

Extension Toolkit Notes

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Yield Management: The Problem of Over-cropping

Terms:

Yield: The harvested crop, in kg per vine or per unit land area (e.g., hectare or jeribe).

Crop level: The crop yield before it is harvested.

Crop load: The harvested crop (kg) per kilogram of cane pruning weight.

Buds: Can be classified by the structures they contain (leaf or fruit buds) and/or the position they occupy on the shoot or arm (basal buds are located near the base of the shoot). It is not possible to distinguish between leaf and fruit buds by external examination. Buds are produced during the bloom of the season preceding that in which they will open. Exposure of canes to sunlight stimulates the production of fruit buds.

Thinning: The process of removing crop from the vine to promote better growth of the remaining crop. Thinning performed before bloom is called flower cluster thinning. Thinning performed after bloom and berry set is called cluster thinning.

Vine Capacity: Is the maximum crop a vine can bear without delaying fruit maturity.

Photosynthate: The carbohydrate products of photosynthesis.

Anthesis: flowering, bloom.

Source-Sink model: This model describes plant parts as either photosynthate sources or photosynthate sinks. Healthy leaves are sources because they produce photosynthate beyond their own requirements, which is then translocated to other parts of the vine. Flowers, fruits and non-photosynthetic tissues are sinks because the net flow of photosynthate is toward them from sources. As leaves senesce they convert from sources to sinks because they become less efficient at producing photosynthate yet have requirements to maintain their basic life processes. As a result there is a net flow of photosynthate toward them.

Preparing meals that can feed and sustain only six people is inadequate for maintaining the health of eighteen. Either the amount of food must be increased or the number of people sharing the meals must be reduced. Likewise, the amount of food a plant

produces is limited by its photosynthetic surface, that is, its exposed leaf area. Consequently, its sources can nourish the maturation of only a limited amount of fruit sinks.

Over-cropping means maintaining a crop level which exceeds vine capacity. It can result in delayed fruit maturity, possible reduced fruit quality, reduced vegetative growth and delayed maturation of shoots into canes. Vines that are chronically over-cropped decline because the plant does not produce enough photosynthate to service fruit growth, replacement of vegetative parts and development of buds. They have more sinks than can be supported by their sources. In some temperate short-season areas approximately 10 to 14 sq cm of leaf area per gram of fruit (or about 18 leaves per cluster) are required to complete the maturation of a grape crop.

Over-cropping is corrected by the process of thinning. The objective of thinning is to balance the partitioning of the limiting photosynthate among the remaining fruit clusters, and between vegetative and reproductive structures, by removing sinks.

Four reasons to control crop load through thinning.

1. To balance leaf area and crop level. Light pruning of the vine during dormancy will leave an amount of buds on the vine that exceeds the vine's capacity. Thinning during the growing season adjusts the number of clusters below the vine's capacity and allows adequate partition of the photosynthate to both the vine's vegetative and fruiting sinks.
2. To promote larger vine size. Small or stunted vines can be trapped into a chronic cycle of over-cropping because small vines expose shoots to more sunlight. This promotes bud fruitfulness. In this case, the vine never grows large enough to bear very large crop loads. Thinning allows more of the photosynthate to be partitioned into the vegetative sinks so that the vine can grow.
3. To improve fruit quality in warm climates. One strategy to increase the soluble solids content of fruit is to simply delay harvest, which allows the sugar content to build up. However, the delay can decrease acidity and cause an undesirable sugar/acid ratio. Thinning can influence this ratio and improve fruit quality.
4. To maintain cropping potential of the vines through bloom period. Severely pruning during the dormant season to retain the proper number of buds for the coming growing season can result in under-cropping if a severe spring frost or cool weather during bloom occurs. A better strategy is to prune the vine less severely during the dormant period so as to carry more than the needed number of buds through the bloom period. Then, the crop is adjusted to the proper cropping level through cluster thinning.

How many clusters should be left to ripen on a vine? It depends on the variety, size of the vine, cultural practices that alter the size of the clusters, the desired crop level and year-to-year variation in vine fruitfulness.

An initial target for grapes of good quality on trellised mature vines (based on data from Michigan, a temperate short-season locality) might be:

Vineyard Management with Adequate Climate	Metric Tonnes /ha
Optimal	15
Good	10
Inadequate	7.5

These targets are very rough guidelines and should be adjusted depending on the varieties grown, vineyard records, local environment and typical area results.

The median yields (mT/ha), based on farmers' surveys, in the Shamali districts for the 2003 cropping season were: 8 (Bagram), 11 (Charekar), 7 (Farza), 2 (Istalef), 0.5 (Kalakan), 1 (Mir Bacha Koot) and 1 (Qara Bagh). Most vineyards in these districts were stressed by a combination of factors—which may include inadequate: pruning, irrigation, powdery mildew control and fertilization—so vineyard management was generally not good.

The farmer, with a target yield in mind, then estimates the number of clusters needed per vine. This requires knowing the number of vines per hectare and the mean weight per cluster. Mean cluster weight depends upon variety, environment and management practices.

For example, assume a farmer has a mature vineyard on five jiribes (one hectare) of 1500 vines. He knows his mean cluster weight per vine from past experience.

For mean cluster weights of either 100g or 200g, the number of clusters his vines should bear for good quality fruit and maintenance of healthy vines are:

Vineyard Management	Approximate number of clusters per vine	
	Assuming 100g / cluster	Assuming 200g / cluster
Optimal	100	50
Good	70	35
Inadequate	50	25

The formula is:

$$(\text{number of clusters per vine}) = (\text{expected yield per ha}) / [(\text{number of vines per ha}) \times (\text{weight per cluster})]$$

The calculated number of clusters should then be checked against the number of shoots per vine. There should be approximately one cluster per shoot as an upper limit.

The farmer in the example will be over-cropping his vineyard if his management practices are inadequate, but he still chooses to keep 100 clusters per vine (at 100g / cluster). A rate of 100 clusters / vine is more appropriate for vineyards receiving optimal management practices.

Important points for extension agents:

Become familiar with your territory

- Know the vineyards in your territory and rank them according to quality of management practices. Are there any examples of exemplary management? What are the factors limiting production? What are the attitudes of farmers toward adopting new technologies? Establish good working relationships with the farmers.
- Develop a sense of appropriate vine capacity in your territory for the varieties of grapes grown. Keep in mind good target numbers of yield (mT/ha) for various levels of management skill based on empirical observations. Be able to provide farmers with realistic estimates of mean cluster weights for the varieties grown in your territory.
- Know the crop levels and yields of the vineyards in your territory. Look for examples of over-cropping. When finding a vineyard with a low cropping level, investigate if over-cropping may have occurred the previous season. Explain to the farmer, in simple and straight-forward language, the consequences of over-cropping. Over-cropping reduces the availability of photosynthate for other physiological processes, e.g. bud formation and vegetative growth. It also reduces the size of berries and clusters.

An extension agent's familiarity with his territory results from careful observation and an inquisitive attitude. Take notes on the developmental progress of the crop in your territory and relate the progress to the quality and quantity of harvest. Hold farmer's meetings and discuss, and note, the status of everyone's grape crop. Lastly, give your manager a report of your notes on a weekly basis.

Information was obtained from these references:

Zabada, Thomas. Crop Control in Grapevines: a Report from the Southwest Michigan Research and Extension Center. Michigan State Univ. SWMREC Report #17.