STORAGE

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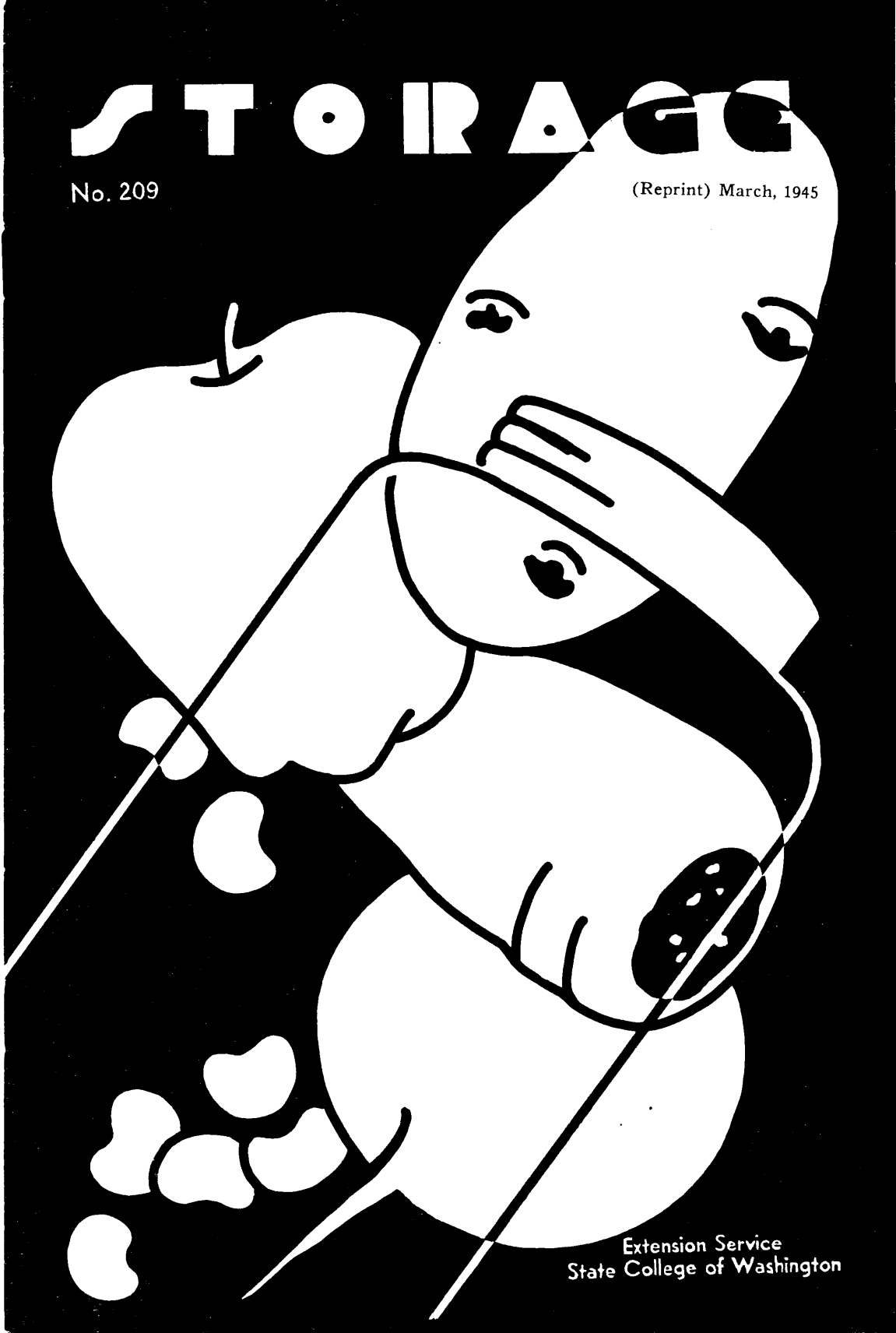

Extension Service
State College of Washington

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Home Fruit and Vegetable Storage

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Fruits and vegetables fresh from the garden are delicious. They are crisp and sweet; they have flavors all their own. When they are fresh, people eat them because they like them. Their health value, too, is well known. Fortunately, their deliciousness can be retained even in storage if a few storage principles are observed. Drawings and plans based upon sound storage principles as well as the principles themselves are described in this bulletin. It is hoped that both those interested in remodeling their present storage units and those interested in constructing new ones will find these suggestions helpful.

TEMPERATURE

Fresh fruits and vegetables placed in storage are alive. They carry on life processes. These processes take place faster in high temperatures than in low temperatures. The success with which fruits and vegetables may be stored, therefore, depends upon how easily a low temperature within the storage unit can be maintained. The lower the temperature, as long as it does not go below freezing, the better, although it is not practical to attempt to hold it much lower than about 40 degrees. The preferred temperatures for storing fruits and vegetables are given in table 1.

The temperature is lowered by cold air coming in through openings provided for this purpose. These openings, called ventilators, are described later. In some storage units they can be opened and closed according to the outdoor temperature but in others they are left open until cold weather arrives when they are closed permanently .

In storage units with ventilators that can be closed, the temperature is lowered in the fall by opening the ventilators in the evening and closing them in the morning. If the door leads directly out of doors it, too, may be left open at night. Keeping the room open at night and closed in the daytime aids in keeping the storage temperature down when the midday outdoor temperature is high.

[1] The authors wish to acknowledge the able assistance of C. L. Vincent, Agricultural Experiment Station, Pullman; W. J. Clore, Irrigation Branch Station, Prosser; C. D. Schwartze and R. T. Randle, Western Washington Experiment Station, Puyallup; M. K. Veldhuis, U. S. Department of Agriculture, Pullman; Esther E. Pond and R. N. Miller, Extension Service, Pullman, Wash.

In storage units with ventilators left open until cold weather, the temperature is lowered by cold air that comes in continually.

In cold regions a means of protection from freezing must be provided. As cold weather approaches pits are covered with alternate layers of soil and straw after the ventilators are closed. If the storage room is next to a warmer room, the door may be left ajar during cold spells, or live coals or a small heater may be set inside the storage room.

Table 1. Recommended Storage Conditions and Approximate Maximum Storage Period For Fruits and Vegetables

Crop	Temperature (°F.)	Relative humidity (per cent)	Maximum storage period
Asparagus	32	95 to 98	1 week
Beans, lima	32	90 to 95	2 to 3 weeks
Beans, snap	40	90 to 98	12 days
Beets	32 to 40	90 to 95	4 to 5 months
Broccoli, sprouting	32	95 to 98	10 days
Brussels sprouts	32	95 to 98	2 months
Cabbage	32 to 40	90 to 98	5 months
Carrots	32 to 40	90 to 95	6 months
Cauliflower	32	90 to 98	30 to 40 days
Celery	32	90 to 98	3 to 5 months
Cucumbers	32 to 40	95 to 98	4 to 5 weeks
Eggplants	32	90 to 95	3 to 4 weeks
Kale	32	95 to 98	1 month
Lettuce	32	95 to 98	3 to 4 weeks
Muskmelons, immature	50	80 to 90	2 weeks
Muskmelons, mature	32	80 to 90	1 month
Onion and onion sets	31 to 32	80 to 95	5 months
Parsnips	32	90 to 95	5 months
Peas, green	32	95 to 98	2 weeks
Peppers	32	95 to 98	40 days
Potatoes	35 to 40	85 to 90	5 to 6 months
Pumpkins	40	50 to 70	2 to 3 months
Rutabagas	32 to 40	90 to 95	3 to 4 months
Squash	40	50 to 70	5 months
Sweet corn	32	90 to 98	3 to 4 weeks
Sweet potatoes	55	50 to 70	4 months
Tomatoes, green	50 to 60	95 to 98	1 month
Tomatoes, ripe	40	95 to 98	10 days
Apples	32	80 to 90	3 to 6 months
Pears	32	80 to 90	3 to 6 months
Filberts	32 to 50	70 to 75	6 months
Walnuts	32 to 50	65 to 70	6 months

HUMIDITY

Failure to keep the air within the storage unit moist enough, but not too moist, is a common cause of spoilage. Apples, as well as vegetables such as carrots, beets and potatoes require lots of air moisture (humidity) to keep them from shrivelling.

There are several ways of providing the right humidity. For those crops requiring high humidity, it is about right in pits and other types of storage with dirt floors. Units without dirts floors may be divided into two compartments—one for high humidity crops (those requiring humidity above 70 per cent) and the other for low humidity crops (those requiring humidity of 70 per cent or below). The floor of the moist room may be covered with 3 or 4 inches of sand to be kept moist. If keeping the sand moist does not furnish enough moisture to prevent shrivelling, humidifiers of various types may be installed. Discarded burlap with water dripping from it may be used, or air may be drawn hrough a layer of moist excelsior or burlap with a fan.

The dry room need be given no special attention as far as humidity is concerned when the storage unit is divided into two compartments.

Another plan is to permit the humidity in the storage unit generally to remain the same as that of the outside air, and to place high humidity crops such as carrots, beets, and parsnips in a "sand box" or a tightly closed container in which the humidity is high. Porcelain jars with tight-fitting lids may be used. The other vegetables and canned goods, with the exception of squash and pumpkins may usually be stored in the main part of the unit when this plan is followed. In Western Washington it may be necessary to store squash and pumpkins where it is drier.

VENTILATION

Cold air, being heavier than warm air, provides a natural means of keeping the storage temperature low. Gardeners living in the Northwest are fortunate in that the night air is usually cool. Ventilators, which allow cold air to enter and warm air to escape, lower the temperature on the inside to a point equalling that on the outside during the coolest part of the day. How permanently the temperature remains at this point depends upon how well the unit is insulated, and how well the cold air is kept from escaping as the storage room is visited.

The size of the ventilator, naturally, must vary with the size of the storage unit. Approximately one square foot of opening for every 1,000 cubic feet of space within is adequate. On this basis a 6″ x 12″ ventilator for the average storage room 6′ x 8′ x 8′ is adequate.

One ventilator is enough for most units of 1000 cubic feet or less. Two, one an outlet at the ceiling, and the other an intake at

the floor, make it possible to cool the room slightly faster than when only one is used. Inasmuch as the difference is only slight and there is no particular advantage in lowering the temperature of the home storage unit rapidly, this need be given but little consideration. Having two, one at the ceiling, and the other at the floor, on the other hand, makes it necessary to close the outlet in the early morning of warm days to keep the cold air from escaping.

The location of the ventilator is extremely important. A single ventilator placed at the **top** of the wall, with its top edge flush with the ceiling, allows the room to fill completely with cold air because all warm air can escape. A single ventilator in this position as shown in Figure 1, therefore, is adequate. In caves and storage units in which part of the wall is not exposed to the out-of-doors, place the ventilator in the ceiling.

There is no standard method of making ventilators for small pits. The chief requirement is that the warm air, particularly during the early part of the storage period, be permitted to escape and cold air to enter. A shaft of straw extending through the soil covering of the roof may serve. A box shaft, extending from near the bottom of the pit to six or eight inches above the outside of the roof is fairly common. The base of the shaft should be perforated with holes. A bundle of three or four small poles or sticks may be used instead of the box shaft. A box or field crate filled with straw and inverted over the top of the pile of vegetables after the first layer of straw is put on permits good ventilation also (Fig. 2). Generally, these more or less temporary ventilators for pits are removed as soon as the temperature within the storage unit has cooled down and additional protection is needed.

THE SIZE OF THE STORAGE UNIT

It is well to build the storage unit large enough to hold the maximum amount of fruits and vegetables normally stored by the family at any one time. In the case of families producing their own fruits and vegetables, capacity for all of the winter's supply is needed. Families who purchase them part at a time, need capacity for the largest supply purchased at any one time. Purchasing a complete supply in the fall and storing it, may offer advantages in convenience and money saving, enough to justify enlarging the storage for this purpose.

Aboveground and basement units, plans of which are shown in figures 9 and 10, are adequate for a family of five. In these the outside door opens into the dry room. Placing it here and using the

first room for low humidity crops and canned goods minimizes the fluctuation of both temperature and humidity of the second room, caused by opening and closing the outside door. Serious fluctuations in the second room can be almost eliminated if care is taken to first close the outside door before going into the second room.

INSULATION

No one should attempt to construct a storage unit as a part of the house or as a separate building without insulating it; it is impossible to maintain a low temperature without insulation. There are many different kinds of insulating materials, the most common of which are listed with their relative insulating values in table 2.

Table 2. Insulating Values of Materials

Material	Relative insulating value
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 lbs. 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

*"Internal resistivity" based on sample 1 foot square, 1 inch thick.

Use these materials according to instructions by the manufacturers.

Ordinarily, insulation is not necessary in pits because the soil soon cools down in the fall and stays cool until late spring. Good

insulation would make it possible to establish a low temperature earlier in the fall and maintain it later in the spring; but, inasmuch as both fruits and vegetables can be stored in pits as early in the fall as they are ready for storage and held there until late in the spring, there is little justification for insulation except possibly the front wall of hillside pits and those partially aboveground.

The relative position of the insulating material and the siding of the wall, influences the insulating value of the material. For example, a wall made by placing inch insulating boards on either side of 2 x 4 studdings has an insulating value of 5. Adding a third board in contact with one of the others increases the value to 6.5, but placing it in the middle of the sealed air space raises it to 7.5.

MOISTURE PROOFING

Placing a vapor seal in the wall aids in keeping the moist room moist and the dry room dry. It also protects the insulating material from moisture. Waterproof building paper is commonly used. Put the vapor seal on the inside of the wall.

TYPES OF STORAGE UNITS

Several different types of storage units are illustrated and described so that gardeners who can grow their winter's supply of vegetables may also store them. The type to be chosen will necessarily depend upon such factors as (1) the quantity of products to be stored; (2) the amount to be spent in building it; (3) the permanence desired; (4) the necessary protection from winter temperatures, and (5) the depth of the soil above the highest water table.

The storage unit need not be expensive. A shallow trench or pit may be built at no cash outlay and with little labor. A modern basement or aboveground unit, on the other hand, may mean an appreciable expenditure. The cash cost of such a unit need not be high, however, inasmuch as the construction involves considerable labor, most of which the owner can do. Although the simple types are not as satisfactory as the more modern types they serve very well.

Under-Ground Types

The earth in contact with the walls of the storage room influences conditions within. This influence may be an advantage or a disadvantage. In the fall when the soil is warm, it is a disadvantage because the soil tends to keep the storage temperature up. When

the soil becomes cold, however, it tends to hold the storage temperature down, which is an advantage. Perhaps the greatest beneficial influence coming from the soil is its tendency to keep the humidity up.

PITS

The pit is one of the simplest types. It may be above ground, or partly above and partly below. The site for the pit must be well drained. To locate such a spot in sections of heavy winter rains is not always easy. If such a spot is not available one can be built in the corner of the garden in a few minutes with a shovel. In most instances the surface need be raised only a few inches.

One large pit, holding the winter's supply of stored vegetables may be built; but because pits are inconvenient to open and close, some gardeners build several small ones, each holding approximately three or four weeks' supply. When this plan is followed the quantity of each vegetable needed for a month is put into each pit.

The Above-Ground Pit

Level off a spot and cover it with three or four inches of straw. Pile the vegetables on the straw, bringing the pile to a point. Cover the pile with three inches of straw and then fill an apple box or similar container with straw and invert it over the top of the pile (Fig. 2); add two inches of soil, leaving the apple box exposed. The straw serves as a ventilator and also keeps out rain and freezing temperatures. In western Washington it may be necessary to lay boards over it to keep out the rain. When the soil freezes over or when cold weather arrives, remove the apple box and complete the two-inch layer of soil over the entire pile. Add another four-inch layer of straw to the entire pile and finally five or six inches of soil, or as much as needed to furnish winter protection. In extremely cold sections of eastern Washington the second layer of straw may be increased to eight or ten inches, or manure instead of straw may be used.

The Tile Storage*

A convenient storage unit can be made by setting a large tile in the ground in a well-drained spot near the house. Such a unit is permanent and easy to open and close.

The Below-ground Pit

The depth of the pit usually varies from one to two feet and other dimensions according to capacity desired. Line the pit with

* The idea obtained from W. B. Ward, Extension Horticulturist, Purdue University, Purdue, Indiana.

five or six inches of clean straw or similar material. Dry squash or tomato vines may be used. Bring the pile of products to a point eight or ten inches above the top of the pit and cover with three or four inches of straw. Complete the covering as described under "the aboveground pit." Remove the products from the pit by making an opening through the covering near one end. Each time it is opened care should be taken to close it well.

The roof structure varies according to the size of the pit. When only up to 200 or 300 pounds of products are to be stored, the straw may be placed directly over the products as just described but when a large quantity is to be stored, a roof support makes for convenience in opening and closing the pit (Fig. 5). Place a substantial, well-anchored ridgepole over the center of the pile, and two light poles flattened on one side or two 2 x 4's on the side shoulders of the pit. To these tack roofing boards consisting of waste lumber of any kind. A pitch of 20 to 30 degrees is desirable. Convenient cracks between some boards simplify taking vegetables out of the pit. Cover the boards with straw and finish the covering as described under "the above-ground pit."

Side Hill Storage

This type is common in rolling areas where large quantities of products are stored (Fig. 6). The amount of excavation to be done is a matter of choice. The greater the excavation the less banking is necessary in making the roof. The pit should be deep enough to permit a seven foot ceiling with other dimensions varying according to the capacity needed. It usually extends into rather than parallel with the bank, thus reducing the exposed wall surface by exposing an end rather than a side.

The walls may be made of plank, concrete, or stone, one of the latter being most common for the front wall because of the greater strength. The top of the front wall should be high enough to keep the soil from rolling down onto the floor at the entrance. An insulated wall may be added on the inside, although this practice is not common except with the front wall.

After the sills and joists (which should be substantial enough to support the heavy soil roof and a tractor or team used in putting it on) are nailed in place, a heavy wire netting is stretched over the joists. A layer of straw two or three feet deep is then spread over the netting. Planking or a concrete floor may be used instead of the netting, in which case the layer of straw may be omitted. The layer of soil is put on immediately, the depth ranging from one to

several feet. The arrangement within may be the same as that for basement or aboveground storage units as described on pages 12 to 14 and shown in Figures 9 and 10.

Twelve-inch tile extending through the roof and above the soil are often used as ventilators. In the absence of tile, a wooden shaft 16 to 18 inches square may be used. The number of ventilators should vary according to the size of the storage room. If the storage is more than 12 feet long, one outlet should be placed near the center and another at the rear. There should be one outlet placed in the ceiling. Intakes may be put at the base of the front wall, or the door may serve as an intake.

Cellar or Cave

Fruits and vegetables are sometimes stored in caves or cellars dug solely for this purpose (Fig. 7). These are completely underground or about four feet underground and four feet aboveground, the size varying according to the capacity desired. In either case they are covered with soil. A ventilator in the ceiling to avoid too much dampness is a desirable feature. The door usually serves as a cold air intake.

This type of pit storage, having an entrance door, is more convenient than most other types. Being away from the house and below ground, it is not as convenient as the basement type, however. The inside arrangement suggested for basement units may be used here also.

Basement and Above-Ground Types

The ideal place for storing fruits and vegetables from the standpoint of convenience is in the basement. Because underground storage is impractical in some regions, a unit either separate from or as a part of the house may be built. Being aboveground it provides a convenient entrance, which is not true of pits. Locate it convenient to the house and where it will fit into the appearance of the landscape. It may be constructed of a variety of materials, although wood is most common. The average outdoor aboveground unit is about 8′ x 12′ with an eight foot ceiling. The size obviously should be adjusted according to the amount of produce to be stored. It should be built to take care of both high and low humidity crops, and canned goods.

Walls

Perhaps the most important consideration to keep in mind when constructing the walls is to provide for adequate insulation. Double walls, filled with poured insulating material, are often used.

They provide good insulation and are inexpensive. Staggering the studding as shown in figures 9 and 10 increases the insulating efficiency.

The wall not only must be well insulated but it must also be permanent. Some insulating material, particularly sawdust and shavings, lose part of their insulating value if allowed to become wet. A vapor seal in the wall, therefore, should not be omitted. It not only protects the insulating material but helps to keep the moist room moist and dry room dry.

The wall may be sided up with various materials. There probably should be two layers, the first consisting of low grade shiplay. The vapor seal, consisting of waterproof building paper can then be put over the shiplap. Six-inch rustic or drop siding or low grade shingles on the outside are satisfactory both from the standpoint of appearance and cost. A smooth material such as shiplap is preferable for the second layer of siding on the inside of the room.

Ceiling

The kind of siding used on the inside walls is also used on the ceiling. Insulating material is placed between the joists. A double shiplap floor with moisture proof paper between laid over the joists protects the insulation and makes the attic usable.

Floors

In the moist room a dirt floor is preferable to other types because of the advantage it offers in keeping the room moist. In the absence of a dirt floor a slatted floor consisting of 1 x 2 inch boards laid ½ inch apart on 2 x 2 joists aids in keeping the sand placed on the floor from being tracked out of the storage. Having the slatted floor in sections makes for convenience in cleaning the room.

In the dry room, where moisture is not wanted, a concrete floor is preferable; it not only aids in keping the room dry but also offers advantages in keeping it clean.

ARRANGEMENT WITHIN THE STORAGE

If all inside space is to be used to best advantage the shelving and partitioning must be well planned. Careful planning not only utilizes the space completely but also adds convenience. Plan bins according to quantities of products to be stored, allowing approximately two cubic feet of space for 100 pounds of such vegetables as potatoes and carrots. Make removable partitions, so they can be removed for airing and cleaning.

Table 3. Shelf Capacity Required for Different Containers

	Approx. width of jars (inches)	Approx. length of shelf required for 100 jars (feet)		Approx. height of jars (inches)	Height of shelf space required (inches)
		2 rows*	3 rows**		
GLASS JARS:					
Half-gallon	4¾	20	14	9¼	11½
Quart	3⅞	17	11	7	8½
Pint					
Wide Mouth	3⅞	17	11	4	5½
Narrow mouth	3¼	14	10	5½	7
Half-pint	3	13	9	3¾	5¼
JELLY GLASSES:					
Tall	2⅞	12	8	3¾	5¼
Squat	3¾	16	11	2¼	3¾
TIN CANS:					
No. 2½	4¼	18	12	4¾	6¼
No. 2	3½	15	10	4⅝	6
JUGS:					
Gallon	6½	28	19	12	13½
Half-gallon	5	21	14	10	11½
STONE JARS:					
3-gallon	10½	44	30	11	12½
2-gallon	9½	40	27	10	11½

* $\frac{\text{Width of jars in inches}}{12} \times \frac{100}{2}$

** $\frac{\text{Width of jars in inches}}{12} \times \frac{100}{3}$

The shelf arrangement mars or makes the efficiency of the dry room perhaps more than any other single item. Place the shelves so that the jars are within easy reach. The highest shelf should not be over 72 inches from the floor and the lowest one not less than nine. Shelves wide enough to accommodate only two rather than three or more rows of jars, setting one directly behind the other, are generally recommended because of the greater ease in placing jars onto and removing them from the narrow shelves. Where space is limited, wider shelves may be used.

Build enough shelves to hold total number of jars, both filled and empty, to be stored at any one time. Allowing approximately 20 per cent more space makes for convenience in shifting jars and returning empties. The space shown in figures 9 and 10 accommodates approximately 800 quart jars, which provides ample space, assuming that the average family of five puts up approximately 600 quarts of canned goods.

The shelves should be removable so that they may be taken out for airing when the storage unit is being cleaned. If part of

them are adjustable it is necessary to put in extra shelf rests or to make the rests themselves adjustable. Shelf stripping, or dowel pins as shown in figures 9 and 10 may be used. When dowel pins are used, allow them to protrude an inch so the shelves need not be too tight.

The amount of vertical space necessary between shelves depends upon the sizes of the jars. Allowing one and one-half inches above the jars makes for convenience although it does use more space. This amount may be reduced to an inch or less by using jars uniform in size and type. The space necessary for the various containers is given in table 3.

Quart jars are used most frequently by the average rural family; pints are next. Assuming that the average family uses quarts and pints exclusively, a logical proportion of each for a family of five is approximately 500 quarts and 100 pints. Making all the shelves suitable for quarts and one section adjustable for pints and two-quarts takes care of the most likely variations from quarts.

PAINTING THE STORAGE

Keeping the outside painted adds to both the life and appearance of outdoor aboveground units. Finishing the inside not only makes it look better and last longer but also makes it easier to keep clean. Inasmuch as the inside is exposed to moisture resulting from humidity within the storage and from washing, the finish should be waterproof and washable. Such a finish is particularly necessary for the shelves.

There are several wood preservatives that may be used. A simple inexpensive combination of materials consists of turpentine one part and boiled linseed oil two parts, applied hot. **Heat the linseed oil in a double boiler. Keep it away from an open flame. Destroy or spread out for airing all used rags.** After applying the turpentine and oil, permit it to dry about 30 minutes and then wipe off the excess material, rubbing with the grain. Boards so treated are not completely waterproof. Apply one or two coats of varnish for further waterproofing. This method preserves the natural appearance of the wood.

Another method of finishing the inside is to use ordinary house paint, applying one thin and one normal coat.

A third and more expensive method is to use an enamel. The enamel should be applied according to directions on the container.

PREPARATION OF PRODUCTS FOR STORAGE

The storage life of fruits and vegetables is influenced by their pre-storage treatment. Store only those which are sound and in good condition. Sort out injured specimens. Be sure they are in the proper stage of maturity, neither overripe nor too green. Place those which will not keep long where they can be used first.

Cleaning vegetables before placing them in storage aids in keeping the storage room in a sanitary condition. If possible, dig root crops when the soil is fairly dry. Ordinarily, normal handling in placing them in storage will clean them. Remove the tops of such crops as carrots about an inch from the crown. Wipe off squash with a cloth if soil sticks to them. The loose husks of onions are sifted out fairly well by normal handling.

LEAVING VEGETABLES IN THE FIELD OVER WINTER

Parsnips, salsify, and horseradish may be left in the field and dug as they are used. Digging part of them in the fall after frosts have killed the tops, and placing them in storage avoids the necessity of digging in the winter when the soil is frozen. In eastern Washington where the ground sometimes freezes to a considerable depth this practice is particularly desirable. Those left in the ground over winter are sometimes injured in eastern Washington by repeated freezing and thawing. This injury may be prevented by covering them with two or three inches of straw held in place with a light covering of soil.

Although root crops such as carrots and beets may be safely left in the ground in western Washington during some seasons, there are several objections to this practice. First of all they sometimes are injured by freezing and by excessive moisture. In the case of carrots, leaving them in the ground permits the continued growth and development of insects which may be more serious in succeeding years because of this practice. These crops left in the ground do not usually remain as dormant as they do in storage. Any growth they make, either root or top, lessens their food value and quality.

SPECIAL CONSIDERATIONS IN STORING MISCELLANEOUS CROPS

Beans

As soon as the pods are mature, pull and allow the plants to dry. Shell the beans when dry enough, and place them in a tray to dry still further. When dry, place them in a container that can be

closed tightly for weevil treatment. Pour carbon disulfide over them at the rate of one tablespoonful per two quarts, and close the lid tightly. **Because carbon disulfide is inflammable, it should be used cautiously**. Maintain a temperature of 60° F. or more during treatment. After treating for 48 hours, empty the beans in a suitable container out of doors for airing. Air them for 24 hours, and then place them in metal or glass containers that can be closed tightly. Store them at low humidity and low temperature.

Cabbage

Cabbage is commonly stored in pits and in humid storage rooms above ground. Because of the undesirable odor, cabbage usually is not stored in the basement. In aboveground rooms the heads are stacked on shelves after trimming off two or three layers of loose outer leaves. The stalk is cut off a couple inches from the base of the head. Each individual head may be wrapped in newspaper to protect it, although this is not necessary.

In large pits or cellars the heads may be placed in bins or stacked on shelves. In small pits the stalks are pulled and packed ordinarily one layer deep with the roots sticking up. Dig a trench six inches deep, two feet wide and as long as needed. Line it with straw and pack the heads carefully. Cover with straw and two inches of soil to hold the straw in place. Freezing will not injure cabbage as long as it does not thaw too rapidly nor freeze and thaw repeatedly. Do not handle it when frozen.

Carrots

Carrots are easy to store if allowed to become fairly mature. Most varieties are sufficiently mature when one and one-half to two inches in diameter. Contrary to common belief the eating quality of mature carrots is equal to, if not superior to that of young carrots.

The sweetness of carrots is highest immediately following harvest, decreasing slightly during the first part of the storage period but becoming constant within a short time. Most of the loss in sweetness is restored after storage for five or six months.

Celery

Celery may be stored in a trench one to two feet wide and deep enough so that when the stalks are set upright in the trench the tops are below the surface of the ground. Remove the plants from the field, roots and all. Set them upright in the trench, packing them close together. Water the roots after packing. Bank the sides

of the trench with soil, and cover the top with boards. When cold weather sets in, cover the boards with straw and soil as much as needed to furnish protection from freezing. Celery picks up odors easily.

Kohlrabi

Kohlrabi should be harvested before it becomes woody. The size varies from one to three inches in diameter, depending upon its rate of growth and the weather conditions during the growing period. The bulbous stems are stored in the same way that beets and carrots are stored.

Onions

Allow the tops to ripen and to become dry before pulling. It may be necessary to break the tops down to get them to ripen soon enough. The bulbs are ripe when the necks are dry and solid.

After harvest, it is necessary to cure them. If grown in large quantities they may be windrowed in the garden. They also may be placed in slatted boxes or trays and stacked in the garden or in any dry airy place. They should not be piled more than three or four inches deep and should be given plenty of ventilation during the curing period. When cured, the necks and outer husks are dry. A period of several days to two weeks, depending upon the weather, is required. When curing is completed, the tops are removed in preparation for storage.

Onions have a normal rest period of two months following harvest, after which they must be protected from sprouting and root growth. Because high temperature induces sprouting and high humidity stimulates root growth, onions are stored at a relatively low temperature with low humidity. They may be placed in shallow bins or trays with slatted bottoms. In the absence of a storage room, any well-aired, dry, dark place may be used as long as the temperature is low but not freezing. Attics are sometimes used.

Parsnips

Parsnips tend to shrivel badly in dry air. They do not possess a protecting coat as do some root crops. To prevent shrivelling, the humidity must be kept high. The general type of storage used for beets and carrots is also used for parsnips.

Contrary to popular opinion, parsnips do not require freezing to develop good eating quality. The sweetness in parsnips is due to the development of sugar, which takes place rather rapidly at temperatures varying from 34°F. to 40°F. Roots stored two weeks at

34°F. possess quality equal to that requiring two months to develop in the field where the soil freezes spasmodically during the winter.

Peppers

Peppers remain firm and smooth for several weeks at temperatures below 50°F. Be sure that they are free from surface moisture when placing them in storage. The plants, with fruits still attached, may be pulled and hung in storage, or the fruits may be removed from the plants and placed on a shelf.

Popcorn

The success with which popcorn may be popped is influenced by its moisture content. Dry it to the popping stage and place it in a glass or metal container that can be closed tightly. The container need not be sealed. Store in a slightly humid room such as that for squash and onions.

Corn too dry for popping may be improved by adding water at the rate of one tablespoonful per quart of shelled corn. Partially fill a fruit jar with corn, add water, put on lid and shake throughly. Store as fresh corn.

It should contain 12 to 13 per cent moisture for best popability and should pop in one and one-half minutes. Corn too dry pops quickly and feebly; corn too wet steams and scorches with only a few kernels popping.

Potatoes

Dig potatoes carefully to avoid injuries. Digging when the soil is dry aids in keeping the storage room clean. During warm bright days, it is well to dig in the morning or evening to prevent injury from sunscald. The tubers should be picked up immediately after digging when the temperature is 90°F. or above.

Hold the temperature at 60°F. and the humidity at 85 per cent with good air circulation for the first ten days of the storage period. This treatment aids in healing injured tubers and disposing of excess moisture. If the temperature is raised to 70°F. and the humidity is held at 85 per cent, the healing may be achieved in four or five days. After this treatment, place them in storage at 35°F. to 40°F. with high humidity. They may be placed in bins 10 to 15 feet deep if necessary.

Potatoes taken directly from storage at 40°F. and used immediately for making chips or french-fried potatoes, turn dark. The darkening may be prevented by placing the potatoes at 60°F. for a few days before processing them.

Pumpkins

The storage requirements for pumpkins are similar to those for squashes. The storage life of pumpkins generally does not exceed two to three months.

Squashes

If squashes are to be stored successfully, they must be mature. Skin breaks resulting from rough handling lead to decay. Good, mature, sound specimens can usually be stored successfully for several months.

They lose weight while in storage. The higher the temperature, the greater the loss. At temperatures ranging from 60°F. to 70°F. the loss in a period of five months may amount to as much as 20 per cent or more.

Place them one or two layers deep on a shelf or in a bin with a slatted floor. Do not lay them on a floor which is inclinded to be damp. A cool, freeze-proof attic is sometimes used with fair success.

Sweet Corn

Attempting to hold sweet corn in storage exposes it to an appreciable loss. High quality is due chiefly to high sugar content. A loss of sugar and a consequent lowering of quality starts almost immediately following harvest. At 85°F. it loses 50 per cent of the sugar within 24 hours after harvest. The loss is four times as great at 50°F. as at 32°F. and continues to increase as the temperature increases.

Tomatoes

Part of the tomato crop sometimes fails to mature by the time the first killing frost comes. The remaining green fruits are of two classes: (1) those starting to color, and (2) those turning from dark green to a very light green or almost white (green mature). By placing these in storage for ripening, the tomato season may be extended.

The most suitable temperature varies from 50° to 70°F. The higher the temperature, the more rapid the ripening. Fruits starting to color may be held 10 days at 50°F.; green mature fruits may be held for one to six weeks at this temperature. The rate of ripening may be governed to the extent that the temperature can be controlled within these limits.

Place the fruits on a tray or shelf one or two layers deep. Using only one layer permits rapid examination daily, to select those which are ready for consumption.

Herbs

Sweet annual marjoram, mints, rose geranium, rosemary, parsley, chives, bush basil, pot marigold, and other herbs may be potted for winter and grown as house plants. Plant them in large pots in good soil containing plenty of organic matter. Because the foliage is the desired product, these plants should be kept in good vigor.

The leaves of such herbs as sage are commonly dried for winter use. Keep the plants in good vigor. Harvest the crops just before the plants start blooming. The stems may be cut close to the ground, tied in bundles, and hung in a dry dustproof place to cure. Curing should be rapid.

The leaves may also be stripped from the freshly-cut stems and placed in trays to dry. The thoroughly dried leaves may then be crushed and put into wide-mouthed jars. These are closed tightly and stored in a dry place.

The seed is the desired product of several herbs. Among these are angelica, anise, celery, sweet cicely, coriander, cumin, dill, fennel, lovage, poppy and sesame. Harvest the seed just before it starts to shatter. Cut the stalks and place them on a paper to dry. When dry, thresh and clean the seed. Allow the cleaned seed to dry still further, and store it in a closed jar in a dry place.

Apples

Apples to be stored should be picked when very firm. They are ready to pick before they begin to drop. The color ordinarily is well developed. The green undercolor usually turns to a lemon yellow when they are ready for storage, which is considerably before they are edible. Sort the fruit carefully to keep decay from starting. One decayed fruit in a box may lead to considerable spoilage.

Place apples in storage immediately following harvest. They keep well at 31°F. with humidity of approximately 80 per cent. The temperature may go to 30°F. without injury, but it should not go much below this point. Apples suitable for storage may be held for eight months at 32° or for one month at 70°. This fact emphasizes the importance of keeping the temperature down.

Pears

Pick pears as soon as the leaf-green color has turned to a light green. When in this stage, they are not yet edible. Sort them carefully. Place them in storage as suggested for apples.

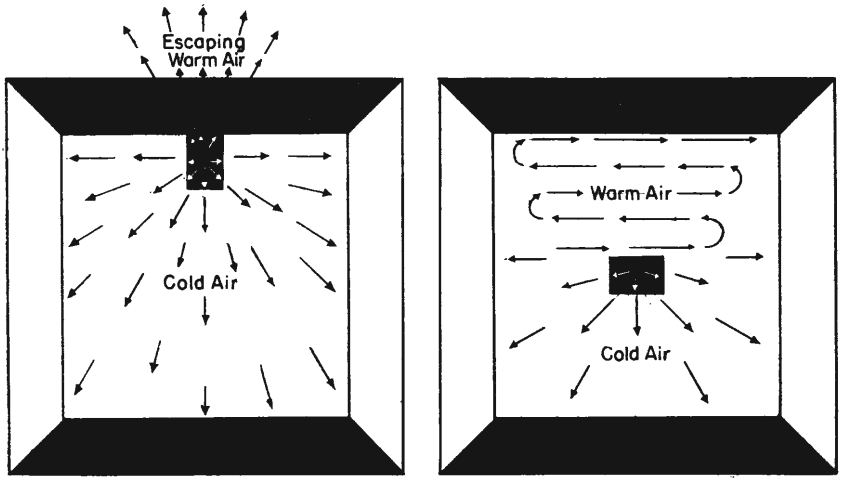


Fig. 1. Drawings showing right and wrong location for ventilator. When ventilator is placed near ceiling all warm air can escape.

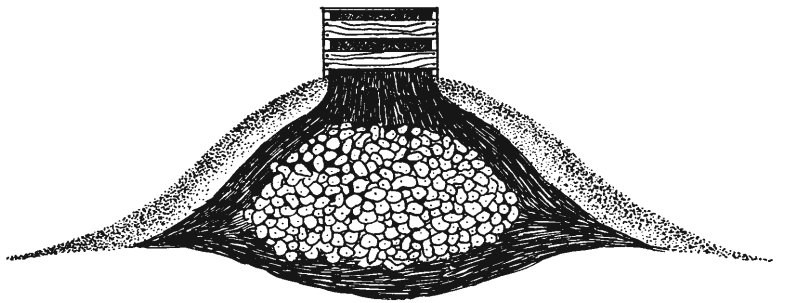


Fig. 2. Small pit above ground level, with apple box ventilator in place. Ventilator is put on when pit is made and vegetables are put in; it allows field heat of vegetables to escape and cold air to enter.

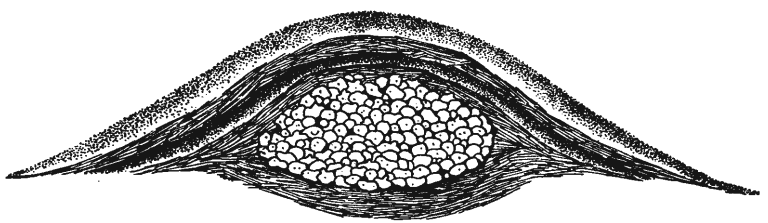


Fig. 3. Small pit above ground level with ventilator removed and winter covering on pit. Ventilator is removed as cold weather approaches. By this time the temperature of the products themselves is low and they give off little heat hereafter.

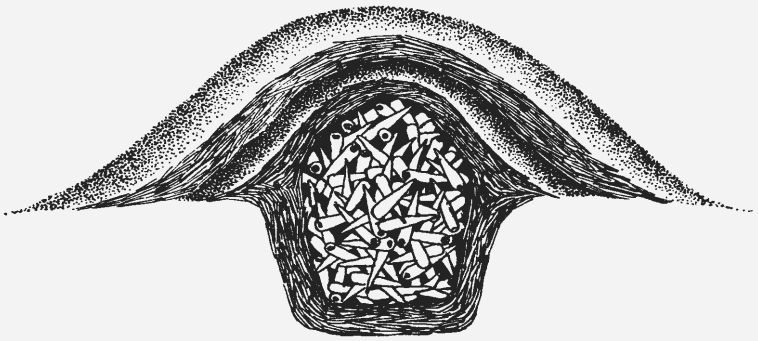


Fig. 4. Shallow pit storage with covering placed directly onto products. Not easy to open and close. Top may cave in as products are removed. Several different kinds of vegetables may be stored in the same pit. Arranging them so that some of each can be obtained through the same opening makes for convenience.

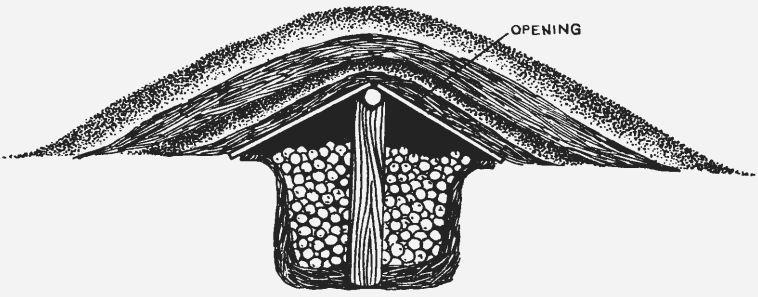


Fig. 5. Shallow pit storage with roof support. Same as Figure 4 with the addition of a roof support. The roof support keeps covering from caving in as products are removed.

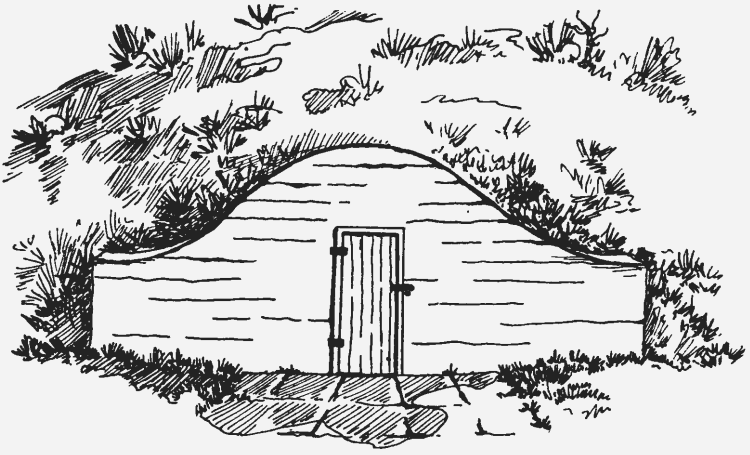


Fig. 6. Side hill storage. Common in areas where the land is rolling. The inside arrangement suggested in Figure 9 may be used.

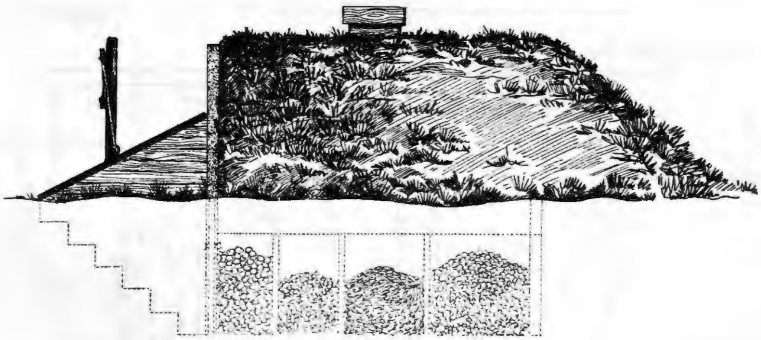


Fig. 7. Cellar or cave. Often used in areas of level land. The inside arrangement suggested in Figure 9 may be used.

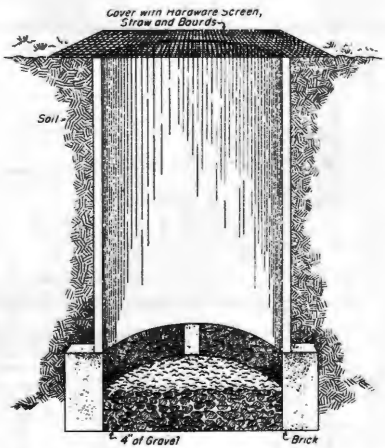


Fig. 8. Tile storage pit . A convenient and fairly permanent storage unit can be made by setting a large tile into the ground.

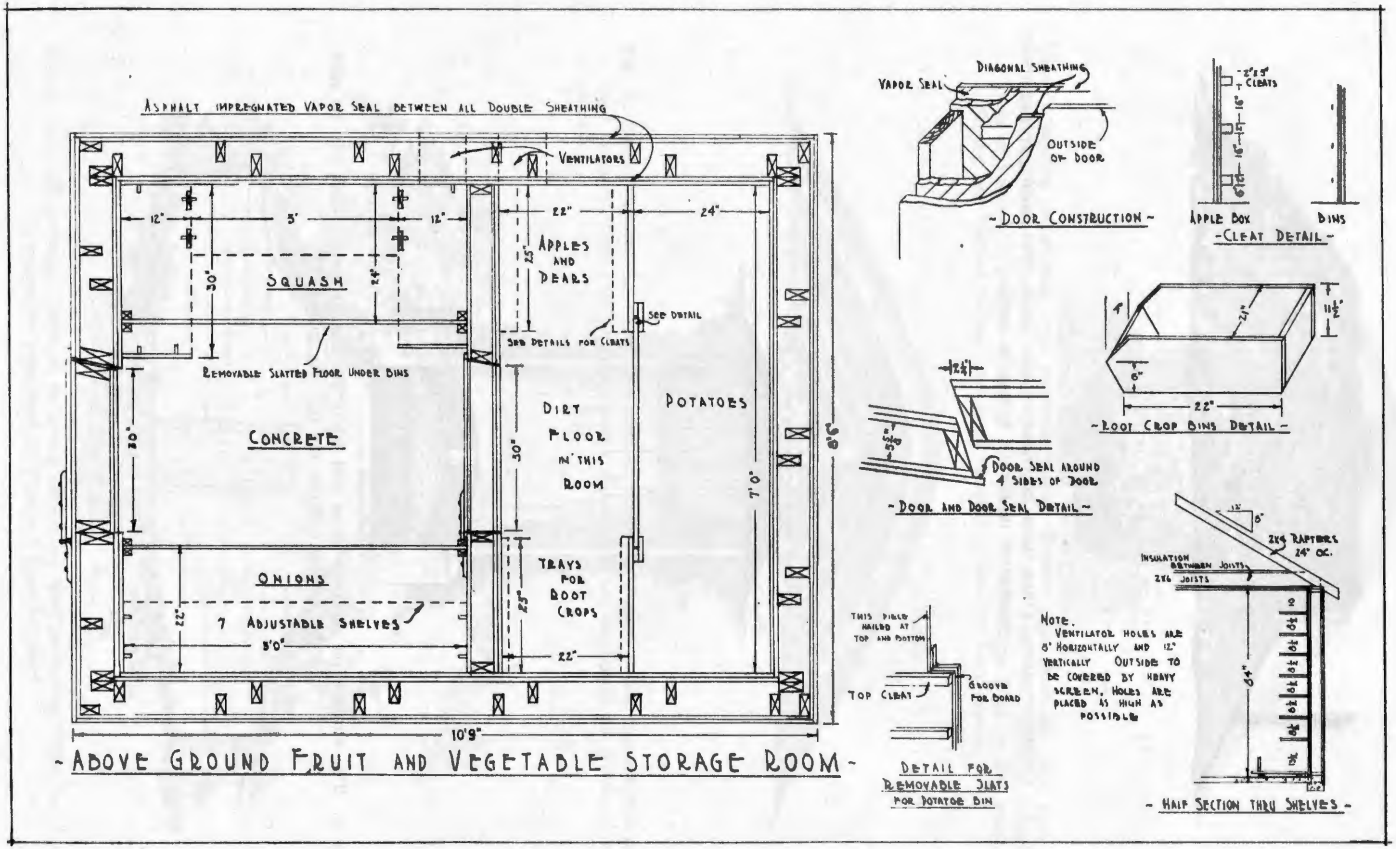
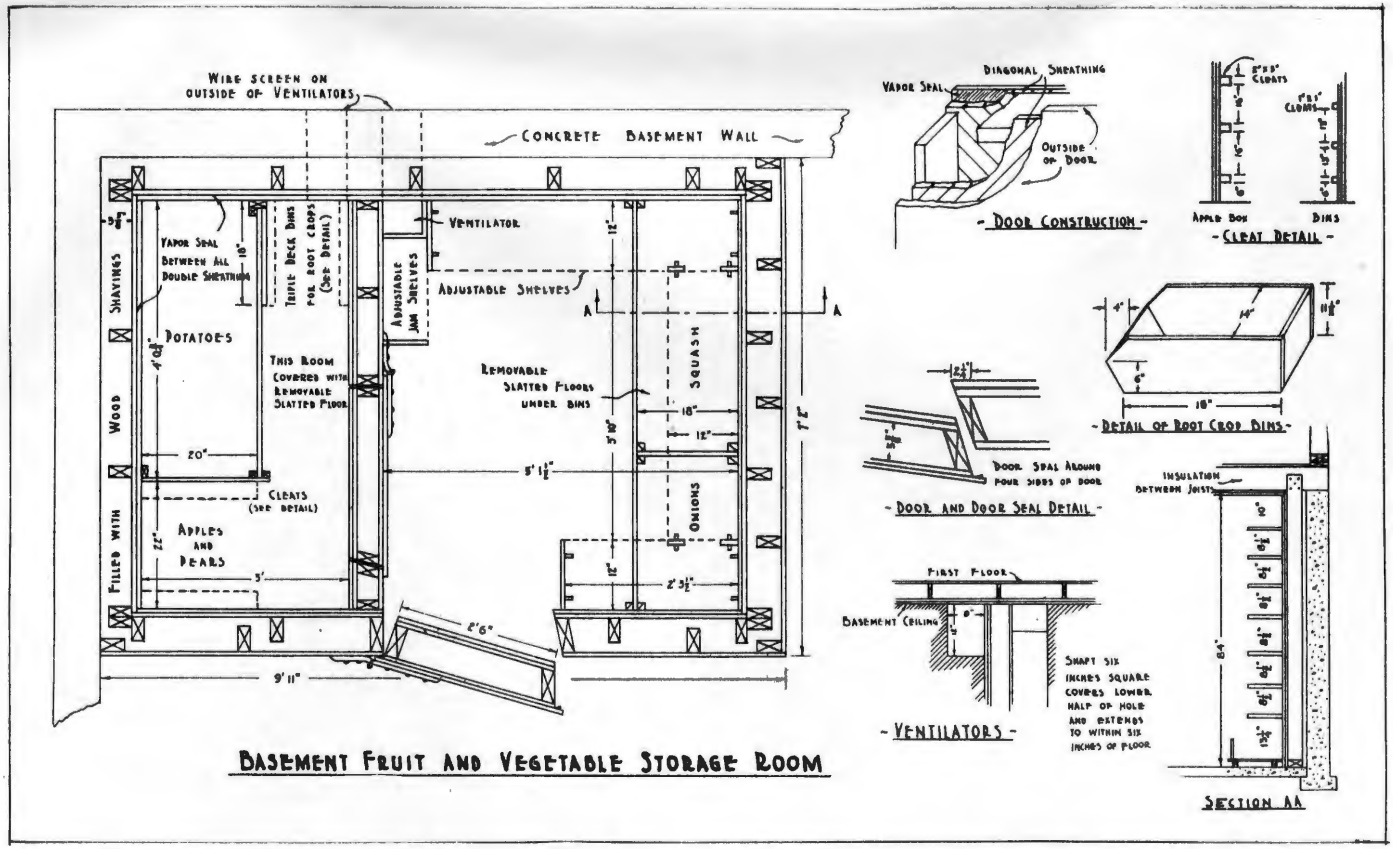


Fig. 9. Aboveground fruit and vegetable storage, separate from the house. Note moist room for high humidity crops and dry room for low humidity crops. Shelves in dry room for canned goods are removable; those in one section are adjustable. Bin partitions are removable to aid in keeping the storage clean.



BASEMENT FRUIT AND VEGETABLE STORAGE ROOM

Fig. 10. Basement fruit and vegetable storage with a humid and a dry room. Bins for carrots, beets, parsnips and similar root crops are in the form of drawers, one above another. Shelf cleats for apple boxes are built in. Shelf arrangement in dry room is the same as for the aboveground storage shown in Figure 9, except that a section of shelves for jam is added.

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