)	.43
Average dry weight of laterals	Wt. = 0.2(Ht) - .69	.30
Tap root dry weight	Wt. = 10.08 - .41(Ht) + .01(Ht)^2	.63
Total root dry weight	Wt. = 27.0 - 1.20(Ht) + .01(Ht)^2	.58
Branch dry weight	Wt. = 9.58 - .40(Ht) + .004(Ht)^2	.55
Stem dry weight	Wt. = 21.27 - .89(Ht) + .01(Ht)^2	.73
Total shoot dry weight	Wt. = 30.86 - 1.29(Ht) + 0.1(Ht)^2	.70
Total seedling dry weight	Wt. = 57.85 - 2.49(Ht) + .03(Ht)^2	.65

† Total seedling 1st order lateral root dry weight divided by the number of lateral roots.

dict both the number and biomass of first order lateral roots. First order laterals may in fact be closely related to outplanting performance as some studies have indicated (Kormanik 1986, Schultz and Thompson 1997). But as a morphological indicator, they require extra time to obtain. As expected, diameter correlated very well with taproot weight, total root dry weight, stem weight, branch dry weight, and total dry weight. The R^2 of all these parameters was .90 or above when regressed against diameter. These relationships may change if root pruning/undercutting are conducted prior to lifting. Other cultural treatments, particularly spacing, may also modify these relationships. Although the nature and the strength of the relationship probably remains the same, the regression equations will vary by nursery.

Interesting trends could be observed when looking at the proportion of total seedling dry weight represented by lateral roots and branches as seedling size increases. Figure 3 shows that as seedlings get bigger (i.e. have larger diameters) the proportion of seedling weight in lateral roots increases, while the proportion of seedling dry weight in the taproot decreases. The same thing happens above ground with branch dry weight increasing as a proportion of total seedling biomass, while the stem proportion decreases. These changes do not result in any significant shifts in the proportion of root and shoot balances, however, as the proportion of seedling weight below ground and the proportion of seedling weight above ground remained constant (55% and 45%, respectively) through the range of seedling diameters studied here.

Seedling height was a poor predictor of all morphological parameters reviewed. The highest R^2 for any parameter was .73 (when height was regressed against stem dry weight).

MANAGEMENT IMPLICATIONS

The very close relationship between RCD and other morphological characteristics supports its continued use as the most important single factor to characterize sweetgum seedling morphology. The number of first order laterals may be accurately predicted by RCD. Height, on the other hand, is poorly correlated with all other morphological attributes and is likely, therefore, to be a poor predictor of outplanting success.

References

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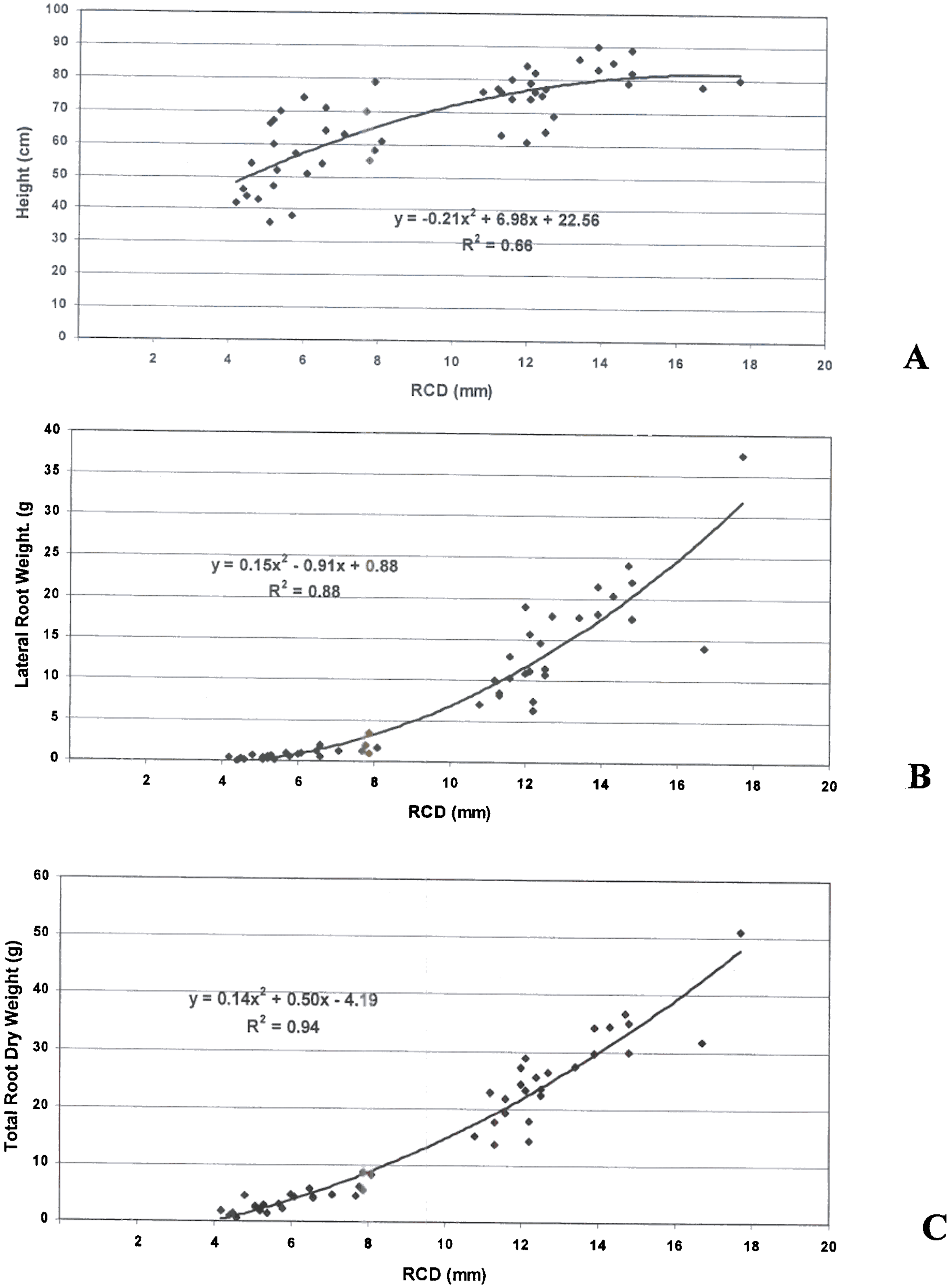
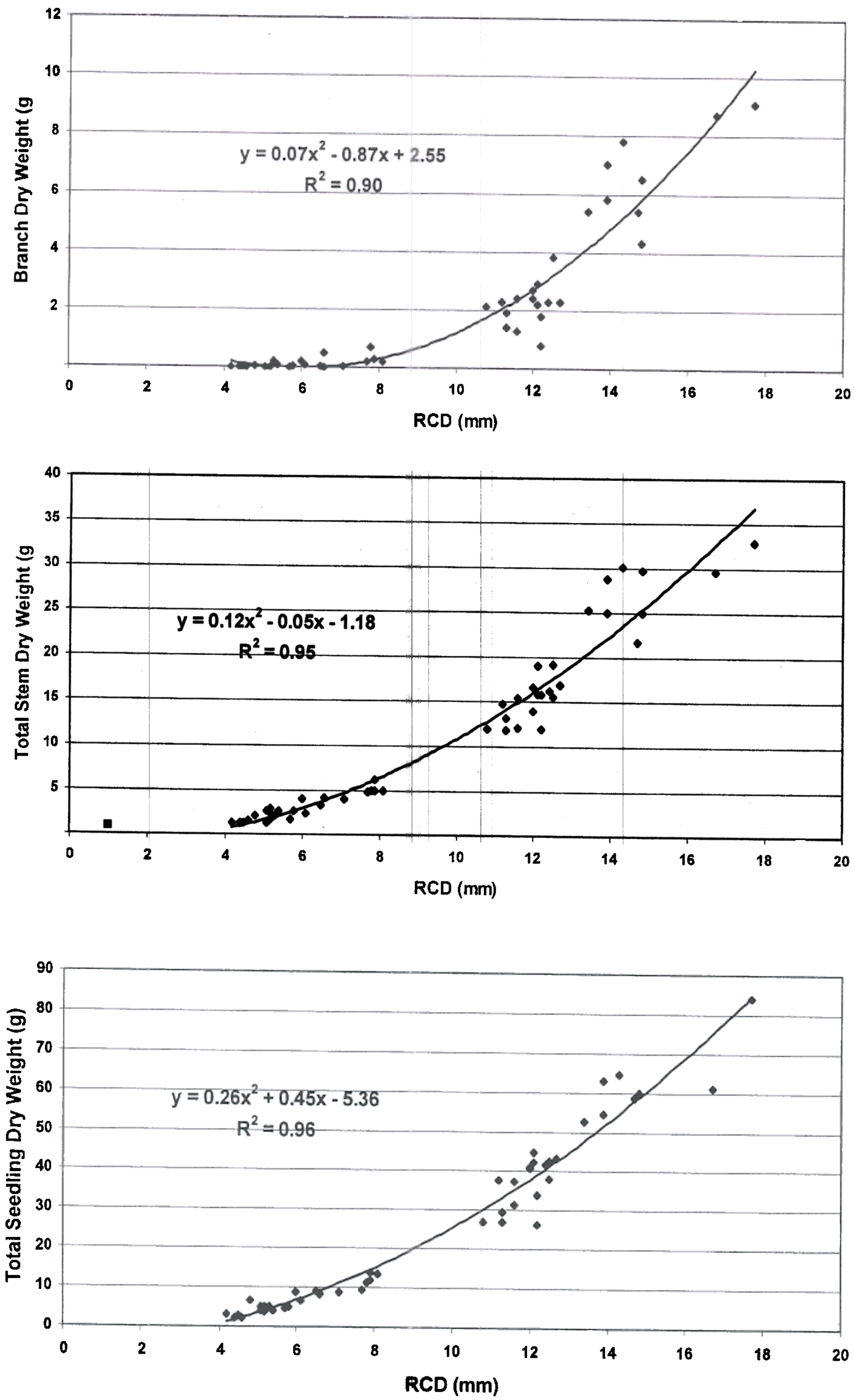


Figure 1. The regression of seedling root collar diameter against seedling height (A), the dry weight of seedling lateral roots (B), and total root dry weight (C).



A

B

C

Figure 2. The regression of seedling root collar diameter with the total dry weight of seedling branches (A), total stem (above ground) dry weight (B), and total seedling dry weight (C).

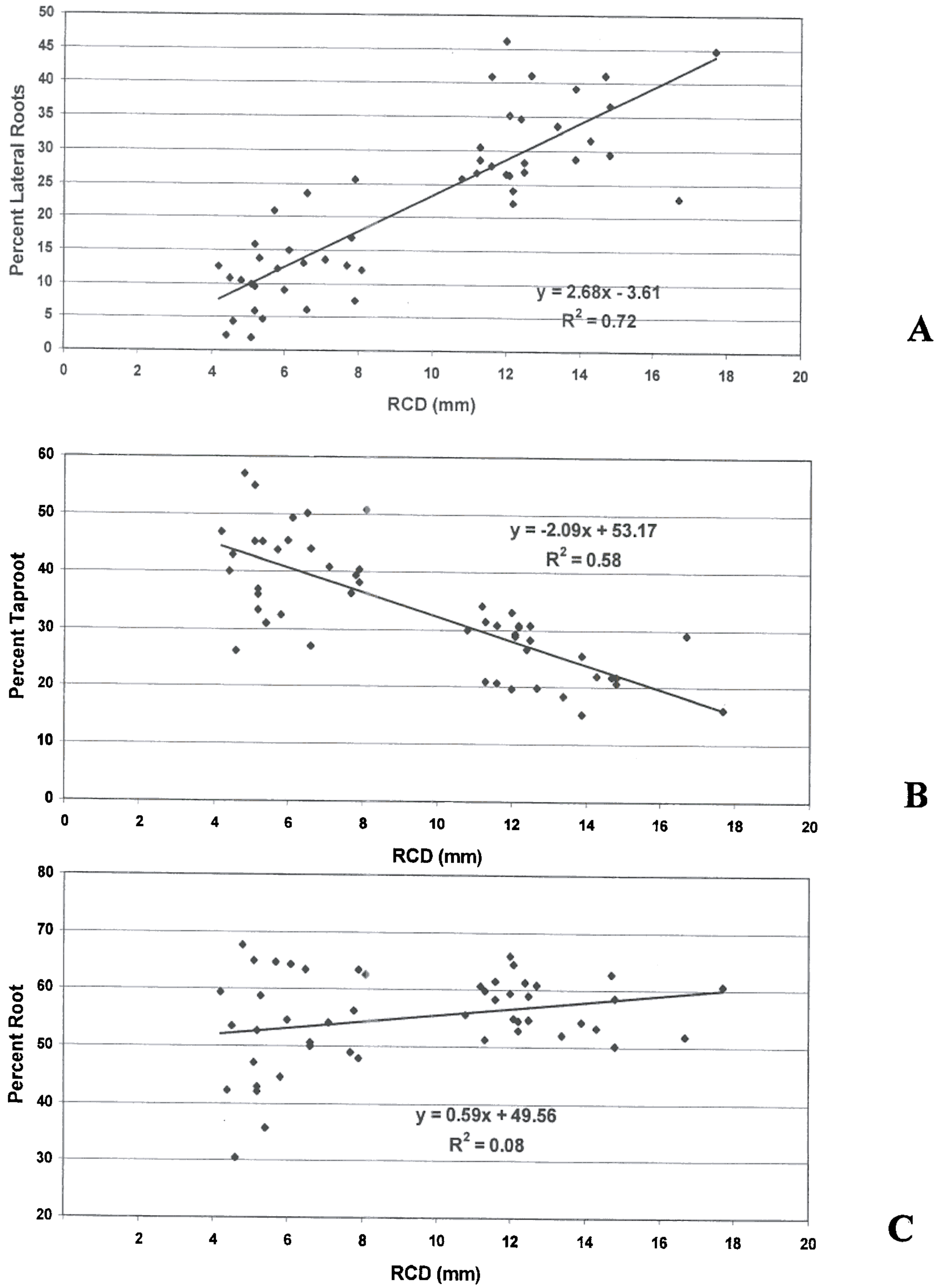


Figure 3. The regression of seedling root collar diameter with percentage of total seedling dry weight in lateral roots (A), the taproot (B), and total root dry weight (C).

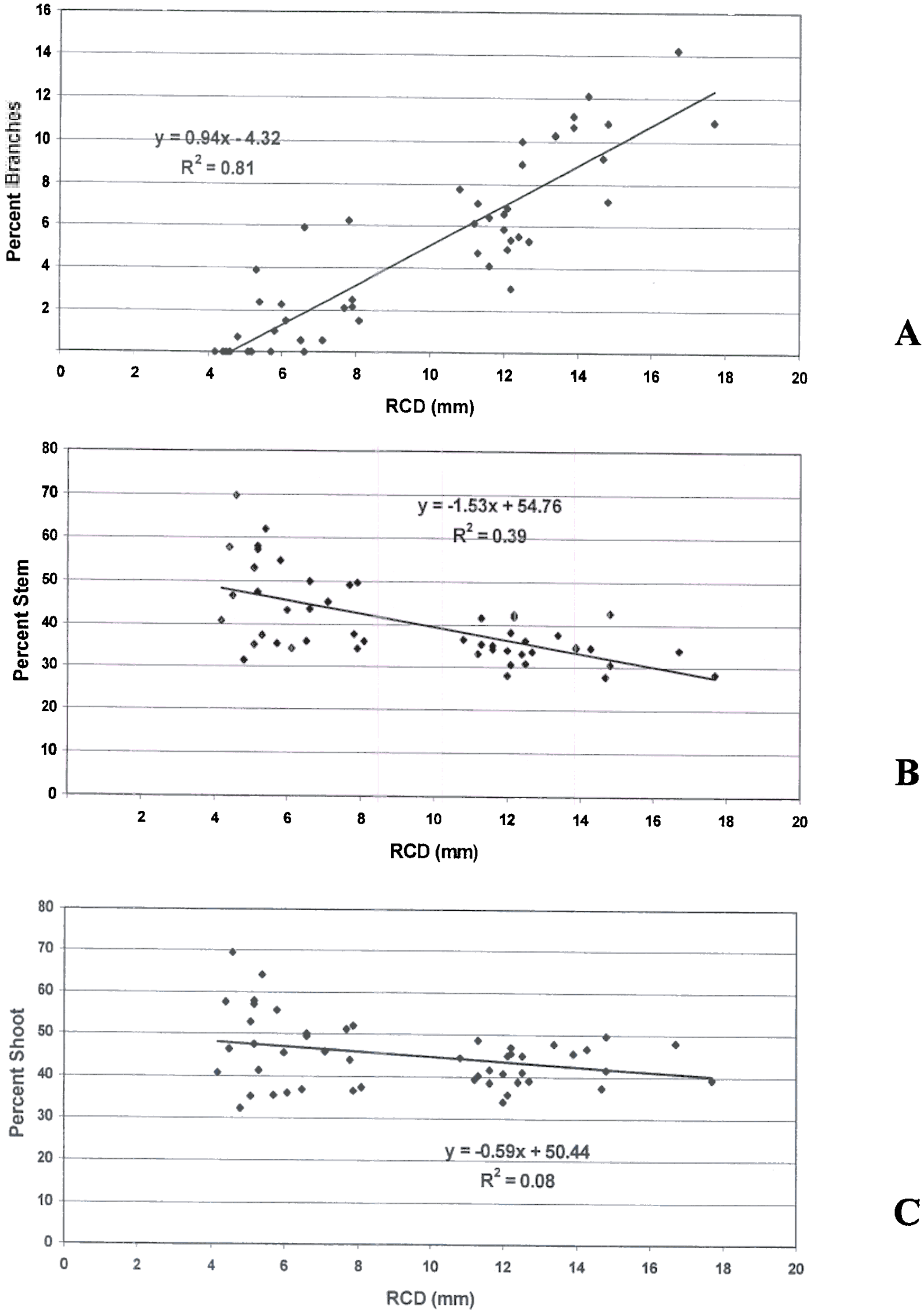


Figure 4. The regression of seedling root collar diameter with the percent of total seedling dry weight in branches (A), stem (B), and total shoot dry weight (C).