

Berms: For citrus production

by Roger Smith

Over the past 20 years, berms of all shapes and sizes have appeared in California citrus orchards. This concept requires an added cost per acre when developing a citrus property. The use of flat-topped berms as indicated in the photo, is highly recommended for 21st century citrus orchards in California.

Improved drainage is often the reason for berming, but California is not in the high rainfall category. So the question is, why go to the extra expense of berms if their primary use is to improve drainage in high rainfall areas? This expense can be as low as \$100 to as high as \$475 an acre, which is a significant additional cost to any new citrus development. This additional cost can't be taken lightly and there should be results in the new planting that would guarantee economic payback of the added costs.

PROS AND CONS FOR BERMS IN CALIFORNIA

Most of the companies we talked to that are committed to the use of berms in their new citrus developments rely on personal experience or anecdotal evidence as justification for the added developmental costs that berms require. We also found different approaches to how big the berm should be, so there probably isn't a "one size fits all" size for berms, but we do think a flat topped berm is important. Here are some of the advantages that were shared with us:

1. Moves water down and away from the tree's root system.
2. Drip irrigation works better on berms than a flat planting.
3. There is the rationale that the top of the berm may heat up faster than traditional plantings on flat fields. This may encourage faster root development on the berms.
4. Trees on berms have appeared to grow about one-third faster and more uniformly than trees planted in flat plantings.
5. The incidence of soil borne diseases may be reduced.
6. Fruit drops and rolls toward the middles,



12 month old Tango trees on flat berms with weed mat. Mat was installed after planting.

which keeps inoculums that cause rotting away from the tree.

7. Development of berms creates more aeration in the soil, which allows for more rapid rooting of the developing tree. It also is more effective in mixing soil fertility into the berm like organic matter, sulfur, or pre-plant fertilizers.
8. It inhibits lateral movement across a grove, which restricts foot traffic that could spread soil pathogens throughout the property.
9. It may help in draining off cold air. Because cold air runs like water, it is possible that berms may move that air out of the grove more effectively.
10. Since the base of the tree is elevated, it is easier to keep the skirt from touching the ground and there is slightly more canopy at the tree's base.
11. Very high production has been experienced on berm plantings, 50-65 bins/Acre.
12. Weed mat can be applied on a berm more effectively than on the flat.

The previously listed advantages have to be balanced with a few challenges. In our investigation, we also discovered some skilled growers that aren't convinced that berms are always a good idea. The use of berms in citrus plantings does create some long-term consequences that are not always easy to deal with. Those may include:

1. Irrigation water for young trees may run off the berm and not effectively irrigate the newly planted tree.
2. Harvest is more difficult on large berms. When picking citrus groves, lateral movement on foot is required, often while carrying a 16-foot ladder. Climbing up and over berms encumbered by a ladder and heavy picking sack makes the job of harvest more difficult for fieldworkers and would slow their efficiency and production per day.
3. Lateral movement is very difficult. If an irrigator on a quad needs to move across the tree row, he either must go up and over the berms or travel to the end of the grove.

4. Cross-hedging or cross-row weed spraying is impossible to achieve with berms.
5. Berms require modification to orchard equipment. In some berm designs, the drive row is not flat so machines like brush shredders, mowers, boom weed sprayers, etc., must be modified to accommodate a v-shaped drive row.
6. The cost of development is increased by \$100 to \$475 per acre. These costs are not just the costs of berming, but also the costs of insuring the ends of the grove are properly graded and that there is a proper accommodation for runoff water.
7. Large berms on undulating field may create mud holes that can't drain. It may be advisable to plant flat and invest the money saved in tile drainage systems.
8. As berms are primarily to improve drainage, installing on hillsides may not be necessary since hillsides automatically drain. However, hillsides often have shallow soil and berms will increase the topsoil available to the trees.
9. Berms restrict the maximum soil area an older tree can access when compared with flat ground. This can cause a dwarfing response that some may say is a negative. It has been proven, however that more trees/acre greatly increases production per acre
10. Tillage between berms is trickier than on the flat. If the equipment comes too close to the berms, roots could be cut. (Some growers offer that a little root pruning is a good thing).



Left: Dense planting of mandarins on high berms with flat middles. Trees 2 1/2 years old.

Below: A flat berm made by the berm maker shown above. Note row end requires smoothing up with a skid-steer prior to planting.



DISCUSSION

Because public scientific trials haven't really occurred in California, there isn't proven evidence berms should always be used. There is no question that working the soil and raising the beds creates a better environment for root development. What is difficult to justify is the added expense per acre. It does appear that trees on berms come into production a year earlier than flat plantings which especially true when replanting an existing citrus orchard.

Where citrus is planted in Central California, soil types vary dramatically. Heavy Porterville adobe clay, fine sandy loams of Sanger, the red San Joaquin soil series, and the light wind-blown soils of Kern County. To be able to make a blanket recommendation for that many variables is impossible. But it is possible to say that berming is a great help for heavy soil condi-

tions, shallow soils, or areas where there is poor drainage. It isn't clear what the advantages of berming are for lighter soils, but it must be mentioned that many progressive citrus companies have chosen to berm even where light soils exist.

When we design soil mixes for our container trees, we find that citrus roots love a high amount of aeration and drainage. Berms with organic matter incorporated pre-plant offer similar effects to enhance rooting after planting. A flat planting doesn't have the same influences.

The advantage of the berm is that it forces the grower to do the optimum amount of land preparation prior to planting. This one factor may be enough of a justification to encourage the investment in building berms for new plantings, but it cannot be over emphasized the importance of trees get-

ting adequate water which is what flat top berms are best. At TreeSource, we encourage you to take the time to work the soil and prepare your site to encourage optimum root growth for the new trees we supply. A part of that process should be the use of berms as the positives outweigh the negatives.



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