EXTENSION SPECIALISTS' PERCEPTIONS OF THE AWARENESS OF COMMERCIAL PEACH GROWERS TO CHEMICALS AS A "POTENTIAL" THINNING AGENT AND SUGGESTED METHODS TO PROMOTE ADOPTION

By

BENEDICT C. OBIUDU

Diploma
Aristotelian University of Thessaloniki
Greece
1972

Master of Science
Cornell University
Ithaca, New York
1976

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
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Thesis Approved:

James P. Key
Thesis Adviser

Robert Terry

Robert A. Reisbeck

Raymond Campbell

Norman N. Durham
Dean of the Graduate College

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INTRODUCTION

Bearing peach trees (Prunus Persica) usually set more fruit than they can properly mature. Hence, finding a method to thin peaches becomes an inevitable problem. The best quality and heaviest production of fruit is produced in the upper one third of the tree (9). The fruit is borne laterally on wood that grew the previous year.

Some of the ways which have been used to reduce the heavy set of fruit include dormant pruning of the trees, hand thinning, various mechanical methods and various chemical thinning agents which have been applied with varying degrees of success.

Some reduction in set can be achieved by excessive pruning. However, the fruits are not well spaced on the limbs and evenly distributed on the tree.

Post bloom chemical thinners, Ethephon[1] - (2 chloroethyl) phosphonic acid and a related compound CGA-15281 (CIBA-Geigy), have been proven to thin peaches effectively (6, 7, 11).

Hand thinning of peaches is widely practiced at present. It is the most expensive and arduous operation in the production of peaches. Even when aided by such devices as poles and rubber hose, it requires so much time that the thinning may be delayed beyond the most effective period.

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[1]This chemical has been released as G-996 in a formulation identified as Amchem 66-329. It contains in addition to the acid the mono-2-chloroethyl ester of the acid and anhydride.

Mechanical thinning with a self-propelled shaker has been used (26). This practice, to be efficient, requires a skilled operator.

An alternative to mechanical and hand thinning is the use of chemicals. There are several advantages to this method as opposed to the traditional hand thinning and mechanical methods. The chemical method is less time consuming and more economical (costing $5-$6 per acre, while hand thinning ranges between $75-$200 per acre) and provides better fruit quality in terms of uniformity of firmness, color, size and taste (9). Sims et al (35) has shown that ethephon applied to peaches at 50ppm at the beginning of stage II of fruit development has resulted in better fruit quality. Though chemical thinning has not thinned all peach varieties successfully, its feasibility seems encouraging.

However, all publications on chemical thinning of peaches make reference to the fact that the degree of thinning can be influenced by such factors as tree vigor, variety, temperature and physiological development of the fruit.

Statement of the Problem

Alternative methods have been used to thin peaches. Blossoms have been thinned by spraying high pressure streams of water on the tree when they are in full bloom. The disadvantage is that a late spring may kill a large percent of the remaining flowers. A more convenient and economical method of thinning peaches is therefore sought.

Peach thinning with dinitro compounds was a definite advancement over hand thinning and various mechanical methods. There have been several disadvantages, however, in the use of dinitro compounds for thinning. These materials have been applied when the trees were in full

bloom. They have resulted in rather serious injury on the leaf buds and one year twigs on Elberta and South Haven variety (1). Also, in most peach growing districts, the crop is still subject to frost damage and the final set cannot be determined at the time of application.

The current trend is now directed toward post-bloom chemical thinners, using the chemicals Ethephon--(2--chloroethyl) phosphonic acid and CGA-15281 (CIBA-Geigy). These chemicals have thinned some varieties of peaches effectively and under certain conditions, seem to hold potential for the thinning of peaches (7, 8, 12). Thus, information is needed about peach grower awareness of chemical thinning.

Purpose of the Study

The purpose of the study was to determine extension horticultural specialists' perceptions of peach growers' awareness of the chemical thinning of peaches in the states (see Appendix B for list of states), where it was thought that peaches were important to the agricultural economy, with suggested ways of diffusing the adoption of "potential" chemical thinning methods through Extension Education.

Scope of the Study

Chemical thinning of peaches to a great extent is still in the experimental stage, hence the sampling population was restricted to horticultural specialists.

Procedures for Data Collection and Analysis

The respondents were Extension Horticultural Specialists, selected from those states (see Appendix B for list of states) where it was

thought that peaches were important to the agricultural economy based on experts knowledge and the review of literature. A survey instrument was designed (see Appendix A) which was in the form of a questionnaire comprised of seventeen questions relating to peach average crop value in dollars and the awareness of chemical thinning. The instrument was designed with the help of a jury of experts, utilizing the state Extension Horticultural Specialists' directory. The questionnaires were sent to 22 Extension Horticultural Specialists in 22 states by mail with return addressed, stamped envelopes enclosed. Based on the data collected and the review of the literature, recommended methods were developed to aid in the promotion of the "potential" chemical thinning method.

Descriptive statistics were used in the analysis of the data gathered by the survey. It consisted of the analysis of the data into mean differences and range according to the procedures as outlined by Runyon et al (33).

Summary

The increased shortage of hand labor in the peach fruit industry has generated interest in chemical thinning of peaches. Chemical thinning has been in the experimental stage long enough for researchers to begin assessing results. Hence, the purpose of this study is to determine the awareness of chemical thinning in those states where it was thought that peaches were important to the agricultural economy.

CHAPTER II

REVIEW OF LITERATURE

Pruning the Bearing Peach Tree

Peach trees bear fruit laterally on wood that grew the previous year (9). The growth and development of new shoots for the following year's crop must be considered when pruning peaches. Therefore, when peach trees are being pruned, consideration must be given to the spacing of shoots for the current season's crop as well as good light distribution throughout the tree to encourage strong vigorous shoot development for the following year's crops (9). The position of these shoots are important as the greatest number of quality peaches are produced in the upper one-third of the tree.

Floral bud development is at an optimum on moderately vigorous shoots. At a given node, the number of developing buds are one, two or three, depending on the variety and tree vigor. Where three buds are at a node, usually the center bud is a vegetative bud while the outer two are floral buds (9). On less vigorous growth, floral buds are often borne singly beside a vigorous shoot attaining a height of about 76.2 cm or more, the lateral buds may consist mostly of vegetative buds, particularly the lower portion of the shoot.

Healthy, vigorous bearing trees produce far more floral buds than are needed for a commercial crop of fruit (8). In view of this, it becomes a necessity to carry out dormant pruning to ensure proper renewal

of fruiting wood throughout the tree along with good quality fruit. Shoot growth of about 30.5 - 40.6 cm on a bearing peach 8 - 12 years old on the majority of the outer branches is sufficient for maintaining good fruit production.

When peach trees are not pruned annually, there is a tendency for the fruiting wood to become weaker and develop on the periphery of the tree. Eventually, a thick topped leggy tree develops almost devoid of low-fruiting wood.

Growth of the Peach Embryo in Relation to Growth and Season of Ripening

Growth of the peach fruit occurs in three stages as shown by Connors (10), namely:

A. The first period consists of the development of the pericarp, nucellus and integuments, during which the embryo is suppressed in growth. The duration of the first period is similar in all varieties.

B. The second stage is called the rest period, during which the seed is formed and the stone becomes hard. This stage is shortest in the earliest ripening variety and longest in the latest. Blake (4) noted this relationship by stating, "The stage subject to greatest modification is stage 2. This may be only one or two weeks in the case of the late-ripening varieties." There is rapid embryo development. The stony pericarp begins to harden and completes the hardening during this period. Hardening of the stony pericarp is most rapid for the early variety.

C. The third stage is characterized by another resumption of rapid growth of flesh to maturity, though this is less rapid than the first,

and continues until the flesh is soft, when it abruptly ceases.

Effect of Thinning on Peach Quality

Stembridge and Gambrell (38) reported that in no instance in their study did bloom and post-bloom application of ethephon result in soft fruits in "Cardinal", "Redskin" and "Redhaven" peaches. They found that in many instances there were increases in flesh firmness.

Sims et al (35) showed that ethephon applied to "Redhaven" and "Cardinal" peach varieties at 50 ppm to 200 ppm at different dates resulted in more uniformity in firmness, ground and flesh color than untreated fruit at shipping maturity. They also found that the 50 ppm application of ethephon on Redhaven reduced fruit ground color. On the Richhaven, the most striking trend was the enhancement of fruit color by ethephon. Soluble solids were also higher from ethephon treatments. These results parallel those of Proebsting et al (27) on Early Italian prunes. They found that ethephon advanced fruit color and soluble solids development. Other investigators (21) reported that foliar sprays of ethephon applied at 50, 100 and 150 ppm to French prune trees at 50 percent petal fall and when seed length was 8.3 to 9.4 mm resulted in increase in soluble solids and fruit size.

Childers (9) showed hand thinning of heavily loaded trees would cost $75 to $200 per acre, as compared with $5 or $6 an acre for the chemical spray technique. He also showed that even if the chemical spray did not do a complete thinning job and some hand thinning would be necessary, the saving in cost could be substantial. Another investigator, Obiudu (24), reported the same results.

History of Hand and Chemical Thinning

Historical Perspective of Hand Thinning of Apples

The historical trend in hand thinning of apple cultivars dates back to 1933. McCormick (22) was the first to successfully correct the alternating bearing habit of two apple cultivars by systematically removing two-thirds to three-fourths of the blossoms in the "on" year. Babb et al (5) showed that hand blossom thinning could correct this alternating habit of the decidedly biennial "wealthy" cultivar, whereas conventional hand thinning of the fruits a month or more after bloom was ineffective in bringing about annual bearing.

Historical Perspective of Chemical Thinning of Apples

The early work on chemical thinning of apples was carried out in 1940 by Magness et al (20). They found that dinitros sprayed on apples during the bloom period could accomplish a selective thinning action. Later studies were done by other investigators (2).

Historical Perspective of Hand Thinning of Peaches

Hand thinning of peaches were reported by Dorsey et al (13) in 1926. These investigators thinned peach varieties "Captain", "Ede Carmaman" and "Elberta" at five week intervals to determine the effect of time of thinning on peach fruit size. Further studies were carried out by Knowlton et al (17) and Shoemaker (36).

Historical Perspective of Post-Bloom Chemical Thinning of Peaches

Available literature review on post-bloom chemical thinning of peaches dates back to 1959. Thompson et al (39) thinned "Redhaven", "Halehaven" and "Redskin" peach varieties with 2-Chlorophenoxy acetic acid and 3-Chlorophenoxy acetic acid 27 days after full bloom. These resulted in larger fruit at harvest without appreciable reduction in total yield per tree. Further studies were carried out by Leuty and Bukovac (18). They sprayed ethephon and 2-(3-chlorophenoxy)-propionic acid (3CPA) on "Early Amber" during the four-day interval that the endosperm was changing from the free nuclear to the completely cellular stage.

Current Studies on Chemical Thinning of Peaches

One purpose of thinning is to produce a large crop of good-sized fruits that have high quality and to prevent breakage of the limbs due to excess weight. In achieving this objective, several investigators (7, 11, 16, 18, 37) carried out experimental trials with different chemicals to reduce set. They found that a reduction in fruit set had a positive effect on increasing fruit size. Obiudu (24) reported that the percentage and quality of largest sized fruit 6 cm and up increased with early thinning at the beginning of stage II of peach fruit development.

Mechanical Thinning of Peaches

Powell et al (26) had thinned "Redskin", "Dixie", "El Sentinel" and "Dixiland" peach cultivated varieties with a self-propelled shaker. They reported that greater success was obtained on the trees pruned to open

center with three well-balanced primary scaffold limbs. The same investigators stated that there were variations among varieties and the levels of tree vigor on the duration of shake.

The study showed that rarely does one achieve fruit distribution with a shaker that can be achieved with a good hand thinning; i.e. fruits spaced 6 inches apart equally throughout the tree. They established that the optimum time for machine thinning is when fruits are 3/4 to 1 inch in diameter.

Presently, mechanical thinning of peaches is being widely accepted by peach producers in every major peach growing region across the country (26). This is primarily out of necessity since the alternative, "potential chemical thinning," is still in the experimental stage. The self-propelled shaker is providing growers an additional tool for performing a very old but extremely important cultural practice of thinning.

Growers have a much greater tendency to underthin than to overthin with the self-propelled shaker. At least 20-24 inches of trunk height are needed for ease of clasping trunk (26). If trees were uniform in structure fruits would be removed uniformly on all sides of trees.

Extension Principles, Goals and Philosophy

The mission of the Agricultural Extension Service is to extend life long, continuing education opportunities to the local people in those areas in which Extension has the competence and the legal and moral obligation to serve (15,34). The Extension Service is a dynamic educational system oriented to the development of educational programs designed to meet the changing needs of diverse publics. In carrying

out this responsibility, the Extension Service is guided by the principle of "helping people to help themselves". The process of Extension education involves working "with" people and not "for" them (28). It joins with people in helping them to identify needs, problems and opportunities; study their resources; and arrive at desirable courses of action in line with their desires, resources and abilities (15). The philosophy of Extension is that people be assisted within a democratic frame work to achieve progress (28). The Extension work is "education for action--action by individuals--action by groups. It is education that helps people develop skills in problem identification, goal determination, analysis, evaluation and choice".

The Adoption Process in Extension Education

The adoption process is the progressive mental process through which an individual goes from the time that individual first becomes aware of an innovation until the individual adopts the innovation. He is likely to go through extended periods of deliberation before trying a new idea or practice (19).

It is obvious to Extension workers that most individuals do not adopt a new idea immediately after becoming aware of its existence. Five stages in the adoption process most commonly accepted today are as follows:

1. Awareness Stage--the individual is exposed to the inovation but lacks complete information about it.

2. Interest Stage--the individual becomes interested in a new idea and seeks additional information about it.

3. Evaluation--the individual mentally applies the innovation to

his present and anticipated future situation and then decides whether or not to try it.

4. Trial Stage--the individual uses the innovation on a small scale in order to determine its utility in his own situation.

5. Adoption Stage--the individual decides to continue full use of the innovation.

Information Sources

Researchers have found it useful to categorize the information sources utilized by farmers and homemakers as:

a. Personal, in which there is a face-to-face exchange between the communicator and the receiver, and

b. Impersonal, in which there is no direct contact between the communicator and the audience.

Rogers (30, 31) noted that impersonal information sources are most important at the awareness and interest stages and personal sources are most important at the evaluation and adoption stages.

Adopter Categories

It is obvious to any acute observer of any social system that not all of its members adopt new ideas at the same time. A general finding of past investigators is that adopter distributions follow a bell-shaped curve over time and approach normality. In other words, only a few individuals adopt a new idea at first, then many individuals follow the example that has been set. Finally, the rate of adoption slows until only a few have not adopted. For example, an Iowa investigation (3) of the adoption of 2, 4-D weed spray indicated that innovators

(the first to adopt a new idea in a community) adopted the practice the same year they became aware of its existence. The laggards (the last to adopt) required ten years to pass through the adoption process. Perhaps it is important to remember that Extension workers can secure almost immediate adoption of innovations with certain individuals but a much longer period of deliberation is required for other portions of their audience.

The result is a bell-shaped, normal curve (32). This finding allows the classification of individuals into five adopter categories on the basis of innovativeness: innovators (the first to adopt), early adopters, early majority, late majority, and laggards. Innovativeness is the degree to which an individual is relatively early in adopting new ideas when compared to others of his social system.

Research by rural sociologists indicate that there are wide differences among adopter categories and that change agents need to utilize different teaching methods with each category. For example, early adopters seek new ideas and may easily be motivated to attend Extension meetings. On the other hand, laggards are suspicious of change agents and often may be reached only directly through the "trickle-down" process (3, 14). A change agent, who cannot reach all clients personally should concentrate his efforts particularly on early adopters. An hour of educational effort spent with this adopter category will yield higher returns in changed behavior than any other adopter category.

Opinion Leaders

Opinion Leaders are influential people in a community and they play an important role in the diffusion of innovation among their

fellow citizens. In this study they could be used to stimulate interest about chemical thinning in their localities. They conform more closely to social system norms than the average member. They use more impersonal, technically accurate, and cosmopolite sources of information. They are more cosmopolite, have more social participation in organizations, higher social status, and are more innovative than their followers. They are most exposed to mass media. They can pass on what they learn to others (14). Also such people are frequently those to whom others look upon for information and advice. Opinion leaders tend to be early adopters rather than innovators. Some individuals in the early majority may also exert opinion leadership.

Mass Media

Media used for transmitting messages include the printed page (newspapers, magazines, bulletins, circular letters, etc.), radio, and television. The radio was regarded by many as a good place to get up-to-date farm information and was used accordingly.

Mass media rank high as means of making people aware of new farm practices and in providing additional information at the interest stage (19). However, mass media are not effective at the evaluation and trial stage.

Advisory Committees in Agricultural Extension

Advisory committees are groups of individuals acting in a planning and advisory capacity to the County Extension staff for Agriculture, Rural Development, Home Economics and 4-H and Youth. The composition of the group will vary with each program area, Program Plan-

ning and Advisory Committees (PPACS) should be representative of the population of the county in relation to geographic areas, socio-economic levels, racial-ethnic groups and commodity and subject-matter organizations (23, 25). Members of the committees may also be representatives of other organizations, support groups, or agencies in the county.

An Advisory Committee could be used in formulating strategic actions that could be most effective in promoting interests and adoption of "potential" chemical thinning by setting up for example a demonstration plot on chemical thinning in such a way that the interests (economics, availability of materials, adaptability of the thinning agent etc.) are well represented.

Planning Powerful Extension Programs

A program is simply a series of intended or actual activities or events. Planning may be described as simply thoughtful and purposeful design (6, 29).

"Powerful" refers to the capacity of a program to influence or to effect change for the planning of a successful program depends on generating a capacity to influence.

Much of the planning of change agents is designed to produce social change, defined as a difference in a selected social variable at time II in contrast to what it was at time I.

"Powerful" Extension Programs could be a determining factor in the adoption of chemical thinning of peaches where the service orientation oval is serving the interest of farmers.

Summary

The literature review covered the following areas:

1. Pruning the Bearing Peach Tree. This section explained the bearing habit of peach trees and the necessity of thinning the fruits. It covered the research, studies and publications in this area.

2. Growth of the Peach Embryo in Relation to Growth and Season of Ripening. This section stressed the importance of timing in peach thinning with illustrative research.

3. Effect of Thinning on Peach Quality. This section explained the quality effects of chemical thinning on peach fruits. Supporting research and studies were also included.

4. History of Hand and Chemical Thinning. It reviewed the available literature on the history of both hand and chemical thinning.

5. Current Studies on Chemical Thinning of Peaches. The section covered current studies and publications on the chemical thinning of peaches.

6. Mechanical Thinning of Peaches. The most current literature on mechanical thinning was reviewed.

7. Trends in the Peach Industry. This section reviewed the present problems facing the peach industry.

8. Extension Principles, Goals, Scope and Philosophy. It reviewed journal articles and books on the mission, goals, scope and philosophy of agricultural extension.

9. The Adoption Process in Extension Education. It covered the processes, adoption categories, and stages an individual undergoes in adopting a new practice and offered some research works on the adoption

process.

10. Information Sources. This part covered the different types of information sources available to the farmers. Reviews were from journal articles.

11. Mass Media. This outlined the different ways of transmitting mass messages and how mass media ranks in aiding the adoption of a new farm practice. The review was from journal articles and textbooks.

12. Adopter Categories. This section covered some research works on adopter categories. Information was obtained from journal articles.

13. Opinion Leaders. The section offered major characteristics of opinion leaders. The review was from textbooks and journal articles.

14. Advisory Committee in Agricultural Extension. It covered some of the important research works on the role, functions and types of people who could serve on the Advisory Committees.

15. Planning Powerful Extension Programs. The section covered the more important qualities of "powerful" Extension programs. Reviews were from journal articles.

CHAPTER III

RESULTS

There have been varied opinions with regard to the awareness of peach chemical thinning among Extension Horticultural specialists. In order to determine more validly these opinions, the study was undertaken to determine the awareness of chemical thinning in 22 states considered as major peach producing areas.

Data presented in this chapter was obtained after developing questionnaires and submitting them to Extension Horticultural specialists in 22 states. Fifteen questionnaires were completed and returned from the horticultural specialists. Final tabulations of data supplied from completed questionnaires were made and an analysis attempted.

The study attempted to determine the Extension horticultural specialists' perception as to peach growers' awareness of the chemical thinning of peaches with suggested ways of providing educational assistance to help growers adopt the method.

Bearing and Nonbearing Acreage and Value in Dollars

It was evident from the data that the peach industry occupies an important part in the agricultural economy of the states studied (Table I).

The total average value in dollars to the agricultural economy of

TABLE I

APPROXIMATE BEARING AND NONBEARING PEACH ACREAGE AND AVERAGE VALUE IN DOLLARS OF PEACHES TO THE AGRICULTURAL ECONOMY OF THE STATES STUDIED

States	Approximate Acreage	Approximate Nonbearing Acreage**	Approximate Average Value in Dollars of Peaches to the Agricultural Economy of the State
California	72,000	15,000	$120,000,000
South Carolina	25,000	3,000	40,000,000
Michigan	13,000	4,500	5,000,000
Georgia	12,000	5,000	20,000,000
Texas	9,000	4,000	3,500,000
Florida	5,000	1,000	---------
Virginia	4,500	900	2,500,000
Arkansas	4,355	1,950	4,800,000
North Carolina	3,500	1,500	5,000,000
Louisiana	3,000	1,000	9,000,000
Maryland	2,664	112	5,000,000
Oklahoma	2,200	500	750,000
Kansas	1,000	300	1,000,000
Mississippi	800	200	1,000,000
Tennessee	600	250	1,000,000
Total	159,119	39,212	$218,650,000
Mean	10,608	2,614	
Range	600-71,400	112-14,888	

*Approximate average value for Florida not given.
**Approximate nonbearing peach acreage is that amount of available land onto which peach cultivation can be extended.

14 states (no response by Florida) amounted to $218,650,000. California ranked highest with a crop value $120,000,000, followed by South Carolina with $40,000,000 and Georgia with $20,000,000. Oklahoma ranked lowest with $750,000.

On the approximate acreage of bearing peach trees, the total acreage was 159,119, which ranged between 600 and 71,400 acres. California ranked highest with 72,000 acres, followed by South Carolina with 25,000 acres and thirdly by Michigan with 13,000 acres. Tennessee had the lowest acreage of 600. The mean of the bearing peach acreage was 10,608.

The approximate total nonbearing acreage of peaches amounted to 39,212 acres in the fifteen states (Table I). The mean was 2,614 acres. The range was between 112-14,888 acres. California had the highest nonbearing acreage, followed by Georgia with 5,000 acres and lastly, Maryland, with 112 acres.

Perhaps the differences in dollar ($) values per acre listed were dependent on whether the crops were for fresh or canning markets. Fresh market peaches are more expensive than those for canning.

The annual dollar ($) variations in the peach industry are dependent on the production level for that year. Peaches, more than any of the fruit crops, vary every year depending on the prevailing weather. In a year where there is a late frost injury the production output will be decreased. Hence value per acre in dollars ($) directly proportional to the production level for that year.

Major Commercial Peach Problems

The frequency of major orchard problems are shown in Figure 1.

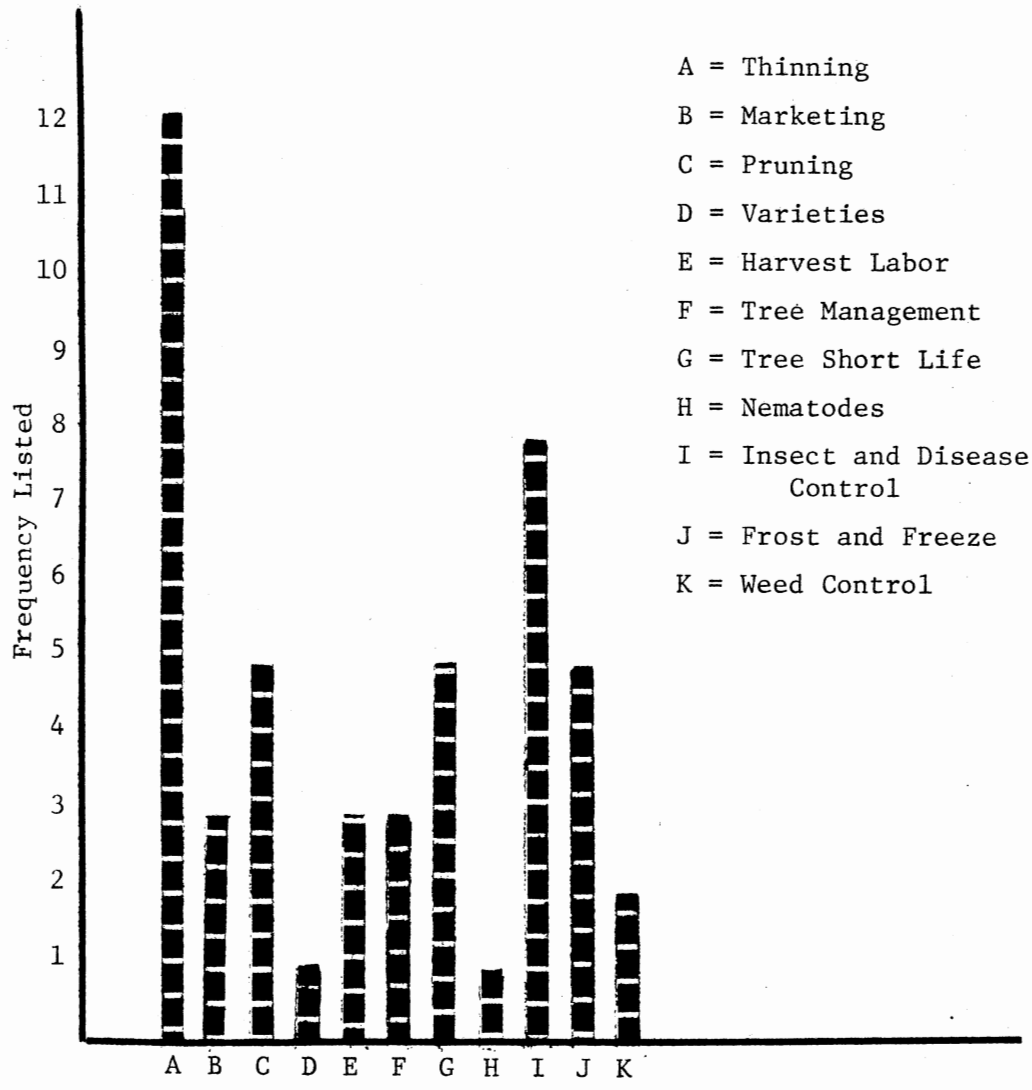

Figure 1. Frequency Listed as One of Three Major Problems Commercial Peach Growers Must Deal with Yearly as Given by the Horticultural Specialists in Fifteen States

Twelve states of the 15 reporting showed fruit thinning as one of the three major problems in their state, which was the highest frequency of the problems. Insect and disease control had the second highest frequency followed by pruning, and short tree life tied for third. Frost and freeze tied for fourth, weed control was fifth while marketing, harvesting labor and tree management tied for sixth as major orchard problems. Varieties and nematodes problems had the least frequency of occurrence as major orchard practices.

Degree of Importance of Thinning

Since Extension Agricultural Specialists from twelve of the 15 states considered fruit thinning as one of the three major problems in peach production in their state, it is evidently quite important. The other three states (20%) considered peach thinning as a slight problem.

Rank Order of Production Factors According to Cost to the Producer

Pest control and the highest overall rank across the fifteen states according to cost compared to other production factors (Table II). Pruning was second in cost, while thinning ranked third in cost to the rest of the other production practices.

Harvesting labor was fourth, followed in fifth by orchard management. Fertilization ranked sixth and irrigation was considered as least in cost in peach production.

On responses of each individual state to the seven production factors as shown in (Table II) with regards to the highest and least

TABLE II

RANK ORDER OF PRODUCTION FACTORS ACCORDING TO COST TO THE PRODUCER[1]

	STATES																
	Ark.	Cal.	Flo.	Ga.	Kan.	La.	Md.	Mich.	Miss.	N.C.	Ok.	S.C.	Tenn.	Tex.[2]	Va.	Total	Overall[3] Rank
Thinning	2	2	3	1	2	2	2	2	5	6	5	1	4	-	3	40	3
Pest Control	4	4	1	4	1	1	5	4	1	1	1	4	2	-	34	1	
Pruning	1	3	4	2	3	3	3	3	2	2	2	2	3	-	2	35	2
Harvesting Labor	3	1	2	3	4	5	1	1	4	3	4	3	5	-	4	43	4
Fertilization	6	6	6	5	5	6	6	6	3	4	6	6	6	-	7	78	6
Irrigation	7	5	7	7	6	7	7	7	7	7	7	5	1	-	6	86	7
Orchard-Management	5		5	6	7	4	4	5	6	5	3	7	7	-	5	76	5

[1]Fourteen out of fifteen states responded to this question.
[2]Texas did not respond to the question.
[3]Overall rank was based on numbers ranging from 1-7 with 1 as highest and 7 lowest.

in cost in peach production, South Carolina, and Georgia (2 states) reported thinning as the first most expensive factor. Arkansas, California, Kansas, Louisiana, Maryland and Michigan (6 states) ranked thinning in second position.

Florida and Virginia (2 states) reported it in third position to other factors in cost of production expenses. Mississippi and Oklahoma ranked it fifth, while North Carolina (1 state) considered it in sixth position to other production factors.

Current Research

Fifty-three percent, or eight states, reported that there is some present research being conducted on chemical thinning in their states. (Table III). Twenty-seven percent, or four states, reported that there is no research in progress and there had been no chemical research in their states in the past five years. Twenty percent, representing three states, showed there is no current research but there had been some chemical thinning research in their states in the past five years.

Chemical Thinning Compounds Being Tested

Of the states presently conducting research studies with chemical compounds, the analysis of the data showed that Arkansas, Florida, South Carolina and Tennessee are using CGA-15281 (Table IV). Tennessee is the only state reported using presently CGA-1786 and Staufer-27969. Ethephon is being tested in Florida, Georgia, Kansas, South Carolina and Virginia, while Naphthalean Acetic Acid (NAA) is presently tested in Kansas.

TABLE III

RESEARCH ON CHEMICAL THINNING IN PROGRESS OR CONDUCTED IN THE LAST FIVE YEARS

When Conducted	States	
	#	%
Last five years	3	20
Current Research	8	53
No Current Research or in last five years	4	27
Total	15	100

TABLE IV

STATES PRESENTLY CONDUCTING RESEARCH WITH VARIOUS CHEMICAL THINNING COMPOUNDS

Chemicals	States
CGA-15281	Arkansas, Flordia, South Carolina, Tennessee
CGA-17856	Tennessee
Ethephon	Florida, Georgia, Kansas, South Carolina, Tennessee, Virginia
NAA	Kansas
Staufer R-27969	Tennessee

Research Project Decline

Concerning the question why chemical thinning research had declined in the states in which it had been conducted in the past five years, these reasons were given by the respondents.

a. There had been a lack of success with some of the existing

chemicals.

b. The use of some chemicals was banned as a result of the Environmental Act of 1969.

c. Frost is still a big problem in peach production, causing inconsistency in yield production.

d. Some of the requirements necessary for their registration are a big cost factor for the issuing chemical company.

Percentage of Growers Using Chemical Thinning Compounds on an Experimental Basis

The states in which there was reported to be some grower trial of chemical thinning included Arkansas with the percentage growers ranging between 0-10% growers involved representing approximately 100 acres.

Percent Grower Adoption

As to the percent of adoption of chemical thinning by growers, California shows 0-10% with no mention of number of acres in use. South Carolina shows 10-20% of the growers adopting chemical thinning with 2000 acres in use. Virginia has 0-10% of the growers adopting chemical thinning of fruits in their commercial production of peaches with 100 acres in use.

Future Acceptance of Chemical Thinning as Reported by Extension Horticulturists

The analysis of the data showed horticultural specialists in 80 percent (12) of the states thought growers would accept and use chemical thinning, should research and extension programs show definite

benefits and advantages of chemical thinning. Seven percent (1) of the respondents were undecided.

Educational Awareness Program on Chemical Thinning

Forty-seven percent (7) of the fifteen responding extension horticulturists showed that there had been an educational awareness program on the chemical thinning of peaches in the last two years for peach growers in their states. Fifty-three percent (8) of the these showed that there had been no educational awareness program on chemical thinning of peaches in the last two years in their states.

Adoption Methods Suggested by the Extension Horticulturists

When the data were analyzed concerning suggested educational methods to help in the adoption of chemical thinning by peach growers as outlined by the horticultural specialists, "field and result demonstrations in grower's orchard" was ranked first compared to the other suggested methods (Table V). This amounted to 44.44 percent of the respondents.

"Influential growers talking of success" was second with 22.22 percent. The presentation of research data based on a wide range of varieties and conditions and use of mass media (radio, TV, publications, newspapers and newsletters) were both ranked third with 11.11 percent. "Tours of orchards where chemical thinners were used" and "through professional horticultural research publications" and "cooperative extension service" were ranked in fourth position with 5.56 percent.

TABLE V

FREQUENCY OF EDUCATIONAL METHODS SUGGESTED BY THE HORTICULTURAL SPECIALISTS TO INTRODUCE PEACH THINNING BY CHEMICAL MEANS TO GROWERS IN THEIR STATES*

Methods	Frequency of Occurrence		
	#	%	Rank
Field and Result Demonstration in grower's orchard	8	44.44	1
Influential Growers talking of success research	4	22.22	2
Through Professional Horticultural Publications and Cooperative Extension Service	1	5.56	4
Presentation of Research Data based on Wide Range Conditions	2	11.11	3
Tours of Orchards Where Chemical Thinners Were Used	1	5.56	4
Mass Media (Radio, TV, Publications, Newspapers and Newsletters)	2	11.11	3

*Nine specialist responded to this question. Several gave more than one answer.

CHAPTER IV

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Peach trees (Prunus-Persica) requires an adequate method to reduce its heavy set of fruits.

Various means such as excessive pruning and hand and mechanical thinning methods have been used but none of these seems to be adequate.

An alternative to these is the chemical thinning method. This method seems to be more effective than the other methods in terms of cost and adequacy in thinning.

In view of this, an attempt was made in this study to determine the perceptions of horticultural extension specialists regarding grower awareness of the "potential" chemical thinning of peaches and to provide suggested methods to promote adoption.

Method

Twenty two extension horticultural specialists representing twenty two states were selected as respondents. It was thought the the peach industry was important to the agricultural economy of these states.

The instrument, a questionnaire, was designed with the help of a jury of experts.

The data were analyzed using descriptive statistics as outlined

by Runyon (33).

Results

Bearing and Nonbearing Acreage and Value in Dollars

The analysis of the data showed that the bearing acreage represented a total value of $218,650,000 and 159,119 acres for the 14 responding states.

About 39,212 acres was reported as nonbearing acreage, which could be used in future as expansion for the bearing acreage.

The differences in dollar ($) values among the states on similar acreages could be as a result of the differences in the variations in cost between fresh market and canning market for their peaches.

Major Commercial Peach Problems

Of the eleven major orchard problems identified among the three major problems for each state, fruit thinning was reported with the highest frequency of occurence while varieties and nematodes problems were reported least in occurence.

Degree of Importance of Thinning

Since twelve of the extension horticultural specialists reported thinning as a major problem out of the responding fifteen states, it must be an important problem. Horticulturists in the other states reported it as only a slight problem.

Rank Order of Production Factors According to Cost to the Producer

On costs of production, insect disease control was rated highest, followed sequentially by pruning, thinning, harvesting labor, orchard management, fertilization and finally irrigation.

Current Research

Concerning the percentage of current research on chemical thinning, 53 percent (8) of the responding 15 states reported some presence of experimental trials. Twenty percent (3) of these had some research in the past five years while the remaining twenty-seven percent or four states reported no previous research effort on chemical thinning.

Chemical Thinning Compounds Being Tested

The chemical compounds used were given as CGA-15281, CGA-17856, Ethephon and Staufer R-27969. The most frequently used were Ethephon and CGA-15281.

Peach Project Decline

The primary reasons given by the fifteen extension horticultural specialists for the present decline in chemical thinning trials were the present restrictions placed on some plant chemical compounds by the Environmental Act of 1969, the high cost of registration, lack of definite success with some of the existing materials, and weather variations.

Percentage of Growers Using Chemical Thinning Compounds on an Experimental Basis

About 0-10 percent of the farmers in two states (Arkansas and Kansas) were reported experimenting with chemical compounds on their farms.

Percent Grower Adoption

The extension specialists in three of the states, California, South Carolina and Virginia, reported that about 10 percent of their growers had adopted chemcial thinning of peaches.

Future Acceptance of Chemical Thinning as Reported by Extension Horticultural Specialists

Eighty percent (12) of the responding extension horticultural specialists believed that peach growers would accept chemical thinning if research and extension education programs could show definite advantages of the method.

Educational Awareness Program on Chemical Thinning

Forty seven percent (7) of the extension horticulturists reported that peach growers had been exposed to an educational awareness program on "potential" chemical thinning method.

Suggested Adoption Methods by the Horticulturists

The fifteen respondents suggested that the "potential" chemical thinning method could be adopted through these methods: "field and result demonstrations in grower's orchard", "influential growers talking of success", "the presentation of research data on a wide range of varieties and conditions", "use of mass media", "tours of orchards were chemical thinners had been used", "through prefessional horticultural research publications" and "cooperative extension service".

Conclusion

From the analysis of the data, it is evident that commercial peach production represents a large acreage of farm land, which has value in the millions of dollars. It means that commerical peach production is an important source of capital in generating revenues in most of the states included in this study. It is also evident from the study that thinning is a major orchard problem since it was rated highest in frequency of occurence of the major problems commercial peach growers must deal with; which insect disease control was reported as the highest cost factor.

Since half of the extension horticultural specialists reported that there had been some extension educational awareness program and current research programs for peach growers, it is evident that the peach growers are aware of the potential chemical thinning method.

It is evident from the suggested methods to promote adoption as given by the extension horticulturists that the economic impact of

chemical thinning as demonstrated by Childers (8) when presented to growers would help in stimulating peach growers towards adoption of chemical thinning of heavily loaded trees would cost $75 - $200 per acre, as compared with $5 - $6 an acre for the chemical spray technique.

Also it was reported by Obiudu (24) that even if the chemical spray did not do a complete thinning job and some hand thinning would be necessary, the saving in cost could be substantial. Growers might be stimulated to try chemical thinning, when research results such as these are presented in farmers meetings.

As soon as some of the thinning compounds become registered readily available and allowed to "float" in the free market with some definite results, then we should observe rapid degrees of acceptance of chemical thinning in peach production. This view was expressed by 80 percent of the respondents in this study.

With the present high cost of labor for hand thinning of peaches, chemical thinning of peaches could serve as a rightful substitute to hand thinning, where research and extension programs show its definite benefits and advantages.

Recommendations

Although there is an educational awareness of chemical thinning among the growers to certain extent this needs to be increased through extension education since the majority of the growers have not adopted chemical thinning method.

It is recommended that chemical thinning compounds such as ethephon and CGA-15281 and others which have passed preliminary tests for thinning peaches conducted by research stations be allowed by EPA to

be used for further research both by peach growers and the horticulturists in order to determine conclusively their results and safety in commercial peach production.

The EPA has set stricter rules recently on the use of chemicals, which has made it further difficult for farmers to try experimentally chemical compounds for thinning. The EPA should re-examine its position on the chemical compounds.

So far there is no chemical that has successfully thinned all varieties of peaches. This quest seems so far difficult. It is suggested that those chemical compounds e.g. ethephon and CGA-15281 which have thinned certain varieties of peaches be recommended only for use on those varieties where they have proved successful.

It recommended that the local extension office serve as distributing agents for some of the chemical compounds which have passed preliminary tests so that peach growers may try them on a small scale. The cooperative extension office will offer an easy access to information on the chemical compounds.

It is suggested that funds be raised at local and state levels to support current research on chemical thinning compounds.

In stimulating adoption it is recommended that demonstration plots in growers' orchards be used and that influential growers in the community be used in quickening the adoption process through combinations of extension education activities, mass media, presentation of research data to growers and through professional horticultural publications.

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APPENDIX A

Dear Dr._____:

The purpose of this survey is to determine the awareness of chemical thinning of peaches in certain areas of the United States by Commercial fruit growers. Could you please take a little time from your busy schedule to complete the enclosed form and return it by _____.

If you have a colleague who could better furnish the information regarding peach growers in your state, would you please pass this on to him. We realize how busy you are during this period of the year and appreciate the fact that you receive many requests such as this. We feel, however, this information will be of great benefit in developing future research and extension programs regarding chemical thinning of peaches.

We will furnish a copy of this data to those of you who indicate that you would like to receive it.

Enclosed is a self-addressed, stamped envelope for your convenience.

Sincerely yours,

Enclosure

The purpose of this survey is to determine the current progress and stage of adoption of the practice of chemical thinning of peach trees. Your help in compiling this information will be greatly appreciated.

Please respond to each item as indicated and return by August 15 in the enclosed self-addressed envelope to:

Dr.
Department of Horticulture
Oklahoma State University
Stillwater, Okla. 74074

1. Name of state (optional)_____

2. Approximate commercial peach acreage in state:

   a)_____ acres of bearing age peaches

   b)_____ acres of nonbearing age peaches

3. Approximate average value of peaches to the agricultural economy of the state.

   _____

4. What would you suggest are the three major problems the commercial peach grower must deal with yearly?

   1)_____

   2)_____

   3)_____

5. If fruit thinning was not listed in the above question, how would you rate it as a problem for the grower?

   _____a) no problem

   _____b) a slight problem

   _____c) a major problem

6. Rank the following production factors according to cost to the producer with 1 the greatest and 7 the lowest:

   _____ Spraying (pest control) _____ Fertilization

   _____ Pruning _____ Irrigation

   _____ Thinning _____ Orchard floor management

   _____ Harvesting

7. Is research currently being conducted in your state by the Agricultural Experiment Station on chemical thinning of peaches?

_____ yes

_____ no

8. If the answer to the above question is yes, what chemicals are currently being tested?

1)_____ 4)_____

2)_____ 5)_____

3)_____ 6)_____

9. If research on chemical thinning of peach trees is not currently being conducted in your state, has there been a research project in this area in the past five years?

_____ yes

_____ no

10. If the answer to the above questions is yes, why was the project discontinued?

_____

11. What percent of the growers are using chemicals as a thinning agent on an experimental basis?

_____ 0% representing _____ acres (approximately)

_____ 9 - 10% " _____ " "

_____ 10 - 20% " _____ " "

_____ over 20% " _____ " "

12. To what extent have growers in your state adopted the practice of chemical peach thinning?

_____ 0% representing _____ Acres (approximately)

_____ 0 - 10% " _____ " "

_____ 10 - 20% " _____ " "

_____ over 20% " _____ " "

13. Do you fell there would be a wide acceptance and use of chemical thinning of peaches by growers in your state if research and extension programs could show definite benefits and advantages of chemical thinning?

_____ yes

_____ no

14. Has there been an educational presentation within the past two years to the peach growers of your state in which information regarding chemical thinning was presented?

_____ yes

_____ no

15. Could you suggest educational methods to help gorwers accept or adopt this new method of peach thinning if research data showed it to be satisfactory?

1)_____

2)_____

3)_____

4)_____

16. Additional comments:

_____

_____

_____

_____

17. Please indicate if you would like a copy of the results of this survey.

_____ yes (to whom should it be mailed?)

_____ no

LIST OF STATES UNDER THE SCOPE

OF THE STUDY

1. California
2. South Carolina
3. Michigan
4. Georgia
5. Texas
6. Florida
7. Virginia
8. Arkansas
9. North Carolina
10. Louisiana
11. Maryland
12. Kansas
13. Mississippi
14. Tennessee
15. Oklahoma

VITA 2

Benedict C. Obiudu

Candidate for the Degree of

Doctor of Education

Thesis: EXTENSION SPECIALISTS' PERCEPTIONS OF THE AWARENESS OF COMMERCIAL PEACH GROWERS TO CHEMICALS AS A "POTENTIAL" THINNING AGENT AND SUGGESTED METHODS TO PROMOTE ADOPTION

Major Field: Agricultural Education

Biographical:

Personal Data: Born in Enugu, Eastern Nigeria, June 4, 1947, the son of Mr. and Mrs. J. I. Obiudu.

Education: Graduated from Trinity High School, Oguta, in December, 1965; received Diploma in General Agriculture from Aristotelian University, Thessaloniki, Greece, in 1972; received Master of Science degree from Cornell University, Ithaca, N. Y., in 1976; enrolled in doctoral program at Oklahoma State University in 1976, and completed requirements for the Doctor of Education at Oklahoma State University in July, 1978.

Professional Experience: Research assistant on chemical thinning of peaches, Cornell University, 1974-1975.