Northern Red Oak Flower to Acorn Survival Increases Following Monthly Applications of Asana® XL

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Abstract. Many insect pests attack northern red oak flowers, acornets, and acorns. Selected trees on the USDA Forest Service, Watauga Northern Red Oak Seed Orchard near Elizabethton, TN were treated monthly during the 1993 and 1994 growing season with Asana XL. At harvest in the fall of 1994, 34 percent of the 1993 flower crop survived to harvest on the Asana® XL treated trees, as compared to 18 percent on comparable unsprayed trees.

Keywords: Northern red oak, *Quercus rubra L.;* filbertworm, *Cydia latiferreana* (Walsingham); acorn weevil, *Curculio, Conotrachelus, Callirhytis* spp., treehoppers, *Platycotis vitata (F.);* seed orchard, Asana® XL, esfenvalerate.

Introduction

Genetically superior pine seed orchards routinely produce improved seed to assist the timber industry in reforesting harvested land. Without the array of first and second generation orchards, reforestation would be based upon seedlings from seed trees or wild seed collections resulting in low genetic quality. Foresters are aware of the need for high quality, fast growing hardwood seedlings for reforestation but in most cases the seedlings that are available are of unknown origin.

The Forest Service maintains and operates the 17 acre Watauga Northern Red Oak Seed Orchard near Elizabethton, TN. The orchard was planted in 1973 as a progeny test by the Tennessee Valley Authority. The study was thinned in 1987-8 to become a USDA Forest Service seed orchard on the Cherokee National Forest in 1984 and the first large seed crops were documented in 1989. **In** 1993, the orchard yielded enough acorns to supply the entire southern appalachian area with high quality northern red oak seedlings for reforestation.

Larry Barber, Entomologist, USDA FS (unpublished data) tagged and followed to maturity the 1989 and 1990 flower crops on selected trees in the Watauga Northern Red Oak Orchard. Only 3.8 percent of the 1989 flower crop remained healthy at harvest some 18 months later while the 1990 flower crop faired better with 27 percent healthy at harvest. No insecticides were applied to either of these flower crops.

Previous literature indicates that acorn weevils of the genus *Curculio* cause the most insect damage to oak acorns (Gibson 1982). These weevils and others in the genus

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Conotrachelus, as well as the filbertworm *Cydia latiferreana* (Walshingham), can destroy a majority of the acorn crop (Solomon et. al. 1987). Both the pip gall produced by *Callirhytis operator (0.S.)* and the stone gall *Callirhytis fructuosa* Weld kill the acorn by either causing the nut to fall prematurely (pip gall) or by the stone gall replacing the seed. Tree hoppers, *Platycotis vittata (F.),* are potentially capable of damaging red oak flowers (Bob Ceich personel communication).

Little work has been done to control insect pests of oak seed crops (Kearby et al. 1986). Previous work, using both trunk implants and granular systemic insecticides showed a reduction in infestation levels but the insecticides may have also caused an increase in the percentage of desiccated acorns (Dorsey et al. 1962 and Dorsey 1967). Trunk implantation of the systemic insecticides phorate and Bidrin® yielded more sound acorns than granular applications of disulfoton and phosphamidon applied to the soil. In 1993, a study was initiated to investigate the effects of insect control measures on acorn production.

Material and Methods

In March 1993, 20 pairs of trees representing 17 families were selected for the study. A family consisted of half-sibling trees upon which acorn production with and without control spraying was assessed. One half of the trees received an insecticide treatment of esfenvalerate, Asana® **XL,** while the other half remained untreated. The treated trees were sprayed monthly throughout the summers of 1993 and 1994, with applications beginning in March. The Asana® XL solution was mixed at a rate of 9.6 fluid ounces in 100 gallons water. The application rate per tree varied during the season from approximately 2 gallons per tree in the early spring to nearly 10 gallons in the summer. The variation in application rates between spring and summer was because in the spring it took less spray solution to achieve proper coverage of the foliage and branches than in the summer when leaf production was at its peak. All applications were with an FMC DMO20 high volume hydraulic sprayer set to apply the spray solution at 350 psi. The trees ranged in height from approximately 30 to 40 feet.

In May 1993, 20 branches on each tree were selected and tagged. Healthy pistillate flower structures were counted and recorded on data sheets at the first inventory. The branches and their developing acorns were revisited seven more times before harvest in November 1994, and the condition of their health was recorded.

In late August 1994, the final inventory was conducted, each tag was visited and the health of each acorn determined from visual observation. All acorns that were determined to be healthy were painted with one drop of fingernail polish and left attached to the tree. Nets were placed under each tree to catch the acorns when they dropped. Acorn collection began the first week of September and continued until November 2, 1995. During this acorn collection period, the nets were visited and the acorns collected three times each week. The painted acorns were separated from the rest of the acorns and placed into plastic bags and put into cold storage for later observation and dissection.

RESULTS AND DISCUSSION

Analysis of the 1993 flower crop survival from May 1993 to August 1994 indicated a significant difference at the one percent level in acorn production between treated and untreated trees. There was a significant family x treatment interaction, indicating that healthy acorn production in some families was not predicated upon the control measure. Thirty four percent of the flower crop survived to August 1994 on trees treated with Asana XL as compared to 18 percent on untreated trees. Both treated and untreated trees showed a dramatic decrease in healthy flowers at the second inventory (Figure 1). After this time, little difference or change in the percent healthy spread between treated and untreated trees was detected until the emergence and attack of acorn weevils in early August 1994.

Identifiable insect damage was observed only in the second year of acorn development and t s was due primarily to pip gall, filbertworm, and acorn weevil attacks. Applying the results of the acorn dissections to the crop remaining in late August, we estimate that 28 percent of the original flower crop on treated trees would produce healthy acorns as compared to 7 percent on unsprayed trees (Figure 1).

Dr. Gerome Grant (personel communication) reported that several species of thrips were identified from the orchard as potential damaging agents to the newly formed flower and acornets. If thrips and treehoppers cause damage to oak flowers in the first year of the flower

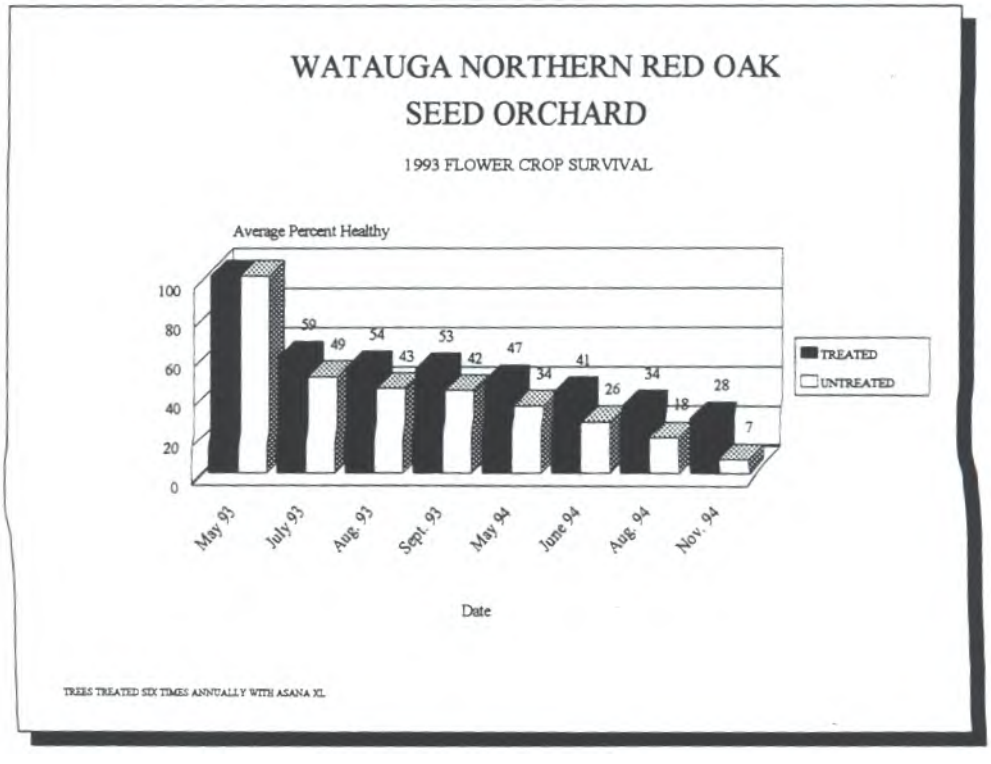

Figure 1. 1993 Watauga northern red oak seed orchard flower crop survival.

development cycle their control would explain the differences between treated and untreated flowers. Asana® XL is a broad spectrum insecticide and capable of controlling both pest groups. Neither potential pest was observed on the inventory trees during this evaluation.

In some families, more than two trees were used. There were six trees from family 915 (Appendix 1) and they responded similarly throughout the study and on average only 1 percent of the nuts were believed to be healthy at final harvest on untreated trees as compared to 29 percent on treated trees. In family 735, four trees were used and the untreated trees had more healthy acorns during the majority of the year, however, significant damage was detected at dissection. These dissections determined that many of the acorns were not healthy on the untreated trees and thus in the over-all rating for this family there were more healthy acorns on treated trees (Appendix 1). Family 323 was also represented by four trees and generally more healthy acorns were found on treated trees. In the remaining families, there were only one treated and one untreated tree. Generally for each pair of trees, more healthy acorns were present after harvest and dissection on the treated trees as compared to the untreated trees (Appendix 2). Only in family 565 were there more apparently healthy acorns at harvest in the untreated tree than on the treated tree. This may indicate genetic differences amoung the families in resistance to insect attacks. Family 526 showed the greatest treatment effect. The treated tree had 47 percent healthy acorns as compared to 2 percent on an untreated tree (Appendix 2). Comparative trees in families 526, 550, 903, and 913 also showed large differences in percent of healthy acorns between treated and untreated trees.

Wildlife such as deer, turkey, groundhogs, and squirrels are often observed in the fall and predation is usually not a problem. However, in 1994 deer were often observed leaving the orchard in the early morning and were assumed to be responsible for partially consumed acorns observed on the nets. Recovery of painted acorns was a problem in some trees. The percent recovery of painted inventory acorns ranged from 95 to 11 on the inventory *trees* (Figure 2).

At harvest, acorn weevils accounted for 37 percent damage on untreated trees as compared to 0.2 percent on treated trees. Filbertworm damage was less than one percent throughout the season including harvested acorns. Both pip gall and stone gall damage was observed at harvest. Losses from pip gall did not show up in our inventory data during August 1994 but were observed in the field. Losses from these two pests were less than one percent.

When dissected, some acorns appeared to be discolored and were categorized as being damaged by an unknown agent. This unknown damage category amounted to 25 percent of the acorns in the untreated trees and 16 percent in treated trees. This damage is characterized as having the appearance of potato rot and could be attributed to insects, such as acorn weevils, feeding in the tissue and introducing fungi or bacteria. In the untreated trees, this damage was found most frequently in acorns with insect damage. On the treated trees, however, it was found in acorns with no evidence of insect activity.

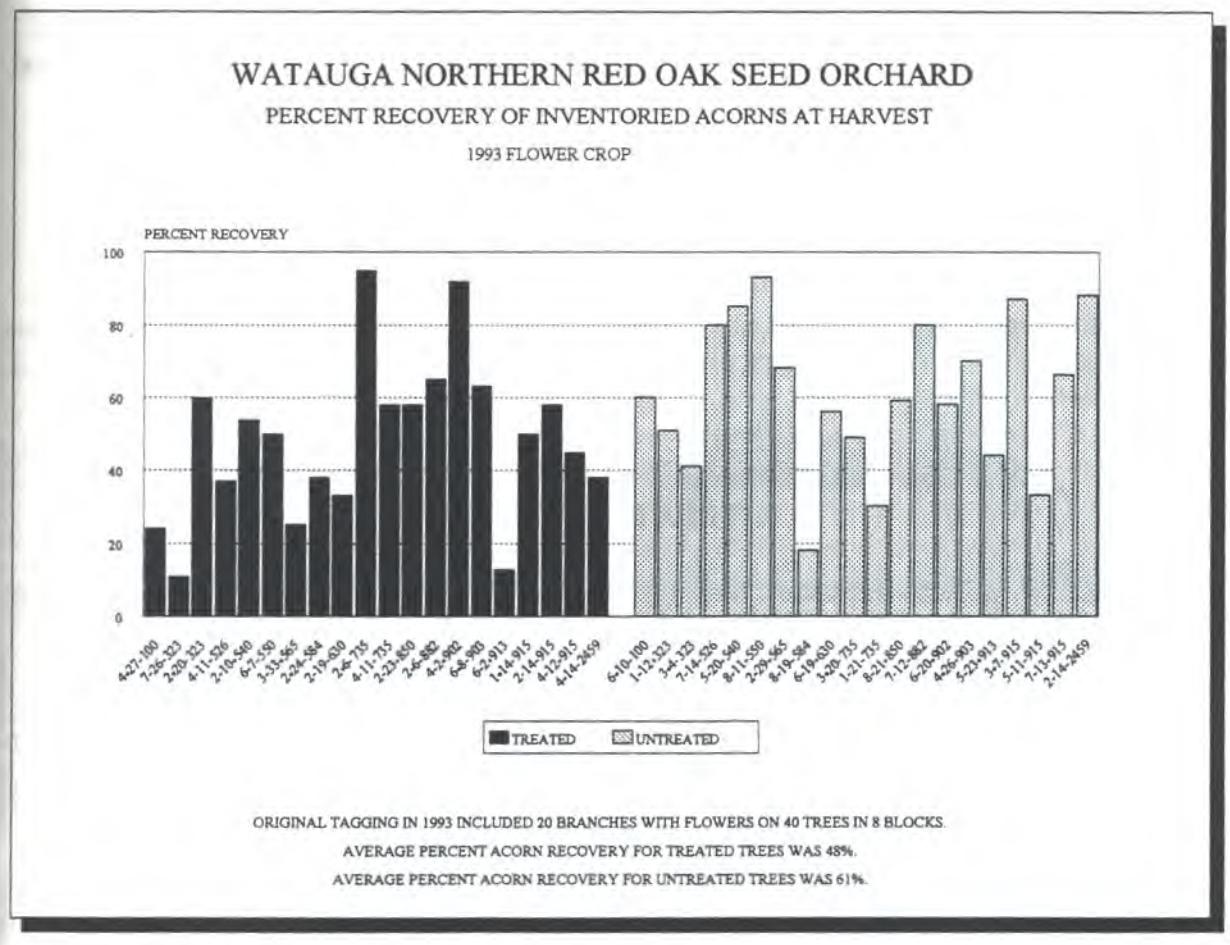

Figure 2. Percent recovery of inventoried acorns at harvest during the fall of 1994.

CONCLUSIONS

Monthly applications of Asana® XL, a synthetic pyrethroid insecticide, increased flower to acorn survival and produced more apparently healthy acorns on treated trees than on similar untreated trees. There appear to be two distinct time periods in the development of red oak acorns when insecticides are especially beneficial in increasing flower to acorn survival. These periods are in the early spring of the first year and in the late summer or fall of the second year.

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Caution: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

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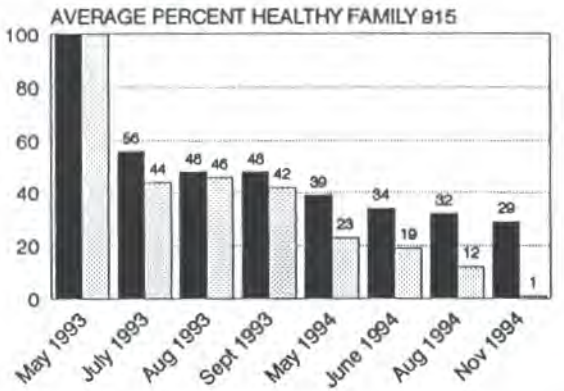
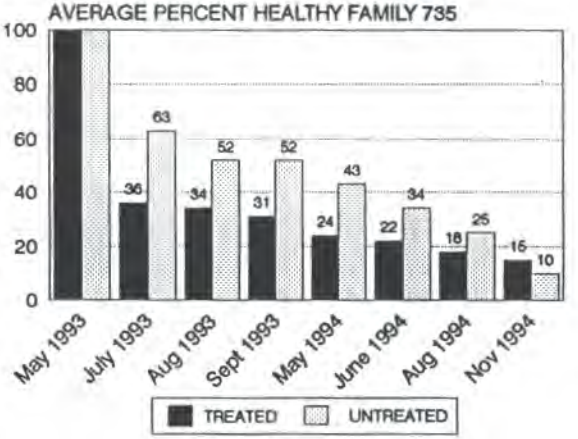
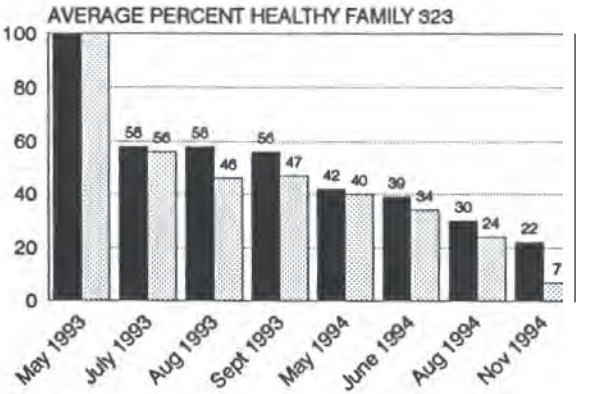
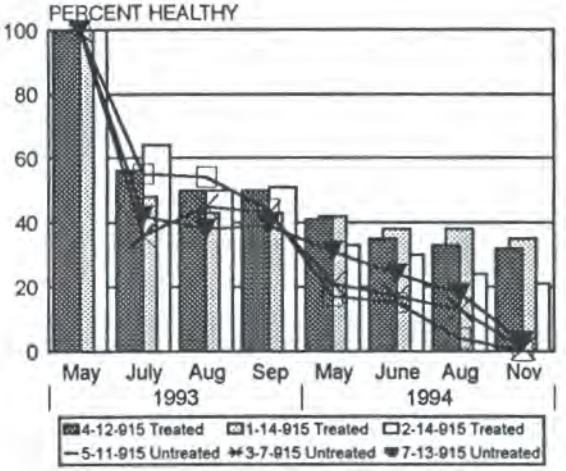
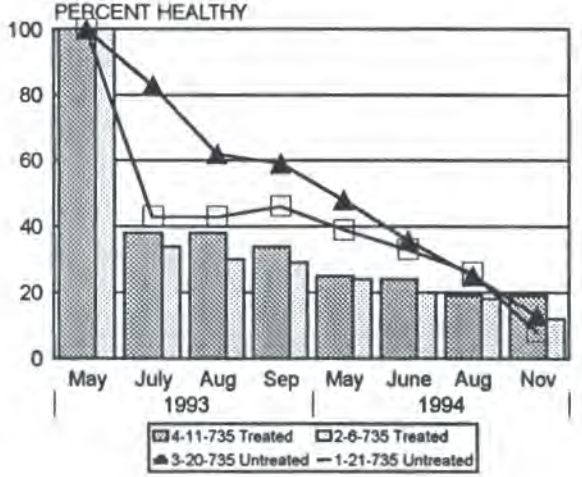
WATAUGA NORTHERN RED OAK SEED ORCHARD
FAMILIES 915, 735, & 323 TREATED VS UNTREATED
1993 FLOWER CROP SURVIVAL

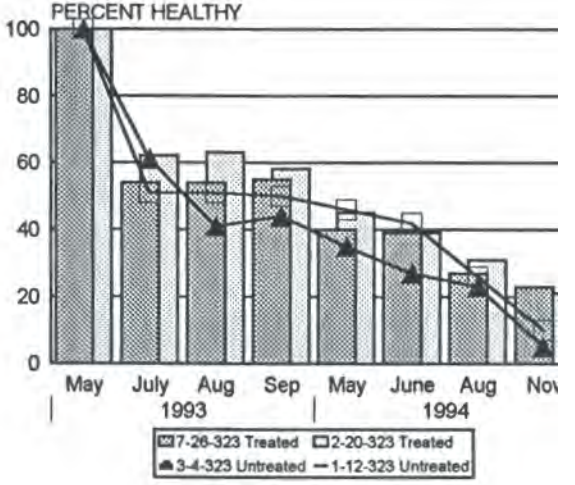










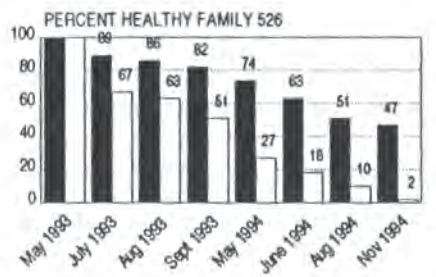


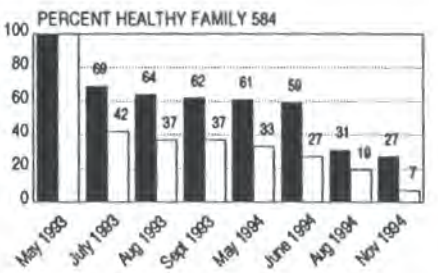
ORIGINAL TAGGING IN 1993 INCLUDED 20 BRANCHES WITH FLOWERS PER TREE.
THREE TREES TREATED MONTHLY WITH ASANA XL 1993 THRU 1994, THREE TREES UNTREATED
NOVEMBER 1994 ALL REMAINING TAGGED ACORNS WERE HARVESTED AND DISSECTED TO DETERMINE HEALTH

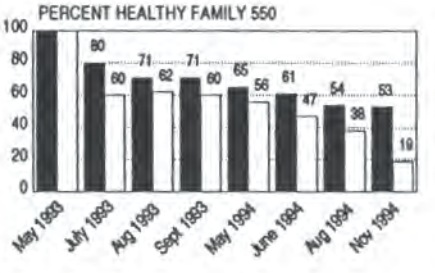
APPENDIX 1

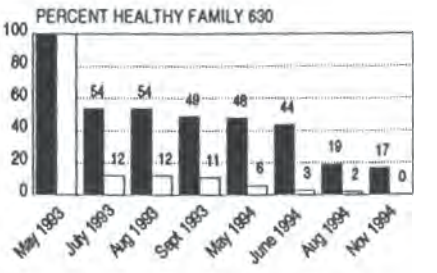
WATAUGA NORTHERN RED OAK SEED ORCHARD

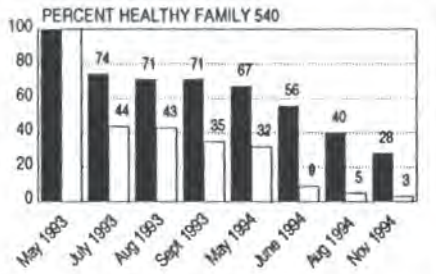
FAMILY COMPARISONS OF TREATED AND UNTREATED TREES

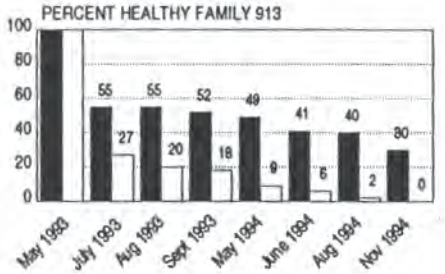


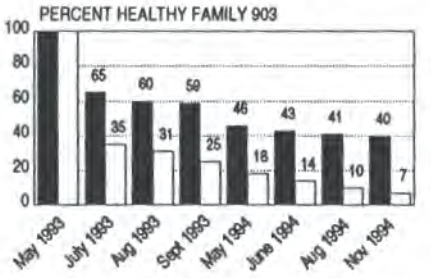


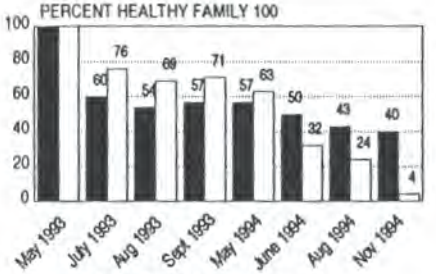


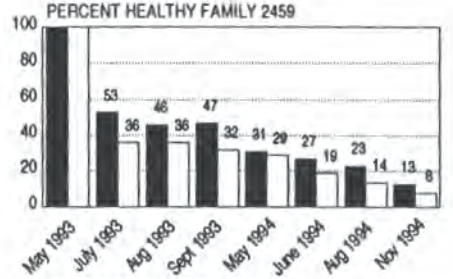


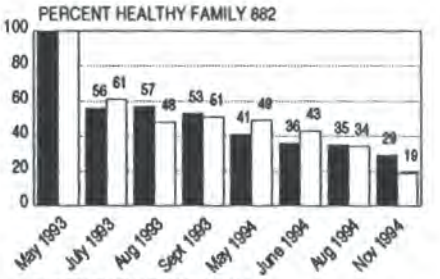


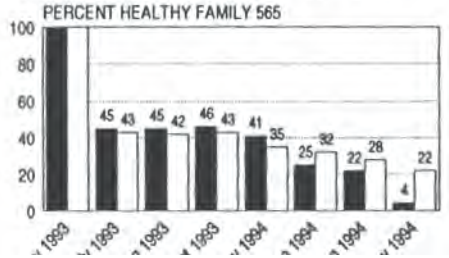


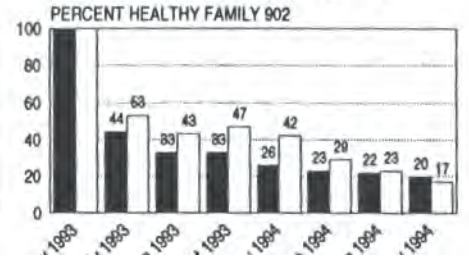


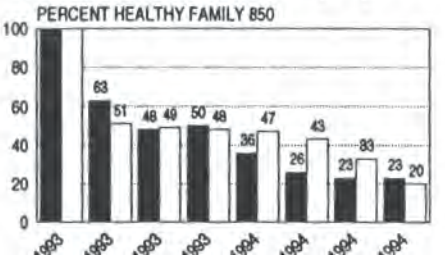


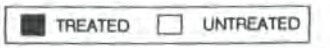












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