



## Resource Guide for Honey Bee Forage Crops

Project Apis m. has compiled the following Resource Guide for several key honey bee forage crops that have been evaluated in the Coastal Region, Central Valley and Sierra Foothill Regions of California. The overall goal of this effort has been to build a more sustainable food supply for honey bees in California. The specific objectives include continuing to identify, develop and test low-water use wildflower and oilseed mixtures as a means of providing a sustainable nutritional resources for the building and retention of honey bees in California.

Seed and/or seed mixes included in this Resource Guide include:

- 1) **Rapini Mustard**
- 2) **Mustard Mix**
- 3) **Capay Clover Mix**
- 4) **Lana Vetch**
- 5) **Hairy Vetch**
- 6) **Purple Vetch**
- 7) **Wildflower Mix**
- 8) **Sainfoin**
- 9) **Borage Oilseed**
- 10) **Camelina Sativa**
- 11) **Meadowfoam**
- 12) **Phacelia ciliata**

# 1) Rapini Mustard

99% Rapini, Brassica rapa

(Sources: Clark Bees, CERUS Consulting)

## Seed Rate:

4 lbs/acre

## Ground Prep:

A good, fine seed bed is desirable since the seed is very small like alfalfa. The soil should be disked, cultipacked with a ring roller, planted and rolled a second time.

Caution: 'Grass killing' herbicides will cause phytotoxicity in Rapini mustard.

## Planting Methods:

Use a grain drill, no till drill, broadcaster, or even a hand-held broadcaster on small areas to evenly distribute the seed.

## Plant:

After Sept. 10<sup>th</sup> through Nov. 10<sup>th</sup>, while soil is still warm – above 55°

Sow before first rains. Plant no more than 1/8" to 1/4" deep. If fertilizing, use a 50-50 blend of nitrogen and phosphate at 100 lbs/acre. Fertilize early in the growing cycle. No need for fertilizer after bloom. If irrigating, keep moist for the first 2 weeks. Thereafter, if leaves curl, may require more water. Plant in fallow areas, where trees are being taken out of production, between young, non-bearing trees and in orchard margins.

## Emergence/Visible:

6 – 8 days

## Bloom:

Nov – Feb

45 days depending on area. Duration may be 60 – 90 days, depending on temperatures.

## Management:

Mow, disk and kill if concerned about almond bloom competition. If not, after bloom, disk under.

## **2) Mustard Mix**

30% Canola (Rapini mustard) *Sinapsis rapa*  
25% Braco White Mustard, *Sinapsis alba*  
25% Nemfix Mustard, *Brassica juncea*  
20% Daikon Radish, *Raphanus sativa*

(Sources: Kamprath Seed, Inc., CERUS Consulting)

### **Seed Rate:**

12 lbs/acre

### **Ground Prep:**

A good, fine seed bed is desirable since most of the seeds are very small like alfalfa. The soil should be disked, cultipacked with a ring roller, planted and rolled a second time.

Caution: 'Grass killing' herbicides will cause phytotoxicity in Rapini mustard.

### **Planting Methods:**

Use a grain drill, no till drill, broadcaster, or even a hand-held broadcaster on small areas to evenly distribute the seed.

### **Plant:**

After Sept. 10<sup>th</sup> through Nov. 10<sup>th</sup>, while soil is still warm – above 55°

Sow before first rains. Plant no more than 1/8" to 1/4" deep. Plant in fallow areas, where trees are being taken out of production, between young, non-bearing trees and in orchard margins.

### **Emergence/Visible:**

6 – 8 days

### **Bloom:**

Nov – Feb

90 days - Canola will be the first to bloom

### **Management:**

Mow, disk and kill if concerned about almond bloom competition. If not, after bloom, disk under.

### **3) Capay Clover Mix**

33% Crimson Clover, *Trifolium incarnatum*  
33% Hykon Rose Clover, *Trifolium hirtum*  
17% Nitro Persian Clover, *Trifolium resupinatum*  
17% Frontier Balansa Clover, *Trifolium michelianum*

(Sources: Kamprath Seed, Inc., CERUS Consulting)

#### **Seed Rate:**

15 lbs/acre

#### **Ground Prep:**

A good, fine seed bed is desirable since most of the seeds are very small like alfalfa. The soil should be disked, cultipacked with a ring roller, planted and rolled a second time. If using a no-till drill the only preparation may be the application of an herbicide to control unwanted weeds. An application of 'grass killing' herbicide may benefit the clovers from shading and moisture stress.

#### **Planting Methods:**

Use a grain drill, no till drill, broadcaster, or even a hand-held broadcaster on small areas to evenly distribute the seed. No fertilizer needed. If able to irrigate, ensure the root zone has available water until the roots reach 6" depth.

#### **Plant:**

After Sept. 10<sup>th</sup> through Nov. 10<sup>th</sup>, while soil is still warm – above 55°  
Sow before first rains. Plant no more than 1/8" to 1/4" deep. Between bearing or newly established orchard trees, on orchard margins, waterways and fallow land.

#### **Emergence/Visible:**

14 days with enough moisture, will grow slow through the winter.

#### **Bloom:**

Early March and will continue through mid-April or a little later depending on rainfall patterns.

#### **Management:**

They should be allowed to grow into May and June so that they both set seeds and provide the longest bloom possible. Thereafter, they can be mowed, disked and killed. To encourage reseeding, do not chip or disk but roll. Push seeds into ground.

## **4) Lana Vetch**

98% Lana Vetch, *Vicia villosa*

(Sources: Kamprath Seed, Inc., CERUS Consulting)

### **Seed Rate:**

40 lbs/acre

### **Ground Prep:**

A good, fine seed bed is desirable since most of the seeds are very small like alfalfa. The soil should be disked, cultipacked with a ring roller, planted and rolled a second time. If using a no-till drill the only preparation may be the application of an herbicide to control unwanted weeds. An application of 'grass killing' herbicide may benefit the clovers from shading and moisture stress.

### **Planting Methods:**

Use a grain drill, no till drill, broadcaster, or even a hand-held broadcaster on small areas to evenly distribute the seed. No fertilizer needed. If able to irrigate, ensure the root zone has available water until the roots reach 6" depth.

### **Plant:**

After Sept. 10<sup>th</sup> through Nov. 10<sup>th</sup>, while soil is still warm – above 55°

Sow before first rains. Plant no more than 1/8" to 1/4" deep. Between bearing or newly established orchard trees, on orchard margins, waterways and fallow ground.

### **Emergence/Visible:**

10 days

### **Bloom:**

Mid- to- late March and into May.

### **Management:**

It should be allowed to grow into May and June so that it both set seeds and provide the longest bloom possible. Thereafter, they can be mowed, disked and killed. To encourage reseeding, do not chip or disk but roll. Push seeds into ground.

## **5) Hairy Vetch**

*Vicia villosa*

(Sources: Kamprath Seed, Inc., CERUS Consulting)

### **Seed Rate:**

25 lbs/acre

### **Ground Prep:**

A good, fine seed bed is desirable since most of the seeds are very small like alfalfa. The soil should be disked, cultipacked with a ring roller, planted and rolled a second time. If using a no-till drill the only preparation may be the application of an herbicide to control unwanted weeds. An application of 'grass killing' herbicide may benefit the clovers from shading and moisture stress.

### **Planting Methods:**

Use a grain drill, no till drill, broadcaster, or even a hand-held broadcaster on small areas to evenly distribute the seed. No fertilizer needed. If able to irrigate, ensure the root zone has available water until the roots reach 6" depth.

### **Plant:**

After Sept. 10<sup>th</sup> through Nov. 10<sup>th</sup>, while soil is still warm – above 55°

Sow before first rains. Plant no more than 1/8" to 1/4" deep. Between bearing or newly established orchard trees, on orchard margins, waterways and fallow ground.

### **Emergence/Visible:**

10 days

### **Bloom:**

Mid- to- late March and into May.

### **Management:**

It should be allowed to grow into May and June so that it both set seeds and provide the longest bloom possible. Thereafter, they can be mowed, disked and killed. To encourage reseeding, do not chip or disk but roll. Push seeds into ground.

## **6) Purple Vetch**

*Vicia benghalensis* L.

(Source: USDA/NRCS)

### **Seed Rate:**

30 lbs/acre

### **Ground Prep:**

A good, fine seed bed is desirable since most of the seeds are very small like alfalfa. The soil should be disked, cultipacked with a ring roller, planted and rolled a second time. If using a no-till drill the only preparation may be the application of an herbicide to control unwanted weeds. An application of 'grass killing' herbicide may benefit the clovers from shading and moisture stress.

### **Planting Methods:**

Direct sow vetch in the fall. Due to the climbing habit of the plant, it is often sown in combination with rye with the rye providing support. In a mixture, 50 pounds of rye and 15 to 20 pounds of vetch per acre should be used. Most varieties of vetch are seeded at 20 to 40 pounds per acre. Vetch will self-reseed.

### **Plant:**

Vetch grows in moist to dry soils and typically reaches its full height only if it attaches itself to a supporting structure. It prefers full sun and neutral to slightly acidic soil.

### **Emergence/Visible:**

14 days

### **Bloom:**

May through August

### **Management:**

Bloom appears in late spring and gives way to 1 to 1.5 inch pods about one month after flowering.

## **7) PAm Wildflower Mix**

26% Five Spot, *Nemophila maculata*  
20% Baby Blue Eyes, *Nemophila menziesii*  
20% California Poppy, *Eschscholzia californica*  
13% California Bluebells, *Phacelia campanularia*  
10% Crimson Clover, *Trifolium incarnatum*  
5% Persian Clover, *Trifolium resupinatum*

### **Seed Rate:**

15 pounds/acre

### **Ground Prep:**

A good, fine seed bed is desirable since most of the seeds are very small like alfalfa. The soil should be disked, cultipacked with a ring roller, planted and rolled a second time. If using a no-till drill the only preparation may be the application of an herbicide to control unwanted weeds. An application of 'grass killing' herbicide may benefit the mix from shading and moisture stress.

### **Planting Methods:**

Use a grain drill, no till drill, broadcaster, or even a hand-held broadcaster on small areas to evenly distribute the seed. In large fallow areas that have been prepared, aerial application followed by cultipacking. No fertilizer needed. If able to irrigate, ensure the root zone has available water until the roots reach 6" depth.

### **Plant:**

After Sept. 10<sup>th</sup> through Nov. 10<sup>th</sup>, while soil is still warm – above 55<sup>o</sup>  
Sow before first rains. Plant no more than 1/8" to 1/4" deep. Between bearing or newly established orchard trees, on orchard margins and waterways.

### **Emergence/Visible:**

10 days for some, others much later. May put up one true leaf and sit all winter then grow in March.

### **Bloom:**

Early March through the 1<sup>st</sup> of May depending on rainfall patterns.

### **Management:**

They should be allowed to grow into May and June so that they both set seeds and provide the longest bloom possible. Thereafter, they can be mowed, disked and killed. To encourage reseeding, do not chip or disk but roll. Push seeds into ground.



## **8) Sainfoin**

*Onobrychis viciifolia* Scop.

(Source: USDA/NRCS)

### **Seed Rate:**

34 lbs/acre

### **Ground Prep:**

Sainfoin is best adapted to soils at least 18 inches deep with a pH of 6.6 to 8.0. It is best adapted to sites receiving at least 14 inches mean annual precipitation. Sainfoin does not do well in sites with high water tables or wet soils.

### **Planting Methods:**

Use a grain drill, no till drill, broadcaster, or even a hand-held broadcaster on small areas to evenly distribute the seed.

### **Plant:**

Sainfoin can be planted in the spring or fall. Seeding depth should be between 0.25 and 0.75 inches.

### **Bloom:**

May - July

### **Management:**

Stands should be allowed to naturally reseed every 2 to 3 years for reestablishment. Stands will persist 3 to 6 years under irrigation but will last longer if root and crown rot diseases are controlled. Its large, deep tap root also makes this species fairly drought tolerant.

## **9) Borage Oilseed**

*Borago officinalis*

(Source: West Coast Seeds, USA Gardeners, Seed to Plate)

### **Seed Rate:**

8 -10 lbs/acre

### **Ground Prep:**

A good, fine seed bed is desirable since the seed is very small. Review history of herbicide use in your candidate field. Select fields with known limited weed pressure. Borage performs best in average to rich and well- drained soil, but will tolerate poor soil conditions. Borage prefers periods of dry conditions.

### **Planting Methods:**

Use a grain drill, no till drill, broadcaster, or even a hand-held broadcaster on small areas to evenly distribute the seed.

### **Plant:**

Borage is a hardy annual and reseeds easily throughout the year. Depending on region, recommended target dates for sowing are February through October. Planting depth can be as shallow as ¼ in. and should not exceed ½ in. Seed spacing 2” apart in rows 12” apart. USDA hardiness zones: 2 -12. Borage will germinate any time of year when soil temperature is at least 70 degrees.

### **Emergence/Visible:**

5 to 15 days depending on temperature

### **Bloom:**

Plants mature in 56 days, depending on temperatures. In mild temperatures, Borage will bloom continuously nearly all year. Duration may be 60 – 90 days, depending on temperatures.

### **Management:**

Flowers may be harvested for a variety of culinary and medicinal uses. Borage has a shallow foot and can easily be removed. Borage does well growing in clumps to help support gangly stems. Borage is an excellent companion plant for production enhancement of tomatoes, brassicas, grapes zucchini, squash, peas and grapes. It is not known to be antagonistic toward any plants. Borage is excellent in compost as its leaves and stems are robust sources of calcium and potassium.

## 10) Camelina Sativa

(Source: Sustainable Oils, Scott Johnson)

### **Seed Rate:**

6-8 lbs per acre

### **Ground Prep:**

A good, fine seed bed is desirable since the seed is very small. Review history of herbicide use in your candidate field. Camelina is susceptible to long-term residual SU and IMI herbicides which are known to be injurious up to 40 months before planting Camelina. It is not recommended to plant Camelina in fields following canola or other Brassicas. Camelina requires a minimum of 12 ppm phosphorous levels comparable to conditions as conventional winter cereals in California. Test soil to determine existing soil nutrient levels at the 0' to 3' depths. Apply fertilizer to reach 100lbs soil nitrogen per acre in the 3' zone combining residual with applied nitrogen. About 10 to 15 lbs. of nitrogen can be applied as a top dressing. Select fields with known limited weed pressure.

### **Planting Methods:**

Use a grain drill, no till drill, broadcaster, or even a hand-held broadcaster on small areas to evenly distribute the seed.

### **Plant:**

The target date to begin planting Camelina is November 1<sup>st</sup> dependent upon adequate moisture for the crop to establish. Seeding rate with drill is 6 -8lbs per acre, 6" spacing into prepared seed bed. Alternative is to broadcast, cover with harrow and follow by press wheel or roller. Seeding dept is ¼" to ½" with shallower depth recommended. Planting depth greater than ½" is not recommended. Adequate soil compaction and good seed-soil contact are highly recommended. Control grass and weeds post-emergence. Monitor grass and weeds after Camelina emerges. Poast herbicide is labeled for post-emergence for Camelina in California

### **Emergence/Visible:**

6 – 8 days

### **Bloom:**

Mid-April to mid-May

45 days depending on area. Duration may be 60 – 90 days, depending on temperatures.

### **Management:**

Harvest when the majority of pods are pale brown and seed shells easily from pods. Stems may still contain greenish tint, but the pods and upper plant will be brown and mature. Sustainable Oils camelina has been historically proven to yield a commercial crop in dry land conditions with 6"-8" of seasonal rains, depending on soil type.

## **11) Meadowfoam Oilseed**

Limnanthes R.

(Source: USDA/NRCS, Purdue.edu)

### **Seed Rate:**

15 lb per acre

### **Ground Prep:**

Meadowfoam grows well on most soil types, however sandy soils with low water holding capacity are less favorable under dry conditions. The seedbed should be moderately fine to allow for uniform seed placement.

### **Planting Methods:**

Plant densities of 3 to 4 plants/square ft have resulted in the highest yields. Different conditions at planting time and soil type will affect the seeding rate necessary to achieve this plant density. Good seed-soil contact is required for uniform germination. Drilling seed 1/4 to 3/4 in. deep in 3 to 7 in. rows, is recommended over broadcast seeding followed by incorporation, although both methods have produced successful yields.

### **Plant:**

Meadowfoam is normally grown as a winter annual in the Pacific Northwest. Planting in October after soil temperatures in the seed zone are below 60°F aids in germination. Warmer soil temperatures promote seed dormancy which can lead to poor germination and poor stand establishment. Meadowfoam has been grown as a spring planted annual in areas where winter temperatures are too cold to allow fall planting.

### **Management:**

Competition from weeds can severely reduce the yield of Meadowfoam. Begin with a weed free seedbed and avoid fields known to have a wild mustard problem.

## 12) *Phacelia ciliata*

*Great Valley Phacelia*

### **Seed Rate:**

7 – 10 pounds/acre

### **Ground Prep:**

A good, fine seed bed is desirable since the seeds are very small. The soil should be disked, cultipacked with a ring roller, planted and rolled a second time. If using a no-till drill the only preparation may be the application of an herbicide to control unwanted weeds. An application of ‘grass killing’ herbicide may benefit the mix from shading and moisture stress.

### **Planting Methods:**

Use a grain drill, no till drill, broadcaster, or even a hand-held broadcaster on small areas to evenly distribute the seed. In large fallow areas that have been prepared, aerial application followed by cultipacking. No fertilizer needed. If able to irrigate, ensure the root zone has available water until the roots reach 6” depth.

### **Plant:**

After Sept. 10<sup>th</sup> through Nov. 10<sup>th</sup>, while soil is still warm – above 55 deg  
Sow before first rains. Plant no more than 1/8” to 1/4” deep. Between bearing or newly established orchard trees, on orchard margins and waterways.

### **Emergence/Visible:**

TBD

### **Bloom:**

February through May

### **Management:**

Plants should be allowed to grow into May and June so that they both set seeds and provide the longest bloom possible. Thereafter, they can be mowed, disked and killed. To encourage reseeding, do not chip or disk but roll. Push seeds into ground.

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