# PROJECTED PISTACHIO PRODUCTION: 2023 THROUGH 2031

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## Executive Summary

In July 2023, American Pistachio Growers (APG) retained The Tootelian Company to project annual pistachio production in California through 2031. This study projected the number of bearing and non-bearing acres, estimated the annual yields per acre, and projected pistachio production on an annual basis for the next nine years.

The key findings of these analyses are:

- The average number of new plantings per year over the last ten years was considered a good representation of what is likely to occur in the foreseeable future. Therefore, this annual average of 28,489 acres is expected to be newly planted each year through 2031.

- Based on the estimate of annual new plantings, the total number of acres of pistachios is expected to grow from nearly 583,400 acres in 2023 to nearly 811,300 acres in 2031. This represents a 4.3% increase per year.

- The number of bearing acres is expected to increase from nearly 453,750 acres in 2023 to about 668,850 acres in 2031, growing at a rate of 5.1% annually. The number of non-bearing acres is expected to increase from nearly 129,650 in 2023 and to nearly 142,450 bearing acres in 2031, growing about 1.2% per year.

- Average yields per acre for "on" and "off" years in the future were based on prior studies of pistachios. With newly planted acres considered the 1st year and measurable production beginning in the 6th year, the yields per acre by year of maturity were estimated to be:

| | 6th Year | 7th Year | 8th Year | 9th Year | 10th Year | 11+ Years |
|---|---|---|---|---|---|---|
| Yield in ON Year | 600 | 1,300 | 2,200 | 3,080 | 3,080 | 3,392 |
| Yield in OFF Year | 600 | 1,300 | 2,200 | 2,520 | 2,520 | 2,208 |

- Based on the ***expected number of bearing acres***, pistachio production was projected to reach 1.36 billion pounds in 2023 (an "on" year) and increase to nearly 2.08 billion pounds in 2031 (an "on" year). Crop yields are expected to be nearly 3,000 pounds per acre in 2023 and be more than 3,100 pounds per acre in 2031.

- In the "on" years, the largest crop is expected to be nearly 2.08 billion pounds in 2031, while the smallest crop is expected to be 1.36 billion pounds in 2023. In the "off" years, the largest crop is expected to be more than 1.36 billion pounds in 2030, and the smallest is expected to be nearly 1.01 billion pounds in 2024.

- The expected overall yield per acre is projected to be as high as 3,130 pounds per acre in 2025 (an "on" year), and as low as about 2,092 pounds per acre in 2028 (an "off" year).

- Overall, with the expected number of bearing acres from 2023 through 2031, production is projected to average nearly 1.47 billion pounds annually, with an average yield of 2,644 pounds per acre per year.

## Introduction

In July 2023, American Pistachio Growers (APG) retained The Tootelian Company to project annual pistachio production in California through 2031. Previous studies projecting production for APG were conducted by Edmond Missiaen, an agricultural economist.

The total number of acres devoted to pistachios is nearly five times what it was twenty years ago, and the number of bearing acres has more than doubled in the last ten years, growing at a rate of nearly 9.2% per year. The implication for the industry is that a substantial increase in pistachio production is likely to occur in the next five to ten years as newly planted acres evolve from non-bearing to fully mature bearing acres.

To address these issues, a methodology was developed that took into account the expanding acreage for pistachios, the number of newly planted acres, annual production as trees progress from non-bearing to maturity, variations in yields per acre that occur in alternative years, and other factors that could impact production. Summary charts of findings are presented in Appendix A.

## Projected Bearing and Non-Bearing Acres

Because total production depends on the number of acres in each year of bearing maturity, pistachio acreage was defined into three categories: newly planted acres, non-bearing acres which includes newly planted acres, and bearing acres. This was important because measurable production begins in the 6$^{th}$ year and increases annually until the 11$^{th}$ year, after which yields vary mostly by factors other than age.

Newly planted acres are those in their 1$^{st}$ year, and non-bearing acres includes all planted acreage in their 1$^{st}$ through 5$^{th}$ years. Bearing acres include acres that are in their 6$^{th}$ year or later. These distinctions make it necessary to project the number of bearing acres and yields per acre in each of the years from the 6$^{th}$ year of maturity through the 11$^{th}$ year and beyond.

Forecasting the number of bearing and non-bearing acres began with data provided by the Administrative Committee for Pistachios (ACP). According to the ACP, there were a total of 554,895 acres planted for pistachios in 2022. Of that, 427,179 acres were bearing and 127,716

were non-bearing. Approximately 270,010 bearing acres were fully mature (i.e., 11+ years) and 157,169 acres were in their 6th through 10th years of maturity.

To estimate future production, it was assumed that newly planted acres in 2018 through 2020 will become bearing acres in 2023 through 2025, and fully mature bearing acres in 2028 through 2031. Similarly, acres planted in 2021 and 2022 will become bearing acres in 2026 and 2027, and will remain in this category through 2031. Projected newly planted acres in 2023 through 2025 will become bearing acres in 2028 through 2031, while projected acres planted after 2025 will remain non-bearing through 2031. This progression is shown below.

| Year | 1st Year | 5th Year | 6th Year | 10th Year | 11+ Years |
|---|---|---|---|---|---|
| 2018 | 26,562 | 37,687 | 32,048 | 12,128 | 18,740 |
| 2019 | 15,230 | 31,641 | 37,687 | 6,730 | 12,128 |
| 2020 | 16,536 | 37,380 | 31,641 | 9,017 | 6,730 |
| 2021 | 34,388 | 18,413 | 37,380 | 30,625 | 9,017 |
| 2022 | 35,000 | 26,562 | 18,413 | 32,048 | 30,625 |
| 2023 | 28,489 | 15,230 | 26,562 | 37,687 | 32,048 |
| 2024 | 28,489 | 16,536 | 15,230 | 31,641 | 37,687 |
| 2025 | 28,489 | 34,388 | 16,536 | 37,380 | 31,641 |
| 2026 | 28,489 | 35,000 | 34,388 | 18,413 | 37,380 |
| 2027 | 28,489 | 28,489 | 35,000 | 26,562 | 18,413 |
| 2028 | 28,489 | 28,489 | 28,489 | 15,230 | 26,562 |
| 2029 | 28,489 | 28,489 | 28,489 | 16,536 | 15,230 |
| 2030 | 28,489 | 28,489 | 28,489 | 34,388 | 16,536 |
| 2031 | 28,489 | 28,489 | 28,489 | 35,000 | 34,388 |

To project future bearing and non-bearing acreage through 2031, the average new plantings per year over the last ten years (i.e., 28,489 acres) was considered a good representation of what is likely to occur in the foreseeable future. Ten years was considered a sufficiently long duration to encompass variations in new plantings, and the overall ten-year average exhibited less variability (i.e., lowest standard deviation from the average) from individual year plantings than did other historical periods analyzed (i.e., 3-year average, 5-year average, 15-year average, 20-year average). Therefore, 28,489 acres were assumed to be the number of newly planted acres each year through 2031.

Based on these estimates, the total number of acres planted is expected to grow from nearly 583,400 acres in 2023 to nearly 811,300 acres in 2031. This represents a 4.3% increase per year. The number of bearing acres will increase from nearly 453,750 acres in 2023 to about 668,850 acres in 2031, growing at a rate of 5.1% annually. The number of non-bearing acres will grow from nearly 129,650 in 2023 to nearly 142,450 in 2031, increasing at a rate of 1.2% per year. This slower growth rate is due to the assumption that newly planted acres will remain fixed at 28,489 per year through 2031. This is shown below.

| Year | Projected Bearing Acres | Projected Non-Bearing Acres | Projected Total Acres | Projected New Planting |
|---|---|---|---|---|
| 2023 | 453,741 | 129,643 | 583,384 | 28,489 |
| 2024 | 468,971 | 142,901 | 611,872 | 28,489 |
| 2025 | 485,507 | 154,854 | 640,361 | 28,489 |
| 2026 | 519,895 | 148,954 | 668,849 | 28,489 |
| 2027 | 554,895 | 142,443 | 697,338 | 28,489 |
| 2028 | 583,384 | 142,443 | 725,826 | 28,489 |
| 2029 | 611,872 | 142,443 | 754,315 | 28,489 |
| 2030 | 640,361 | 142,443 | 782,803 | 28,489 |
| 2031 | 668,849 | 142,443 | 811,292 | 28,489 |
| Annual Growth Rate: 2022-31 | 5.1% | 1.2% | 4.3% | |

The expected number of bearing and non-bearing acres are shown below. These numbers of bearing acres were then used in conjunction with projected yields per acre by year of maturity to estimate total production through 2031.

| Year—Alternative | **Expected** Bearing | **Expected** Non-Bearing |
|---|---|---|
| 2023-On | 453,741 | 129,643 |
| 2024-Off | 468,971 | 142,901 |
| 2025-On | 485,507 | 154,854 |
| 2026-Off | 519,895 | 148,954 |
| 2027-On | 554,895 | 142,443 |
| 2028-Off | 583,384 | 142,443 |
| 2029-On | 611,872 | 142,443 |
| 2030-Off | 640,361 | 142,443 |
| 2031-On | 668,849 | 142,443 |

## Projected Yields per Acre

Yields per acre vary based on a variety of factors, including the trees' years of maturity and their alternative cycle. Because pistachios are an alternate bearing crop, yields vary considerably depending whether the trees are in an "on" (i.e., higher yield) or "off" (i.e., lower yield) year. According to UC Davis, yields per acre begin to alternate when trees reach their 9$^{th}$ year and continue on from then.[1]

Typically, alternative bearing cycles have an "on" year followed by an "off" year. While alternate years have not always occurred in the past, they closely followed this pattern of production. Over the last ten years, there were five "on" years and five "off" years, with only one instance of consecutive "on" years (i.e., 2020 and 2021) and no instances of consecutive "off" years. And, in the last twenty years, there were ten "on" years and ten "off" years, with only two instances of

[1] "Sample Costs to Establish and Produce Pistachios," University of California Davis Department of Agriculture and Resource Economics, 2020, p. 13.

consecutive "on" years (i.e., 2009 and 2010, 2020 and 2021) and only one instance of consecutive "off" years (i.e., 2005 and 2006).

Historically, the average yield per acre in "on" years has been significantly greater than the average yield in "off" years. From 2013 to 2022, the average yield per acre in an "on" year was 50.7% greater than the average for an "off" year, and this has remained fairly consistent since from 2003 to 2022 the average was 50.2% greater.

Estimates of yields per acre were taken from studies conducted by UC Davis[2] and by Edmond Missiaen who made projections for APG in prior years.[3] Based on these studies, a set of expected estimates for yields per acre were developed for "on" and "off" years in the future.

| | 6th Year | 7th Year | 8th Year | 9th Year | 10th Year | 11+ Years |
|---|---|---|---|---|---|---|
| **EXPECTED** | | | | | | |
| Yield in ON Year | 600 | 1,300 | 2,200 | 3,080 | 3,080 | 3,392 |
| Yield in OFF Year | 600 | 1,300 | 2,200 | 2,520 | 2,520 | 2,208 |

To validate the estimates, they were tested against actual production over the last ten years to determine how closely the calculated overall average yield per acre using these estimates matched the actual overall average reported by ACP. This was deemed possible since both UC Davis and Missiaen used their same average yields per acre in their recent and prior studies. The average calculated yield per acre from 2013 through 2022 was nearly identical to that of the actual average reported by ACP, understating the ACP average by only 0.8%.

These percentages above and below the averages were applied to the "expected" yields per acre in the "on" and "off" years through 2031. Since both UC Davis and Missiaen maintained the same average yields per acre in both their recent and prior studies, it was decided that the average yields per acre should remain constant for projecting production through 2031.

## Projected Pistachio Production

To project pistachio production, the numbers of expected bearing acres by year of maturity were multiplied by their expected yields per acre. Since 2022 was an "off" year, it was assumed that 2023 would be an "on" year, and the rotation between "on" and "off" years would continue through 2031.

It is important to note that other factors, such as water availability, density of tree plantings, weather, etc. can impact yields per acre. Implementation of the Sustainable Groundwater Management Act (SGMA) also could have an effect on overall yields per acre. Factors such as these, however, were not included in the projections because future conditions were too speculative to estimate.

[2] "Sample Costs to Establish and Produce Pistachios," University of California Davis Department of Agriculture and Resource Economics, 2020, 2015, 2008.
[3] Missiaen, Edmond. "U.S. Pistachio Future Production Projections 2019 to 2026," and "U.S. Pistachio Future Production Projections 2013 to 2021."

Therefore, ***variations in annual production are the result of when new plantings move into their bearing years, the number of acres in each year of bearing maturity, and whether it is an "on" or "off" year.***

A summary chart is presented following the bullet points. Based on the ***expected bearing acreage and expected yields per acre***:

- Pistachio production was projected to reach 1.36 billion pounds in 2023 (an "on" year) and increase to nearly 2.08 billion pounds in 2031 (an "on" year).

- In the "on" years, the largest crop is expected to reach nearly 2.08 billion pounds in 2031, while the smallest crop is expected to be 1.36 billion pounds in 2023.

- In the "off" years, the largest crop is expected to be more than 1.36 billion pounds in 2030, and the smallest is expected to be nearly 1.01 billion pounds in 2024.

- The average ***expected*** overall yield per acre would be as high as 3,130 pounds per acre in 2025 (an "on" year), and as low as 2,092 pounds per acre in 2028 (an "off" year).

- Overall, with the expected bearing acreage from 2023 through 2031, the average annual production is projected to be nearly 1.47 billion pounds, with an average yield of 2,644 pounds per acre per year.

***If yields are at the high range*** with the expected number of bearing acres:

- Pistachio production is projected to be nearly 1.53 billion pounds in 2023 (an "on" year) and increase to nearly 2.34 billion pounds in 2031 (an "on" year).

- With the high range in yields per acre, production could be as high as nearly 2.34 billion pounds in 2031 (an "on" year) and as low as nearly 1.17 billion pounds in 2024 (an "off" year).

- Yields could be as high as 3,524 per acre (2025, an "on" year) and as low as 2,409 per acre (2028, an "off" year).

- Overall, with the high range in bearing acreage from 2023 through 2031, the average annual production is projected to be nearly 1.67 billion pounds, with an average yield of 3,003 pounds per acre per year.

***If yields are at the low range*** with the expected number of bearing acres:

- Production could reach more than 1.19 billion pounds in 2023 and rise to more than 1.81 billion pounds in 2031.

- With the low range in yields per acre, production could be high as more than 1.81 billion pounds in 2031 (an "on" year) and as low as 850.64 million pounds in 2024 (an "off" year).

- Yields could be as high as 2,736 per acre (2025, an "on" year) and as low as 1,766 per acre (2026, an "off" year).

- Overall, with the low range in bearing acreage from 2023 through 2031, the average annual production is projected to be nearly 1.27 billion pounds, with an average yield of 2,286 pounds per acre per year.

| Year—Alternative | Production at **Expected** Yield/Acre | Production at **High** Yield/Acre | Production at **Low** Yield/Acre | **Expected** Overall Yield/Acre | **High** Overall Yield/Acre | **Low** Overall Yield/Acre |
|---|---|---|---|---|---|---|
| 2023-On | 1,360,084,937 | 1,525,400,718 | 1,194,769,156 | 2,997 | 3,362 | 2,633 |
| 2024-Off | 1,008,420,205 | 1,166,278,865 | 850,639,525 | 2,150 | 2,487 | 1,814 |
| 2025-On | 1,519,573,367 | 1,710,720,801 | 1,328,425,932 | 3,130 | 3,524 | 2,736 |
| 2026-Off | 1,091,712,161 | 1,265,255,789 | 918,254,261 | 2,100 | 2,434 | 1,766 |
| 2027-On | 1,679,601,597 | 1,890,259,044 | 1,468,944,149 | 3,027 | 3,407 | 2,647 |
| 2028-Off | 1,220,361,651 | 1,405,184,491 | 1,035,630,112 | 2,092 | 2,409 | 1,775 |
| 2029-On | 1,878,512,335 | 2,111,853,249 | 1,645,171,420 | 3,070 | 3,451 | 2,689 |
| 2030-Off | 1,363,878,886 | 1,576,876,714 | 1,150,986,277 | 2,130 | 2,462 | 1,797 |
| 2031-On | 2,075,596,951 | 2,337,168,969 | 1,814,024,933 | 3,103 | 3,494 | 2,712 |
| Average: 2023-31 | 1,466,415,788 | 1,665,444,293 | 1,267,427,307 | 2,644 | 3,003 | 2,286 |

## Summary and Conclusions

This study projected the number of bearing and non-bearing acres, estimated the annual yields per acre, and projected pistachio production on an annual basis for the next nine years.

The key findings of these analyses are:

- The average number of new plantings per year over the last ten years was considered a good representation of what is likely to occur in the foreseeable future. Therefore, this annual average of 28,489 acres is expected to be newly planted each year through 2031.

- Based on the estimate of annual new plantings, the total number of acres of pistachios is expected to grow from nearly 583,400 acres in 2023 to nearly 811,300 acres in 2031. This represents a 4.3% increase per year.

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| Yield in ON Year | 600 | 1,300 | 2,200 | 3,080 | 3,080 | 3,392 |
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- Based on the ***expected* number of bearing acres**, pistachio production was projected to reach 1.36 billion pounds in 2023 (an "on" year) and increase to nearly 2.08 billion pounds in 2031 (an "on" year). Crop yields are expected to be nearly 3,000 pounds per acre in 2023 and be more than 3,100 pounds per acre in 2031.

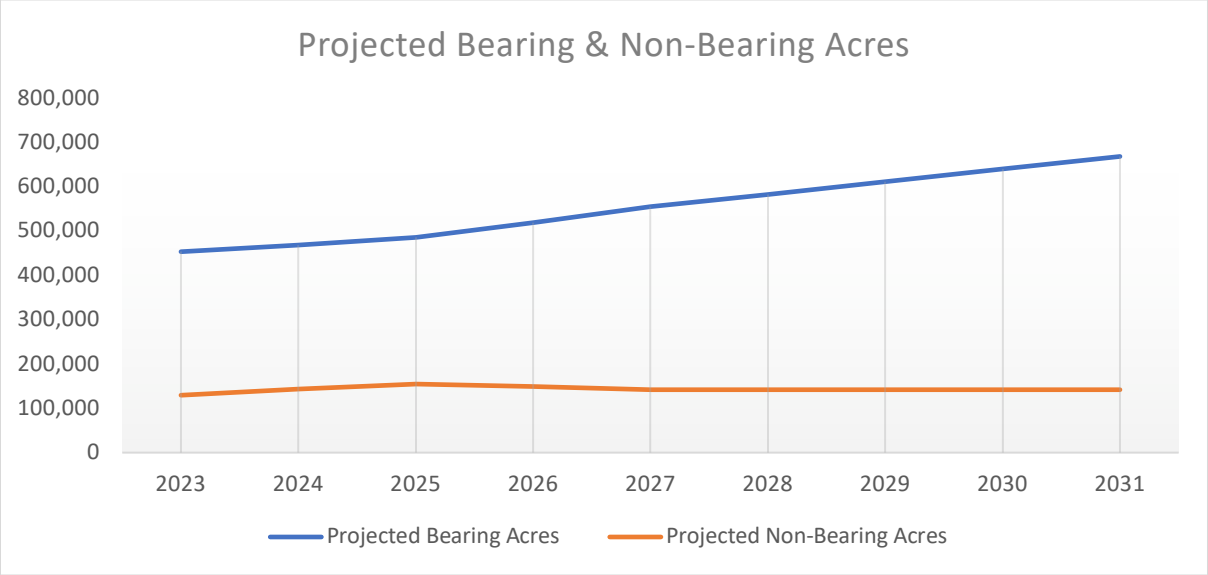
- In the "on" years, the largest crop is expected to be nearly 2.08 billion pounds in 2031, while the smallest crop is expected to be 1.36 billion pounds in 2023. In the "off" years, the largest crop is expected to be more than 1.36 billion pounds in 2030, and the smallest is expected to be nearly 1.01 billion pounds in 2024.

- The expected overall yield per acre is projected to be as high as 3,130 pounds per acre in 2025 (an "on" year), and as low as about 2,092 pounds per acre in 2028 (an "off" year).

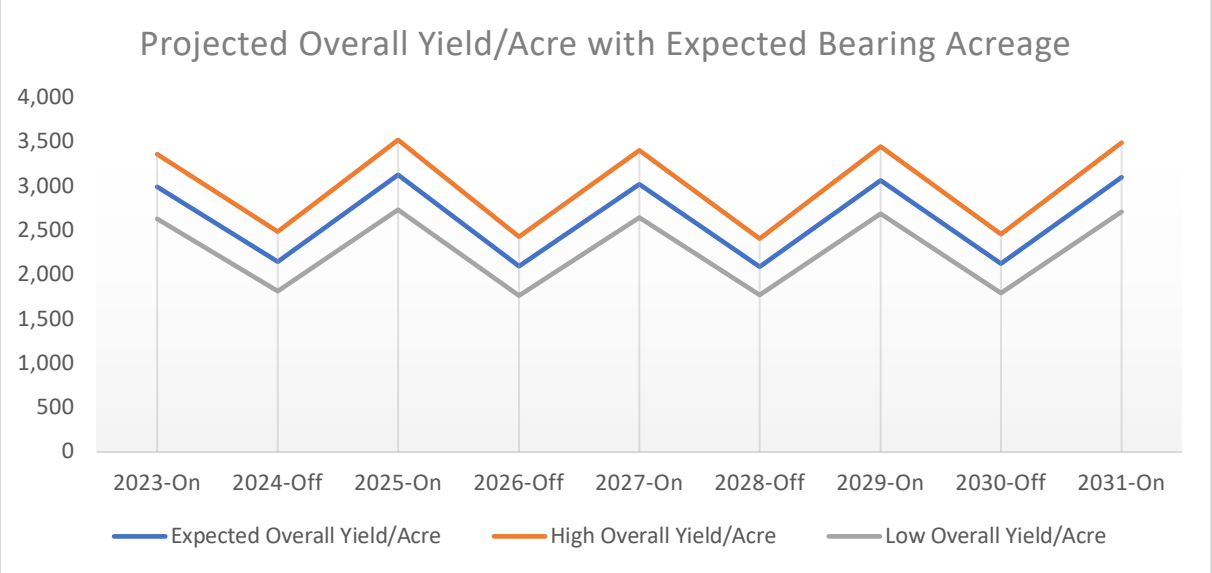
- Overall, with the expected number of bearing acres from 2023 through 2031, production is projected to average nearly 1.47 billion pounds annually, with an average yield of 2,644 pounds per acre per year.

# Appendix A:  Summary Charts

## Projected Number of Bearing and Non-Bearing Acres




## Projected Yields per Acre with Expected Number of Bearing Acres



## Projected Production with Expected Number of Bearing Acres