

Further sanitizing with a chlorine solution may be needed. Belt conveyors and other equipment can be spot-sprayed with a 100 ppm chlorine solution. Boots, gloves, smocks, and aprons should be cleaned or replaced as needed.

Pest control

A pest control program will minimize risk of contamination by rodents or other animals. In an open or exposed packinghouse operation, the best control is constant vigilance and elimination of any discovered animals and their potential nesting locations. Product and/or product remnants will attract pests; therefore, the daily cleaning of the packing house to eliminate the attractive food source should help reduce pests.

Facility sanitation

Packinghouse facilities have the potential for developing microbial growth on walls, tunnels, ceilings, floors, doors, and drains. Scheduled washdown and/or sanitizing of the facility will reduce the potential for microbial growth. The cooling system should be monitored and cleaned as

necessary, depending on the type of system.

Temperature control

Maintaining proper holdingroom temperature will promote product quality and reduce microbial growth. Temperature should be monitored in order to ensure established product temperature parameters.

Shipping

Vehicles

Trucks must be inspected for sanitary condition and optimum transit temperature before being loaded with produce. Check for visible cleanliness, odors, dirt, and/or other debris prior to loading. Any truck showing these conditions should be rejected. Check for pest infestation, physical condition, and the presence of a properly aligned air chute before loading. Make sure a Ryan temperature recorder is present to monitor cold temperature during transit. Never load produce into a warm truck.



Good Agricultural Practices for the Production and Handling of Green Beans and Peas

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Introduction

Green beans and peas may be harvested by hand and packed directly in the field for the fresh market. They may also be harvested by machine, loaded into a bulk container or truck, and hauled to a packing shed for cleaning, packaging, and cooling. Field sanitation practices are very important to reduce the spread of disease among plants and to prevent the possibility of contamination by pathogens harmful to humans.

Preharvest

Raw product safety

The principal hazard to green beans or peas is microbial contamination from pathogens harmful to humans. Ensuring the safety of these products begins with preventing exposure in the field. The best guarantee of a safe, raw product is a proactive food safety program that has been designed and implemented to identify and prevent hazards during production and postharvest handling. Growers/shippers should familiarize themselves with safe production practices so they might be viewed as qualified suppliers among potential buyers.

Land-use history

Grazing animals on or near crop land can introduce bacteria harmful to humans into the soil. Growers should ensure that land has not been used for animal husbandry during the current growing season and that it is not close to either animal feedlots or water runoff from grazing lands. Previous improper use of pesticides can result in hazardous residues on raw products.

Fertilizer use

Incompletely composted organic fertilizers may contain bacteria harmful to humans from animal or human feces. If organic fertilizers are used, they must be certified as completely composted. Inorganic fertilizers originate from nontoxic, synthetic chemi-

cals, so no pathogens are present. Composted sewage sludge should not be used, as it may contain pathogens as well as heavy metal contamination.

Irrigation

Natural surface water (*e.g.*, canal, lake, pond) provides enough organic matter to support the growth of bacterial pathogens. It may be used with caution for irrigation but should be tested for the presence of the bacterium *Escherichia coli* (*E. coli*), which is an indicator of fecal contamination. Groundwater is less likely to harbor pathogens that will harm humans but should be analyzed for heavy metal and pesticide contamination.

Overhead irrigation is more likely to spread contamination to above-ground plant parts than is root-zone irrigation. Growers should document how water is stored, if animals are confined nearby, and if water is potable (safe for drinking).

Pesticide usage

Growers must comply with all federal and state labels and must be able to answer the following questions: Do you oversee your pesticide-spraying program? Do you have record-keeping procedures to track all spraying of this crop? Do you or the state/federal government regularly test your crops for residue levels?

Harvesting and Handling

Picking

Hand-harvesting may lead to pathogen contamination if field workers practice poor hygiene. Field crews must be trained and monitored for personal hygiene, and portable bathrooms and hand-washing facilities must be provided in the field and must be maintained.

Field containers

Harvest containers should be nontoxic, easy to clean, and free of extraneous materials (*e.g.*, nails, wood splinters, etc.). They must be approved by the U.S. Department of Agriculture (USDA) or the Food and Drug Administration (FDA) for field use. After

cleaning, they can be sanitized by using a very strong sodium hypochlorite solution dispensed from a high-pressure sprayer.

Harvesting

Green beans and peas must be harvested at optimum maturity based on buyer specifications. Pods should be harvested when the sieve size is small and pods are straight and dark green. Overmature pods that are yellowed, curved, or damaged from insects or rot must be removed. Harvest crews must be trained to remove extraneous leaves, stems, or soil clods. Field-packed crates should be removed promptly after filling so that excessive heat buildup does not occur. Crates should be cooled as soon as possible.

Mechanical harvesters can be a primary source of disease carryover if they become contaminated. Harvesters should be cleaned and adjusted daily. Fans should be set to remove the maximum amount of trash so that it is left in the field. Bulk bins or truck bodies should be routinely sanitized to keep disease inoculum from building on their surfaces and infecting sound produce. Once picked, the beans or peas need to be shaded until they enter the packing shed.

One of the most important factors in efficient harvester operation is that the crop be grown for the harvester. Fields should be kept flat during seeding or cultivation. Varieties should be selected that set beans in the top of the plant away from the ground. Irrigation should be employed when necessary so that the plants elongate and raise the crop away from the soil. When plants are stunted, green beans touch the ground, and rotten ends are the result. Pesticide application should be adjusted based on the diseases and or insects present. Once the crop leaves the field, it is too late to control insect or disease losses.

Postharvest Handling Precooling and storage

Once harvested, green beans can be hydrocooled to remove field heat. Both green beans and peas can be room-cooled. Both are also susceptible to chilling injury.

Neither precooling nor storage temperatures should be lower than 45°F. Relative humidity should be 90 to 95 percent. All products should be shipped in refrigerated trailers with temperature monitors.

Receiving

Harvest crews should remove as much dirt and mud from the product as is possible before the product leaves the field. The initial inspection at the packing house should remove any remaining debris before the beans reach the mechanical sorters or water flumes.

Water

Water used in cleaning and cooling should be chlorinated at a concentration of 75 to 100 ppm of free chlorine. Chlorination can be accomplished using a gas injection system, adding bleach, or using calcium hypochlorite tablets.

Chlorination levels in the water should be monitored frequently during operation through the use of a chlorine test kit. Water pH should be maintained between 6.5 and 7.5 to avoid having to use excess chlorine and in order to maintain recommended free chlorine levels. Excessive use of chlorine causes gassing off (objectionable chlorine odor). Excessive chlorine gas can irritate workers' skin, is corrosive to equipment, and increases sanitation costs.

Employee hygiene

Good employee hygiene is critical in reducing contamination by workers. Employee training, health screening, and constant monitoring of packinghouse sanitation practices (hand washing, personal hygiene) are important. All grading line personnel should wear gloves.

Packinghouse equipment

Packinghouse equipment should always be maintained in clean condition. The remnants of product left on belts, tables, lines, and conveyors could provide a food source for microbial growth; thus standard cleaning procedures should include scrubbing to remove particles.

