

## Westwind Field Trial Factsheet - WSARE WS20-912

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**Research Objective:** Evaluate a surface-applied hull/shell mix amendment maintained over time with off-ground harvest. What are the effects on potassium (K) cycling, soil-plant water dynamics, and microbial community composition?

**Experimental Design:** Randomized complete block design. Treatments applied to entire rows.

**Treatments:**

- (1) Control: no amendments, on-ground harvest
- (2) Control: no amendments, off-ground harvest
- (3) Hull/shell mix (8 tons/ac) removed annually by on-ground harvest
- (4) Hull/shell mix (8 tons/ ac) maintained over time with off-ground harvest

Reponses	Methods	Results
Hull/shell amendments	Nutrients, Decomposition, Microbial community (PLFA)	<ul style="list-style-type: none"><li>Hull/shell layer released K rapidly as water was applied, briefly retaining K additions from fertilizer and compost before re-releasing.</li><li>Hulls/shells decomposed by ~half after 1 year, ~90% after 2 years.</li><li>The C:N ratio, estimated C, and net dry mass steadily declined.</li><li>The hull/shell organic layer maintained with off ground supported beneficial microbial groups and high levels of microbial biomass.</li></ul>
Soil	Exchangeable K (XK), Fertility (pH, CEC, SOM, etc.), Microbial community (PLFA)	<ul style="list-style-type: none"><li>Hulls/shells increased XK in top 0-10 cm, occasionally deeper depths.</li><li>High K from hulls/shells occasionally displaced soil sodium and magnesium but did not affect other soil fertility components.</li><li>After 1 year the amended catch frame soils had increased soil bacteria, then after 1.5 years higher bacteria, fungi, and beneficial subgroups such as saprophytes and arbuscular mycorrhizal fungi.</li></ul>
Water Dynamics	ERT, Soil probes, Stem Water Potential	<ul style="list-style-type: none"><li>Amended catch frame soil had higher water infiltration rate and reduced soil surface evaporation compared to the control soil.</li><li>Upper 0-10 cm of amended catch frame soil tended to have higher average soil water and moderated temperatures than control soil.</li><li>In 2021, the amendment moderated tree water stress after 6 days without irrigation, but no effects in 2022 during pulse irrigation.</li></ul>
Tree	July leaf nutrient status, Yield & Trunk circumferences, Root biomass	<ul style="list-style-type: none"><li>Amendment significantly increased July leaf K especially when maintained with catch frame harvest. Leaf Mg decreased but was still sufficient. No differences in leaf N, P, Ca, S, B, Zn, Mn, Fe, Cu, Na.</li><li>No effects on yield or trunk circumferences.</li><li>Higher root biomass under hull/shell amendments in Spring 2022.</li></ul>

### Conclusions & Practical Applications:

The hull/shell amendment increased K cycling, decomposed rapidly, improved water dynamics during dry periods by acting as a mulch, and increased root biomass. Maintaining the amendment with off-ground harvest maximized K benefits, established a microbially-rich organic layer on the soil surface and increased microbial biomass in the soil beneath it. Beneficial microbial functional groups included saprophytes and arbuscular mycorrhizae.

## Potassium Calculation from Hulls and Shells

- Convert 1 ton of hulls & shells (HS) into dry weight. Use 13% moisture

$$1 - .13 = .87 = 87\% \text{ dry weight}$$

$$.87 * 2000 \text{ lbs} = 1740 \text{ lbs dry hulls/shells}$$

- Use 2.37% K in HS to find amount of K per ton

$$1740 \text{ lbs dry} * 2.37\% = 41.3 \text{ lbs K per ton HS}$$

- In 5 fresh tons of HS, you have

$$41.3 \text{ lbs K ton HS} * 5 \text{ tons} = 206.5 \text{ lbs K}$$

- Convert into units of  $K_2O$ . ( $1.21 * K = K_2O$ )

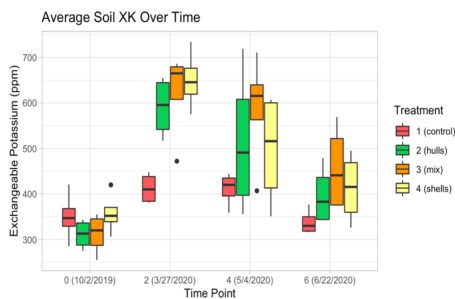
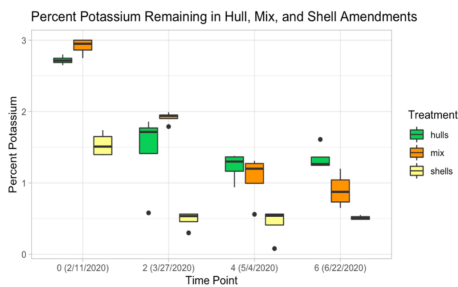
$$1.21 * 206.5 \text{ lbs K} = 250 \text{ lbs } K_2O \text{ per 5 tons HS}$$

Lbs  $K_2O$  per ton is

$$1.21 * 41.3 \text{ lbs K} = 50 \text{ lbs } K_2O \text{ per ton HS}$$

- There is ~85% release of K from HS per season

$$0.85 * 250 \text{ lbs } K_2O = 212.5 \text{ lbs } K_2O \text{ released per season for 5 tons HS}$$



Response Variable	All Dates	Monthly	Daily	Hourly
Water (%)	T1 < T4	T1 < T4	T1 < T4 especially as soil dries	T1 < T4
Temperature	T1 < T4	T1 < T4	T1 more extreme, T4 more moderate	T1 more extreme, T4 more moderate
Conductivity	T1 < T4	T1 < T4 especially with high soil water	T1 < T4 especially with high soil water	T1 < T4 especially at night
PWEC	T1 < T4	T1 < T4	variable	T1 < T4 at night
Permittivity	T1 < T4	T1 < T4	variable	T1 < T4

Soil probes at 0-10 cm depth. T4 (most regenerative) had higher average soil water, moderate temperature, higher soil conductivity, and higher overall PWEC and permittivity compared to T1 (control).

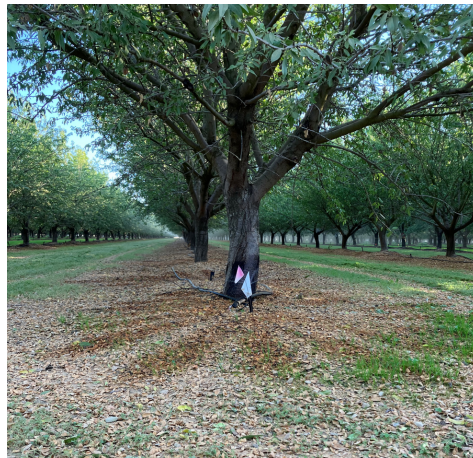
At time point 2, %K in amendment decreases and at the same time, XK in the soil increases as most of the K from hull/shell material has been released.

Link to Sacramento Valley Orchard Blogpost: <https://www.sacvalleyorchards.com/blog/almonds-blog/applying-amendments/>.

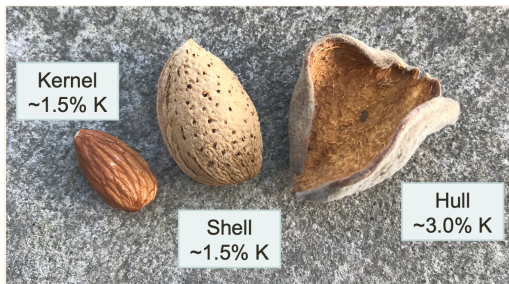
Pictures by Sydney Cho and Ellie Andrews



Hull and shell application Fall 2022



Irrigation event after applied hulls/shells Fall 2022



Almond kernel, shell, and hull



Catch frame harvest equipment (Brandon Klever)



Undisturbed hull/shell organic layers on Fall 2020 (left) and Fall 2022 (right).