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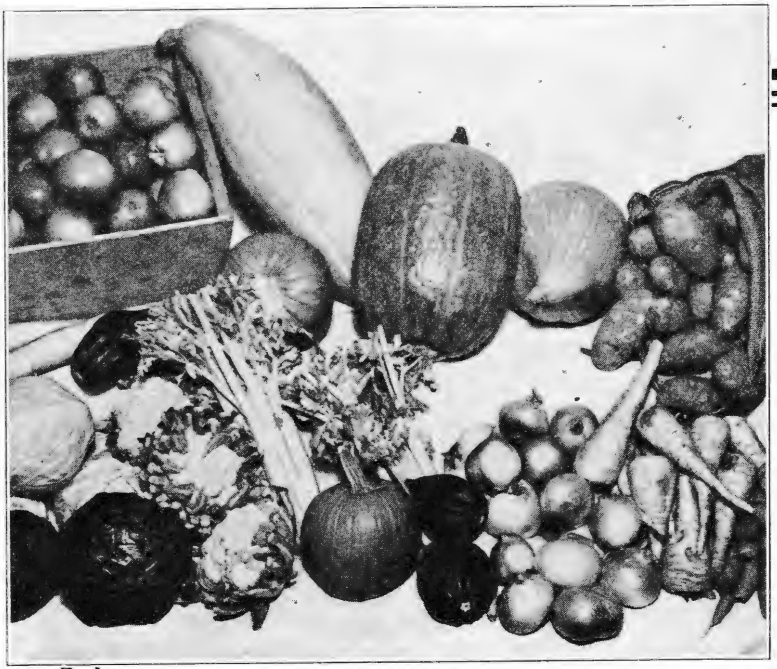

HOME FRUIT AND VEGETABLE STORAGE

EXTENSION SERVICE
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HOME FRUIT AND VEGETABLE STORAGE

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Storing is a quick, cheap, and easy means of preserving fruits and vegetables. A supply of fruits and vegetables in a home storage enables a family to use these products during the winter when they are often omitted from the family diet. Many rural families produce most of their fruits and vegetables, while others purchase many of them. If the needed winter supply can be purchased during the harvest period and placed into the home storage, an appreciable saving may be made. An adequate home fruit and vegetable storage is a practical and economical investment for each farm home.

TYPES OF STORAGE UNITS

Because of the great climatic and soil variation within the state it is necessary to construct storages according to local conditions. Many families are not financially able to build storage facilities as elaborate as is desired. The crops to be stored must also be considered in selecting the kind of storage to be built. There are several types of fruit and vegtable storage units varying in cost of construction, so that every farm may be equipped with suitable storing facilities. Among these, the **above-ground,** the **outside cellar, the basement,** and **the pit** are the principal types.

Above Ground Storage

The above-ground storage is suitable in conditions under which other types are impractical. Where the water table is near the surface or where the water in the soil arises near the surface for a short time, an under-ground storage is out of the question. In an under-ground storage the warm soil being

* The author wishes to express his appreciation to James Bassett who assisted in constructing the plans of Figures 1, 2, and 3.

in contact with a wall not too well insulated tends to heat the air taken into the storage during the cool fall nights. Because of this fact, controlling temperature is simpler in above-ground than in most under-ground storages. Being on the ground level the above-ground storage is more accessible and easier to keep clean than an under-ground storage. The initial construction cost is greater for an above-ground than for an under-ground storage. It appears that the advantages of an above-ground storage offset the added cost of construction.

Floor. Under some conditions an insulated floor is desirable in order that temperature and humidity may be controlled. A completely enclosed air space between the floor and the soil beneath will aid in insulating the floor by eliminating the air currents beneath the floor. A satisfactory floor is suggested in figure 2. Where humidity is not apt to be excessive and where temperature is not hard to control, a dirt floor may be satisfactory. If a dirt floor is to be used, great care should be taken that the storage be located in a well-drained spot and that the floor level be eight to 12 inches above the outside ground level. If the crops in the storage are to be piled more than three feet deep a false floor constructed of 1x4 boards on 2x4 bases with half-inch cracks between the 1x4 boards, should be placed on the main floor.

Wall. It is essential that the walls and ceiling be well insulated in order that the temperature and humidity within the storage may be controlled. In constructing the walls it is necessary to provide for using sufficient available materials. A double wall with a 6-inch space for insulating material, as shown in figure 3, makes a continuous layer of good insulation. A wall with a double row of studding, as shown in figure 3, is more impervious than one of the usual type in which the studdings extend through the thickness of the wall. The added cost appears to be more than over balanced by improved insulation. Waterproof building paper placed between the outside siding and a layer of shiplap siding next to the

studding is desirable. Newspapers placed inside of the building paper may be used with building paper to improve the imperviousness of the wall. Waterproof material aids in keeping the filling dry. **This is very essential.** The inside part of the wall is similar to the outside part except that the inside studdings stand flatside next to the shiplap.

Entrance. Opening and closing the door often causes considerable fluctuation in temperature within the storage. This is particularly true if there is just a single door. A passage-way or separate room partitioned off from the main storage room will greatly reduce temperature fluctuations. This entrance room may be used for storing canned fruits and handling eggs as indicated in figure 1. If both doors are well insulated the temperature in this entrance compartment will seldom get too cold for canned goods.

Arrangement within storage. Shelving and partitioning within the storage should be constructd to make products very accessible. Bin partitions should be made, so that it will not be necessary to pile the crops too deep. A space for sorting and receiving the vegetables as they are hauled from the field to storage as indicated in Fig. 1 will aid greatly in keeping the storage clean. This space is also a convenient place for grading products as they are brought into the storage. All partitions and shelves should be removable to facilitate cleaning and thorough airing. The partition boards may thus be removed and exposed to sun for sterilization at times when the storage is not in use.

Outside Cellar

Outside cellars are often used for fruit and vegetable storage. They may be constructed at a low cash expenditure. It is very necessary that they be located in a well-drained spot and well supported to prevent caving in. The walls may be concrete or boarded up with heavy plank, depending upon the permanence desired and the possible expenditure. When constructed with walls of this kind the insulation cannot be

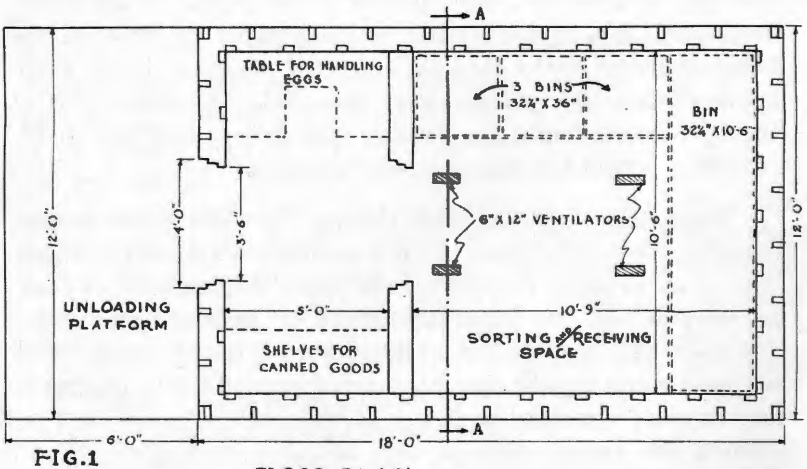

FIG.1 FLOOR PLAN

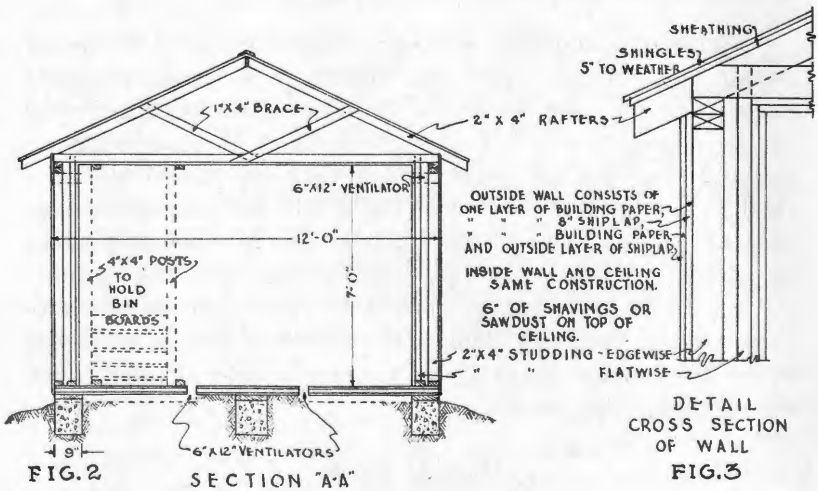

FIG.2 SECTION "A-A"

DETAIL CROSS SECTION OF WALL FIG.3

as good as that in the above ground storage described previously, and as a result it cannot be cooled down as quickly in the fall. When the soil has once cooled down in the fall the temperature within the storage can be well regulated during the winter. In areas where the summer nights are cool it should be possible to keep the summer temperature within the storage relatively low by manipulating the ventilators properly.

The cellar should be dug deep enough, so that it may be covered with two feet of soil. If dug deep enough the top surface may be even with the outside surface of the ground making the cellar inconspicuous. This, of course, will involve extra digging. To those who think an arch-topped storage, as commonly seen on farmsteads, detracts from the appearance of the home grounds, this may be desired. The additional depth should not greatly complicate ventilation or controlling temperature although it will cause additional inconvenience.

Pit Storage

Apples, beets, carrots, potatoes, cabbage, mangels, turnips, parsnips, and salsify may be stored in outside pits. (Fig. 4.) Pits should be used only when the other methods of storage are not available. It is essential that the pit be located on a well-drained spot. It may be constructed by digging a trench 1 to 3 feet deep, 3 feet wide and as long as needed. A ventilating shaft extending from near the floor through the stored products to 2 feet above the cover is desired. The shaft should be at least 6 to 8 inches in diameter and perforated with holes as indicated in figure 4 in order that as the warm

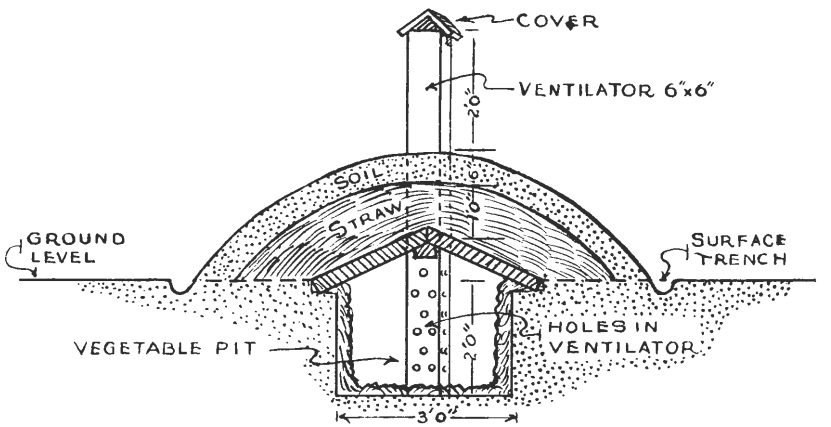

FIG. 4

air rises in the storage it can enter the shaft and pass out. A top to exclude rain and snow is desirable. One ventilator for each 8 feet of storage pit is sufficient. A roof framework to support the cover as indicated in figure 4 will prevent the straw and soil from falling into the pit as the products are removed. In early fall after the products have been placed into the pit a 10-inch layer of straw, or hay or a 6-inch layer of strawy manure may be placed over the pit. Peat may also be used for covering. As the weather turns cold, layers of soil should be applied, the amount depending upon the temperature.

It is difficult to ventilate a pit storage and subsequently the temperature and humidity within the storage are not easily regulated. Neither is it easy to remove products from the pit. For these reasons this type of storage is less desirable than most other types.

Basement Storage

A part of the house basement is commonly used for storing fruits and vegetables. The portion near the furnace is too warm for storing most crops. This is particularly true of root crops. By partitioning off that portion farthest from the furnace a fairly satisfactory fruit and vegetable storage may be constructed.

It is very important that the storage room be well insulated. Too much emphasis cannot be placed upon this point. Walls constructed on the order of those shown in figure 3 are satisfactory. The insulating values of concrete, hollow tile, and other materials are given in the table on page 10. It will probably be necessary to add insulating materials to the original partition wall, giving special consideration to the upper part through which the joists pass if they are continuous from one room to the other.

The storage room should have at least one and preferably two windows for ventilation. Proper attention is seldom given to ventilating the basement storage. When there are two windows one may be used for a cold-air intake and the

other for an outlet. The cold-air shaft should extend from the cold air window to within 6 inches of the floor. If there is only one window it may be divided equally for an outlet and an inlet, placing the inlet at the base and the outlet at the top. If separate windows are used for inlet and outlet, the upper one should be used for the outlet and the lower one for the inlet. Because the warm air rises, the outlet should be placed as near the ceiling as possible.

Properly constructed, the basement storage should be as satisfactory as any other type of underground storage.

VENTILATION

In common storages a good means of ventilation is very essential, in order to maintain desired temperatures. The low temperature within the storage is reached by taking in cool air and liberating warm air. The cool air after entering the storage is heated by the respiration heat given off by the stored products and by the warm products being brought into the storage. The air thus heated being lighter than cool air, rises. With well-constructed intakes near the floor and exits at the ceiling as indicated in the drawing a supply of cool air may be maintained by manipulating the vents properly. Approximately 60 to 80 square inches of flue space should be allowed for each 1,000 cubic feet of storage space. The flue should be at least six inches by 12 inches. During the cool fall nights the ventilators should be open and in the day time they should be closed. In extremely cold areas it may be necessary to place a lantern or small stove in the storage for a few days during the winter and to stuff straw or burlap in the vent in order to prevent freezing. The ventilator so closed, should be opened as soon as the extreme weather ceases in order that the air within the storage may be kept fresh. Moisture collecting on the walls and ceiling is probably due to poor ventilation.

INSULATION

Constant fluctuating conditions prevent satisfactory storage. Adequate insulation of the storage room will do

much toward minimizing temperature and humidity changes. Suitable insulating materials can often be obtained at very low costs. Sawdust, shavings, newspapers and other by-pro-

INSULATING VALUES OF MATERIALS

Material	"Internal resistivity" based on sample 1 foot square, 1 inch thick.	
Air space, no radiation or convection (ideal condition, not found in ordinary construction)	5.70	excellent
Flexible (grass, hair, wood and similar fiber), weighing from 2 to 13 lb. per cu. ft.	3.70	good
Fluffy rock, slag or other mineral fiber, weighing about 12 lb. per cu. ft.	3.33	good
Nonstructural (cork board without artificial binder, or "low-density" fiber boards) weighing about 10 lb. per cu. ft.	3.33	good
Cork particles, 3/16 inch in diameter, weighing about 10.7 lb. per cu. ft.	3.22	good
Semi-rigid (grass, flax, and similar fiber), weighing about 13 lb. per cu. ft.	3.12	good
Structural (bagasse, cornstalk, straw, wood, and similar fiber), weighing from 15 to 19 lb. per cu. ft.	3.03	good
Sawdust, dry, various kinds, weighing about 12 lb. per cu. ft.	2.44	fair
Shavings, dry from planer, weighing about 9 lb. per cu. ft.	2.44	fair
Dry fluffy gypsum, weighing about 24 lb. per cu. ft.	2.08	fair
Dry cellular gypsum, weighing about 18 lb. per cu. ft.	1.70	fair
Plaster, gypsum	.30	poor
Brick, common	.20	poor
Cinder concrete, weighing about 110 lb. per cu. ft.	.19	poor
Concrete weighing about 150 lb. per cu. ft.	.084	poor
Concrete weighing about 150 lb. per cu. ft., 8 inches thick	.672	poor
Hollow tile, horizontal flues, 4 inches thick	1.00	poor
Hollow tile, horizontal flues, 6 inches thick	1.56	poor
Hollow tile, horizontal flues, 8 inches thick	1.67	poor
Hollow tile, horizontal flues, 10 inches thick	1.73	poor
Hollow tile, horizontal flues, 12 inches thick	2.50	poor
Concrete block, 8 inches thick	1.00	poor
Concrete block, 12 inches thick	1.25	poor

ducts and natural insulators are often used. When these materials are used great care should be taken that they be perfectly dry when applied. The filling materials should be well-packed. They may be chemically treated to insure dryness. The efficiency of any insulating material is reduced by moisture. Care must also be taken against rodents working in the materials and thus making them ineffective as insulators. There are also many good commercial products on the market at the present time.

The efficiency of a storage depends upon the insulating values of the materials used. The insulating value of some materials commonly used are listed in the table on page 10. These materials are listed in the order of their insulating value as determined by Backstrom.* It is evident from this table that ground cork is more efficient than sawdust and that an 8-inch concrete wall is less efficient than an 8-inch wall constructed of hollow tile.

CONDITION OF CROPS FOR STORAGE

Products for storage should be of good quality and free from disease, insect and mechanical injuries. Injuries allow decay organisms to enter. No crops should be placed in storage until they are clean and dry. Dryness in the case of root crops consists of freedom from apparent moisture on the outer surface. Some vegetables often become woody and lose flavor with age. Onions, squash, and pumpkins keep best when fully mature. Few vegetables and fruits withstand actual freezing. Apples should be very firm when placed in storage. It is well to select fall maturing varieties so that they are in prime condition when it is time to place them into storage.

STORAGE REQUIREMENTS OF CROPS

Fresh fruits and vegetables to be stored are living materials. When these living materials cease to be alive, decay

* The above table gives the insulating value of materials commonly used in constructing storage units. Except where a greater thickness is indicated the figure in the column denotes the insulating value of a volume of material, 1 foot square and 1 inch thick. Highest figures indicate greatest efficiency. Russel E. Backstrom, Insulation on the Farm, U. S. Department of Commerce, 1933.

sets in. If these living materials are to remain alive suitable conditions for carrying on life processes must be provided. Experienced investigators have determined the best temperatures for storing these crops. These temperatures are given with the respective crops. All fruits and vegetables do not require the same storage temperature. Humidity or air moisture requirements also vary with different crops, some requiring dry atmosphere and others keeping better if the air contains a fair amount of moisture. Excessive moisture in the storage favors decay.

Beets, carrots, parsnips, rutabagas, winter radishes, kohlrabi, turnips, and salsify should be topped just above the crown, without cutting the crown. A cool room, with temperature ranging from 32° to 40° F. seems most satisfactory for these crops. The humidity should be medium to high. Dry air causes shriveling.

Except in unusually moist areas as found in the western part of the state these crops may also be stored in large covered earthenware jars or metal cans. To prepare them for storage in this way the tops should be removed as described above. After the roots are clean and completely dry they are placed in the containers, which are then closed with a fairly tight lid.

Part of the parsnips may be dug in the fall and stored as other root crops in order that they be available when the ground is frozen in the winter. The parsnip rows in the garden may be mulched with leaves or straw to prevent freezing so they may be dug during the winter.

Potatoes. The best temperature for potatoes seems to be 40° to 50° F. Potatoes apparently do not require strong air circulation. Strong light should be excluded from the potato bins to prevent greening. If they are piled more than 3 feet deep a false wall may be provided to facilitate circulation. In large piles the heat given off by the potatoes in the center of the pile sometimes causes sprouting and decaying. This may be avoided by constructing a ventilating shaft

through the center of the pile. Potatoes nipped by frost should never be placed in storage.

Onions. Onions should be solid, thoroughly matured, cured, and dried before they are put into storage. Soft necks that have not been allowed to become dry often cause spoilage. The best temperature seems to be 32° to 34° F. They should not be piled more than 5 or 6 layers deep. Placing them in slatted crates will facilitate ventilation. They must be kept dry.

Celery. Celery may be stored in a cool room. The stalks with roots left attached, should be stood close together in a shallow box. As the stalks are placed in the box an inch or two of moist soil should be worked in around the base of the stalks. After all stalks are placed in the box and the tops have become thoroughly dry, a burlap or paper covering should be placed over the box to prevent drying. It probably will be necessary to moisten the soil occasionally, being careful not to wet the leaves.

Cabbage. Cabbage seems to keep best at 32° to 40° F. Because of the undesirable odor caused by cabbage it is not often stored in the basement. Only good solid heads should be stored. Before the cabbage is placed into storage the outside leaves should be removed and the head inverted for a period to drain out water adhering to the leaves. After removing the roots fairly close to the head it may be wrapped in paper and placed on the storage shelf. Cabbage may also be stored in a trench ten inches deep. The stalks may be pulled and inverted in the trench after possibly removing a few outer leaves. The heads may then be covered with straw and soil or soil alone leaving the roots protruding out of the ground.

Squash and pumpkins. These vegetables keep best at 40° to 50° F. This is considerably warmer than the best temperatures for most other vegetables. A shelf near the furnace is often very suitable. The air should be dry. It is highly important that all specimens for storage be mature.

They should be picked before severe frosts occur. It is not advisable to pile them more than one layer deep. Injuries from rough handling induce decay.

Tomatoes. Immature tomatoes may be stored by picking them and placing them in storage at 50° to 60° F. The fruit-bearing vines may also be pulled and hung up and the fruit picked as it ripens.

Peppers. Peppers may be stored by pulling the fruit-bearing plants and hanging them in a storage where the temperature is 40° to 50° F.

Beans and peas. These crops should be treated for weevils before storing. This may be done by heating the seed at from 120° to 145° F. for 5 to 6 hours or by storing the seed at 32° F. or lower. Carbon disulphide may also be used. This material is inflammable, necessitating extreme fire precaution. Treatment may be made by placing the seed in a tight container and pouring the liquid onto the seed at the rate of 1 ounce per bushel of seed and closing the container. It should be kept at 70° F. for 24 to 48 hours during treatment. Following treatment the seed should be kept in containers and placed in the regular storage place.

Another way to kill bean weevils and the prevention of their increase during the winter is to store the seeds in dry air-slaked lime, one pound for each two pounds of beans or for large quantities, one pound to four pounds of beans.

Pea weevils may be killed by suspending the seeds in a bag in cold water and heating it to 140° F., then pouring the peas out where they will dry quickly. Seeds may be heated dry at a temperature of 135° F. for 3 or 4 hours. All stages of the insect can be killed without injuring germination.

Popcorn. Popcorn should be kept in an outdoor storage. When stored in the house, it often becomes too dry to pop and if kept in the cellar it becomes too damp.

Apples and Pears. Apples and pears should be held at 32° to 40° F. The humidity should be high and the air circulation good. Apples are usually ready to pick when well colored and the green undercolor has turned lemon yellow. Apples for storage should be picked when very firm. If picked when over-ripe they do not keep well. Pears are picked when the leaf green color has turned to a light green. Both apples and pears are picked before reaching the eating stage. It is important that they be placed in storage immediately after picking. It is desirable to place them in boxes and crates, in order that they may be placed on and removed from shelves conveniently.

Herbs. Herbs grown for their foliage should be cut when they are in full growth, but before they become too woody. The plants may be cut near the ground, tied in bunches and hung in a cool, dry place for curing. When dried, the plants may be put in paper bags or in fruit jars to keep out dust. Placing them in tight jars retains the natural aroma. Herbs grown for seed should be allowed to ripen before harvesting.

CARE OF CROPS IN STORAGE

Considerable spoilage often results from allowing decaying specimens to remain with sound specimens. In order to avoid this the products should be examined frequently. It is usually worthwhile to sort such crops as potatoes and apples occasionally.

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