ICE DAMAGE EFFECTS ON THINNED LOBLOLLY PINE (*PINUS TAEDA*) STANDS IN SOUTHEASTERN OKLAHOMA

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Loblolly pine plantations in southeastern Oklahoma and Arkansas are periodically subjected to damaging ice storms. Following one such event, damage to a 25-year-old, previously thinned stand was assessed and quantitative relationships were developed to guide stand management in ice storm-prone areas.

Our objective was to assess the impact of ice-loading on stand structure and survivability, and to determine the predictive power of pre-storm stand parameters to estimate potential susceptibility of plantations to ice damage.

The loblolly pine stand was measured for the following: (1) pre-storm tree height (feet), (2) pre-storm dbh (inches), (3) pre-storm height (feet) to base of live crown, (4) pre-storm percent live crown, (5) post-storm dbh (inches), (6) post-storm tree mortality, (7) post-storm tree diameter (inches) at point of bole breakage, (8) post-storm height (feet), (9) post-storm tree height (feet) at point of bole breakage, (10) post-storm height (feet) to base of live crown, (*11)* post-storm percent of crown missing or damaged,(12) post storm percent of live crown, (13) post storm tree lean, and (14) post storm insect damage (present or absent). Parameters 1, 2, 4, 5, 8, 10, 11, and 12 are predictors that were assessed in the development of a regression equation to predict potential damage by ice to thinned stands.

Loblolly pine pre-storm tree dbh, height, and percent live crown were useful to predict post ice storm tree height loss (Table 1). The prediction equation (Height Loss Due to Ice Damage = - 26.40 + Pre-storm dbh (1.82) + Pre-storm Percent Live Crown (-3.26) + Pre-storm Height (- 0.14)) (R^2 = 0. 213 (F = 17.90, df (3, 198), $p<0.0001$)) could be used to estimate potential loss of tree height and in turn the amount of standing timber volume lost due to ice damage. This equation had the maximum R^2 among all equations with three independent variables.

The regression analysis suggested that the pre-storm tree diameter is the strongest predictor ($t = 4.60$, $p<0.0001$) of potential height loss due to ice damage (Table 2). With this in mind, another regression analysis was performed regressing post-storm tree height loss to pre-storm dbh. Height Loss Due to Ice Damage = - 36.80 + Pre-storm dbh (1.68) (R^2 = 0. 209 (F = 53.13 df (1, 200), $p<0.0001$)). Therefore, the height loss could be predicted from pre-storm dbh alone ($t = 7.29$, $p<0.0001$). This equation is much simpler and of particular value when pre-storm tree height and pre-storm percent of live crown were not known.

In this study, trees with larger dbh's tended to lose more height due to ice-loading. Shorter trees with a smaller live crown ratios were more likely to be damaged.

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Table 1—Pre- and post-storm loblolly pine metrics

Variable	% CROWN DAMAGE	N	MEAN	STD DEV	MAX	MIN
Pre-Storm Height Year 2000 (Feet)	No Crown Damage	202	75.6	4.7	88.5	54.5
Pre-Storm Diameter Year 2000 (Inches)	No Crown Damage	202	13.4	3.1	24.7	6.6
Pre-Storm Percent Live Crown Year 2000	No Crown Damage	202	27.8	8.0	48.7	14.3
Post Storm Height Year 2001 (Feet)	No Crown Damage	48	76.2	7.5	89.8	58.9
	1% TO 25%	46	76.2	4.9	88.1	63.0
	26% T0 50%	58	73.4	7.0	94.4	56.3
	51% TO 75%	18	62.1	10.2	74	41.9
	76% TO 99%	8	62.7	8.7	71.1	48.2
	100 % CROWN LOSS	24	37.4	14.9	56.8	14.8
Post Storm Diameter Year 2001 (Inches)	No Crown Damage	48	9.1	2.7	17.6	5.7
	1% TO 25%	46	14.0	3.2	21.5	1.5
	26% T0 50%	58	14.5	3.6	25.5	7.9
	51% TO 75%	18	13.5	2.7	17	8.2
	76% TO 99%	8	11.8	2.9	19.1	9.2
	100 % LOSS OF CROWN	24	9.2	2.0	13.5	6.2
Total Height Loss From Damage (Feet)	No Crown Damage	48	0	0	0	0
	1% TO 25%	46	7.2	5.8	19.17	0
	26% T0 50%	58	12.7	5.5	25.0	0
	51% TO 75%	18	15.1	5.4	23.0	8.3
	76% TO 99%	8	15.7	4.3	22.9	11.1
	100 % LOSS OF CROWN	24	39.9	13.3	66.0	21.0

Table 2—Regression analysis of predictors of tree height loss.

R-Squared	Coefficient of Variance	Root MSE	Mean Height Loss
0.210246	-68.17096	10.21518	-14.98465

Parameter	Estimate	STD Error	t Value	Pr > | t |
Intercept	-26.39867788	12.13364051	-2.18	0.308
Pre Storm Diameter	1.81907633	0.39553198	4.6	<.0001
Pre Storm Percent Live Crown	-3.25611597	11.35658543	-0.29	0.7746
Pre Storm Height	-0.138337156	0.15756510	-0.88	0.3809