NORTH AMERICAN TRUFFLE GROWER ANNUAL REPORT 2023

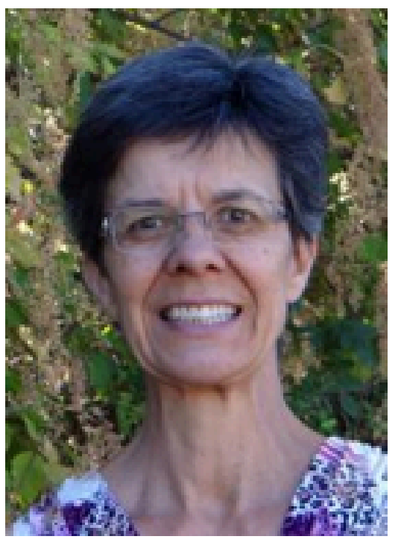
Data to describe the industry and gain valuable insight on truffle production throughout North America.

We need your data!

http://ucanr.edu/trufflesurvey

This annual survey is used to collect producer data to better understand the truffle industry in North America. The questions help characterize important demographics like orchard types, truffle species grown, site conditions, management practices, and production status. The results will be used to guide future research needs and align growers with researchers. Data is collected annually with a reporting period of November - October. Survey respondents will receive a unique link each October to modify the previous year's data. New growers or prospective growers can fill out their initial survey at http://ucanr.edu/trufflesurvey

North America Truffle Survey Team

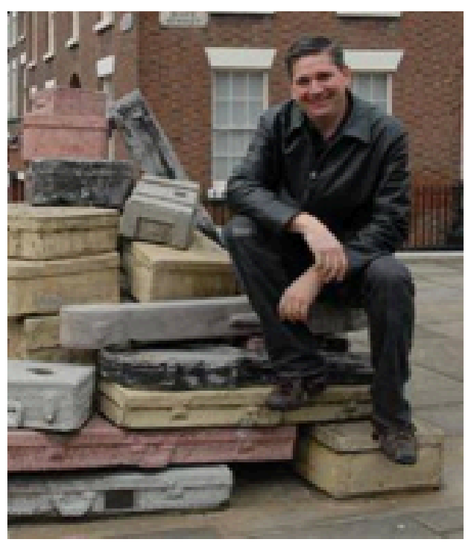


Dr. Shannon Berch

Retired Research Scientist, British Columbia

Dr. Peter Oviatt

Earned a PhD from MIT studying the interactions of fungi, plants and people in soils of high human impact



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Truffle grower, Carolina Truffiéres, Fletcher NC

Ann Scanlon

Truffle grower, Sugarloaf, California

Please note the following before viewing the survey results:

- All identifying information about orchards has been anonymized and will never be publicly available.
- Participants were asked to complete separate surveys for orchards in different locations and for orchards with different management strategies at the same location.
- Participants had the option to skip questions, so the figures presented are based on the available number of responses, which is listed for each figure.

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WHAT IS YOUR GROWING EXPERIENCE?

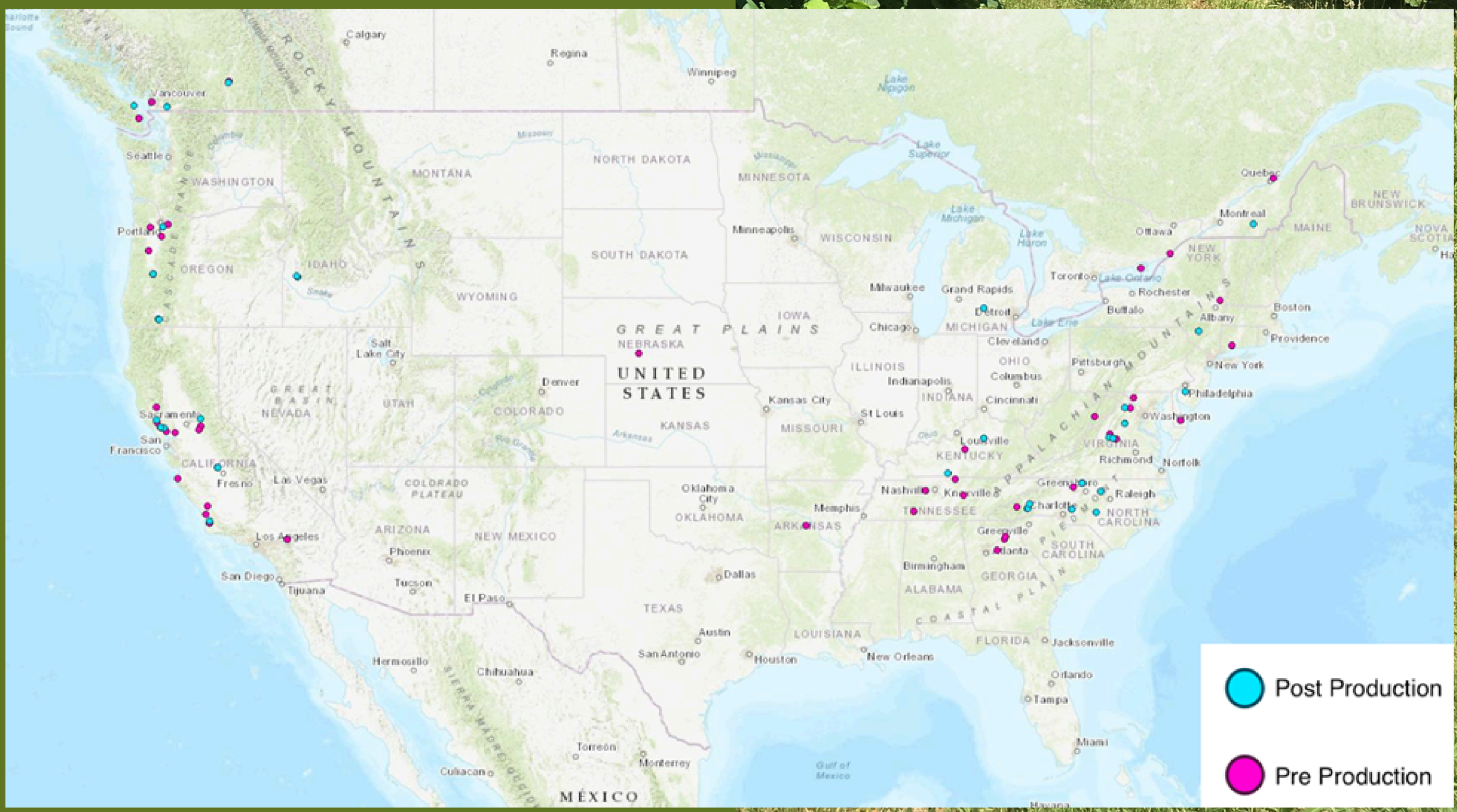
Total responses: 164

Grower Experience	Count	Percentage
Prospective grower	40	24%
Pre-production	77	47%
Post-production	40	24%
Other	7	4%

Growers are asked to self identify. Prospective growers include individuals interested in growing truffles or looking to learn more about the industry. These respondents may also be looking for property, or have property and are getting ready to plant. The Other category includes those that are integral to the truffle industry including dog handlers, trainers, consultants, etc.

ORCHARD LOCATION

Total responses: 81

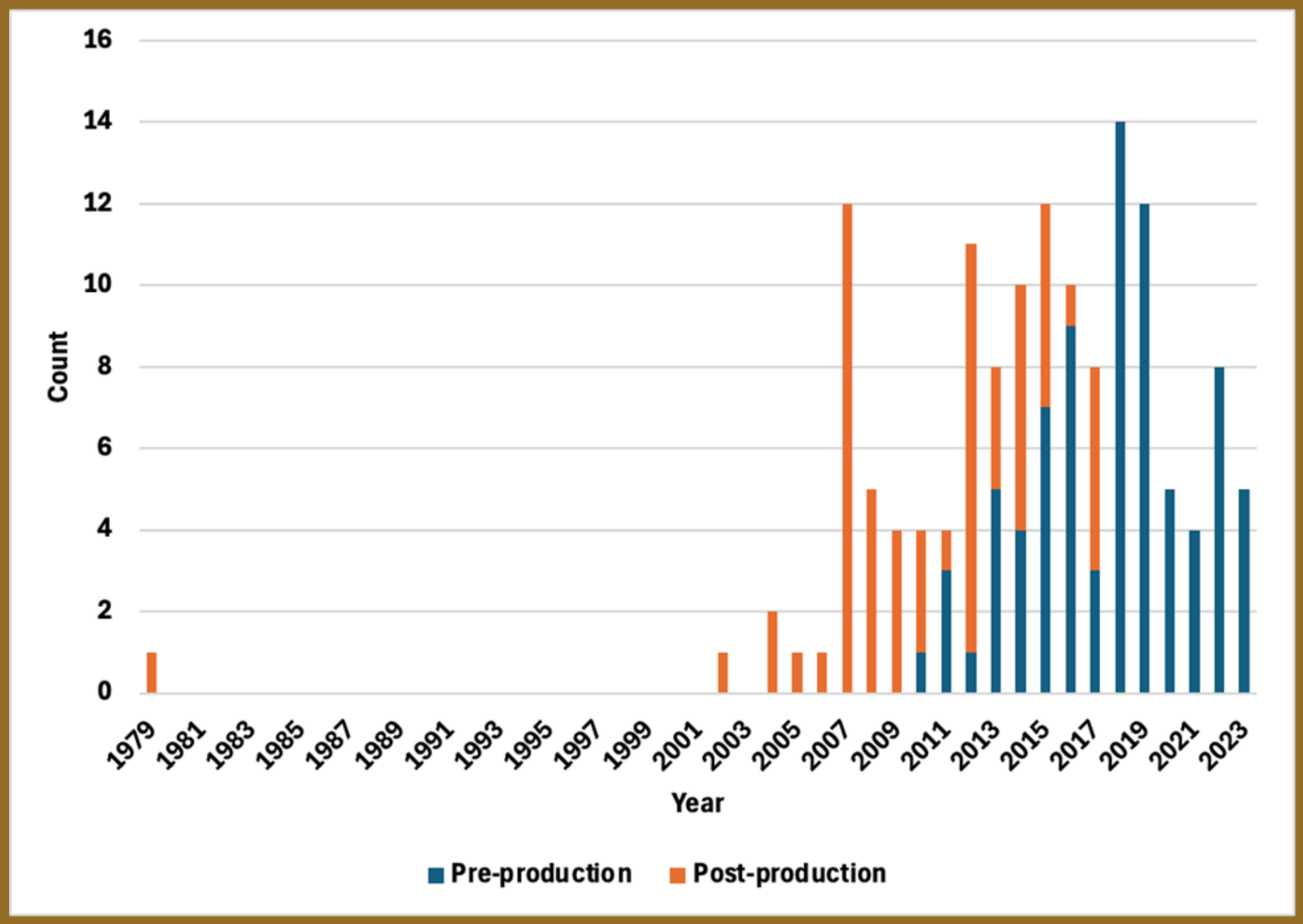


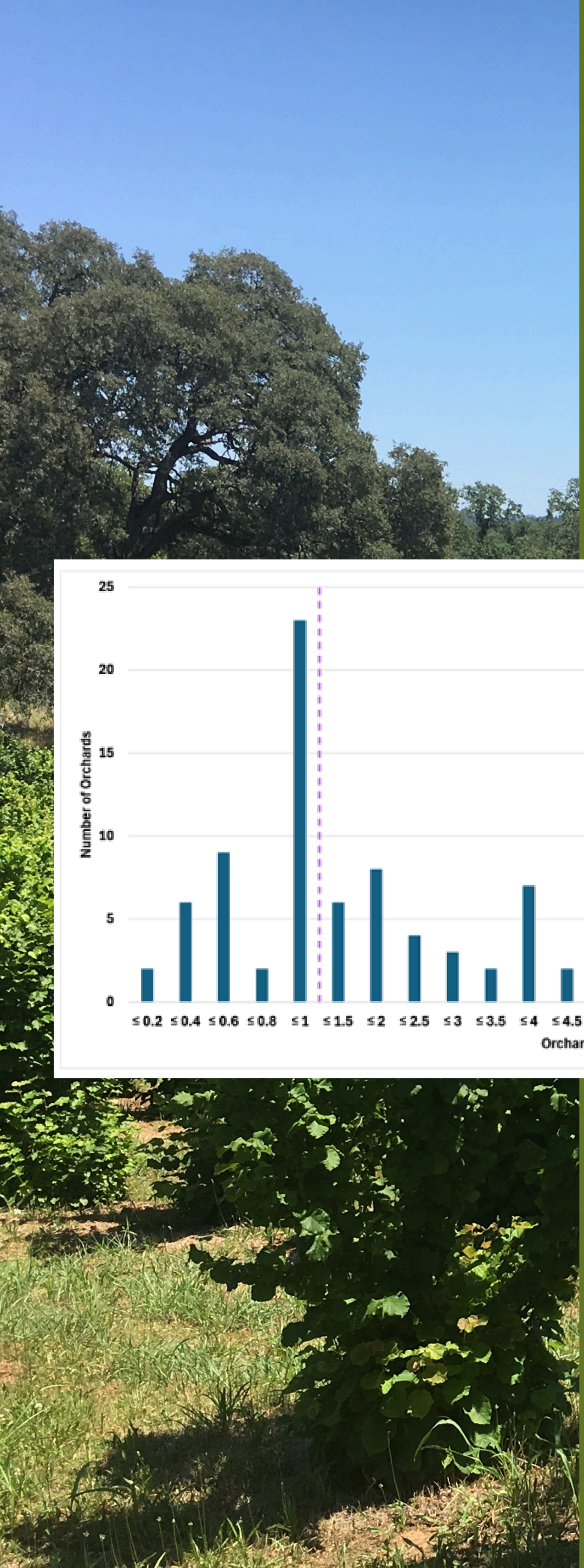
WHAT YEAR WAS YOUR ORCHARD PLANTED?

TOTAL RESPONSES: 142

Note: This chart displays two separate datasets:

First, it shows the number of orchards planted annually, and color differences can be ignored. Second, the color coding shows which orchards have come into production between the year they were planted and the time of the survey (2023). There are three distinct clusters:
1) All reported orchards planted between 1979 and 2009 came into production sometime after planting. Please note that this does not indicate that age alone is necessary to achieve truffle production.
2) Some orchards planted between 2010 and 2017 have since started producing truffles while others have not.
3) All orchards planted between 2018 and 2023 have yet to reach production.



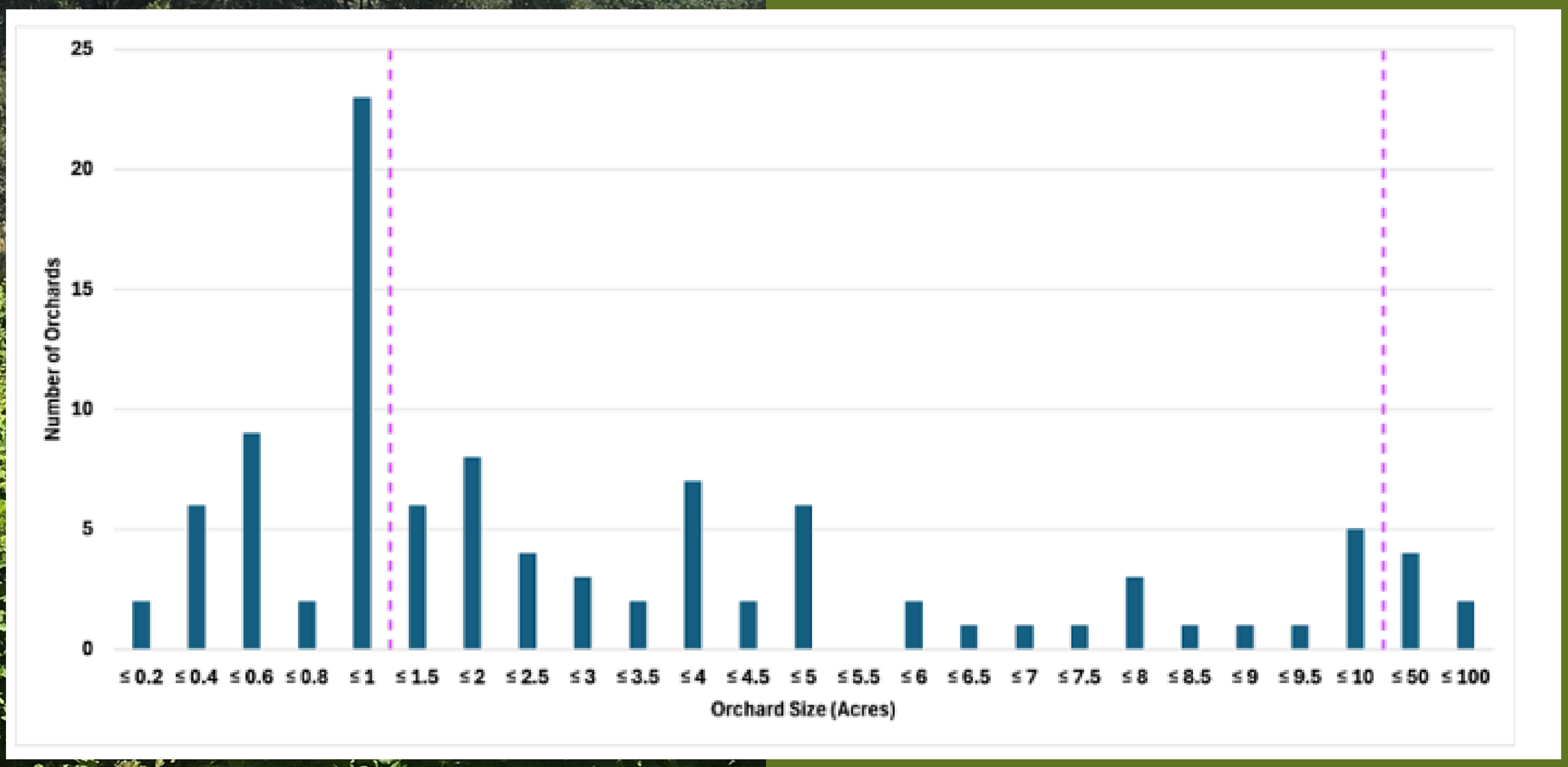


ORCHARD SIZE

TOTAL RESPONSES: 109

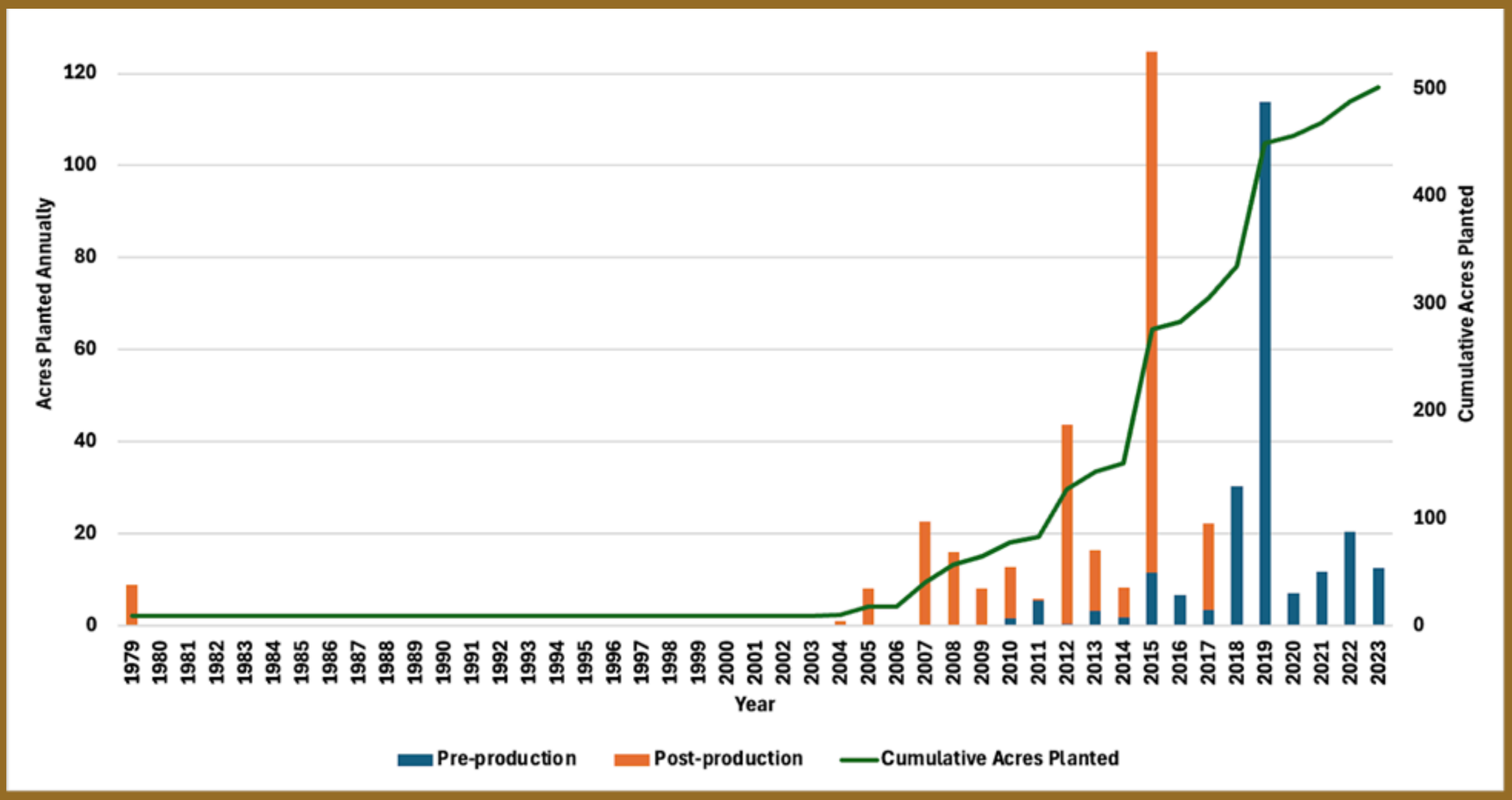
Total acreage: 528.52 acres
Total Post Production: 270.83 acres
Total Pre production: 257.69 acres
Average orchard size: 4.85 acres

Note: Orchard sizes were grouped using different increments to make it easier to visualize the full range, from the smallest to the largest orchards. Orchards between 0 and 1 acre were binned in 0.2-acre increments, those between 1 and 10 acres were binned in 0.5-acre increments, and orchards between 10 to 200 acres were binned in 50-acre increments. Each different increment is indicated with a dashed magenta line.



TRUFFLE ORCHARD ACREAGE EXPANSION OVER TIME

TOTAL RESPONSES: 102



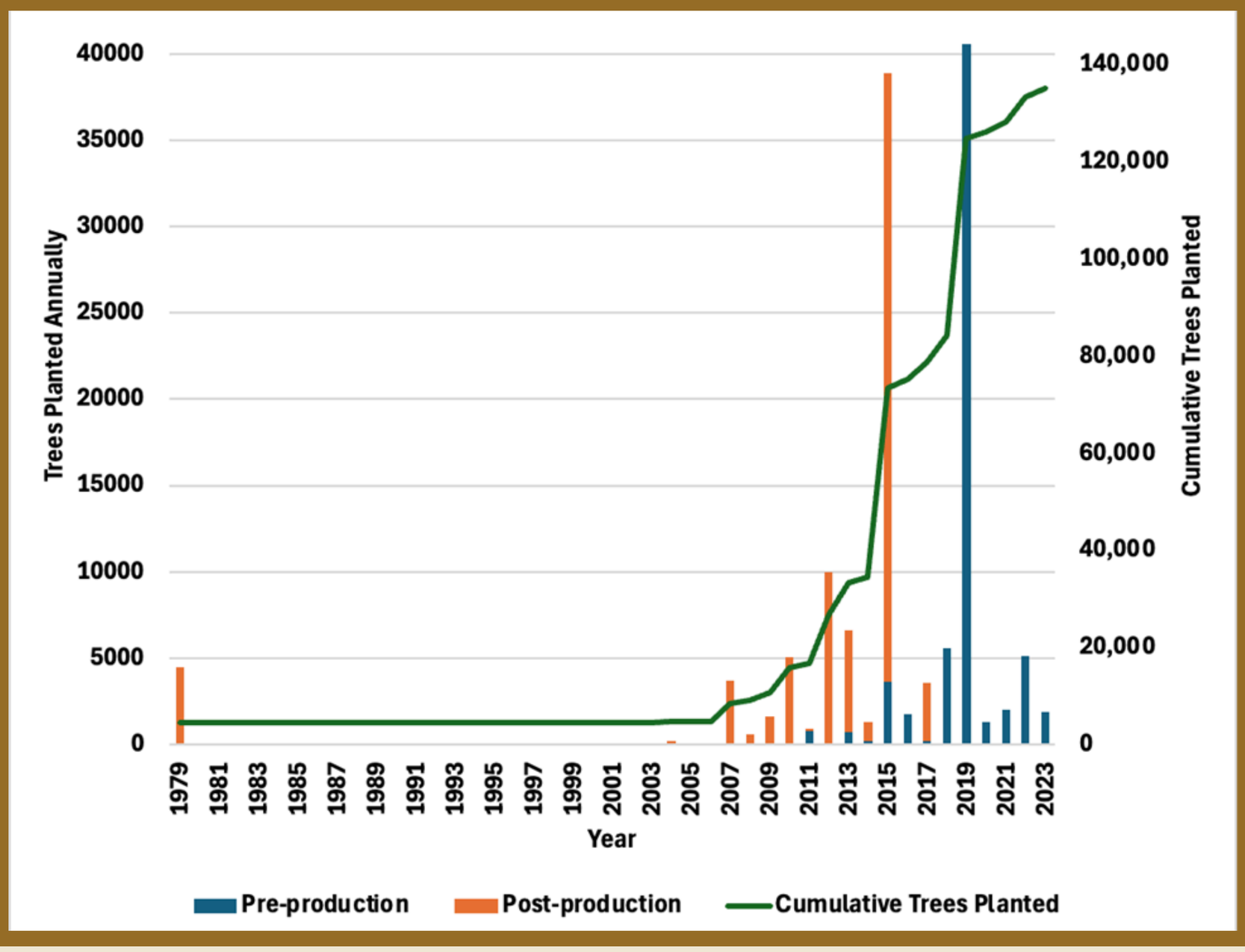
TOTAL NUMBER OF TREES PLANTED

TOTAL RESPONSES: 94

- Total trees planted = 135,143 host trees in all orchards
- Average number of trees planted per orchard = 1,438 trees
- Average number of trees planted per acre: 293 trees

TOTAL NUMBER OF HOST TREES OVER TIME

TOTAL RESPONSES: 94

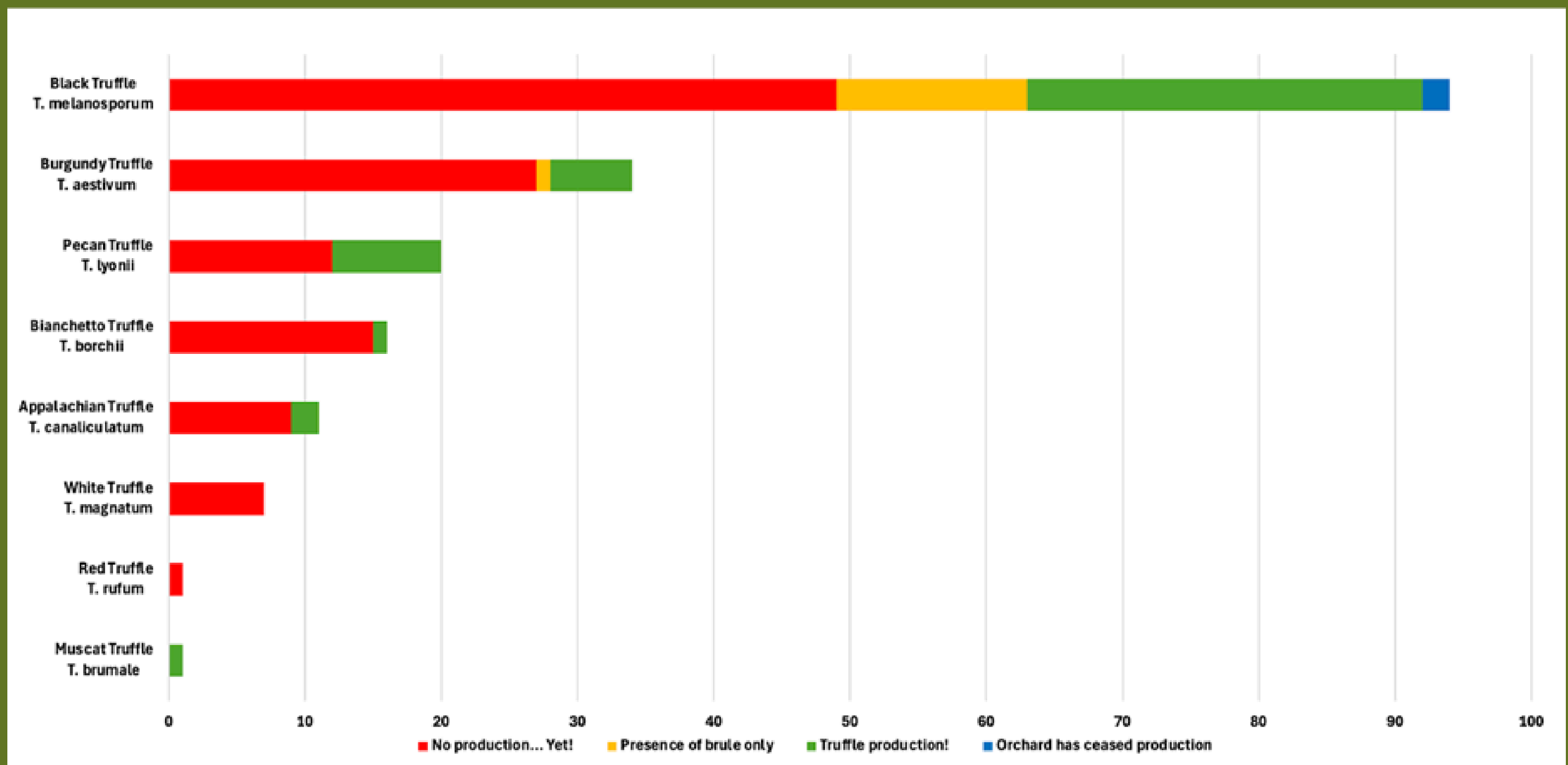


For both graphs, cumulative acres and cumulative trees are tracked with the green line and use the right Y-axis. The acres/trees planted annually are tracked with the left Y-axis. Figures account for trees planted and don't account for trees that have died since being planted.

WHAT TRUFFLE SPECIES IS YOUR ORCHARD INOCULATED WITH?

TOTAL RESPONSES: 71

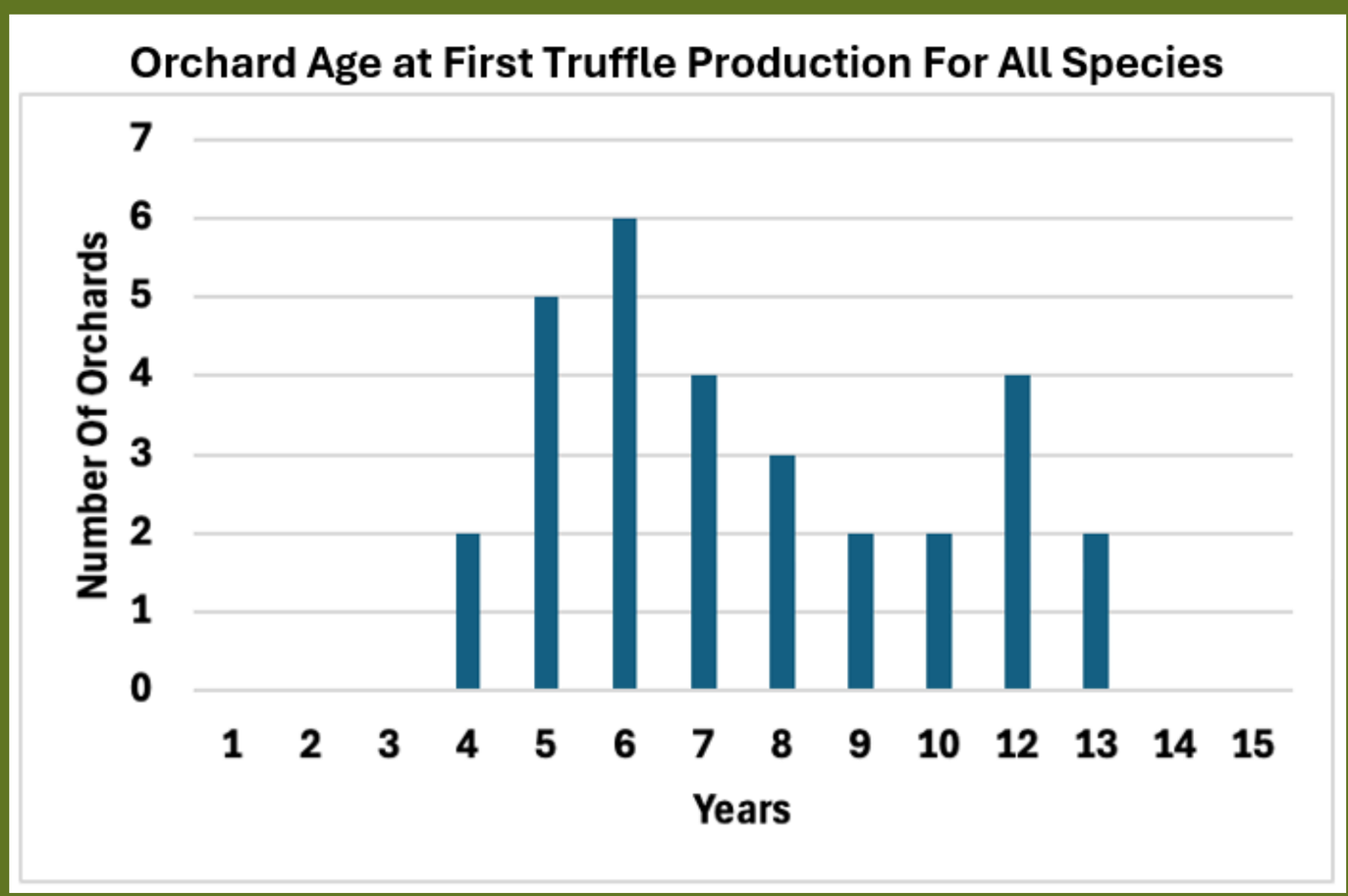
This chart displays the number of orchards inoculated with a certain truffle species. Some participants indicated that they grow more than one truffle species in a single orchard, so the number of orchards exceeds the number of responses. The data is further color-coded by production status.
1) Red indicates that the orchard has yet to reach production.
2) Yellow represents orchards where brulé is present, but no production yet.
3) Green represents orchards currently reported to be in production.
4) Blue represents orchards that have ceased truffle production.



HOW OLD WAS YOUR ORCHARD WHEN YOU FOUND THE FIRST TRUFFLE?

TOTAL RESPONSES: 30

Average orchard age at the time of first production for all truffle species: 7.7 ± 2.8 years old



WHAT TREE SPECIES ARE PRESENT IN YOUR ORCHARD?

TOTAL RESPONSES: 131

There are 39 different host tree species growing in North American truffle orchards. The three most commonly grown species are indicated with orange text.

Answers with an asterisk (*) were filled in by participants and were not visible to all survey respondents.

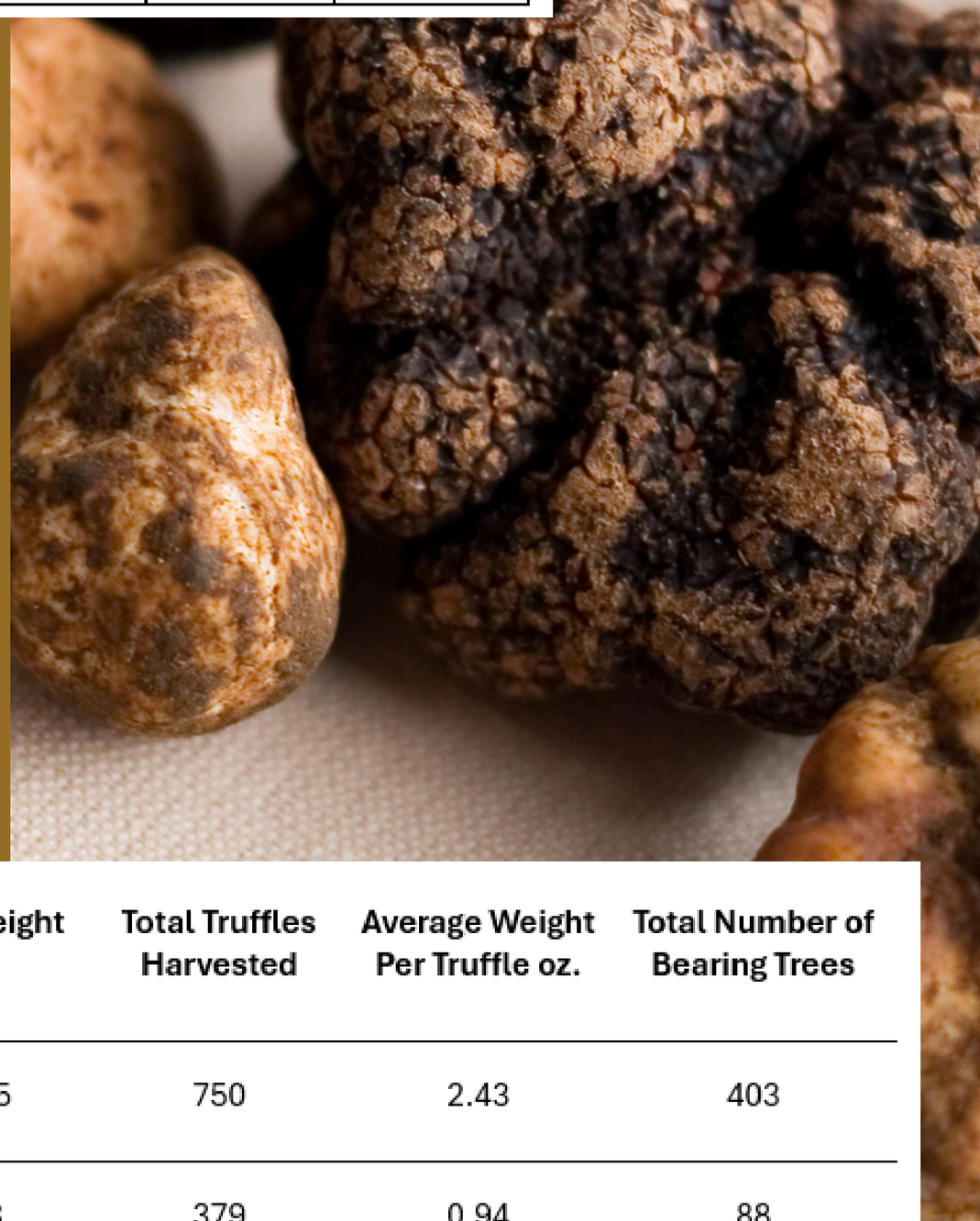
		Orchard Count	Percentage
Oak Family	**English Oak (*Quercus robur*)**	**75**	**57.3**
	Holly Oak (*Quercus ilex*)	**29**	**22.1**
	Cork Oak (*Quercus* suber)	3	2.3
	Bicolor Oak (*Quercus bicolor*)*	1	0.8
	Black Oak (*Quercus kelloggii*)*	1	0.8
	Bur Oak (*Quercus macrocarpa*)*	9	6.9
	Chinquapin Oak (*Quercus muehlenbergii*)*	3	2.3
	Downy Oak (*Quercus pubescens*)*	3	2.3
	Garry oak (*Quercus garryana*)*	3	2.3
	Holm Oak (*Quercus rotundifolia*)*	1	0.8
	Japanese Oak (*Quercus mongolica*)*	1	0.8
	Kermes Oak (*Quercus coccifera*)*	4	3.1
	Northern Red Oak (*Quercus rubra*)*	3	2.3
	Oak (*Quercus spp.*)*	4	3.1
	Portuguese Oak (*Quercus faginea*)*	1	0.8
	Southern Live Oak (*Quercus virginiana*)*	1	0.8
	Valley Oak (*Quercus lobata*)*	4	3.1
	White Oak (*Quercus alba*)*	4	3.1
Birch Family	**Hazelnut / Filbert (Corylus avellana)**	**74**	**56.5**
	American Hazelnut (*Corylus americana*)*	2	1.5
	Hazel (*Corylus spp.*)*	1	0.8
	Turkish hazel (*Corylus colurna*)*	1	0.8
	European hornbeam (*Carpinus betulus*)*	1	0.8
Pine Family	Douglas Fir (*Pseudotsuga menziesii*)*	2	1.5
	Eastern White Pine (*Pinus strobus*)*	1	0.8
	Loblolly pine (*Pinus taeda*)*	3	2.3
	Norway spruce (*Picea abies*)*	1	0.8
	Pine (*Pinus spp.*)*	4	3.1
	Spruce (*Picea spp.*)*	2	1.5
	Stone Pine (*Pinus pinea*)*	2	1.5
Beech Family	Chestnut (*Castanea spp.*)*	3	2.3
	Chestnut Hybrid (*Castanea sativa* × *Castanea crenata*)*	1	0.8
	Dunstan Chestnut (*Castanea dentata* × *Castanea mollissima*)*	1	0.8
	European beech (*Fagus sylvatica*)*	1	0.8
Willow Family	Poplar (*Populus spp.*)*	1	0.8
	Willow (*Salix spp.*)*	1	0.8
Other	Pecan (*Carya illinoinensis*)	6	4.6
	American Linden (*Tilia americana*)*	1	0.8
	Holly (*Ilex spp.*)*	1	0.8

WHAT TRUFFLE AND TREE SPECIES ARE PRODUCING TRUFFLES IN YOUR ORCHARD?

TOTAL RESPONSES: 28

	Black Truffle *T. melanosporum*	**Burgundy Truffle** *T. aestivum*	**Pecan Truffle** *T. lyonii*	*T. cumberlandense*	**Appalachian Truffle** *T. canaliculatum*	**Bianchetto Truffle** *T. borchii*	**Muscat Truffle** *T. brumale*
English Oak *Quercus robur*	10	1	1				
Filbert *Corylus maxima*	8	1	2	3	1		
Hazel *Corylus avellana*	6	4	1			1	1
Chestnut *Castenea spp.*		2					
Pecan *Carya illinoinensis*			2				

This table displays the number of growers producing truffles during the 2022-2023 season using specific truffle and tree species combinations. The number is influenced by how many growers are using that combination and doesn't necessarily reflect the potential for production. For instance, the higher count of black truffles on English oak (10) compared to burgundy truffles on filberts (1) is related to black truffles being the most cultivated species in North America.
Participants could enter data for multiple species, so the numbers are greater than the total responses.



TOTAL YEARLY TRUFFLE PRODCTION

TOTAL RESPONSES: 23

Total reported production for season: 158.37 pounds

	Number of Producing Orchards	**Total Weight lbs.**	**Total Truffles Harvested**	**Average Weight Per Truffle oz.**	**Total Number of Bearing Trees**
Black Truffle *Tuber melanosporum*	11	105.5	750	2.43	403
Burgundy Truffle *Tuber aestivum*	5	17.3	379	0.94	88
Appalachian Truffle *Tuber canaliculatum*	1	2	Not Reported	Not Reported	3
Pecan Truffle *Tuber lyonii*	5	0.57	29	0.07	9

WHAT TYPES OF ORCHARD MANAGEMENT STRATEGIES DO YOU CONDUCT ON AN ANNUAL BASIS?

TOTAL RESPOSES: 117

	Pre-production (77)		Post-production (40)	
	%	Count	%	Count
Liming	43	56	23	58
Weed management	61	79	32	80
Irrigation	57	74	32	80
Pruning	41	53	31	78
Tillage	35	46	15	38
Reinoculation	14	18	24	60
Fertilizer, including compost and biochar	10	13	8	20
Aeration*	0	0	4	10
Mowing*	6	8	1	3
Pest Management*	7	9	2	5
Cover crop/ mulch*	8	10	1	3
None	3	4	0	0

WHAT LAB ANALYSIS HAVE YOU DONE?

TOTAL RESPONSES: 117

	Pre-production (77)		Post-production (40)	
	Count	%	Count	%
pH	55	71	34	85
Soil analysis (physical/chemical)	52	68	32	80
Presence of mycorrhizae	30	39	26	65
DNA verification of orchard soil, inoculum, and whole/fragmented truffles	15	20	18	45
Tree health analysis	7	9	6	15
Tissue analysis	4	5	3	8
None	3	4	0	0

Percentages represent the number of orchards that receive each treatment or lab analysis. Answers with an asterisk (*) were filled in by participants in the "Other" section and were not visible to all survey respondents. The reported numbers may not represent all producers. Participants could select all that apply, so percentages can exceed 100%.

WHAT IS THE pH OF YOUR SOIL?

TOTAL RESPONSES: 86

	Count	pH
Post-production	32	7.61 ± 0.29
Pre-production	50	7.26 ± 0.52
Prospective grower	4	7.35 ± 0.54

WHAT PRACTICES DO YOU IMPLEMENT ANNUALLY TO AMEND YOUR SOIL?

TOTAL RESPONSES: 114

	Pre-production (40)		Post-production (74)	
	%	Count	%	Count
Regular/as needed application of lime (or other form of calcium)	26	35	30	75
One-time application of lime (or other form of calcium) when the orchard was planted	27	37	13	33
Regular/as needed addition of products such as hydrated lime, dolomite or wood ash	7	10	9	23
Limestone	5	7	8	20
Application of lime (or other form of calcium) before trees were planted.	9	12	3	8
Crushed oyster shells*	1	1	0	0
No adjustments needed in this orchard	5	7	0	0
None	2	3	0	0

WHAT MONITORING EQUIPMENT DO YOU USE?

TOTAL RESPONSES: 105

	Pre-production (68)		Post-production (37)	
	Count	%	Count	%
Weather station	26	38	11	30
Soil water potential sensor	17	25	9	24
Soil water content sensor	15	22	4	11
Soil temperature sensor	13	19	4	11
Feel and Appearance*	1	2	1	3
Rain Gauge*	2	3	0	0
Tensiometer*	1	2	1	3
None	32	47	16	43

WHAT ISSUES HAVE YOU EXPERIENCED IN YOUR ORCHARD?

TOTAL RESPONSES: 105

	Pre-production (66)		Post-production (39)	
	%	Count	%	Count
Mammals (e.g. gophers, voles, deer, and moose)	40	61	30	77
Tree diseases (e.g. eastern filbert blight and powdery mildew)	12	18	17	44
Insect pests (e.g. aphids and Japanese beetles)	11	17	16	41
Contamination from unintended truffle species or other fungi	8	12	9	23
Breeching	0	0	9	23
Ceased production	0	0	5	13
Birds	3	5	4	10
Freezing*	1	2	1	3
Weeds*	2	3	0	0
Over pruning*	0	0	1	3
Drought*	3	5	1	3
Soil Compaction*	1	2	0	0
None	11	17	0	0

Percentages represent the number of orchards where each form of monitoring equipment, issue, marketing strategy, and business supplementation is used. Answers with an asterisk (*) were filled in by participants in the "Other" section and were not visible to all survey respondents. The reported numbers may not represent all producers. Participants could select all that apply, so percentages can exceed 100%.

HOW DO YOU MARKET YOUR ORCHARD OR TRUFFLES?

TOTAL RESPONSES: 103

	Pre-production (68)		Post-production (38)	
	Count	%	Count	%
Direct to chefs/consumers	13	20	20	51
Farm website and/or social media	3	5	6	15
Work with a broker	2	3	4	10
Domestic/global sales	1	2	1	3
Your own marketing/distribution	1	2	1	3
After truffle hunts*	0	0	1	3
Boutique Store, Food Events, Agritourism*	0	0	1	3
No marketing	44	69	15	39

WHAT METHODS DO YOU USE TO SUPPLEMENT YOUR BUSINESS?

TOTAL RESPONSES: 106

	Pre-production (68)		Post-production (38)	
	Count	**%**	**Count**	**%**
Consulting	4	6	10	26
Farm stays (including Airbnb), tours, and/or hunts	6	9	9	24
Import	3	4	4	11
Prepared meals	0	0	3	8
Dog training	2	3	0	0
Farm tours	0	0	1	3
Other produce sales (e.g. citrus, berry, etc.) *	7	10	0	0
Winery and wine grape sales*	6	9	1	3
Orchard surveys with truffle dog*	2	3	1	3
Selling inoculated trees*	0	0	1	3
None	39	57	20	53

PROSPECTIVE GROWERS - WHAT IS THE INTENDED SIZE OF THE ORCHARD YOU PLAN TO PLANT?

TOTAL RESPONSES: 22

Total 140.25 acres
Average 6.38 acres

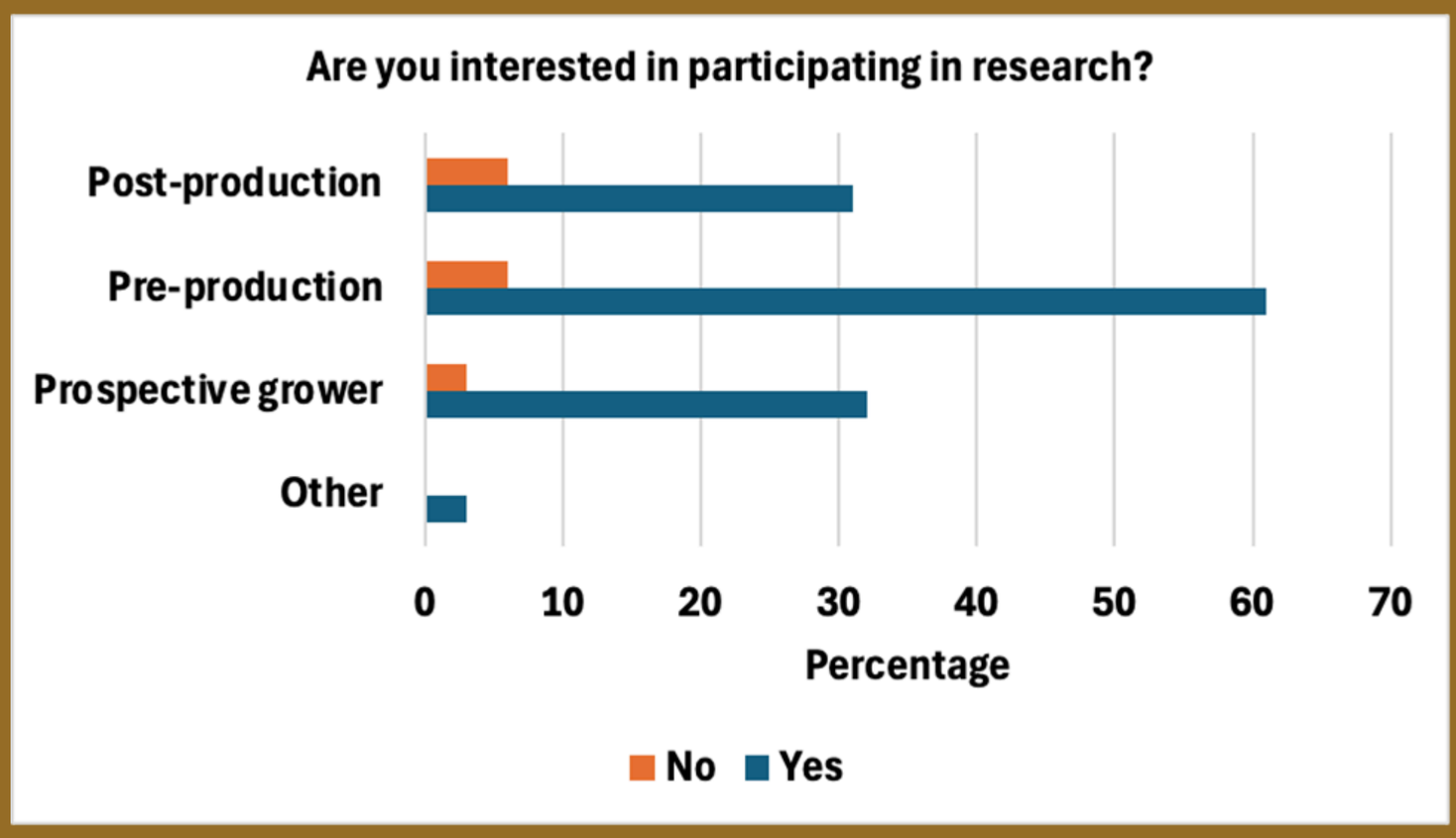
WHAT TRUFFLE SPECIES DO YOU INTEND TO GROW?

TOTAL RESPONSES: 26

	Count
Black Truffle (*Tuber melanosporum*)	11
Bianchetto Truffle (*Tuber borchii*)	9
Appalachian Truffle (*Tuber canaliculatum*)	7
Burgundy Truffle (*Tuber aestivum*)	5
White Truffle (*Tuber magnatum*)	5
Pecan Truffle (*Tuber lyonii*)	3
Uncertain	3

ARE YOU INTERESTED IN PARTICIPATING IN RESEARCH PROJECTS TO IMPROVE TRUFFLE CULTIVATION PRACTICES?

TOTAL RESPONSES: 142



THANK YOU TO THOSE WHO PARTICIPATED IN THE GROWER SURVEY