Cucumber

Cultivation Insights

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Cucumbers and Marketable Yield

- Marketable yield of greenhouse cucumber production determines the profitability of the crop.
- Marketable yield is the amount of salable fruit produced by a crop.
- Marketable yield is affected by many factors, including growing conditions and variety selection.

Marketable Yield

The marketable yield of a cucumber crop is the amount of fruit produced by the crop that meets the quality standards of a traditional buyer (grocery store, vegetable broker). Marketable yield is determined by two factors, the amount of fruit produced by the crop, measured as the number of fruit or weight of fruit, and fruit quality factors, which include fruit length, diameter, shape, color, firmness, and the presence of injuries, blemishes, and scars. Marketability depends on the market demand and the preferences of buyers and consumers. What is considered marketable is unique to each grower, depending on the demands and specifications of their buyers, and buyer specifications do not necessarily match the grading standards set by the USDA.[1]

Growers and buyers have various systems for categorizing fruit quality. Some segregate fruit into classes of fancy, No. 1, and culls.[2] Others may use a system of marketable, edible, and non-edible, where the edible (but not marketable) fruit is sold to alternative buyers, such as services that specialize in selling edible but blemished produce.[1]

The amount of marketable yield and production costs are the primary factors in determining the profitability of a crop. The costs of production include the costs of labor, materials, and overhead associated with the various aspects of production, including:

- seeding, seedling care, transplanting
- growth medium system, irrigation, nutrition
- pruning and trellising
- pest and disease management
- facilities and energy costs (heating, lights, fans)
- harvest and disposal of unmarketable fruit
- packing, storage, transportation, and marketing

Other than packing, storage, transportation, and marketing expenses, the costs of production apply to non-marketable fruit just as they apply to marketable fruit. This lowers both the gross and net profitability of a crop and increases the cost of production per marketable fruit. A grower pays for the costs associated with producing fruit, whether the fruit is marketable or not. Each plant can only produce a certain number of cucumbers. Thus, the formation of non-marketable fruit reduces the number of marketable fruit that the plant can produce. Therefore, it is in the grower's best interest to not only maximize the number of marketable fruit but to minimize the number of non-marketable fruit produced.[3,4] If 5% of a crop is not marketable, the gross profit will be 5% less than it could be, but the total costs of producing that crop still apply, further reducing the net profit for the grower.

Fruit Quality

To be considered marketable, cucumbers must meet expected quality standards. The desired fruit length varies by region. A typical desired length for Long English varieties is 0 to 35 cm (12 to 14 in) with a diameter of 4.13 to 4.76 cm (1.625 to 1.875 in).[5] However, small (28 to 32 cm, 11 to 12.5 in), medium (32 to 37 cm, 12.5 to 14.5 in), and large (37 to 42 cm, 14.5 to 16.5 in) fruit are usually marketable. The fruit should be well-formed and mostly cylindrical with only slight tapering at each end. The color should be a uniform, characteristic green over the entire fruit surface. The fruit should be fresh, firm, and free from defects, including scars, bruising, cuts, and decay.[6,7]

Maximizing Marketable Yield

There are many factors that can impact the marketable yield of protected culture cucumbers. The temperature of the greenhouse affects the growth of the plant, flowering and fruit set, rate of fruit development, and fruit color. The optimum average daily temperature for cucumber production is 21°C (70°F). As plants become established after transplanting, there should be little difference between daytime and nighttime temperatures. Once vines have reached the overhead wire, nighttime temperatures should be lowered to encourage thicker laterals and stronger flowers.[3] However, temperatures should not be allowed to drop below 18°C (65°F) to sustain maximum production, and production and fruit quality will decline if temperatures are allowed to rise above 35°C (95°F).[7] The transition from nighttime to daytime temperatures should occur gradually to minimize water condensation on the fruit, raising temperatures by 1°C per hour to attain the target daytime temperature at least 30 minutes before sunrise. Rapid venting to lower temperatures can result in chilling injury on the fruit.

The optimal relative humidity for fruit production is 95%. Vapor pressure deficits (VPD) should be maintained between 0.4 and 0.8 to minimize condensation on the fruit but still allow for active transpiration by the plants.

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Light is used by the plant to produce sugar through photosynthesis. Light availability can be a limiting factor for greenhouse production due to high plant densities and low levels of natural light during the late fall, winter, and early spring. Proper plant spacing allows for adequate light penetration, which leads to higher fruit quality (length and color), higher yield potential, and decreased disease development.[3] In high sunlight regions and for summer production, plant densities should be 1.5 to 2.1 plants per m^2. In lower light regions and for crops grown primarily during the short-day seasons, more space per plant may be needed. Supplemental light can be used to increase production during low light periods if it is economically feasible.

Plants should be trained and pruned to allow for good light penetration into the canopy, allowing for a balance of foliage and fruit to sustain production. Too many leaves can delay fruit set and harvest; too many fruit can delay fruit maturation and result in fruit abortion or distortion. A high fruit load can also suppress flower development, leading to uneven rates of fruit production.[3] Long English varieties are often pruned to one fruit per alternate node along the main stem until the stem reaches the overhead wire. For late fall and winter plantings, the production should be limited to four or five fruit below the wire. In summer production, six to eight fruit can be allowed to develop below the wire. After main stems have reach the wire, they are pruned to one fruit per node on the main stem for high-wire systems and on the laterals for umbrella systems.[3]

Enrichment with carbon dioxide can help maximize fruit production, especially during cold periods when vents are closed to retain heat. Even when vents are open, CO_2 levels can drop to a point where photosynthesis is limited during periods of bright sun, slowing growth and reducing yield potential. CO_2 enrichment to 1000 ppm has been shown to increase fruit production by 10 to 20% and improve fruit quality and color.[3,8]

Pests and diseases should be managed to protect fruit quality and the photosynthetic leaf area of the plants. Maintaining good air circulation and pruning lower and senescing leaves can help manage some foliar diseases. The application of fungicides and insecticides (including biocontrol agents and natural enemies) may be needed in some situations. Pollinators should be prevented from entering greenhouses because pollination of parthenocarpic varieties can result in the formation of seed, leading to fruit distortion and bitter flavors.[3,7]

For plants to remain productive, fruit should be harvested in a timely manner to limit the number of fruit on the plant at any one time.[9] Fruit should be harvested as soon as they reach the desired and uniform length, diameter, and shape before yellowing develops. Long English varieties usually reach maximum fruit length 10 to 14 days after flowering, with the fruit becoming more cylindrical by day 14.[3,7] Under most conditions, fruit should be harvested daily so that they do not become overmature. During low light periods or at the end of the season when production slows, harvesting may be less frequent. Fruit should be cut from the stem rather than broken off by twisting.

Variety Selection

It is important to consider growing conditions and disease pressure when selecting cucumber varieties with the best fit for a production system. Plant types with the proper architecture for the chosen trellising/pruning system facilitate adequate light penetration, crop maintenance, and harvest. For high-wire systems where labor is readily available, using compact plants with short internodes can help maximize fruit production. However, with umbrella systems and systems that rely on lower labor inputs, open-canopy varieties with longer internodes provide the best balance of production and labor requirements because they require less pruning, and it is easier to harvest the fruit. An open canopy allows for better airflow and light penetration, often resulting in conditions that are less favorable for disease development. An open canopy also allows better penetration of fungicide sprays, potentially increasing the effectiveness of treatments and reducing the number of sprays needed for disease control.[3,7]

Varieties also differ in their tendency toward vegetative vs. generative growth, leaves and stems vs. flowers and fruit. If conditions during the primary growing period push the plants toward more vegetative growth (low light conditions), selecting a more generative variety can help maintain a balanced level of growth. If conditions favor more generative growth (warm with high light levels), then selecting a variety that tends toward more vegetative growth will help maintain that balance. Selecting varieties with appropriate disease resistance characteristics is also important. Having a variety with adequate resistance to prevalent diseases can reduce the need for fungicide applications and protect potential yield and fruit quality characteristics. For most viral diseases, disease resistance is one of the few management options available, and the choice of a resistant variety can have a substantial impact on the level of marketable yield of the crop.

Sources

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Websites verified 8/19/2021

For additional agronomic information, please contact your local seed representative.

Performance may vary, from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields. The recommendations in this article are based upon information obtained from the cited sources and should be used as a quick reference for information about greenhouse cucumber production. The content of this article should not be substituted for the professional opinion of a producer, grower, agronomist, pathologist and similar professional dealing with this specific crop.

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