Sustainable Conservation

On-farm Recharge Pilot Projects
Case Study

Grower: Russel and Matt Efird

Crop: Raisin grapes

Location: Fresno County

Project Description

Russel and Matt Efird grow raisins, almonds, walnuts, pistachios, and canning peaches in Fresno County, California. Groundwater levels on their farm have decreased 50 feet from 1992 through 2022. On-farm recharge can help to reverse groundwater overdrafting and cease land subsidence occurring in the subbasin.

This farm can be a good measure of raisin grape tolerance to recharge timing and how much flood water can be applied without increased fungal disease, such as bunch rot, compared to the growers' standard practice. One of the most commonly asked questions about on-farm recharge is, "How much water can be applied and when should recharge be ceased to protect crop health?" Research continues to determine basic recharge guidelines on the timing of and how much recharge water is optimum for a given crop and soil type.

Field Description

Category	Details
Acres (recharge site)	12 acres
Acres (control site)	13 acres
Type of crop	Fiesta raisin grapes
Age of crop	Planted in 1993 (25 years old at time of recharge)
Average root depth	7–8 feet
Irrigation infrastructure	• The vineyard was irrigated by flood valves, double drip lines, and micro sprinklers. • Drip or micro sprinklers were the standard irrigation during the irrigation season. • The flood system was used to conduct on-farm recharge.
Soil amendment	Dairy compost was incorporated into every other row (6 tons/acre) in the late fall after the growing season.

Hydrogeology

Category	Details
Soil texture	Sandy Loam
Land IQ rating	Moderately Good to Excellent
Soil Agricultural Groundwater Banking Index rating	Good
Restrictive layers	• Both the recharge field and the control field were deeply ripped prior to planting in 1993. • Every other row was chiseled (14–16 inches depth) in 2014 for one row and in 2016 for the other row.
Depth to groundwater	• 1992: 100 feet • 2009: 120 feet • 2018: 142 feet • 2022: 150 feet

On-Farm Recharge Logistics

Category	Details
Source of water	Kings River water was delivered from Consolidated Irrigation District (CID) canal system.
Maximum diversion rate	Turnouts have a capacity of 1,012 cubic feet per second.
Method of diversion	Gravity-fed district water canal turnout at the farm.
Cost of water	The CID charges growers an annual $50 per acre surface water delivery fee. No additional fee was charged to growers who elected to divert water for on-farm recharge during this time.
Field preparation and management during recharge	The field was already set up for flood irrigation. The only preparation needed was placement of some strategic berms.
Nutrient management	The Efirds applied recharge water only on rows where the manure compost was not applied in order to avoid nutrient leaching.
Average inundation height	5 inches
Duration of inundation	Less than four hours

Category	Details
Time to dry down	After turning the water off, the field required a dry time of one day to be able to walk on firm ground without muddy conditions. In order to minimize soil compaction, tractor work started 10 to 14 days after shutting off water.

Recharge Events

Recharge Site

Dates of recharge (2018)	Duration (days)	Field size (acres)	Water applied (total acre-feet)	Water applied (feet per acre)	ETc (feet)	Net water recharged (total acre-feet	Net water recharged (feet per acre)
April 28–May 5	6	12	25.84	2.15	0.12	24.11	2.01
May 6–May 9	4	12	25.84	2.15	0.12	24.11	2.01

Table notes: Dates of recharge, field size, and water applied sourced from the grower. Crop evapotranspiration (ETc) value sourced from California Irrigation Management Information System station #71C.
Net water recharged = water applied – (1.2 x ETc x acres).

Control Site (Irrigation Only)

Dates of recharge (2018)	Duration (days)	Field size (acres)	Water applied (total acre-feet)	Water applied (feet per acre)	ETc (feet)	Net water recharged (total acre-feet	Net water recharged (feet per acre)
May 4–May 5	2	13	5.19	0.40	0.02	4.88	0.38

Table notes: Dates of recharge, field size and water applied sourced from the grower. Crop evapotranspiration (ETc) value sourced from California Irrigation Management Information System station #71C.
Net water recharged = water applied – (1.2 x ETc x acres).

Changes in Field Conditions

Category	Details
Diseases and weeds	• Some limited bunch rot in the control field and the treated field was seen by the growers. Powdery mildew and bunch rot are typical occurrences of leaf, stem, and fruit disease. Aerial fungicide applications are routinely included in cultural practices, according to the growers, who also notes that it is typical to see bunch rot in areas closer to irrigation valves. Although the Efirds were concerned about promoting powdery mildew under flood conditions, they could not confirm additional mildew resulted from recharging. • The growers think they needed more weed control spray across the treated field and the untreated field. They said they cannot determine if the need was because of the flooding, which would take several replications of recharge at this farm site.
Yields	Both the recharge field and the control field yielded 3.29 tons of raisin grapes per acre.
Salinity	Salinity levels in the recharge area and the control area were generally lower than the soil salinity threshold level (1,500 miliSeimens per centimeter or mS/cm) that can cause growth reduction and yield problems. The salinity levels were monitored from 2 inches to 46 inches of soil depth.
Changes to field practices	The Efirds noted that they needed one more fungicide application and one extra herbicide application before harvest, and more labor hours were required. But they also said that this should be expected when extra water is applied to fields.

Growers' Experience

Category	Details
Grower observations	• In the future, the growers are reluctant to put on extra water after March and would instead focus on recharging when vines are dormant. This is due to potential disease issues that could adversely affect yield and quality. • The Efirds saw that the Fiesta raisin variety has heavier foliage than others, which could potentially make it more susceptible to Bunch Rot because of higher canopy humidity. However, the growers also noted that the raisins were rained on multiple times close to harvest, which may have also contributed to Bunch Rot. • The Efirds think that many growers will focus on the benefits of using surface water for on-farm recharge in order to help reduce the build-up of salts in the field and groundwater.
Grower motivations	• The growers believe that recharge is beneficial for replenishing groundwater but want to see more support from state and federal agencies for individual growers doing on-farm recharge. • On-farm recharge can help replenish several wells on their property that are used for pumping groundwater.

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