Using insect pollinators for alfalfa and clover

Isolating plots

The cage frames and covers are used to isolate the different accessions in the field to keep them from cross pollinating.

After the transplants have been in the field for a few weeks they will need weeding and need to be checked for flowers. The clover plots flowering should be covered and have any open flowers picked off after the cover is on. Before covering plots, weed them and with alfalfa trim all the plants to remove any flowers and to try and equalize growth between the plants in the plot. Weed all the plots and then start to cover rows at a time always covering any other plots that are starting to flower first.

After all the plots are covered check for when there is 50% or more flowers in a cage and then put in bees. Weed the cages before honeybees are put in. Also check the cages for any unusual plants that may be in the cage that could be contamination. Purple flower alfalfa in what should be yellow flower or one plant that does not look exactly like all the others. These plants may be contamination and should be checked closely and culled if necessary before bees are put in and that cage closely monitored every few days to see if anymore strange plants are in the plot. Also check plots that don't seem like they are the right genus/species, they may have incorrect Id or a label mix up.

Once all the cages are covered keep checking for weeds, bee needs, that the cages are staying sealed and do not have holes, leaks in the drip tape and for insect pests until the seed is ready for harvest. Be sure to check all the cages after any high winds for damage or being pulled out of the soil. Also check cages that may need to have multiple harvests during the summer. Walk each row when the irrigation is turned on to check for leaks and fix them. That is a reason to run the irrigation in honeybee cages in the morning so the cages can be entered to fix leaks.

Cage frames and covers

The cages most used by our project are the old 8 x 10 and the new 9 x 11. The 8 x 10 foot cages are being phased out as they are damaged. The frames for the 8 x 10 cages are solid metal tube frames that can be stacked for storage. There are two sizes of the old cage frames, tall ones and short ones. All of the old covers will fit over the short frames but not all will fit on the tall ones. The old frames tend to break and require welding to fix them so as they fall apart they are being discarded. The frames for the new covers will not fit the old covers because they are bigger. The new frames are made from 1/2 inch

steel pipe and have Kee Klamp fittings (#20-4) for the corners. The new cages frames can be taken apart for storage. As more new cage covers are ordered more cage frames will be made. The new covers could use the old cage frames if necessary. The frame corners used to make the 20 x 20 cage frames could also be used to make frames of any size to fit the smaller cages by cutting the pipe to connect the corners into whatever size is needed.

The new cage covers are custom made for the project by a company in Georgia (look at attached information) and they will make any size or shape you request. Order any new covers well in advance of needing them. The purchasing of new covers is a good use of any extra end of the year money needing to be spent. The cage frame Kee Klamps can come of different vendors (check for the best price) and again order them well in advance since they are made in England. The steel water pipe comes from local vendors (check for the best price).

The old cage covers have both zippers and Velcro for the doors. The zippers can fail after they are in the field and if this happens use binder clips to keep the door closed. The old cages also need to be closely checked for holes after they are in the field and patched. Get rid of any cages with broken zippers and large holes in the fall and make a note to replace with new cages. There should be about 400 small cages at all times for the regeneration needs. The small cage covers used on the Roza Farm are stored in the old lunchroom in the equipment yard. They should be rolled up and stacked every fall. Cages needing repair should be tagged and brought down to the shop.

The large 20 x 20 and 10 x 20 cages are stored in the back of the shop and are used by the ARS Alfalfa breeding program. The frames for those cages are made from welded metal pipe corners and the right size connecting pipes for the cage size. The cage frames are stored on the Roza in the equipment yard south of the small storage shed or there may be frames in the back of the shop.

Setting up cages

After all the transplants have been planted the cage frames can be set up on the plots needing to be covered. Check to make sure the drip tape does not get pinched. The over winter plots can have cage frames set up on them after the field has been tilled and before the drip tube is laid. There is less of a problem with the drip tape being pinched if it runs over the top of the frame pipe. Once the frames are in place, they need to have t-posts placed in the corners and tied to the frames to help stabilize them in high winds. The new frames need a post in every corner and the old frames only need it in two corners. The posts do not have to be very deep, just enough to keep the cage from shaking. After the post are in, the non drip tape sides of the cages need to be trenched about 1/2 foot to bury the cage cover edges and help hold the cage in place. The sides where the drip tape runs under will only have soil placed on the top of the skirt (no trench) to help keep the drip tape from being pinched. When the irrigation is run after new cages have been put up, check to make sure the water is passing through the new cages and to the end of the row. Dig out soil under the tape or block up the cage frame if necessary to unpinch the tape.

The cages that are on the field edge rows and the top and bottom cages of each row should have extra care to securely anchor them since they will take the full force of a windstorm. Also cages in the over winter field that will be standing alone need to have the skirts dug in deep. The goal of burying the skirt of the cages is to seal out any entrance or exit for bees. Pile up soil as needed to seal the bottom of the cage doors and check them after windstorms, or when workers have opened cages or after bees have been put in. It is a good idea to check the cages once a week for holes caused by broken cage frames and rodents. Tell the field workers to also check the cages for holes when they are working and make a cage repair kit they can always have with them in the field. The kit should have needles, thread, binder clips, cage material and duct tape. Show new workers how to properly close and seal the doors.

Managing pollinators

Honeybees

Honeybees are mainly used for *Trifolium* (clover) species and can be used for the alfalfa and lotus species if leafcutter bees are not available.

Honeybees are obtained using an outside contractor and currently come from Corral Creek Pollinators (owner is Jeff Lunden, who also works at the Prosser station). In April give Jeff an estimate of how many hives will be needed during the summer (i.e. number of cages containing clover). During the summer, to order honeybees, give Jeff a cage map of the field marked with what cages need bees and Jeff will put the bees in the cages. It also helps Jeff if the cages can be marked with colored flags if there are few cages spread around the field. Give the order one week before the bees are needed.

The hives are small four frame boxes called nucs. They will last from three to five weeks, sometimes longer. Jeff puts feeders on the hives. We need to supply the bees with water. One quart plastic buckets (i.e. yogurt containers) work well. The bees need something to land on in the container to drink from, cage material cut into strips, placed in side and stapled to the top works great (like a life boat ladder for the bees to climb out if they fall in the water). Place the bucket on level ground next to the hive. Check the water three times a week and use a flower watering can to fill the buckets by pouring water through the side of the cage. After high winds check to see if the hives or water have blown over and upright them if needed.

Make sure anyone working in the cages with honey bees is not allergic to bees

The honeybees are not very active in the cool early morning or on overcast days so if work needs to be done in a cage with bees do it then and be careful not to grab a bee with your hand. Hives that are not needed any more can be moved out of the cage and put in the corner of the field. Let Jeff know he can pick them up. If a hives dies too early let Jeff know so he can replace it. Sometimes hives can be moved from one cage to another to replace a dead hive but make sure they are different plant species to minimize pollen contamination.

Some pesticides easily kill honeybees. Be very careful to spray cages with only bee-friendly sprays if bees are to be put in soon or are already in the cages. Do not let bee toxic spray drift blow towards the honeybee cages from another part of the field. Best time to spray is at night when the bees are in the hive and there are many hours for the spray to dry on the plants. Read the pesticide guide for what sprays are safe for bees and the time intervals for putting bees in the field after spraying. If there is a pest problem that will require a bee-toxic spray to fix, hives can be removed from the cage and then put back in when it is safe.

Leafcutters

Leafcutter bees are used to pollinate *Medicago* (alfalfa) and *Lotus* (trefoil) species

Leafcutters are purchased from suppliers who will ship them in the spring as loose cells. The bees are hatched out as needed during the summer. The cells are kept dormant by keeping them at 40 F. in the refrigerator (DO NOT let them freeze or they will be killed) until needed. They are then put in trays and placed in the bee incubator (Figure ___) to be hatched out. It takes about 21days for adult bees to start hatching and the hatch cycle lasts about 7 days. The adult bees can be kept alive in the refrigerator for about 3 days max. It is best to release the bees in the field as soon as possible.

Bees are sold by the gallon and 10 gallons are usually more than enough for a season Be sure to tell the supplier that you want them as soon as possible because you want to start some to hatch in May for overwinter plots that flower early. You want to have a constant supply of bees from May to September with the heaviest demand in July and August. Try to start the trays evenly spaced during the month.

- May, two trays, two quarts each
- June, four trays, two quarts each
- July, six trays, three quarts each
- August, five trays, two quarts each

How to hatch out leaf cutter bees

There are special wood incubation boxes, lids and jars to hatch and harvest the bees. To set up an incubation box:

1. Line bottom of box with paper towels and wet it down.
2. Put the quantity of bees needed into the box and spread them out even on the bottom. Do not have the bee layer thicker than one inch.
3. Lightly wet the bee cells with a spray bottle
4. Cover with two inches of vermiculite and
5. Wet the vermiculite thoroughly with the spray bottle.
6. Place the box in the incubator.

The incubator should be set at 80 to 85 F. and the inside light set on a ten hour on cycle. The water trays on the bottom of the incubator should be kept full and the vermiculite wetted lightly every day to keep the humidity up in the incubator. DO NOT water the bee cells too heavily or they will get moldy and die. The wood box helps keep the bees dry but make sure only the vermiculite is getting wet not the cells. The incubator also has a power vent with a thermostat to keep the inside from getting too hot. Make sure the thermostats are set correctly to keep the bees from getting too hot. Excessive heat will kill the bees. If the bees are not warm enough they will take longer to hatch.

Controlling leaf cutter parasites

The incubator is equipped with bug lights to kill parasites that hatch out of the cells. Keep the water traps under the lights clean and full of water. The vermiculite on top of the cells keeps the parasites, after they hatch, from getting in to more of the cells and at night when the inside lights are off the bug lights attract the parasites and kill them. With out the vermiculite and bug lights the parasites can kill over 80% of the cells! Once the bees are hatching and being trapped in the jars parasites will also be trapped in the jar but they cannot harm adult bees.

When you first start to see adult leafcutters in the water traps, cover the tray that is hatching with the special lid with the jar holes. Put short strips if cage material from the vermiculite layer out of the jar hole for the bees to climb and help get them into the jar. Then get a mason jar with a cone trap lid on it and put in the jar hole of the box lid. The bees will then climb up into the jar and get trapped in the jar by the cone. The light that shines into the box from the jar attracts the bees. The jars are then switched as they fill with bees. Change the jars three or four time a day but once a day is ok if that is all that can be done. Bees will die if left in the jars for more than a day in the incubator. The jars with bees are the put in the refrigerator and allowed to cool until the bees cannot move and then the bees can be sorted and put into small tubes for taking to the field.

Females are the best pollinators but if you need bees and there are only males, they can be used too

There are male and female bees. The males hatch first so the first few days of the hatch are all males, then the females start to hatch and the last few days of the hatch are mostly females. When sorting bees for the cages, ten to twenty bees per cage are good. Try to have mostly females with two or three males to keep them happy. It is good to put bees in the cages once a week or until you can look at a cage and see bees working the flowers. The females are easy to tell from the males because they are bigger, have black eyes and gray hairs on their more pointed abdomen. The males are smaller, with green eyes and a more rounded hairless abdomen.

Caring for leafcutter bees in cages

The leafcutter bee will live for about three weeks in the cages and they do not need any care after being put into the cages except to have a nesting board put in the cage. The nesting board is a 6 x 4 x 2 in. wood or foam block with many 3.5 in. pencil size holes drilled in it for the bees to nest and lay eggs in. Grooved laminate boards can also be wired together to make nesting boards. The bees will sleep in the board at night. No water is needed for the leafcutters in the cages.

With leafcutter cages, if you need to control problem insect pests in the cages you can spray something that will kill the bees and then put more bees in after it is safe. That is why it is good to have more bees than you need in case you kill bees while spraying. Always check to see if the bees are still alive in all the cages after spraying. Always try to use bee friendly sprays first and only kill bees if necessary.

Fig1. Cage frame

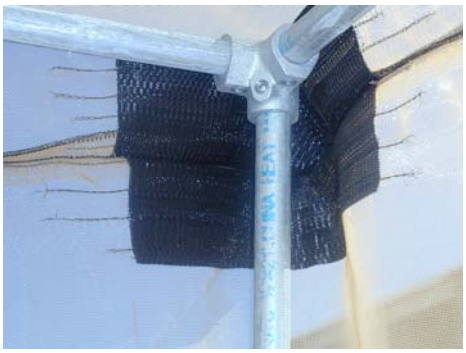

Fig. 2. Cage cover

Fig 3, 4, 5. Leaf cutter bee incubator built by Andrew Bell (andybell@wsu.edu)

Fig. 4

Fig 5

Fig 6. Queenless honey bee nuc supplied by outside contractor for $60.00/cage (2005)