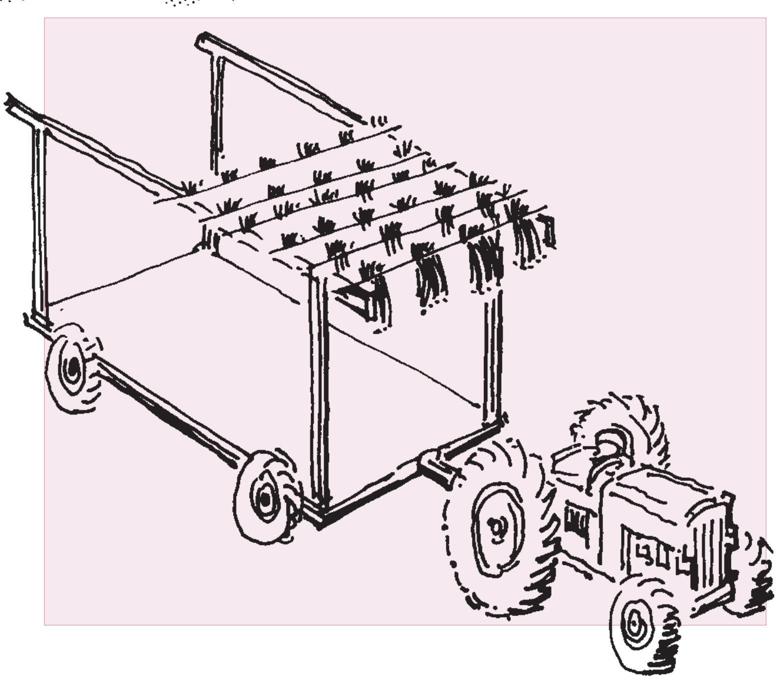


Commercial Specialty
Cut Flower Production

HARVEST SYSTEMS

The Collection of Activities for Gathering and Handling Field-Grown Specialty Cut Flowers

**KANSAS STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
AND COOPERATIVE EXTENSION SERVICE**

HARVEST SYSTEMS

The Collection of Activities for Gathering and Handling Field-Grown Specialty Cut Flowers

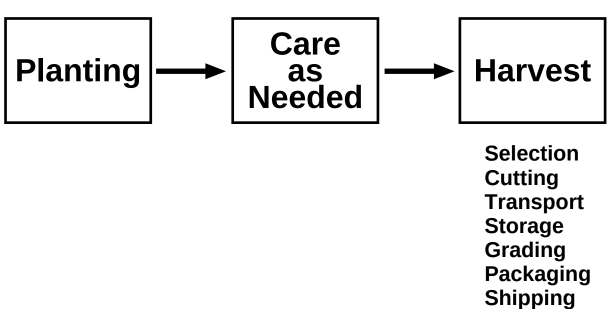
At the time of harvest, the quality of the flowering stems is the best it will ever be. When a stem is cut, it begins to die. The task of the grower and harvest crew, from harvest on, is to slow the decline of the flowering stem. A quality product is essential for a grower to survive in the marketplace. All harvest systems must be designed to slow the decline of the flowering stem and provide the retailer and consumer with the longest vaselife possible. Any activity that accelerates the decline should be avoided or modified to minimize the effects on quality.

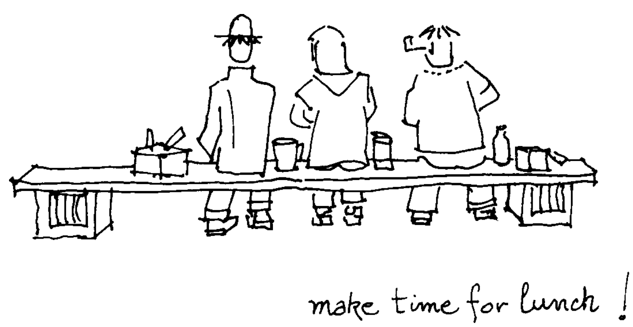
Harvest Labor

The harvest section of the Stevens Labor Model (Figure 1) is defined as all activities involved from the moment the flower is ready to harvest until it is shipped to the customer. There are several subsystems involved in the harvest process.

The Stevens Labor Model for effective labor utilization requires systems to be designed for each activity. Each system should be designed so as to not require workers to make decisions. “No decision” systems are a key element in minimizing the labor required for a task. It takes time to make a decision—the more time spent in extended indecision, the greater the labor cost for the activity. The manager (grower) should study the activity, observe the process, and request input from the workers who will be most knowledgeable about how the task is done. A no-decision system, a way of doing the activity that does not require workers to make a decision, should then be designed. Remember that labor is the single highest cost of producing specialty cut flowers. System development and effectively using labor is critical to profitability, especially for the one-person company. There are 25 hours in a day—the extra hour is your lunch hour. If you spend your time inefficiently, there will be less time for lunch, family, friends or balance in your life.

Figure 1. The Stevens Labor Model





Research has shown activities in the harvest portion of the Stevens Labor Model to comprise 45 to 60 percent of the total labor required to produce specialty cut flowers. Of all the harvest activities, the systems of selection and cutting are the most critical in labor management. Both of these labor activities require workers to constantly make decisions. I know of no system that has been developed that has effectively removed all decisions from these two activities.

Selection Labor

In selecting a flowering stem to harvest, each stem with a flower must be considered and two questions answered. Is this flower at the correct stage of maturity for harvest? Is this flower and stem of sufficient quality to justify harvesting? It takes time to answer both questions for every flowering stem in the production bed. The longer a worker takes to answer both questions, the longer it takes to select each flowering stem to harvest—time is money. Figure 2 illustrates the selection decision.

Cutting Labor

Once the decision to cut a particular flowering stem has been made, then the decision of where on the stem to cut must be reached. The length of the stem attached to the flower has value but so does the length of the stem left attached to the plant. The longer the stem cut with the flower, the higher its value. Longer flowering stems provide increased salability, and likely increased income. The shorter the flowering stem is cut, the more stem remains attached to the plant. The longer the remaining stem, the greater the number of leaves left for photosynthesis, thereby increasing the productive capacity of the plant to produce more flowers. Do I cut here for a longer flowering stem, or do I cut here to maintain the productivity of the plant? In plants being produced in rows, it is also beneficial to cut the stem just above a node located on the side of the stem pointed toward a void or toward the outside of the plant. New growth will be strongest from this node and its growth directed outward, keeping the center of the plant open for better light penetration and improved air circulation for disease control. Again, it takes time to select the best point at which to cut the stem. Indecision time, time spent thinking, is costly time. Figure 3 illustrates the decision of where to cut the stem.

Designing Systems That Require Worker Decisions

The Stevens Labor Model says to develop “no decisions” systems, ways of doing a labor activity that do not require the worker to make a decision. The activities of stem selection and cutting require more than one decision to be made in each activity. How does the labor model address this situation? The first tenet of the Stevens Labor Model is to design “no decision” systems. The second tenant of the labor model is whenever it is not possible to develop a “no decision” system, then develop a system that manages the “time in extended indecision.” It is the time spent trying to reach a decision, the “extended indecision time,” which is most ineffective.

First, develop a system for selecting which flowering stems to cut. Establish the selection criteria. Teach the

Figure 2. Which Flowering Stem Should be Cut Today?

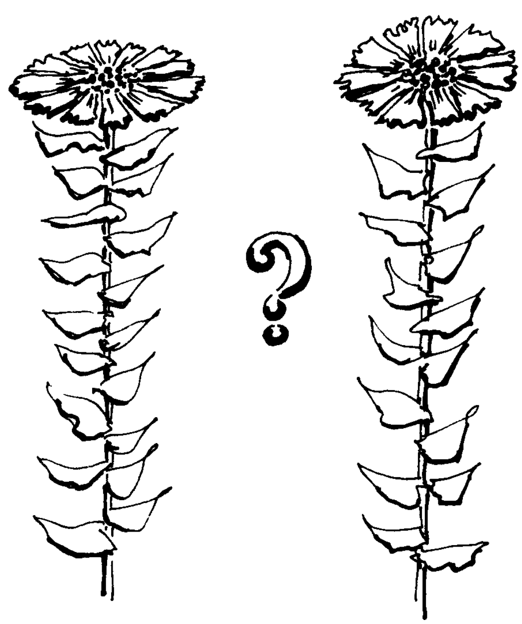
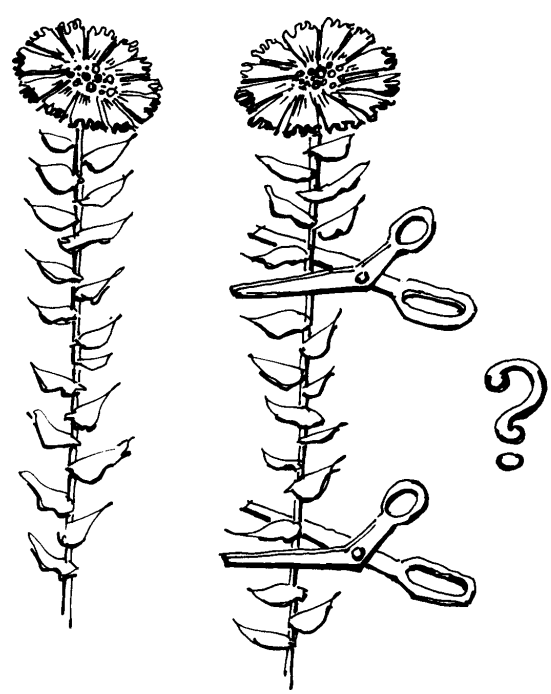


Figure 3. Where Should This Flowering Stem be Cut?



harvest workers the selection criteria. How you teach the selection criteria is critical to reducing the indecision time. **Do not teach the harvest workers what an ideal or perfect flowering stem looks like. Teach them what an unacceptable stem looks like.** There should be far fewer unacceptable stems in the production bed and, therefore, fewer decisions to be made. Train them to quickly recognize faults. The selection system then simply becomes: Harvest everything without a fault. Indecision time has been minimized and labor is most effective. This system also tends to yield more harvestable flowers, increasing income. More flowering stems are acceptable when compared to faults or measures of poor quality than when compared to perfection, for what flowers will be truly perfect.

The same principle holds true for the cutting system. Establish the criteria for where to cut. Teach the harvest workers the cutting site criteria. Again, how the criteria is taught is critical to reducing the "indecision time." **Do not teach the harvest workers how long to cut the flowering stem. Teach them how long to leave the plant stem.** What is the minimum stem length you must leave attached to the plant to maintain its health and vigor (productivity)? The cutting system simply becomes: Cut to leave so many inches. Indecision time has been minimized and labor is most effective.

Do not stop training the harvest crew. The greater the time lapse between the training and the activity, the greater the time harvest workers spend in indecision. Harvest labor rapidly becomes ineffective and labor cost for harvesting flowers will increase dramatically. **You must train and retrain constantly for all systems that require workers to make a decision.** This does not mean you must call a meeting, bring all workers together in a room and prepare and present a formal training program. The system should involve the next level supervisor, the foreman, working elbow to elbow with each harvest worker for a minute or two each time a crop is harvested. The supervisor subtlety, and by example, reminds each worker what is not acceptable and how much stem to leave on the plant. The supervisor then moves on to other workers.

Many growers I have worked with on lowering labor costs pride themselves on how long many of their workers have been working for their company. I ask about worker training. Growers reply, "All workers have been trained to pick quality flowers." When asked about how and when this training is accomplished, the growers response is typically the same. "All new employees are thoroughly trained in flower quality before they can be on the harvest crew." And then what is your training program? "None, all my employees know what a quality flower is." What is your average employee turnover rate? "It is very low, my workers tend to stay with me." How long? "The average is about four or five years, some much longer." So the average worker was trained to harvest about four to five years ago and has not been trained since? Each day a person has new life experiences. Each day they bring new perspectives to the job. Each day they see and do things slightly differently. After four to five years, how differently are they approaching the decisions of selection and cutting? The potential for extended indecision becomes greater the longer the time lapse from being trained in decision criteria. Extended indecision is very expensive.

An important management principle is to spend your time where it will make or save you the most money. The greatest potential for labor savings is in the harvest activities, as these activities comprise half or more of total labor. The harvest systems with the greatest potential for labor ineffectiveness are the selection and cutting systems. All other harvest systems have "no decision" systems which can be developed. A manager should spend time developing and continuously monitoring selection and cutting systems.

Harvest—Stage of Maturity

Table 1 lists the optimal stage of maturity for harvesting a variety of species of specialty cut flowers. Flowers for direct sale to final consumers, such as in farmers markets, should be harvested slightly more mature than flowers sold to retailers for resale. Selling to wholesalers requires a slightly less mature flower than a retailer would require. The ideal stage of maturity will also vary with the intended use. Flowers for drying should be harvested when almost fully open, while for fresh use they should be less mature. The information provided in the table should be considered as a general guideline of harvest maturity for retail sales direct to final consumers.

Always use a sharp knife or shears to harvest flowers. Dull blades tend to crush stem ends and may restrict the flow of water into stems and, thereby, diminish product salability. Do not lay cut stems on the ground during harvest. Particles of dirt or bacteria may be picked up along with the stems and clog the water conductive tissues.

Flower Care During Harvest

Remember, the quality of the flowers is the best it will ever be at the moment of harvest. After harvest, flower quality can only decline as the flower matures and the stem dies. Great care and attention to the smallest detail must be taken to slow the decline of the flowering stem

Table 1.

Guidelines for Optimal Harvest Stage of Maturity of Specialty Cut Flowers for Direct Sale to the Final Consumer.

Common Name	Stage of Maturity
Aster	flowers fully open
Astilbe	one-half of the florets open
Bachelor's Button, Cornflower	flowers just beginning to open
Calendula	flowers fully open
Cockscomb	one-half of florets open
Coreopsis	flowers fully open
Dahlia	flowers fully open
Delphinium	one-half of florets open
Dutch Iris	when flower buds are colored
Freesia	when first bud is fully open
Gladiolus	one to two florets fully open
Globe Thistle	when flowers are half open
Goldenrod	one-half of florets open
Heather	one-half of florets open
Hollyhock	one-third of florets open
Larkspur	two to five florets open
Lisianthus	three to five open flowers
Liatris, Gayfeather	one-half of florets open
Love-in-a-Mist, Nigella	when flowers are open
Marigold	when flowers are almost fully open
Peony	puffy, colored buds
Peruvian Lily, Alstroemeria	one to three florets open
Phlox	one-half of florets open
Pincushion Flower, Scabiosa	flowers half open
Purple Cone Flower	flowers almost fully open
Sea Holly	flowers fully open
Snapdragon	one-third of florets open
Statice—annual	one-half of bracts open
Statice—Sea Lavender	when majority of flowers are open
Sunflower	flowers almost fully open
Sweet Pea	one-third of florets open
Tuberose	one-half of florets open
Yarrow	when flowers are almost fully open
Zinnia	when flowers are almost fully open

during the harvest activities. The rate at which a flowering stem declines is dependant on the tissue temperature and water status of the flower, stem and foliage. High temperatures accelerate the rate of decline. It is not practical to pull a refrigerated cooler through the fields while harvesting, but other practices can be of value. Plant tissue temperatures will be lower during cooler parts of the day. Harvesting early, during the cool of a morning, will aid in maintaining quality. A note of caution is necessary. Do not harvest until after any dew has evaporated off the flowers. Damp flowers packaged or placed into refrigerated storage may develop Botrytis, a fungal disease which attacks and destroys salability of the flowers.

Another method of maintaining cooler tissue temperatures is to keep the harvested flowering stems in the shade until transported to the grading/packing area and refrigerated storage. A covered harvest trailer is an excellent method of providing this shade. Figure 4 is a drawing of the covered harvest trailer Jerry Longren, horticulture research farm manager, designed for use at the Kansas State University Research and Extension Center.

The other important factor in maintaining quality of the harvested flowering stem is to maintain the water status of the plant tissue. Harvested stems, left dry until brought into the grading/packing shed, may wilt to a point beyond their ability to recover. Cut stems should be placed into either water or a fresh flower food (floral preservative solution). The typical flower food solution contains water; a simple sugar, which serves as a food source; a chemical to prevent or retard the growth of microorganisms which can plug the conductive tissue; and an ingredient to acidify the water, typically citric

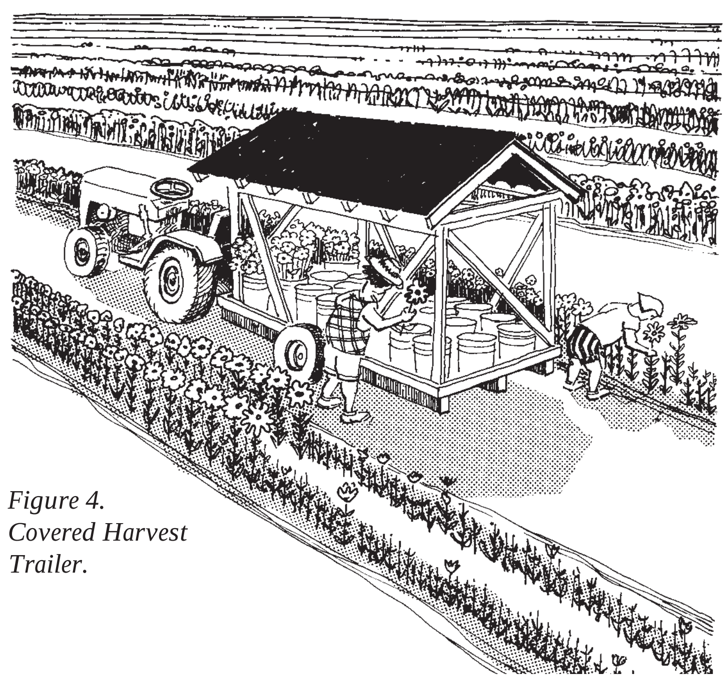
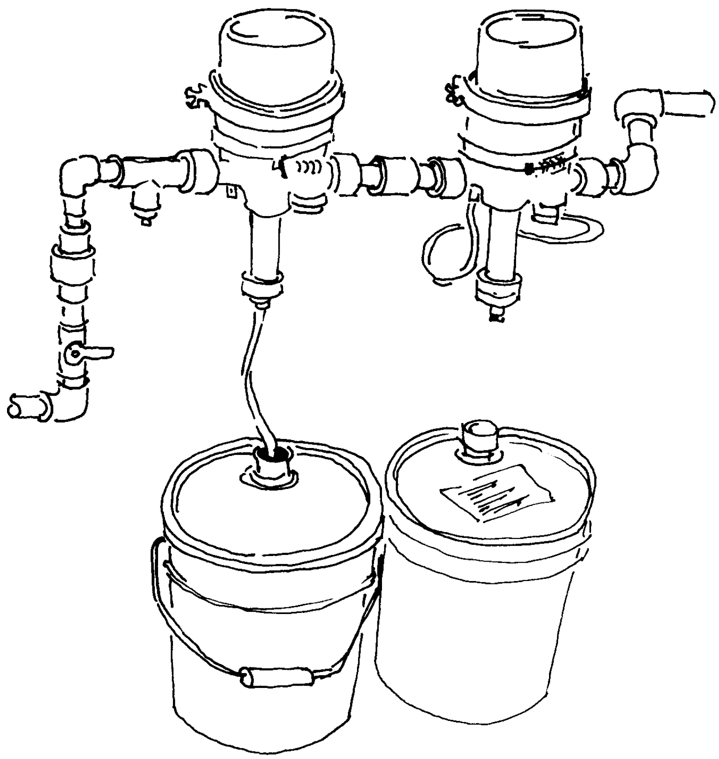


Figure 4. Covered Harvest Trailer.

acid. Fresh flower preservatives are available from several companies.

A system of preparing preservative solutions must be developed to provide a consistent concentration of preservative in each harvest container and to control the cost of labor to mix the solutions. A simple system would be to fill a scoop with preservative; scrape excess preservative off level with the top of the scoop; dump it into a bucket; fill the bucket with water to a line; and stir the solution until the preservative is completely dissolved in the water. In this system, the amount of preservative being used must be consistently measured. The amount of water being added must always be the same and the solution must be stirred to completely dissolve the preservative in the water. Any variation in any of these three activities will result in variation of preservative concentration and may affect the uniformity of flower quality. Careful and continuous attention to all details is essential to producing and delivering a quality product.

Figure 5. An Injector System for Dispensing Floral Preservative Solutions.



Another system of preparing preservative solutions is to use an injector with a commercially prepared, concentrated preservative solution. The injector is placed into a bypass line of the water system (with backflow prevention). The draw tube of the injector is placed into a container of the concentrated solution. When the water spigot is turned on, the injector places a measured amount of preservative solution into the water line and the harvest container is filled with a uniform and consistent concentration of preservative solution. No matter how much solution is placed into the harvest container, the concentration is always the same. A worker does not measure or stir anything, they simply place the injector draw tube into the purchased container of concentrated solution. Figure 5 is a drawing of such an injector system. It shows a second injector for the possibility of utilizing an additional treatment, as might be used for ethylene sensitive flowers. This system provides consistent uniformity of solution concentration with minimal labor being used. It is a simplified system for a grower to effectively manage both quality and labor cost.

Harvest Containers

Plastic containers are ideal for use in holding harvested flowers. Metal containers should be avoided because of the possibility of rust forming and blocking the stems' conductive tissue. Chemicals in floral preservatives may also react with metal containers. A wide variety of shapes and sizes of plastic containers, which are suitable for flowers, are available. Figure 6 shows a range of plastic

Figure 6. Plastic Buckets Used for Handling Cut Flowers.

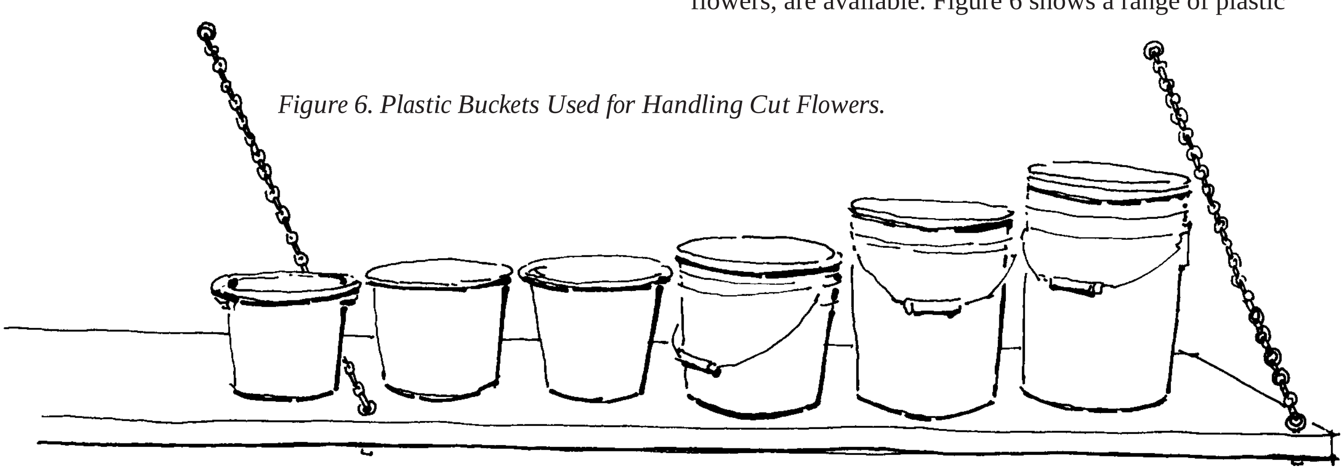


Figure 7. Stacked Bucket System.

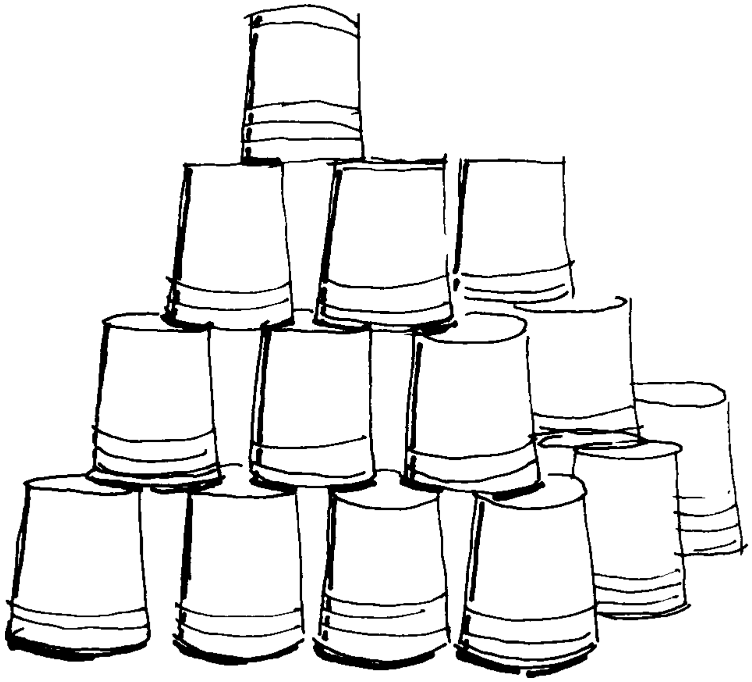
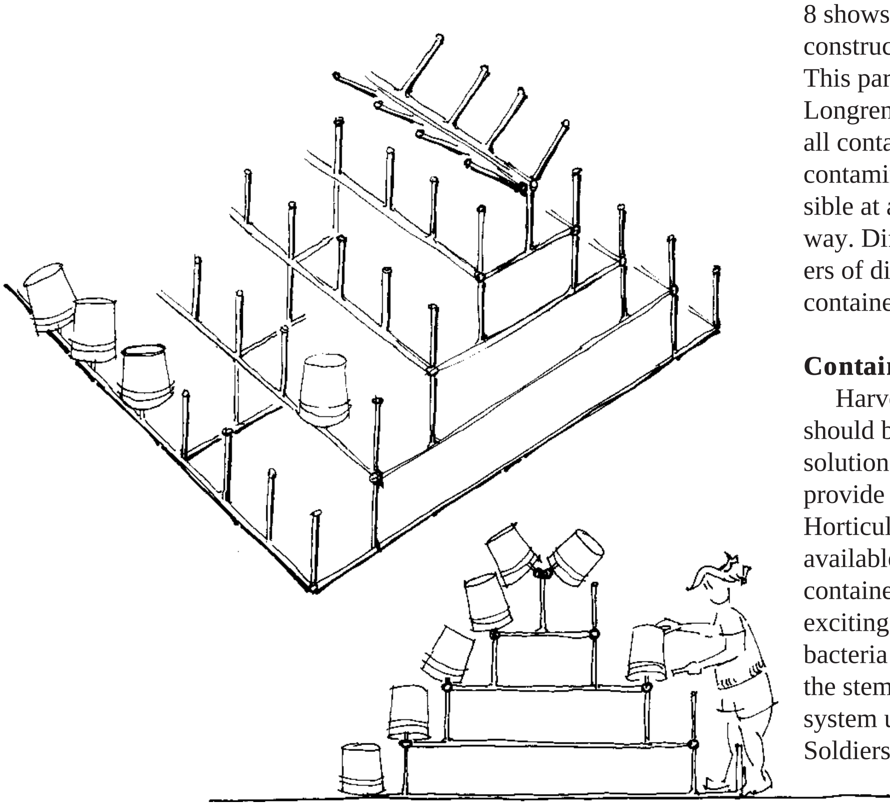


Figure 8. A Welded Pipe Rack for Storing Containers.



bucket sizes arranged on a cooler shelf. Differing bucket heights are used to accommodate various crop stem lengths.

Harvest containers need to be stored when not in use. They should be stored in an area and manner which will keep them clean. Stacking plastic buckets by inserting them into each other will store the greatest number of buckets in the smallest possible space. This method saves space and reduces capital investment in warehouse space. However, this container storage system has a couple of serious deficiencies. The dirtiest portion of most containers is the bottom outside surface which sits on the floor or ground. By inserting containers into each other, this dirty surface is placed inside another container creating the potential for dirt to be inside each and every container. An even stronger reason for not stacking in this manner is the wasted time and high worker frustration level encountered when harvest workers must attempt to pull apart containers which have become stuck together. This wasted time can become very expensive, both in labor cost and in delaying the time of harvest while playing with the buckets.

Alternative container storage systems exist. Figure 7 shows plastic buckets turned upside down and stacked in alternating rows. This system requires more floor space than insert stacking, but keeps a greater number of containers cleaner and creates no hassle in separating buckets.

Harvest containers can also be stored on a rack. Figure 8 shows a diagonal and an end view of a simple way to construct a rack made from scrap pipe welded together. This particular rack was a winter project of Jerry Longren. This rack system has the advantage of keeping all containers off the floor away from potential dirt contamination. Each individual container is also accessible at any time without having to move others out of the way. Differing pipe lengths would accommodate containers of differing depths. It makes a great drying rack for containers which have been washed clean.

Container Sanitation

Harvest containers and cutting shears and knives should be routinely disinfected. A mild chlorine bleach solution of one part water to nine parts bleach will provide good control of potential disease infection. Horticultural detergents which contain biocides are also available for cleaning buckets. Harvest and storage containers should be washed between each use. Not an exciting job, but necessary to reduce the risk of dirt, bacteria or algae clogging the water conducting tissue of the stem and flower. Figure 9 shows a bucket cleaning system used by John Zehrer at Star Valley Flowers in Soldiers Grove, Wisconsin. A large tub containing soapy water and power driven brushes with an adjacent smaller tub for rinsing the containers comprise the system. Parts of the system were originally used to clean milk cans at a Wisconsin dairy and found in a salvage yard.

Figure 10 shows detail of the brush arrangement. The container is placed over one rotating brush to clean the inside, while a second powered brush and a stationary brush clean the outside.

Transport Systems

Flowering stems to be sold as a fresh product must be transported from the plant; to the harvester's arms; to the aisle between production beds; to a roadway; to a holding/storage facility; to a grading/packing area; to refrigerated storage; and finally to the delivery truck. Stems which will be marketed as preserved materials must also be transported in and out of processing areas. Each of these product movement activities require a system to be developed. How will the stems be handled? Will the stems be bunched at the cutting site or left as individual stems for grading later? Will the stems be placed in a container or stacked loose? How many stems will a harvester hold in their arms before placing them somewhere else? How far will the harvester have to walk carrying cut stems before placing them into the next transport subsystem? Will the stems be placed into a preservative solution? When in the transport process will this happen? How will the preservative solution be transported from the site where it is mixed to a container and the container to the cutting area? In what form and how will the stems be moved into and out of refrigerated storage or processing facilities? An effective system must be developed for each of these labor activities.

A transport system and all the subsystems must be developed specifically for each company. The site plan, topography, production system, existing equipment and facilities, workforce and the intended market all affect the transport labor system design. Remember the relay team, don't drop the baton. Transport systems must be integrated with all other aspects of the company. The linkages between each activity are critical. Design each subsystem so as to enhance the performance or lower the cost of the next activity in the system. As an example, the length and width of the production bed affect the labor cost of transport. A wider bed requires the harvester to bend over and reach in farther to harvest flowers from the center portion of the bed than would a narrow bed. A more awkward position will slow harvest and creates a greater distance to move individual flowers. The longer production beds are, the greater the distance flowers may have to be hand carried to a trailer for transport. This does not mean to say that all production beds should be a

Figure 9. Container Cleaning System.

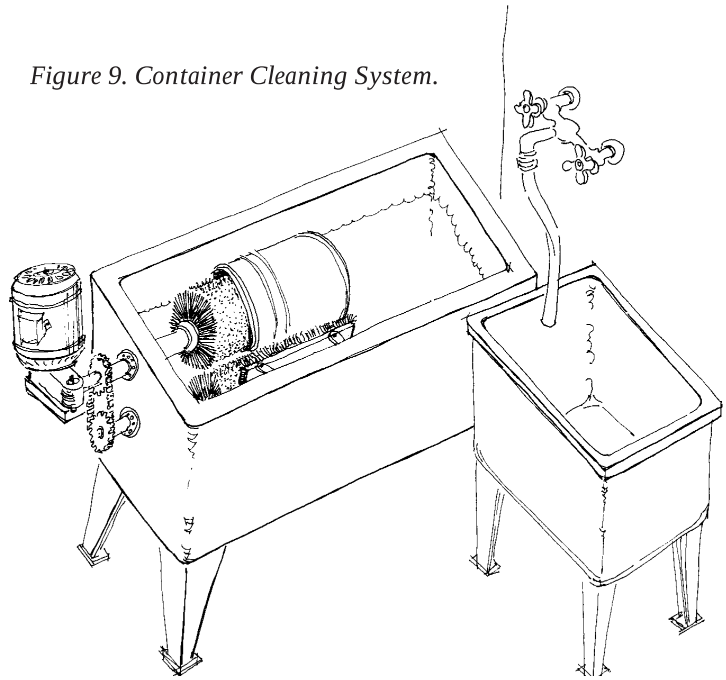
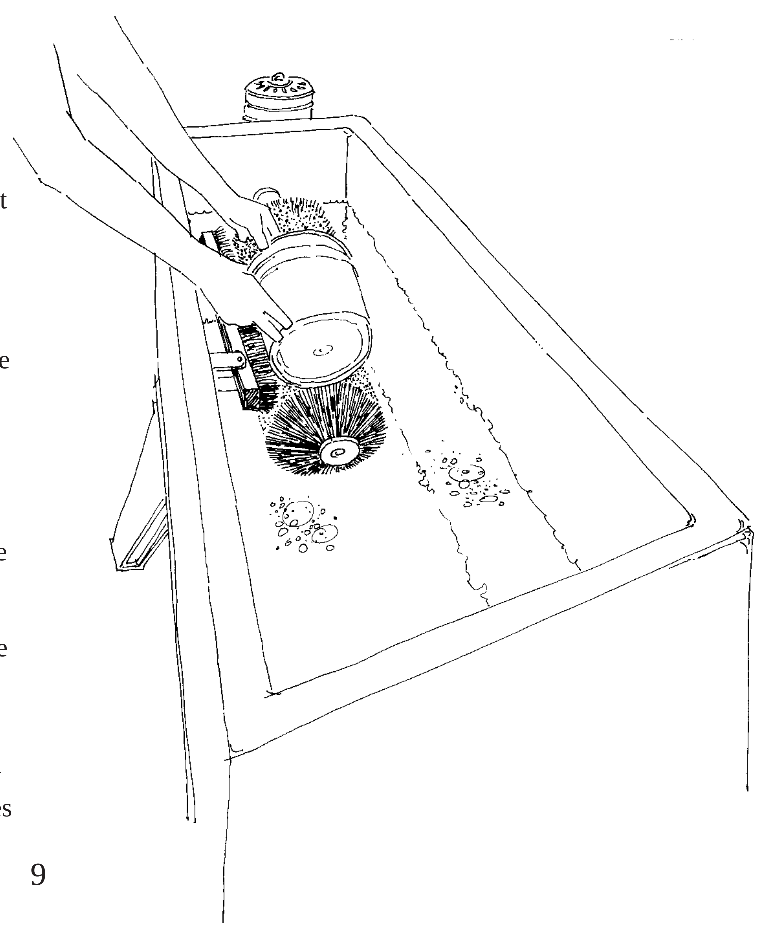


Figure 10. Brush Detail.



single plant-row wide by a single plant in length before an aisle, for that may be inefficient space utilization. It does illustrate the interrelationship between site design and transport labor activities.

Figure 11 illustrates a transport system designed for a crop to be dried which is “clear cut,” that is, it is harvested at the same time. A three-sided platform is mounted on the three-point hitch of a tractor. The crop is cut and placed directly into the bin with the tractor being backed down the bed as the harvest progresses. The harvest worker does not carry the cut stems anywhere, but merely turns around to place the crop into the bin. Only large quantities of the harvested crop at a time are moved any distance.

Figure 11. A Dried Flower Transport System for a “Clear-Cut” Crop.

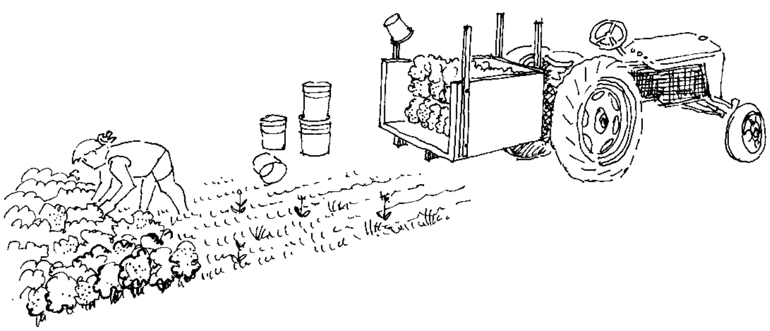


Figure 12 A Transport System.

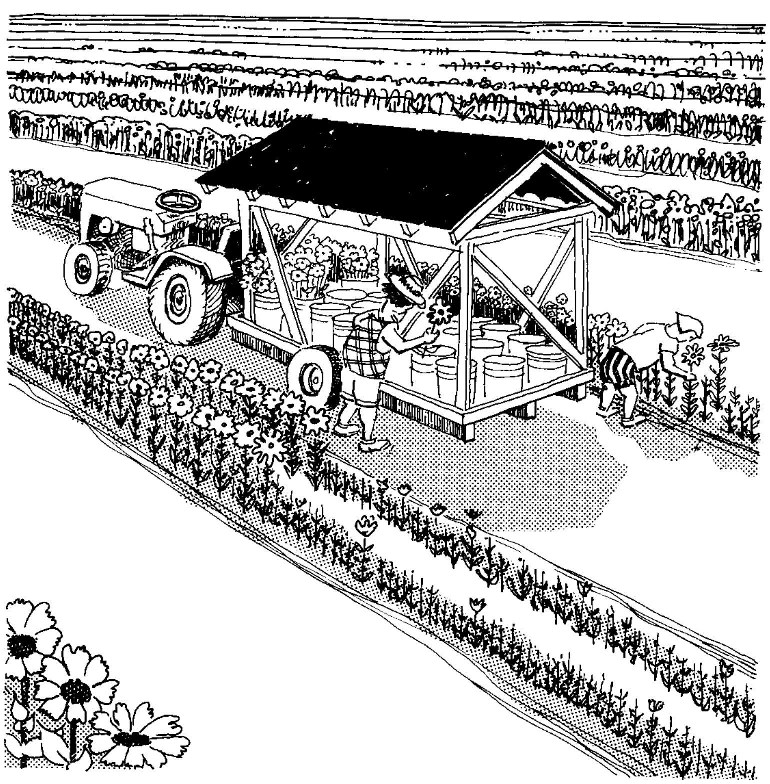


Figure 12 is the same figure used earlier as an example of a covered harvest trailer. It illustrates an integrated system combining several subsystems into a single piece of equipment:

*It transports the harvest containers and preservative solution to the production area.

*The covered trailer provides shade (a cooler environment) for the harvested flowers.

*It serves as a staging area for gathering a large number of flowers before transport to a handling/storage facility.

*It eliminates the need for harvest workers to walk carrying small bunches of flowers and allows for bed length to be increased reducing the need for cross aisles.

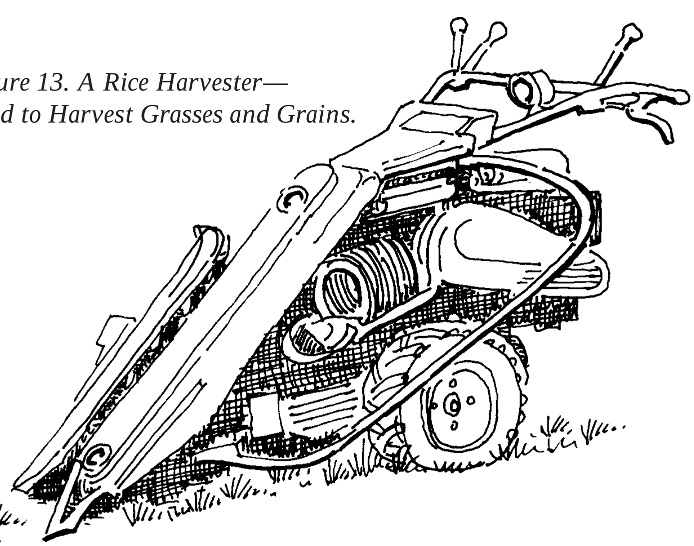
*It allows the workers to hold fewer stems in their arms at a time, thereby, increasing cutting efficiency.

A Harvest System

The following series of figures illustrate an excellent example of an integrated system for the harvest of grass and grain crops to be sold as dried decorative materials. The system was designed and developed by John Hurd of Avatar’s World in Edgerton, Wisconsin, who says it actually is a modified tobacco harvest system. Watching this system in operation impresses one with how simple the process and equipment is. It is even more impressive, when one observes how much work is done, with minimal labor, in a very short period of time.

A piece of equipment designed to harvest rice is used to harvest the crop (Figure 13). It operates similar to a sickle-bar mower, clear cutting the crop just an inch or two above the ground surface. A series of fingers moves the cut stems up a slot to a point where they are gathered into a bundle, tied and then ejected from the harvester (Figure 14). The machine can be set to tie different size

Figure 13. A Rice Harvester— Used to Harvest Grasses and Grains.



bundles depending on the desired dry weight of the product. A three-legged saw horse (Figure 15) with a metal bracket (rectangular sleeve) on the end holds a wood lath suspended parallel to and above the ground. Harvested and tied bundles are spread out, split from the center, and placed hanging by the bundle tie over the lath. Four bundles are hung on each lath. The lathed bundles are then stacked in the field (Figure 16).

The laths are then picked up and placed onto a specially designed harvest trailer (Figure 17). The trailer is built with two rails spaced apart so the ends of each lath will rest on them. The bundles then hang suspended from the lath between the rails. Loading the trailer is accomplished by walking between the rails and working from the back forward. The use of the laths allows four bundles to be moved at a time. The trailer is moved from pile to pile collecting the lathed bundles. No product is moved by walking any but the shortest distance.

The loaded harvest trailer is then pulled into the drying barn where the product is hung to dry (Figure 18). Notice the openings in the side of the barn. They are hinged

Figure 14. Harvesting and Tying Into Bundles.

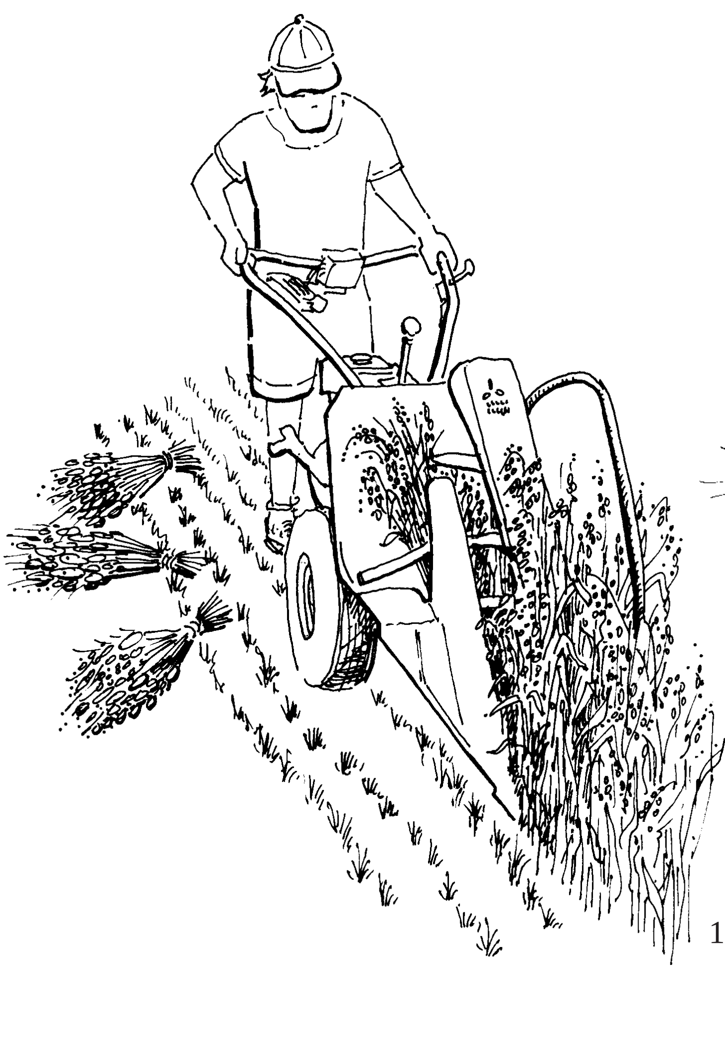


Figure 15. Lath Holder.

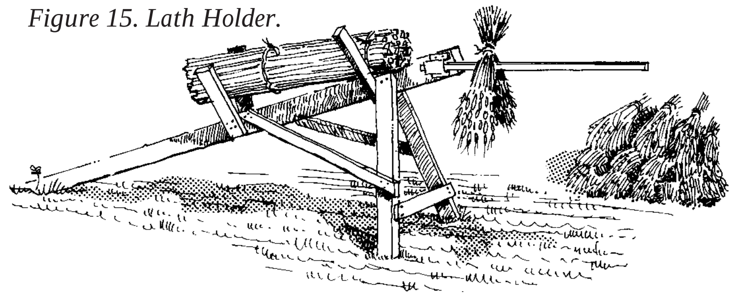


Figure 16. Lathed Bundles.

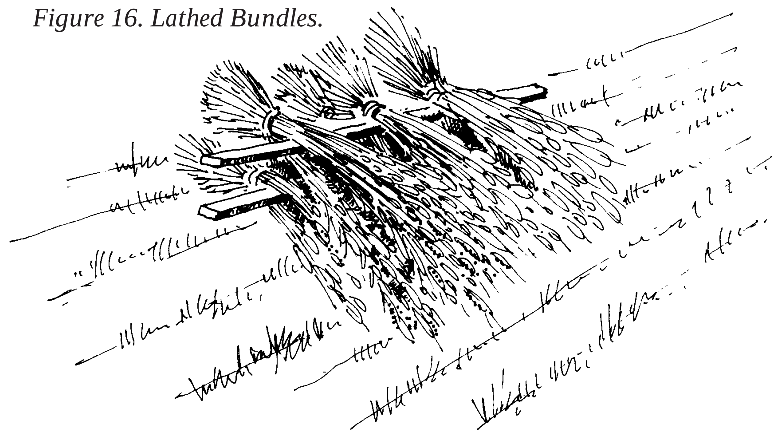


Figure 17. Harvest Trailer.

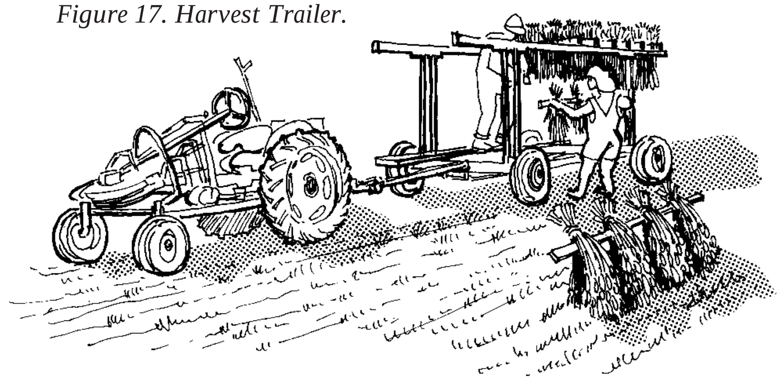
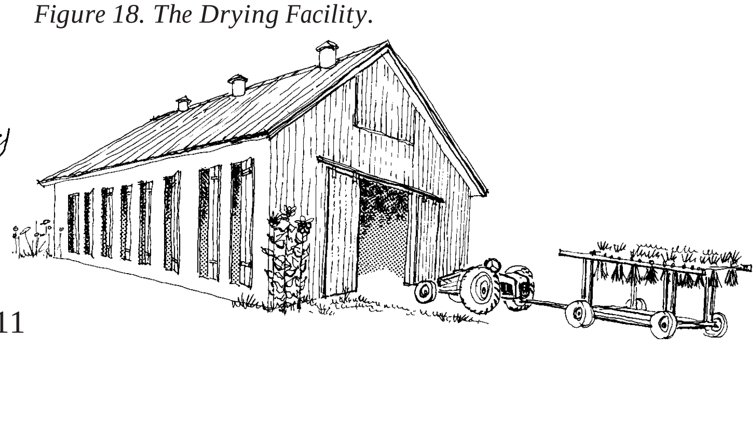


Figure 18. The Drying Facility.



panels, which when left open, allow for natural ventilation of the barn to aid in the drying process. The barn was originally a tobacco drying barn adapted for drying decorative plant materials.

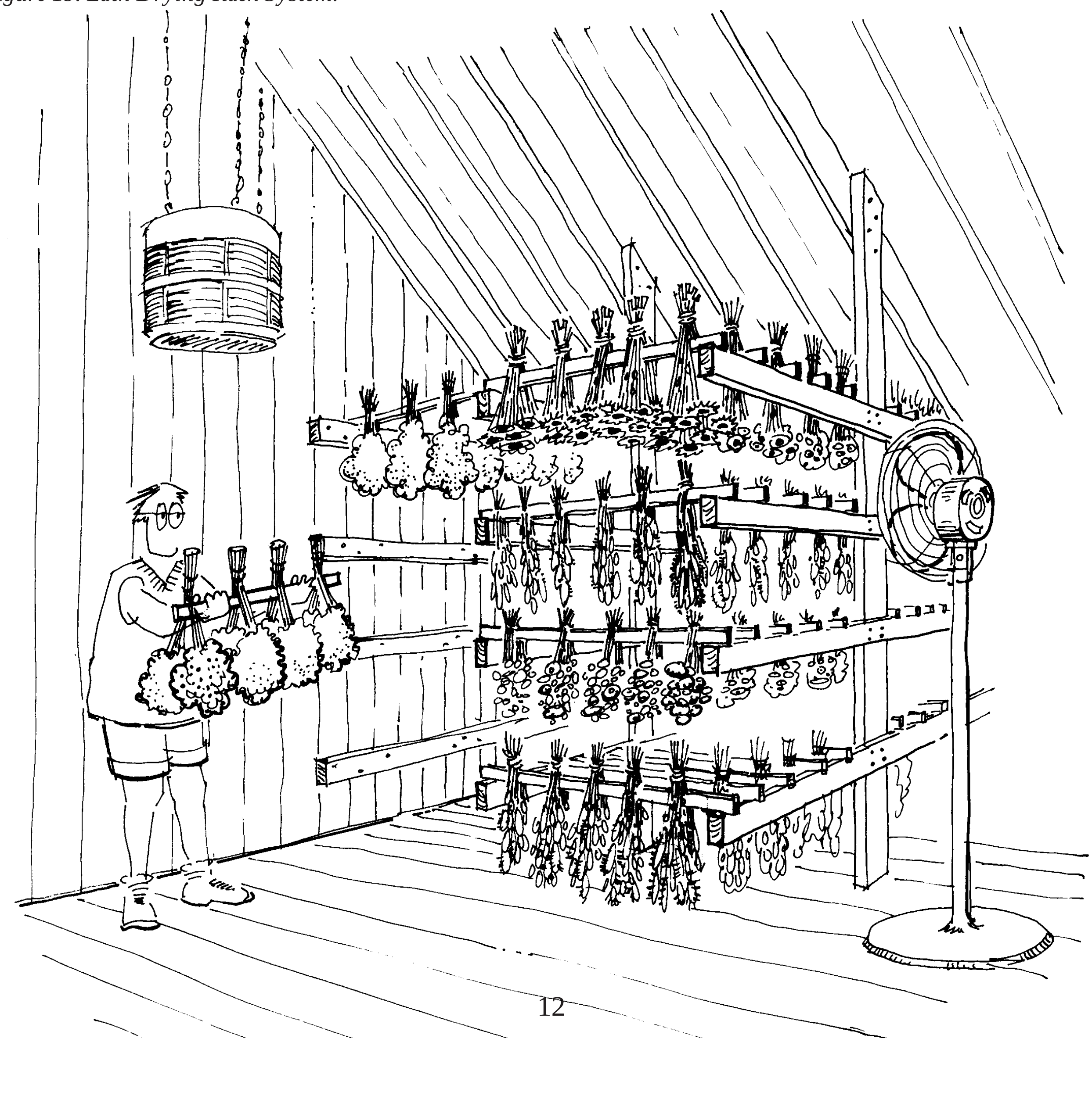
Figure 19 illustrates a lath drying rack system in the attic of a barn. It is a series of parallel rails which support the ends of laths, which in turn support bunches of plant materials. The vertical distance between rails is set to accommodate the stem length of the plants being hung to dry. The lath system facilitates product movement into, and out of, the drying area. Bunch spacing for proper drying is done one time, out in the field. This spacing is then maintained throughout the transport system.

Harvest systems have a great impact on product quality and cost of labor. They must be designed to maintain quality of the plant stem and flower, while controlling the cost of the labor to perform the harvest activities. Equipment, materials, and labor must be integrated into an effective system.

Post-Harvest

After flowers have been transported from the field to the storage/packing facility, careful handling to prevent damage and rapid decline is important. Bruising and breaking flowers destroys their aesthetic and economic value. Wounded plant tissue increases the production of ethylene gas, a natural plant growth hormone, accelerating maturation of flowers and greatly shortening vaselife.

Figure 19. Lath Drying Rack System.



Ethylene

Ethylene is produced by old flowers, decaying plant material, and ripening fruit. Controlling your inventory of flowers, using a first in–first out system and discarding flowers past their prime will aid in reducing ethylene damage to your fresh flower products. Good sanitation measures, removing all plant residues from storage areas and not placing any fruit or fruit-type vegetables near stored flowers, will reduce the potential for ethylene damage.

Ethylene is produced by the combustion of gasoline and propane and as a byproduct of welding. Do not operate tractors, trucks, or any engine within the storage/handling area or near air vents which provide ventilation for the facility. Do not share building space with maintenance activities.

Ethylene is also produced naturally in flowers. It is involved in the maturation of flowers. Reducing the level of ethylene present in a flower will extend it's vaselife. Some species are particularly sensitive to ethylene and need to be protected from its effects. Silver thiosulfate (STS) is commonly used to reduce the effects of ethylene on some species of fresh cut flowers. In some ethylene sensitive species, STS may increase vaselife; improve the percentage of buds which fully open; or help inhibit the premature shattering of florets. Table 2 lists species of flowers which are particularly sensitive to ethylene.

Table 2.

Flower Species Particularly Sensitive to Ethylene.

Achillea	Daucus	Lysimachia
Agapanthus	Delphinium	Phlox
Allium	Dicentra	Penstemon
Alstroemeria	Eremurus	Physostegia
Antirrhinum	Freesia	Ranunculus
Aquilegia	Gladiolus	Scabiosa
Astilbe	Godetia	Solidago
Bouvardia	Gypsophila	Stock
Campanula	Lavatera	Sweet Pea
Carnation	Lily	Veronica
Centaurea	Limonium	

Two qualities of STS must be considered when designing a system to treat fresh flowers. STS is not a very stable compound. It has a shelf life, after which it should not be used. STS should be purchased in quantities which will be used within its projected shelf life. STS also has the potential to pollute groundwater and soil. Approved disposal systems must be followed. They can be purchased along with the STS solution from suppliers.

Fresh Flower Food

Cut stems should be placed into either water or a fresh flower food (floral preservative solution). The typical fresh flower food contains water; a simple sugar, that serves as a food source; a chemical to prevent or retard the growth of microorganisms that can plug the conductive tissue; and an ingredient to acidify the water, typically citric acid.

The quality of your water can influence the effectiveness of the fresh flower food solution on prolonging flower appearance. Each of the commercially prepared fresh flower food solutions may react differently with any calcium, magnesium or other salt naturally occurring in your water. Many community water systems routinely add fluorine or chlorine to the water. These added chemicals may react differently with each manufacturers fresh flower food preparation. The alkalinity of the water will affect the ability of the acidifying agent to lower the pH of the water to desired levels. The water you will use to make the solutions should be analyzed for total dissolved salts, content of individual salts, pH and alkalinity. Ideally, the final food solution should have a pH in the range of 3.0 to 4.5.

When a flowering stem is cut from the plant, it is severed from its food supply. The food source must be replaced. Simple sugars are used as the source of nutrition for fresh cut flowers. They provide the energy to complete flower development, open buds and maintain color. Fresh flower food solutions used to maintain flowers typically contain 0.5 to 1 percent sugar. Food solutions used as pulse treatments to encourage a greater number of buds to open on flowers, like gladiolus, may contain up to 20 percent sugar. It should be noted that flowering stems are placed in these high concentration solutions for only relatively short periods of time. The solution is "pulsed" in and the stem removed to water or a low concentration, maintenance solution, of flower food. Not all flowering species benefit from sugar in the solution (gerbera, asters), and may respond with shortened vase life.

Each grower should trial several commercial fresh flower food solutions with their water and product mix of flowering species. Purchase a variety of food products, mix according to directions, and place three to five vases of flowers containing each solution in a well-lighted room at a constant temperature. Also fill some vases with tap water to use as a reference to test whether or not the food solutions are an improvement. Record vase life, percentage of buds opening and note changes in color of flowers and foliage. Repeat the test for each of the flowering species that you grow. Choose the solution that performs best for the greatest number of species within your product mix. An accurate measurement of the recommended concentration of fresh flower food is important. Too much or too little of any ingredient in the solution can seriously affect flower quality. A complete, uniform mixing of the food solution is essential to consistent, satisfactory results. Fresh flower foods (preservatives) are available from several companies.

Recutting Stems

Whenever practical, all stems should be recut underwater. Cutting stem ends underwater prevents air bubbles from entering the stem and blocking the conductive tissue. One to 3 inches of the stem should be removed to be assured of removing any air bubbles present. Recutting flowers underwater will remove potential air blockage. However, you may find some flowers will hydrate properly when cut in air. Equipment can be made to recut large volumes of flowers underwater without unreasonably increasing labor. Many small growers may find the practice of recutting underwater to require a greater use of labor than they can justify. Caution should be used in making this determination. Is the practice truly not cost effective or is the decision being made inappropriately, on a nuisance factor? Test your recutting methods periodically by comparing vase life of your flowers to the alternative recutting method.

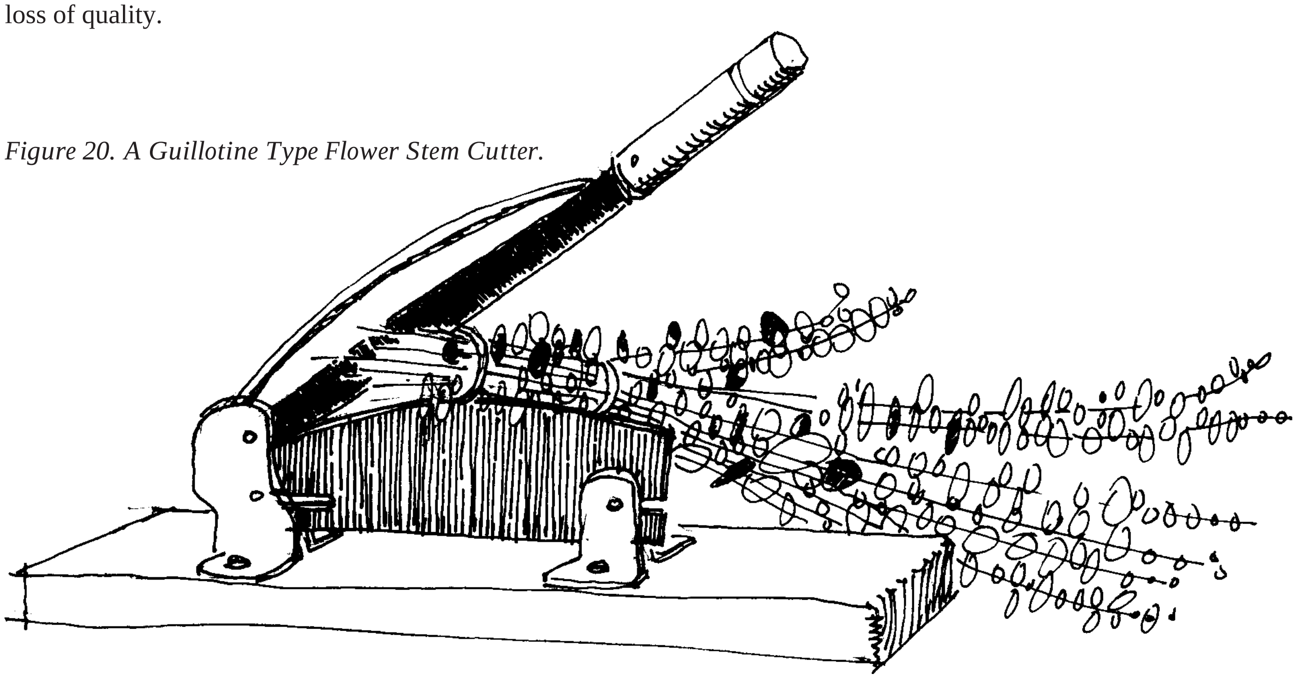
Figure 20 illustrates a commonly used "guillotine cutter." After bunching, the bottom 1 to 3 inches of the stem ends are cut off to remove any stem blockage and to even-up the ends to assure all stems an opportunity drink. Uneven ends may result in the shorter stems being suspended above the solution and becoming wilted, with loss of quality.

Bunching and Sleeving

Stems should be graded and tied into uniform bunches. Bunch size should be determined by the standards of the marketplace. Either a specific number of stems or a standardized weight per bunch is used to determine bunch size. A standard bunch of many flowers (roses, carnations) consists of 25 stems. Other flowering species (liatris, dutch iris, peony) are sold as 10 stems to the bunch. Gladiolus are typically sold in 10-stem bunches in the wholesale trade, but are often sold in five-stem bunches at farmers markets. Growers selling in small or local markets may bunch according to whatever standards suit their particular market situation. Growers wishing to sell in regional or national wholesale markets will be required to grade and bunch according to industry standards. Many leaders within the industry would like to see a standardized bunch of flowers become universally defined to consist of 10 stems.

When tying flowering stems into a bunch, place the tie 3 to 4 inches up from the stem ends to allow room for recutting without retying the bunch. After tying, the bunch may be placed into a funnel-shaped sleeve to protect the flowers and stems from breakage during handling, storage, or packing activities. Figure 21 shows a bunch of flowers being placed into a plastic sleeve. The easel type stand with backplate allows for effective bunch placement into the sleeve with reduced breakage. A simple, low-cost, bunch sleeving system.

Figure 20. A Guillotine Type Flower Stem Cutter.



Storage Containers

The same inventory of containers used for harvesting flowers can be used for storing the graded and sleeved bunches. The containers should be cleaned before use. Do not use the same container that was used to transport the flowers from the field before it has been recleaned.

Solution Depth

The fresh flower food solution in the storage container should be deep enough to cover the ends of all stems with sufficient margin for error and to allow for uptake without having to constantly refill to avoid stems sucking air. This is not to say the container should be filled to any great depth. Excess solution is wasteful and costly in materials and labor, as it should not be reused. The deeper the solution, the greater the potential amount of dirt and debris which may wash off submerged stems and leaves. Rinsing stems and leaves under tap water before recutting and placing into containers with solution will aid in keeping storage solutions clean. Leaves should be removed from the stems up to a point just above where they won’t become submerged in the solution. A no-decision system should be developed for placing the correct amount of fresh food solution into the storage buckets. A fill-to line marked on the inside of all buckets is part of such a system.

Summary

Postharvest systems should be designed to provide proper treatment of each plant species to prolong quality of the flowering stem and to make the most effective use of labor possible. Often, growers concentrate on providing proper postharvest handling and storage conditions to their floral products and ignore the labor activities required to provide those conditions.

Chemicals for the STS and fresh flower food solutions must be unloaded from delivery trucks; transported to a storage area; transported from storage to the area where they are mixed with water for use; proper amounts measured and completely dissolved; solutions placed into buckets to proper depth; flowers graded, bunched and sleeved; bunches placed into buckets of solution, and buckets of flowers transported to refrigerated storage.

The harvest process flow charts on pages 14 and 15 display labor activities involved from stem selection to shipping. Note the number of times the product is transported. Nothing should move far, move in the largest quantities possible, and pay close attention to ease of loading and unloading, are the tenets of transport system design.

Effective labor systems and subsystems must be developed, implemented, and monitored for each harvest activity. Too frequently, excessive labor expense is incurred in these postharvest activities. Growers, as plant people, tend to concentrate on growing activities and lose interest in effectively managing other areas of the business. Remember, one-half or more of total labor is used in the Harvest portion of the Stevens Labor Model. Don’t loose profit by not managing labor at the end of the production process.

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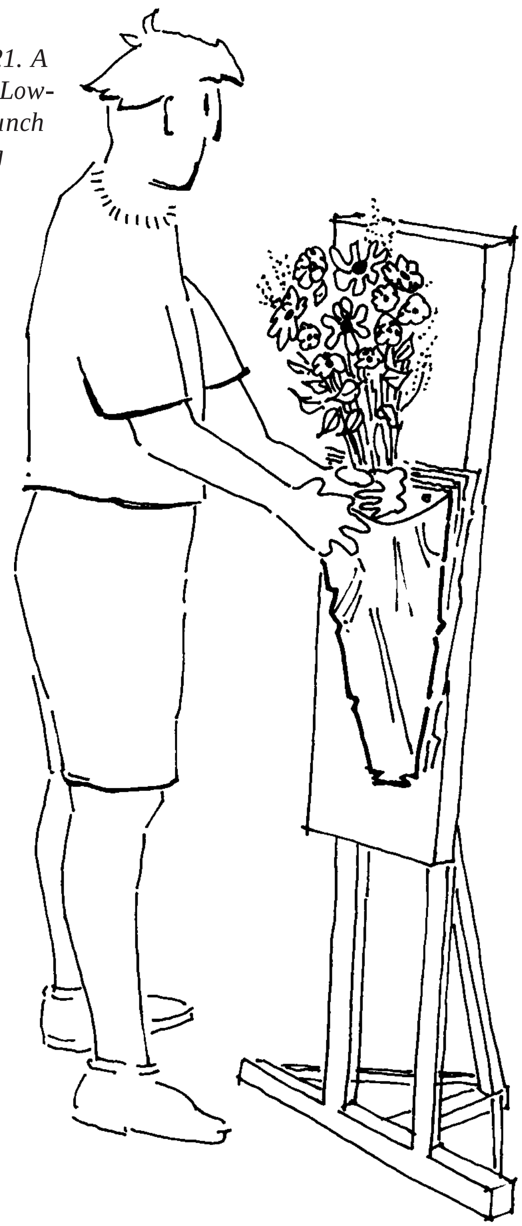
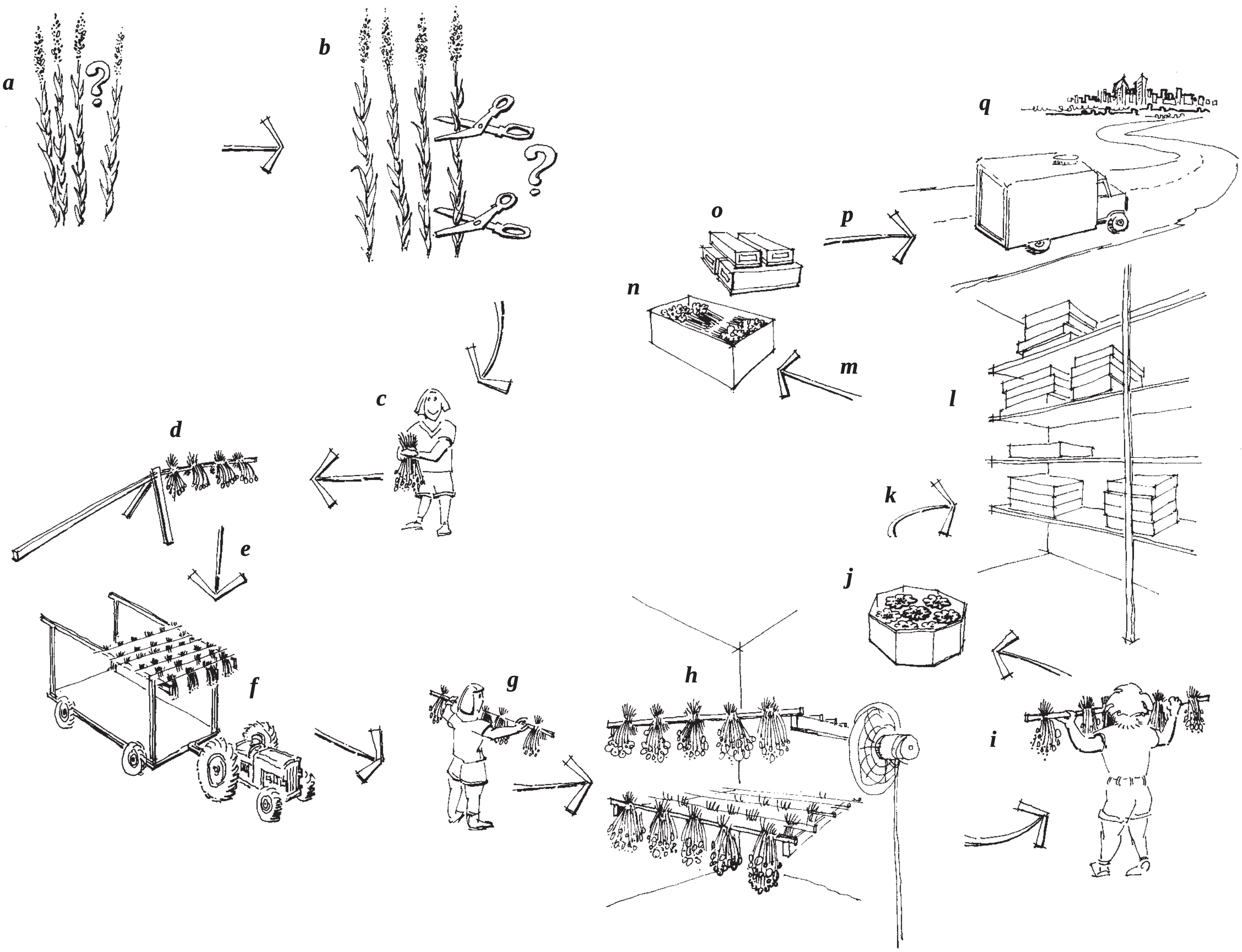
Figure 21. A Simple, Low-Cost, Bunch Sleeving System.

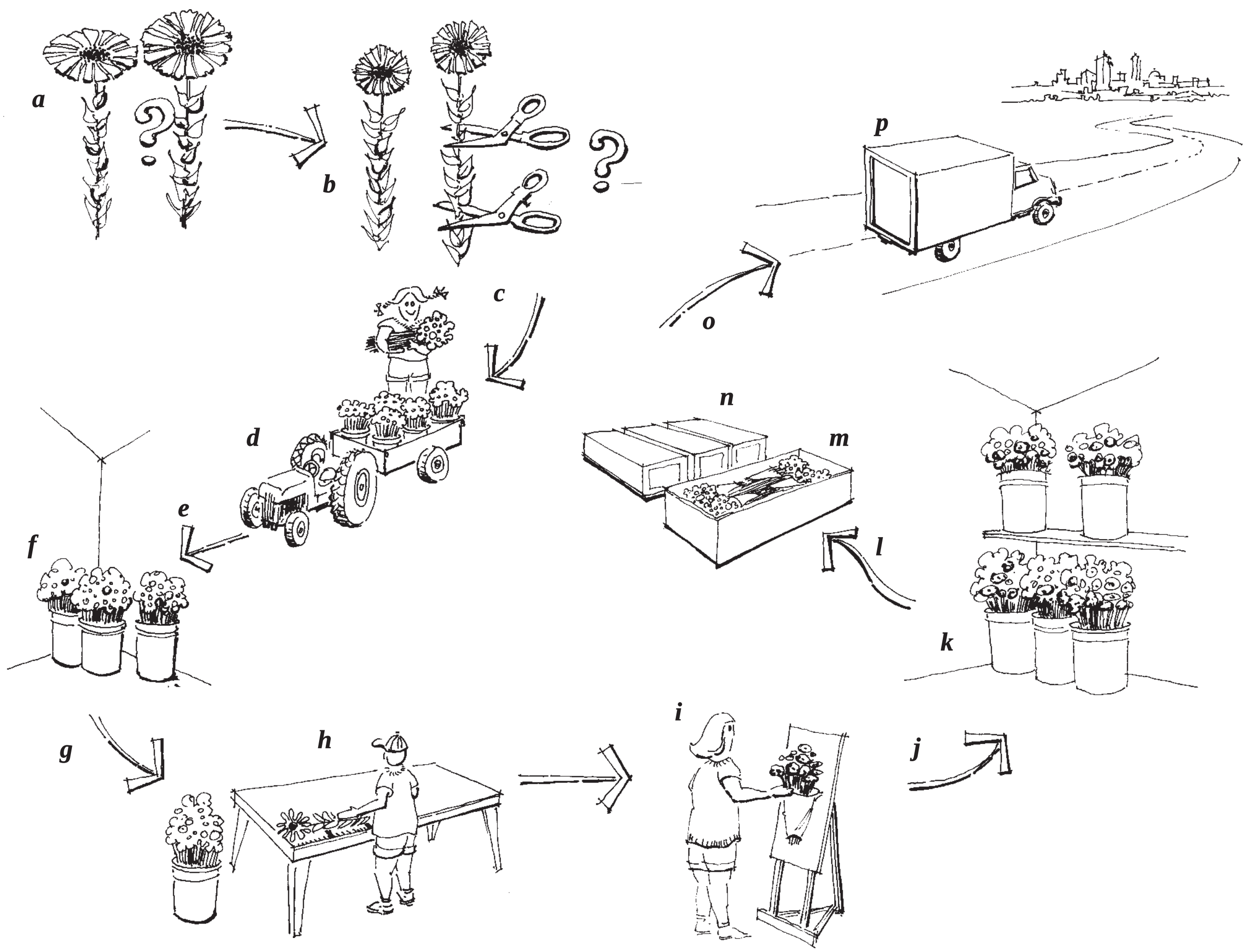


Harvest Process Flow Chart—Dried Flowers.



a.	*select*	*g.*	*transport*	*m.*	*transport*
b.	*cut*	*h.*	*dry*	*n.*	*box*
c.	*transport*	*i.*	*transport*	*o.*	*stage*
d.	*lath*	*j.*	*grading and packaging*	*p.*	*load*
e.	*load*	*k.*	*transport*	*q.*	*ship*
f.	*transport*	*l.*	*warehouse*		

Harvest Process Flow Chart—Fresh Cut Flowers.



a.	*select*	*g.*	*transport*	*m.*	*box*
b.	*cut*	*h.*	*grading*	*n.*	*stage*
c.	*load*	*i.*	*sleeve*	*o.*	*load*
d.	*transport*	*j.*	*transport*	*p.*	*ship*
e.	*unload*	*k.*	*storage*		
f.	*storage*	*l.*	*transport*		

Notes

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