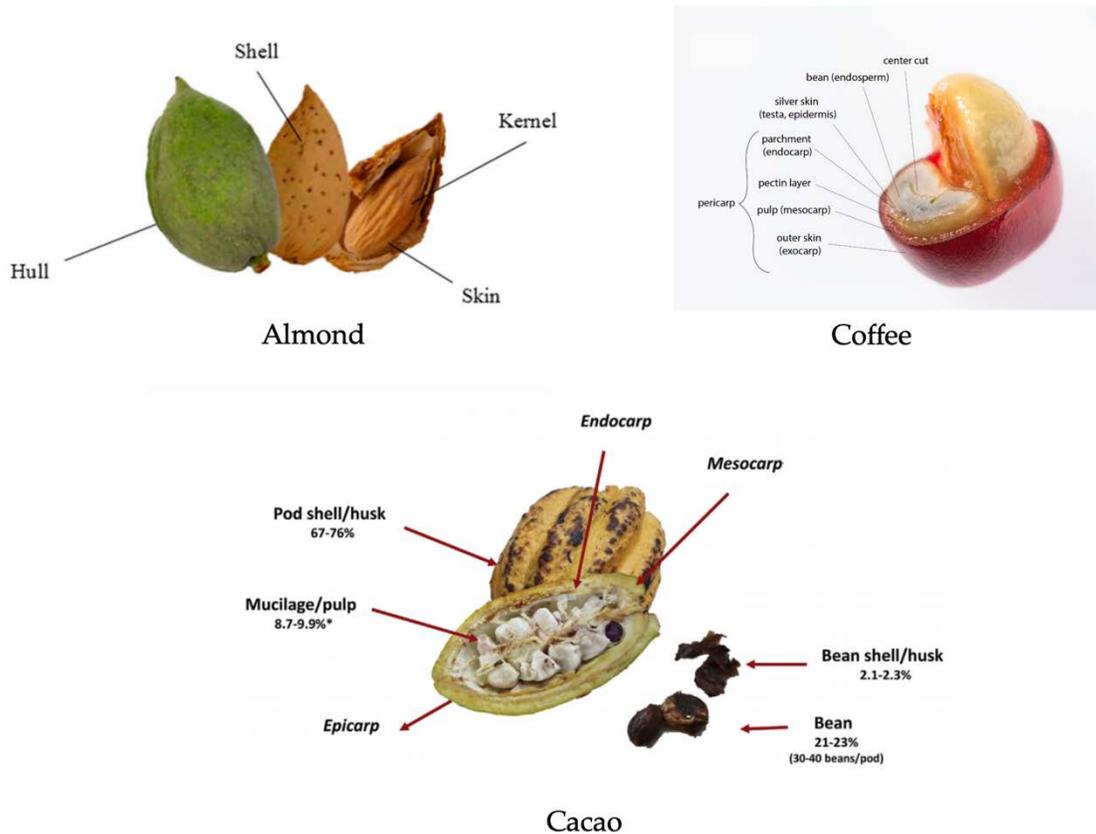


## Tree Crop Pericarp Examples



Supplementary Diagram 1. Tree Crop Pericarp Examples: almond, cacao, coffee. Crop hulls, husks, shells, and outer skin are materials that can be used as K-rich organic matter amendments. Diagram was adapted using imagery of almond from Prgomet et al. 2017 [(Prgomet et al., 2017)], coffee from Klingel et al. 2020 [(Klingel et al., 2020)], cacao from Campos-Vega et al. 2018 [(Campos-Vega et al., 2018)].

Prgomet, I., Gonçalves, B., Domínguez-Perles, R., Pascual-Seva, N., & Barros, A. I. R. N. A. (2017). Valorization Challenges to Almond Residues: Phytochemical Composition and Functional Application. *Molecules*, 22(10). <https://doi.org/10.3390/molecules22101774>

Klingel, T., Kremer, J. I., Gottstein, V., Rajcic de Rezende, T., Schwarz, S., & Lachenmeier, D. W. (2020). A Review of Coffee By-Products Including Leaf, Flower, Cherry, Husk, Silver Skin, and Spent Grounds as Novel Foods within the European Union. *Foods*, 9(5). <https://doi.org/10.3390/foods9050665>

Campos-Vega, R., Nieto-Figueroa, K. H., & Oomah, B. D. (2018). Cocoa (*Theobroma cacao* L.) pod husk: Renewable source of bioactive compounds. *Trends in Food Science & Technology*, 81, 172–184. <https://doi.org/10.1016/j.tifs.2018.09.022>

## Supplementary Diagram 2

### Example Application Rate Calculation - Almond Hulls and Shells

#### 1. Find crop yield dry weight tons/ac.

For example, an almond orchard produces 2500 lb/ac kernel yield and 7500 lb/ac hulls and shells. Kernels are around 25% of the crop weight leaving the orchard at harvest, and hulls and shells are around 75% (fresh weight). Hulls alone are 50% fresh weight in this example.

#### 2. Find corresponding residue dry weight tons/ac.

Weigh samples of fresh samples of hulls, shells, and kernels dehydrate, and weigh again dry.

Percent dry weight of hulls = dry weight / fresh weight = 60 grams / 70 grams = 85%

5000 lb/ac hulls x 0.85 = 4250 dry weight lb/ac hulls

Percent dry weight of shells = 65 grams / 70 grams = 93%

2500 lb/ac shells x 0.93 = 2325 dry weight lb/ac shells

Percent dry weight of shells = 68 grams / 70 grams = 97%

2500 lb/ac shells x 0.97 = 2425 dry weight lb/ac kernels

#### 3. Find or estimate %K in residue materials and kernel separately.

Send in samples of hulls, shells, and kernel to a lab for analysis for K content or estimate. In this example, lab results show hulls are 3% K by dry weight, shells are 1.5% K, and kernels are 1.1% K.

#### 4. Calculate total lb/ac K removed at harvest in hulls, shells, kernel.

Multiply percent K in hulls/shells and kernel by respective dry weight.

0.03 percent K in hulls x 4250 lb/ac dry hulls dry = 127.5 lb/ac K in hulls

0.015 percent K in shells x 2325 lb/ac dry shells dry = 34.8 lb/ac K in shells

0.011 percent K in hulls x 2425 lb/ac dry kernels dry = 26.7 lb/ac K in kernels

#### 5. Calculate tons/ac material needed to supply K removed.

Sum of total K removed lb/ac = 127.5 in hulls + 34.8 in shells + 26.7 in kernels = 189 lb/ac K removed

In this example, 189 lb/ac K is needed to replace removal rate. If hulls & shells are returned as an amendment on a per acre basis, only 26.7 lb/ac K needs to be applied. Or, hulls & shells could be returned as an amendment at a higher rate to supply the full required 189 lb/ac K.

#### 6. Find % moisture of material right before application if needed.

If moisture has likely changed since %K was obtained, consider adjusting application rate based on current % moisture.

#### 7. Calculate rate required to supply full K demand.

In this example, only hulls will be applied.

189 lb K / ? lb hulls = 3 / 100

189 x 100 / 3 = 6300 lb hulls/ac dry weight

Assuming hulls are 93% moisture still from step 2,

6300 lb hulls dry / ? lb hulls fresh = 85 / 100

6300 x 100 / 85 = 7412 lb hulls fresh weight

To completely fulfill K demand, ~7410 lbs/ac fresh hulls could be applied over tree roots. Application strategy should consider factors such as water inputs, timing, and soil type. Alternately, a portion of total K demand could be integrated with inorganic fertilizer K.

#### 8. Compare K fertilizer and hull/shell application costs and benefits.

For inorganic and organic sources of K, compare costs of acquisition, transportation, application, labor, etc. Consider crop system benefits related to yield, tree health, nutrition, water, soil health, agroecosystem and regional sustainability. This practice can be adjusted to serve unique goals and contexts.