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DEER DAMAGE TO CITRUS GROVES IN SOUTH FLORIDA[1,2]

by

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INTRODUCTION

Florida's deer population increased from 32,000 (Newman and Griffin, 1950) to over 164,000 (Harlow and Jones, 1965) between 1950 and 1964. A phenomenal expansion in Florida's agriculture coincided with this five-fold increase in deer. Of particular importance in this respect is the increase in citrus groves in South Florida. In the past, citrus was restricted principally to the sandy, rolling hill sections of peninsula Florida. During recent years, however, there has been a marked increase in the utilization of the slash and longleaf pine flatwoods and even fresh water marshes for citrus culture. Extensive water control measures, developed for such locations (Sites, *et al,* 1964), has made citrus expansion into these lowlands possible. A recent estimate places the one-tree annual value of the citrus crop at $256,000,000 (University of Florida Institute of Food and Agricultural Sciences, 1964). Consequently, any factor affecting citrus production attracts major attention in Florida.

The present study was supported by a two-year grant from the Florida Game and Fresh Water Fish Commission through the use of Federal Aid (P/R) funds. Results are based upon a questionnaire survey conducted during the late winter and spring of 1966 and a series of deer preference and spray repellant tests carried on during the fall of 1966 and the winter of 1966-67.

PREVIOUS INVESTIGATIONS

Land managers and wildlife ecologists have long been concerned with the problem of deer damage to agricultural crops and with its control. Perhaps the earliest mention of the citrus-deer problem was by Biehn (1951), who reported that citrus was the crop most seriously affected by deer in California. Damage was attributed to (1) increasing deer populations, (2) reduced amounts of natural browsing and watering areas coincident with spreading settlement and economic development, and (3) the presence of attractive food crops planted in ranges normally occupied by deer. A later paper from California (Strauss, 1966), reports deer browsing as the most critical factor influencing the development of a young citrus orchard.

The existence of a deer problem in Florida citrus groves was recognized in the early 1950's in a report by Stanberry (undated). At that time citrus damage by deer was associated with the extension of plantings onto wildlands with an existing substantial deer population, rather than with an increase in the size of the state's deer herd. Young trees were most commonly damaged, probably because of their low height and the small amount of foliage per tree. Since fruit production

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was greatly affected, browsing damage was cumulative in nature. For example, when young trees were killed by overbrowsing, costs to the grove owner included purchasing and planting new stock in addition to the cost of delayed fruit production. Damage was greatest during the months of January and February and occurred most frequently in areas bordered by natural cover.

QUESTIONNAIRE SURVEY

The nature and extent of deer damage to citrus reported here are based upon a questionnaire (see Appendix) distributed to all members of the Florida Citrus Production Managers Association, a statewide organization of 140 grove owners or supervisors in close contact with much of the state's citrus acreage. Additional questionnaires were mailed to selected County Agricultural Agents for distribution to growers whom they knew had experienced deer damage. Information reported here is based upon the three-year period 1963 to 1965.

DEER PREFERENCE AND REPELLENT TESTS

These field tests constituted a separate phase of the study and were designed to ascertain the relative preferences of deer for different varieties of citrus and to rate the effectiveness of certain selected repellents in alleviating browsing on citrus. The citrus varieties tested were: (1) a sweet orange, Valencia (*Citrus sinensis*); (2) a grapefruit, Marsh seedless (*C. paradisi*); (3) a tangerine, Dancy (*C. reticulata*); and (4) a tangerine hybrid, Orlando tangelo. Repellents tested are listed in Table 1, along with information on the concentrations and the "sticker" used.

TABLE 1—REPELLENTS, STICKER, AND CONCENTRATIONS OF EACH USED IN SPRAY FORMULATIONS, OCTOBER 1966 THROUGH FEBRUARY 1967

Repellent		Sticker	
Name	Concentration	Name	Concentration
Improved ZIP	0.8% ZAC[1]	——	——
Improved ZIP	1.6% ZAC	——	——
Arasan 42-S	4.0% TMTD[2]	Rhoplex AC-33	4.0%
Arasan 42-S	8.0% TMTD	Rhoplex AC-33	8.0%
Double H. Brand	0.5% active ingredients[3]	Rhoplex AC-33	0.5%
Phillips Petroleum R-1580	1.0% experimental chemical	Rhoplex AC-33	1.0%

Preference and repellent tests were conducted on a 960-acre grove situated in east peninsular Florida in Osceola County, four miles southwest of Holopaw (Figure 1). The area is characterized as pine flatwoods consisting of a mixture of slash pine (*Pinus elliottii*) and longleaf pine (*P. palustris*) interspersed with variously shaped low areas, called "heads," occupied principally by pond cypress (*Taxodium distichum*). Rainfall usually averages about 50 inches a year, but up to 10 or more inches may fall during a few days from tropical storms or thunderstorms. At the other extreme, droughts of six to eight weeks and longer may occur during the spring or fall months. Water control, essential to citrus culture in such low sites, is accomplished by a network of drainage ditches. Citrus trees are planted on broad beds (two rows per bed) between the ditches.

Data for evaluating repellents and deer preferences were obtained from a series of 12 rows of nursery grown experimental trees placed two rows at each of six different locations (Figure 1). Each row consisted of 28 trees, reflecting the four varieties and seven spray treatments (six spray formulations and a control), making a total of 336 trees. Test trees were interplanted between the trees in the existing orange grove

[1] Zinc dimethyldithiocarbamate cyclohexamine complex
[2] Tetramethylthiuram disulfide
[3] Amhydrous soap, pine oil and nicotine alkaloids

and arranged randomly within each row. Each row was thus a separate block, and there were two blocks at each of six locations. The experimental design was therefore six 4 x 7 factorial sub-experiments, each with a randomized complete block design.

Repellents were applied with small 3-gallon hand sprayers. The effect of deer on the experimental trees was determined by counting the number of leaves browsed by deer on each tree.

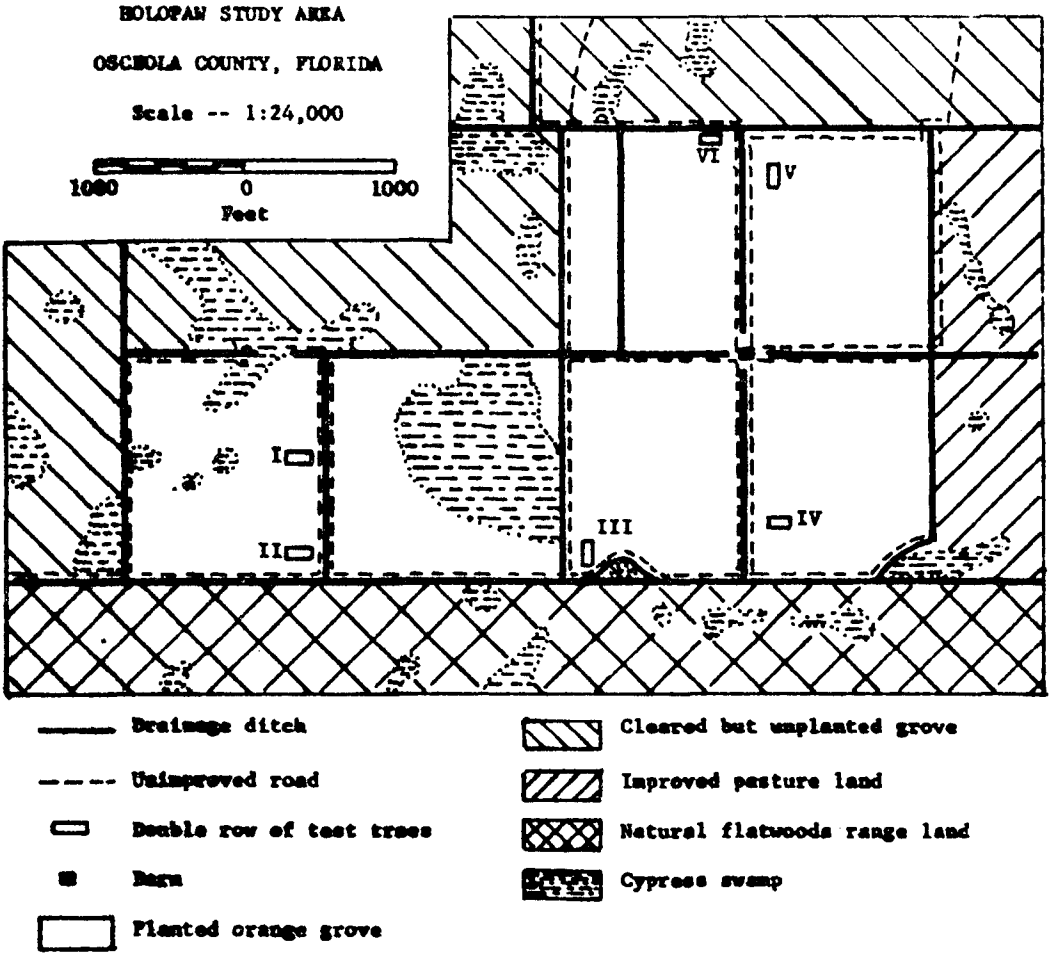

Figure 1 — Drainage system, principal vegetation types and locations of test trees in Holopaw study area, Osceola County, Florida.

DEER DAMAGE TO CITRUS TREES

Acreage and number of growers involved

Questionnaires were returned from 105 production managers responsible for 234,185 acres, or 29% of Florida's 816,000 acres in citrus. Out of this number only 10 (9.5%) reported damage to their groves from deer. Due to the method of reporting locations of browsing damage, it was impossible to estimate the percentage of the total citrus acreage affected by deer.

Types of damage and number of trees

Deer damage to citrus trees ranged all the way from complete destruction of the tree to minor, or negligible damage. Of the 93,670 trees damaged during 1963-1965, 8% were killed by deer (Table 2). The largest percentage (44%) of the damaged trees were set back in their growth from six to twelve months. Others (29%) had a definite reduction in their crop of fruit attributable to browsing, while approximately 20% of the trees suffered only negligible damage.

TABLE 2—RELATIVE IMPORTANCE OF DEER DAMAGE TO CITRUS TREES IN FLORIDA, 1963 TO 1965.

Damage Category	Trees Affected in 3-year Period	
	Number	Percent
Killed	7,500	8.0
Set back in growth	40,980	43.8
Fruit crop reduced	27,000	28.8
Negligible	18,190	19.4
Totals	93,670	100.0

The above description of deer damage to citrus is perhaps oversimplified. Some trees, for example, may be browsed repeatedly and eventually killed by deer. Such trees suffer all types of damage described. Furthermore, the time of year when browsing damage occurs may also be significant. If it takes place during the winter months it may stimulate the production of tender sprouts which will be killed back by subsequent frosts. Cold weather can also kill trees in such a tender condition, whereas without the browsing in the first place the trees probably could endure the cold. Another type of damage from deer occurs when bucks rub their antlers in young trees. Although not killed outright, these trees are worthless for further citrus production.

As with most types of wildlife damage, certain landowners frequently bear the brunt of the costs involved. One grower, for example, had a 230-acre planting of citrus so severely and continuously browsed that it was a total loss. At the same time, this grower was receiving a substantial sum of money for leasing his hunting rights, thereby making the protection of his wildlife crop desirable. However, the excessive deer problem turned his citrus growing enterprise into a losing proposition.

Season of damage

Most citrus growers reported that browsing was most critical during the months of December and January, which is slightly earlier in the year than Stanberry's (*op. cit.*) report of January and February as the critical months. However, the concensus was that damage could occur at any time of the year, depending upon local conditions and the state of growth of the trees. Where deer are a problem with citrus, browsing is normally heaviest immediately following each of the three or four flushes of annual growth.

Age of damaged trees

Deer browsing was most commonly reported on trees four years or less in age. This is partly related to the fact that recently established groves are more likely to be surrounded by areas of suitable natural habitat for deer, whereas older groves tend to be in areas of poorer deer habitat. More importantly, however, younger trees are smaller in diameter, shorter in height, and bear fewer leaves per tree. Any browsing on such trees is more likely to be classed as severe, or at least more easily noticed, than on large trees.

Varieties of citrus browsed

Orange trees were generally reported as being more heavily damaged than grapefruits, tangelos or tangarines. Some growers felt that tangerines were least preferred by deer.

REPELLENT-PREFERENCE TESTS

All formulations tested significantly discouraged browsing deer as indicated by decreased defoliation of from 59% to 76%, or an average of 72% (Table 3). The most effective repellents were Improved ZIP (0.8% and 1.6% ZAC), Phillips Petroleum product R-1580 (1.0% active ingredients), and Arasan 42-S (4.0% and 8.0% TMTD). These reduced defoliation of the trees from 70% to 76% as compared to the controls. Double H Brand (0.5% active ingredients), which reduced browsing by 59%, was not statistically different from Arasan 42-S (8.0% TMTD) which caused a 70% reduction in browsing damage.

TABLE 3 — COMPARISON OF REPELLENT TREATMENTS EXPRESSED AS THE AVERAGE NUMBER OF LEAVES BROWSED PER TREE DURING THE PERIOD FROM OCTOBER 1966 TO FEBRUARY 1967.

Repellent Formulation	Number of Leaves	Reduction From Control
Improved ZIP (0.8% ZAC)	5.8a[1]	76.2%
Phillips R-1580 (1.0% active ingredients)	6.0a	75.4%
Improved ZIP (1.6% ZAC)	6.2a	74.5%
Arasan 42-S (4.0% TMTD)	6.2a	74.5%
Arasan 42-S (8.0% TMTD)	7.3a b	70.1%
Double H Brand (0.5% active ingredients)	9.9 b	59.4%
Average reduction in browsing	71.7%	
Control	24.4	——

There were marked differences (significant at the 1% level of probability) in browsing as related to the specific variety of citrus (Table 4). Valencia oranges were browsed at least two and one-half times more heavily (19.2 browsed leaves per tree) than any other variety. Dancy tangerines were least browsed with 4.3 leaves per tree removed by deer. Marsh seedless grapefruit and Orlando tangelo were intermediate, each with 7 browsed leaves per tree.

TABLE 4 — DEER PREFERENCE ORDER FOR CITRUS VARIETIES BASED UPON NUMBER OF LEAVES BROWSED PER TREE FROM OCTOBER 1966 THROUGH FEBRUARY 1967.

Preference Order	Citrus Variety	No. Browsed Leaves per Tree
1	Valencia orange	19.2
2	Marsh seedless grapefruit	7.3
3	Orlando tangelo	6.8
4	Dancy tangerine	4.3

COSTS OF CONTROLLING DEER DAMAGE

The protection of a 160-acre citrus grove from deer with Improved ZIP would cost approximately $11.50 per acre for a two-year period. Strauss (1966) reported one grower in California who experienced a 95% reduction in deer browsing by spraying only the outer four rows of a 12-acre planting with Arasan. If this were done in a 160-acre grove, it would reduce the cost of spraying to approximately $2.50 per acre.

Another means of protecting the trees would be to construct a deer-proof fence patterned after one described by Jones (1965). If untreated posts (i.e., locally cut cypress or pine posts) were used, the costs would amount to $12.37 per acre, but the fence probably would not last more than two years. If the fence were built of creosoted treated posts, costs

[1] Treatment means followed by the same small-case letter are not significantly different at the 5% level of probability.

would average $16.09 per acre. In this case, however, the fence would last 8 to 10 years, or more, and it might be justified where the farm operations include the production of cattle as well as citrus.

SUMMARY

Ten out of 105 grove managers who responded to a questionnaire survey acknowledged deer damage to 94,000 citrus trees during the period 1963 to 1965. The most common types of damage were retarding growth from six to twelve months (44%) and reducing the fruit crop (29%). Killing of the trees accounted for 8% of the damage. Negligible damage occurred to 20% of the trees. December and January were the most critical months.

The reduction in browsing that resulted from spraying experimental trees with the following repellents was: Improved ZIP (0.8% ZAC), 76%; Phillips Petroleum product R-1580, 75%; Improved ZIP (1.6% ZAC), 74%; Arasan 42-S (4.0% TMTD), 74%; Arasan 42-S (8.0% TMTD), 70%; and Double H Brand, 59%. Valencia orange trees were most preferred by deer; Dancy tangerines were least preferred. Marsh seedless grapefruit and Orlando tanglo were intermediate in the order of preference.

The costs of protecting citrus trees from deer damage by repellents may range from $2.50 to $11.50 per acre over a period of two years for a 160-acre grove, depending upon whether only a portion or the entire grove is treated. Fencing out deer would cost from about $12.50 per acre if locally cut, untreated posts were used to $16.00 per acre if creosote-treated posts were used.

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A SURVEY OF DEER DAMAGE TO FLORIDA CITRUS TREES

1. How many acres of citrus groves do you supervise or keep under surveillance? Under 4 years old:_____ acres. Over 4 years old: _____acres.
2. Do you know of any browsing damage on the above acreage in the last 3 years that you are reasonably sure was caused by *deer*?
   _____ Yes _____ No.
   If "NO" omit the remaining questions, but please return this questionnaire in the enclosed envelope. Include, if you wish, any knowledge you may have of the deer problem.
   If "YES," please continue.

3. At how many locations has deer damage occurred? _____

4. Two locations where trees were most heavily browsed:

	Location No. 1	Location No. 2
County		
Nearest town		
No. trees browsed in any way*		
Year(s) and month(s) of damage		
(Circle year of heaviest damage. Also circle months of heaviest damage for each year.) 1963		
1964		
1965		
Varieties browsed		
(Circle variety most heavily browsed)		
Age(s) of trees browsed		
Leaf damage: (Circle one)	None, light, severe	None, light, severe
Twig damage: (Circle one)	None, light, severe	None, light, severe
Trunk or limb damage (Circle one)	None, light, severe	None, light, severe
No. trees killed*		
No. trees set back 6 to 12 months*		
No. trees with crop reduced*		
No. trees with negligible damage*		

*"No. trees" means total number in the 3-year period.

5. Is damage increasing_____, decreasing_____, same_____.

6. To the best of your knowledge, was a nutritional spray applied 6 weeks or less prior to the browsing?
_____ Yes _____ No _____ Unknown

7. Do you have a particular tree in a browsed area that is clearly and deliberately avoided by browsing deer?
_____Definitely Yes _____I think so
_____I think not
_____Definitely No _____I don't know

8. Do you have a situation where field trials of deer control measures could be made, and would you permit such trials?
_____Yes _____No

9. If you have any ideas for preventing deer damage without destroying the deer, feel free to include them.

10. Other comments.

Your assistance is very much appreciated. Please return this questionnaire in the enclosed envelope to Lloyd G. Stith, 248-S Flavet III, University of Florida, Gainesville, Fla.

Your Name_____
Address _____
Organization _____