

This is a section from the

# 2023/2024 New Jersey Commercial Tree Fruit Production Guide

The recommendations are **NOT** for home gardener use.

The **full guide** can be found on the Rutgers New Jersey Agricultural Experiment Station (NJAES) website at: <a href="https://njaes.rutgers.edu/pubs/publication.php?pid=e002">https://njaes.rutgers.edu/pubs/publication.php?pid=e002</a>. The guide is revised biennially.

Cooperating Agencies: Rutgers, The State University of New Jersey, U.S. Department of Agriculture, and New Jersey Board of County Commissioners. Rutgers Cooperative Extension, a unit of the Rutgers New Jersey Agricultural Experiment Station, is an equal opportunity program provider and employer.

# **PREFACE**

### NOT TO BE USED BY HOME GARDENERS

This is your personal copy of the 2023/2024 New Jersey Commercial Tree Fruit Production Guide. Do not use previous editions for pesticide recommendations. Keep previous copies on file for pesticide records. This guide is based on Rutgers and U.S. Department of Agriculture research results, combined with industry and grower knowledge and experience.

The authors welcome constructive criticism and suggestions from growers and industry personnel who may wish to help improve future editions of this publication.

The New Jersey State Agricultural Development Committee adopted the Tree Fruit Production Guide as the commercial tree fruit production agricultural management practice (AMP) N.J.A.C. 2:76-2A.6 to protect commercial farm operations from private and public nuisance lawsuits. Updates to this guide are not automatically included in the AMP.

This fruit production guide is intended for the **commercial grower**. The proper choice of the herbicide, pesticide, and plant growth regulators is the individual fruit grower's responsibility. This guide is intended to facilitate decision-making. This guide is not a substitute for pesticide labeling. **Read the label before applying any pesticide**.

This guide will be updated as changes in labels and restrictions warrant. All necessary and important changes in recommendations will be announced at twilight fruit meetings and posted in the Plant Pest Advisory Newsletter. Record these changes in this publication to keep it up to date. The Plant and Pest Advisory Newsletter subscription forms are available from your local agricultural agent, and at <a href="https://plant-pest-advisory.rutgers.edu/">https://plant-pest-advisory.rutgers.edu/</a>.

#### **Trade or Brand Names**

The trade or brand names given herein are supplied with the understanding that no discrimination is intended and no endorsement by Rutgers Cooperative Extension is implied.

#### **Authors**

Ms. Patricia Hastings, Dr. George Hamilton

Dr. Megan Muehlbauer, Mr. Winfred Cowgill

Dr. Megan Muehlbauer, Dr. Joseph Heckman

Dr. Hemant Gohil, Dr. Daniel Ward

Dr. Thierry Besançon

Dr. Norman Lalancette, Mr. David Schmitt

Dr. Anne Nielsen, Mr. Dean Polk, Mr. David Schmitt

#### Discipline

**Pesticide Safety** 

Horticulture, Plant Growth Regulators

Soil Fertility, Orchard Nutrition

Horticulture, Orchard Frost Protection

Weed Science

Pathology

Entomology

#### Front Cover Illustration

Rebecca Sloane

#### Coordinated and Edited by

Dr. Megan Muehlbauer

Dr. Margret van Vuuren

# **PESTICIDE USE DISCLAIMER**

# THE LABEL IS THE LAW

A pesticide applicator is legally bound by the labeling found on and with the pesticide container in their possession. Before using a pesticide, check and always follow the <u>labeling distributed with the product</u> at the point of sale for legally enforceable rates and restrictions.

In addition to the pesticide products listed in this Production Guide, other formulations or brands with the same active ingredient(s) may be commercially available.

#### ALWAYS CHECK THE LABELING ON THE PRODUCT CONTAINER ITSELF:

- a) to ensure a pesticide is labeled for the same use,
- b) to ensure the pesticide is labeled for the desired crop,
- c) for differences in rates and percent active ingredient, and
- d) additional restrictions.

Check the physical product label for the maximum amount of pesticide per application and the maximum number of applications per year.

**IMPORTANT: DO NOT RELY ON ELECTRONIC LABELING** (unless it is "web labeling" found directly on the product container). *Online pesticide* labels may not be the same as the labeling distributed with the product. Some services include: Proagrica's CDMS <a href="http://www.cdms.net/">http://www.cdms.net/</a>; Agworld DBX powered by Greenbook <a href="https://www.greenbook.net">https://www.greenbook.net</a>; or Agrian <a href="https://www.agrian.com/labelcenter/results.cfm">https://www.agrian.com/labelcenter/results.cfm</a>.

These electronic label services provide use disclaimers, and in some cases, legally binding User Agreements assigning ALL liability to USER of service. For example, Agrian's webpages\* cite (in red): The material and content contained in the Agrian Label Database is for general information only. Agrian Inc. does not provide any guarantee or assurance that the information obtained through this service is accurate, current, or correct, and is therefore not liable for any loss resulting, directly or indirectly, from reliance upon this service. This Label Database does not replace the official manufacturer issued label. Users of this database must read and follow the actual product label affixed to the container before use of the product. Use of the Label Database is subject to the Terms of Use and Privacy Policy \* [date accessed: 12/23/2022].

See a detailed regulatory discussion of this and other essential information on Pesticide Safety and the Pesticide Label in Chapter 1. Electronic labeling is discussed in section 1.3.1.

# **TABLE OF CONTENTS**

		PAGE
PREFACE		
PESTICIDE USE DISCLAIMER		2
TABLE OF	CONTENTS	3
CHAPTER	es s	
1	PESTICIDE SAFETY	9
1.1	General Information	9
1.2	Certification and Licensing of NJ Pesticide Applicators	10
1.3	The Pesticide Label	12
1.3.1	Labels and Labeling	12
1.3.2	Label Statements: Restricted Use Classification, Signal Words, First Aid, and Other	13
1.3.3	Significant Labeling Changes: Soil Fumigants, Paraquat Dicloride, and Chlorpyrifos	18
1.4	Handling Pesticides	20
1.4.1	Prior to Pesticide Application	20
1.4.2	Pesticide Application	21
1.4.3	Pesticide Transport	22
1.4.4	Pesticide Storage	22
1.4.5	Disposal of Pesticide Containers	24
1.4.6	Disposal of Pesticides	25
1.4.7	Pesticide Spills	26
1.5	Reducing Risks to Handlers and Workers	28
1.5.1	Agricultural Worker Protection: Inform, Protect, and Mitigate	28
1.5.2	Personal Protective Equipment for Pesticides	32
1.5.2.1	Body Protection for Early Entry Workers and Pesticide Handlers	32
1.5.2.2	Respiratory Protection for Pesticide Handlers	35
1.6	Protect the Environment	37
1.6.1	Minimize Off-Target Drift	37
1.6.2	Protect Surface and Ground Water	38
1.6.3	Protect Non-Target Organisms	40
1.7	State Contacts for NJ Pesticide Applicator Programs	45
2	PESTICIDE CALIBRATION AND STABILITY	46
2.1	Sprayer Calibration and the Tree Row Volume Method	46
2.2	Effect of pH on Pesticide Stability and Efficacy	51
3	ORCHARD NUTRITION	53
3.1	Soil Management for New and Established Orchards	53
3.2	Soil Testing	54
3.3	Leaf Tissue Analysis	56
3.4	Orchard Soil Fertility Management	57
3.4.1	Soil pH and Lime Applications	57
3.4.2	Soil Nutrient Applications and Timing	59

3	ORCHARD NUTRITION - CONTINUED	PAGE
3.4.3	Long Term Sustainable Soil Nutrient Management	63
3.5	Adapting Soil Fertility Recommendations to Organic Farming	64
4	ORCHARD FROST PROTECTION	65
4.1	Monitoring for Active Frost Protection	65
4.2	Active Frost Protection Methods	70
4.2.1	Irrigation	70
4.2.2	Heat Application	72
4.2.3	Mixing Air	73
4.2.4	Chemical Methods	74
4.3	Frost Protection References	74
5	ORCHARD WEED CONTROL	75
5.1	Weed Control Measures and Orchard Floor Management	75
5.2	Herbicides Categories	76
5.3	Herbicide Application Notes	77
5.4	Influence of Soil Properties and Water (Rainfall and Irrigation) on Herbicides	78
5.5	Reducing the Risk of Herbicide Resistance	81
5.6	Weed Control in Tree Rows	81
5.7	Weed Control in Sod Between Tree Rows	82
5.8	Tree Fruit Herbicide Recommendations	83
5.9	Troublesome Weeds	94
6	TREE FRUIT DISEASES, PESTS, AND CONTROLS	100
6.1	Diseases and Disorders of Stone Fruit	100
6.1.1	Diseases of Stone Fruit	100
6.1.2	Special Nectarine Pest Control Issues	109
6.1.3	Postharvest Peach and Nectarine Treatment	110
6.2	Diseases and Disorders of Apples	111
6.2.1	Early Season Apple Diseases	111
6.2.2	Summer Apple Diseases	114
6.2.3	Physiological Apple Disorders	115
6.2.4	Postharvest Apple Diseases and Disorders	116
6.3	Fungicides and Bactericides	117
6.4	Insect and Mite Pests of Fruit Trees	130
6.5	Resistance Management, Insecticides, and Miticides	136
6.5.1	Resistance Management	136
6.5.2	IRAC Classification for Tree Fruit Insecticides and Miticides	136
6.5.3	Insecticides and Miticides	138
6.5.4	Third Party and Generic Labels	144
6.6	Nematode Control	146
6.7	Vole Control	148
7	PEACHES AND NECTARINES	150
7.1	Peach and Nectarine Cultivars	150
7.2	Peach and Nectarine Rootstocks	151
7.3	Thinning and Harvest Management	151

7	PEACHES AND NECTARINES - CONTINUED	PAGE
7.4	Peach and Nectarine Winter Injury	153
7.5	Peach and Nectarine Insect and Mite Control Strategies	153
7.6	Peach and Nectarine Integrated Pest Management	155
7.6.1	Mating Disruption Technology for Key Peach and Nectarine Insect Pests	155
7.6.2	Peach and Nectarine IPM Treatment Guidelines	156
7.7	Efficacy of Pesticides for Peach and Nectarine Disease, Insect and Mite Control	160
7.8	Peach and Nectarine Disease and Pest Management	163
7.9	Peach and Nectarine Disease and Pest Management, Non-Bearing Trees	189
8	CHERRIES	190
8.1	Limitations to Cherry Production in New Jersey	190
8.2	Cultivar and Pollinator Choices for Sweet Cherries	191
8.3	Cultivar Choices for Tart Cherries	192
8.4	Cherry Rootstocks	193
8.5	References Cherry Cultivation	193
8.6	Cherry Disease and Pest Management	194
9	PLUMS	211
9.1	Plum Varieties	211
9.2	Plum Rootstocks	213
9.3	Plum Pollination	213
9.4	Plum Disease and Pest Management	214
10	APPLES	225
10.1	Apple Cultivars	225
10.2	Apple Rootstocks	227
10.3	Specific Issues for Apple Orchard Nutrition	231
10.4	Apple Pollination	233
10.5	Use of Plant Growth Regulators in Apple Orchards	235
10.5.1	Apple Crop Load Management and Precision Thinning	235
10.5.2	Other Uses For Plant Growth Regulators in Apple	239
10.6	Apple Insect and Mite Control Strategies	244
10.7	Apple Integrated Pest Management	246
10.7.1	Mating Disruption Technology for Key Apple Insect Pests	246
10.7.2	Apple IPM Treatment Guidelines	247
10.8	Efficacy of Pesticides for Apple Disease, Insect and Mite Control	249
10.9	Apple Disease and Pest Management	252
11	PEARS	280
11.1	European Pears	280
11.2	Asian Pears	281
11.3	Use of Plant Growth Regulators in Pear Orchards	283
11.4	Pear Disease and Pest Management	285
12	ADDITIONAL RESOURCES	298

TABLES		PAGE
1.1	EPA Signal Words According to Toxicity Categories (I, II, III, IV) of Pesticide Products	15
1.2	Fruit Pesticides Shown to Have Moderate to High Toxicity Effects on Bees	44
2.1	Approximate Spray Volume for Coverage at the Full-Leaf Stage of Canopy Development	48
2.2	Optimum pH and Half-Life at Different pH Values for Selected Pesticides	52
3.1	Optimal Foliar Nutrient Ranges of Macronutrients for Different Fruit Trees	56
3.2	Optimal Foliar Nutrient Ranges for Micronutrients for Different Fruit Trees	56
3.3	Target Cation Exchange Values for Calcium, Magnesium, and Potassium	58
3.4	Recommended Pounds of Calcium Carbonate Equivalent per Acre (lb CCE/A) for a Target	58
	Soil pH of 6.5	
3.5	Nutrient Recommendations for Preparing Soils for New Tree Plantings and Maintaining Orchard Middles for Apple, Peach, and Other Tree Fruit Production	62
3.6	Nutrient Recommendations for Tree Fruit Production	63
4.1	Critical Spring Temperatures (°F) for Tree Fruit Bud Stages	66
4.2	Determination of Wet Bulb Temperature (°F) Using Ambient and Dew Point Temperatures	68
4.3	Frost Protection Instruments	69
5.1	Herbicide Water Solubility and Soil Adsorption Characteristics	79
5.2	Crop Safety of Herbicides for Use in Tree Fruits	84
5.3	Herbicide Effectiveness on Major Annual Weeds in Tree Fruits	88
5.4	Recommended Preemergence Herbicide Rates (Active Ingredients, lb/A)	90
5.5	Recommended Postemergence Herbicide Rates (Active Ingredients, lb/A)	91
5.6	Herbicide Reentry and Preharvest Interval Restrictions	92
6.1	Relative Susceptibility of Peach and Nectarine Cultivars to Bacterial Spot	102
6.2	Relative Susceptibility of Peach Cultivars to Rusty Spot	108
6.3	Materials for Hydrocooler	110
6.4	Minimum Requirements for Apple Scab Leaf Infection	112
6.5	Efficacy and Use of Insecticides to Control Brown Marmorated Stink Bug	135
6.6	IRAC Classification for Tree Fruit Insecticides	137
6.7	IRAC Classification for Tree Fruit Miticides	138
6.8	Active Ingredient, New Trade Names and Traditional Trade Names of Insecticides	144
6.9	Nematode Treatment Guidelines	147
6.10	Fumigant and Non-Fumigant Nematicides	147
6.11	Vole Control with Rodenticides	149
7.1	Comparison Chart of Peach and Nectarine Cultivars	150
7.2	Peach and Nectarine Chemical Thinning	152
7.3	Peach and Nectarine Harvest Management	152
7.4	Oriental Fruit Moth Timing	157
7.5	Degree Development of Plum Curculio	158
7.6	Tufted Apple Budmoth Timing	159
7.7	Efficacy of Fungicides and Bactericides for Peach and Nectarine Disease Control	160
7.8	Efficacy of Insecticides and Acaricides for Peach and Nectarine Insect and Mite Control	161

TABLES -	CONTINUED	PAGE
8.1	Recommended White or Yellow Fleshed Sweet Cherry Cultivars	191
8.2	Recommended Red or Black Fleshed Sweet Cherry Cultivars	191
8.3	Recommended Blush Sweet Cherry Cultivars	192
8.4	Tart Cherries Cultivars	192
8.5	Table 8.5 Gisela Series Rootstocks to consider in New Jersey	193
10.1	Some Examples of Tree Spacing	230
10.2	Summary of Apple Thinning Timing and Materials	238
10.3	Recommendations for Rescue Thinning with Ethephon	238
10.4	Improving Apple Fruit Quality, Size, and Shape	240
10.5	Apple Return Bloom Enhancement	241
10.6	Apple Pre-Harvest Drop Control	242
10.7	Improvement of Apple Branching	243
10.8	Efficacy of Fungicides and Bactericides for Apple Disease Control	249
10.9	Efficacy of Insecticides and Acaricides for Apple Insect and Mite Control	250
11.1	Plant Growth Regulators for Pear Fruit Thinning	284
11.2	Plant Growth Regulators for Pear Harvest Management and Fruit Quality	284
11.3	Plant Growth Regulators for Pear Branching	284

FIGURES		PAGE
1.1	EPA Pesticide Label Pollinator Protection Box	42
1.2	EPA Pesticide Label Excerpt of "Directions for Use" for Neonicotinoid Pesticides	43
2.1	Proportional Distribution of Airblast Spray Required for Good Coverage	50
3.1	Soil Test Response Curve	55
3.2	Nutrient Application Rates in Relation to Soil Test Category	59
4.1	Frost Damage in Apple and Peach Bloom	65
4.2	Strong Inversion Layer over a Field in Pennsylvania	67
4.3	Damaged and Undamaged Pistils after a Frost Event	68
4.4	Frost Protection Using an Overhead Irrigation System in the High Density Apple Orchard in PA	70
4.5	Example of Continuous Ice Formation over Apple Tree Using Overhead Irrigation	71
4.6	Frost Protection Using Under-Tree Sprinkler Irrigation in Peach Orchard in DE	71
4.7	Frost Protection Using a Mobile Propane Heater	72
4.8	Wind Machine in Apple Block of Gardenhour Orchards in Maryland	73
4.9	Frost Protection Using a Helicopter in Fifer Orchard, Delaware	74

If you are having a medical emergency after using pesticides, always call 911 immediately.



## In Case of an Accident

- Remove the person from exposure
- Get away from the treated or contaminated area immediately
- Remove contaminated clothing
- Wash with soap and clean water
- Call a physician and/or the National Poison Control Center (1-800-222-1222).
   Your call will be routed to your State Poison Control Center.
- Have the pesticide label with you!
- Be prepared to give the <u>EPA registration number</u> to the responding center/agency