

## GINSENG DRYER DESIGN

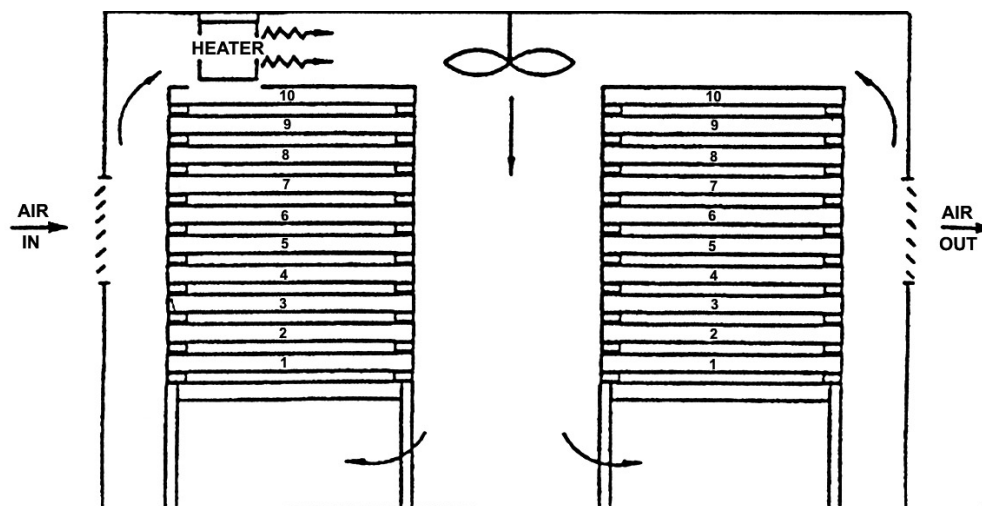
Many different styles of dryers are used to dry ginseng ranging from small food dehydrators to large sheds and modified bulk tobacco kilns. Because ginseng is such a valuable crop, it has traditionally been dried in thin layers in buildings where the root was easily inspected during the drying process to identify and correct problems.

On larger ginseng farms, there has been increased interest in drying ginseng more efficiently without sacrificing quality. The trend has been to use forced air systems where the root is loaded at much higher rates per unit floor area of the dryer to reduce the cost of the equipment and buildings. Perhaps the bulk tobacco kiln modified for drying ginseng is the most readily recognized example of this trend. Many bulk tobacco (ginseng) kilns are built as a prefabricated building or kit of one size to be installed on an on-site foundation, but the same dryers could be custom built in a wide variety of sizes.

### SHED DRYER

The shed dryer shown in Figure 1 is a simplified version of this style of dryer. Thin layers, less than 3 inches deep, of ginseng are spread on trays with wire mesh bottoms. These trays are then stacked on sawhorses with spacers between them or in racks. The shed (or room) has open floor space all around the trays to allow for inspection of the root during drying. The shallow trays and open areas for inspection result in low loading rates for the building floor space (lbs/sq ft). Two examples given by Curran (1983) identify fresh ginseng loading rates of approximately 3 lbs/sq ft. Loading rates in the shed are limited by the air circulation through the trays of ginseng. Lack of air movement through the ginseng will result in spoilage through mold growth. It is difficult to force air through the ginseng when there are lots of open areas for the air to flow around the ginseng.

**Figure 1** Cross-Section of Shed Dryer



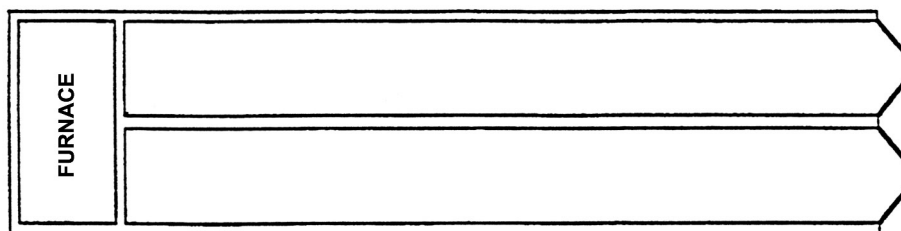
Some shed dryers are designed to encourage the stratification of air at different temperatures to achieve lower temperatures at the floor and warmer air at the ceiling (cold air is heavier than warm air). When drying racks are used, this dryer can be managed so that fresh root is loaded in trays at the bottom of the rack and the trays are moved up in the rack to higher temperatures. This system can be used for continuous drying of ginseng as opposed to drying batches of ginseng. In all cases the dryer requires a heater to control temperature and either an air exhausting system or a dehumidifier to control humidity. The source of heat or method of dehumidification is not important. What is more important is the temperature, humidity and circulation of air that ensures the ginseng is exposed to a uniform environment.

## BULK TOBACCO KILNS

More recently, bulk tobacco kilns have been increasingly used for drying ginseng partially as a result of the Ontario tobacco industry diversifying into alternate crops such as ginseng. Bulk tobacco kilns are designed with a fan forced air circulation pattern (refer to Figure 2). Air is supplied to a plenum beneath a perforated floor under pressure. The perforated floor is intended to uniformly distribute air throughout the dryer. The air passes vertically up through the ginseng and then returns above the ginseng trays back to the furnace.

Directed-fired natural gas or propane heaters are used to control the temperature. Fresh outside air is drawn into the furnace when the humidity is to be lowered and air is exhausted through a pressure-sensitive damper at the other end of the dryer.

**Figure 2 Plan View of a Bulk Tobacco Kiln**



Care must be exercised to ensure uniform, efficient drying conditions are achieved with the conversion from tobacco dryers to ginseng. Dollies are normally used to hold a stack of ginseng trays which makes loading and unloading the bulk kilns quicker and easier. However, if air is allowed to bypass the ginseng trays, the air will not pass through the thickest piles of ginseng which will create the potential for mold growth. One method to prevent this is to clad the open sides of the dollies and attach a stiff skirt to the bottom of the dollies that reaches the floor. The floor outside of the dollies should be covered with plywood. The dolly cladding, skirt and plywood on the floor all assist to force all the air through the ginseng trays.

These tray modifications have been used with high loading rates of up to 45 lb / sq ft in bulk tobacco kilns monitored by Ontario researchers in the late 1980's. They also observed that the root at the furnace end dried two days earlier than the loading end in a modified tobacco kiln that was monitored by them. This was attributed to the design of the bulk kiln's lower plenum and furnace unit, which causes non-uniform airflow.

In particular non-uniform airflow is likely caused by an air plenum that is too small for the amount of airflow. Steps have been taken by manufacturers of bulk tobacco kilns to correct the non-uniformity of airflow along the length of the dryer in a number of ways.

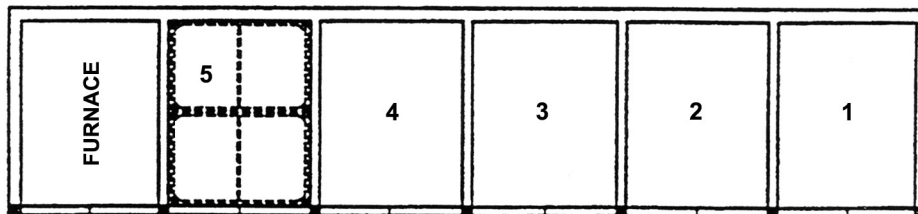
## BCMAFF GINSENG DRYER

In the fall of 1990 The Associated Ginseng Growers (TAGG) of British Columbia requested assistance from the Soils and Engineering Branch of the B.C. Ministry of Agriculture, Food and Fisheries (BCMAFF), for the design of a locally fabricated ginseng dryer. In attempting to carry out the design staff found very little scientific information on ginseng dryers or their management. Even basic empirical data concerning drying the ginseng root was extremely limited. Staff carried out a literature search and a review of two B.C. dryers that were open to inspection. From this information a design was prepared for a commercial dryer that was constructed by Mr. Ray Dunsdon at Kamloops in time for drying his 1991 crop. The dryer design was based mainly on past drying experience of the B.C. growers as well as some Ontario reports on the conversion of tobacco kilns to ginseng dryers.

The main difference between the modified bulk tobacco kilns and the B.C. designed dryer is that the BCMAFF dryer has doors along the side of the dryer to allow convenient access to all the trays in the dryer (refer to Figures 3a & 3b). This access not only allows inspection during drying, however, it also allows the removal of individual trays when the ginseng is dry.

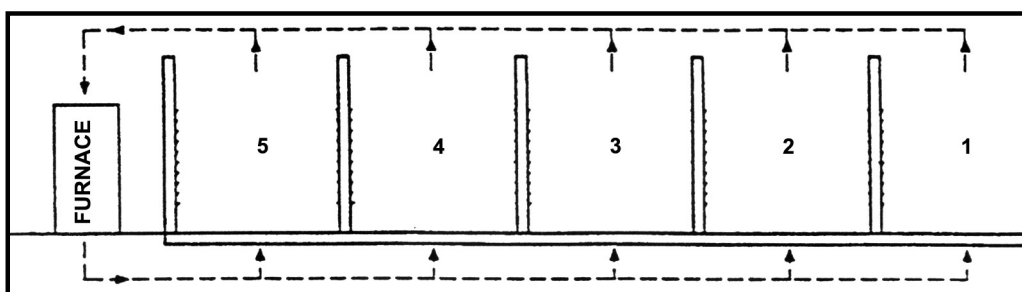
**Figure 3a Plan View of BCMAFF Dryer**

The BCMAFF dryer incorporates a deeper air plenum with lower air velocities to create a more uniform airflow through the perforated floor. The perforated floor is made of plywood with small holes drilled in a grid pattern. The pattern can be modified until the airflow is uniform throughout the kiln. It would be prudent to construct the floor sections so that they are replaceable with other grid spacings if required for balancing the airflow.



The dryer is designed with tray supports bolted to the walls to prevent any air from bypassing around the trays. If dollies are used to facilitate the loading of the trays, the system should be designed to minimize the effort required to eliminate bypass air. The dryer constructed by Mr. Dunsdon utilized a furnace supplied by a manufacturer of bulk tobacco kilns and utilized the same basic drying principles with the aforementioned changes that were mainly intended to improve the management versatility of the dryer.

**Figure 3b Cross-Section of BCMAFF Dryer**



The dryer could be constructed almost any size. Current designs utilize 40 cubic feet per minute of air for each square foot of exposed floor area (40 cfm/sq ft). This air should be supplied at a static pressure of one inch water gauge. Centrifugal (squirrel cage) fans will supply a more constant airflow under varying pressures compared to axial flow (propeller) fans. Centrifugal fans also tend to be quieter. To minimize fan noise choose fans that run at lower speeds for example 1,725 revolutions per minute (RPM) as opposed to 3,450 RPM.

The heater should be capable of 120° F and be sized to account for the conduction heat loss of the building, warming the ginseng and trays and the heat loss created by exhausting moist warm air to lower the humidity in the dryer. For purposes of estimation only, this can be assumed to 800 British Thermal Units per hour for each square foot of exposed floor area (800 BTU/hr/sq ft) for early fall conditions in British Columbia.

## **DRYER OPERATION**

Improvement of the design, operation and management of ginseng dryers requires some basic research. Branch staff prepared a list of basic questions and proposed a set of experiments to answer some of these questions. The information was presented to Dr. Bill Bailey of Simon Fraser University (SFU) who is familiar with ginseng production and had monitored one of the B.C. dryers. Dr. Bailey prepared an application to the B.C. Science Council with the support of BCMAFF and industry.

Research was carried out at SFU during the fall period of 1991, 1992 and 1993. Further information on ginseng dryer operation is detailed in [Factsheet 280.380-1 Ginseng Dryer Operation](#).

## **DRYER SIZING AND LAYOUT**

To properly size and layout a dryer system requires an estimation of the annual harvest and knowledge of how the harvest is planned through the harvest period. How many digs will there be? Is cold storage between digging and drying available? Many growers who build their own dryers have decided to purchase the dryer's furnace from a tobacco kiln manufacturer. The tobacco furnace is manufactured in large quantities and has proven to be dependable and cost effective. These furnaces typically have a capacity of approximately 400,000 Btu/hr and 15,000 cubic feet per minute (cfm.) airflow. The furnace is offered only in one size and consequently most dryers have been constructed to match the furnace's drying capacity. Some growers have loaded up to 20,000 pounds of fresh root into dryers equipped with this furnace. High loading rates require a higher level of management from the dryer operator.

Depending on the ginseng grower's set of circumstances, it may be best to have a single large dryer to take the whole crop in one batch or it may be preferred to have a small dryer with many batches. Perhaps having a custom operator dig, wash, and dry is the most suitable option. These decisions should be made based on the availability of labour, digging equipment, and cold storage. The growers marketing plans should also be considered.

## **FUTURE DRYER DESIGNS**

The current technology used to dry ginseng is inexpensive and very simple. The drying season for ginseng is very short, from two weeks to dry one batch of ginseng to a maximum of about five batches (ten weeks) of ginseng if cold storage is used to extend the drying season. Growers must compare capital costs of more sophisticated dryers with the cost of current designs to ensure that higher costs can be recovered in improved dryer efficiencies or ginseng root quality.

## REFERENCES

Curran, D-E 1983. *The Complete Ginseng Growers Manual*. D.F. Curran Productions. 146p.

Van Daltsen, KB., W.G. Bailey and Y. Guo 1992. *Influence of Airflow, Loading Rates and Size Sorting on the Drying of American Ginseng*. *Drying '92*, Part B, p1370-1378. 1992 Elsevier Science Publishers B.V., The Netherlands.

Van Hooren, D.L. and H.R. Lester, 1990. *Methods to utilize tobacco kilns for curing (drying) and/or storage of alternate crops - interim report, 1989 year*. Report No. 90 - 5103, Agricultural Energy Centre, Ontario Ministry of Agriculture and Food, Delhi, Ontario, 33p.

For further information on related topics, please visit our website

**Resource Management Branch**

[www.agf.gov.bc.ca/resmgmt](http://www.agf.gov.bc.ca/resmgmt)

Linking to our

[Publications and Conceptual Plans](#)

---

**FOR FURTHER INFORMATION CONTACT:**

Bert van Daltsen, P Eng, Farm Mechanization Engineer  
Phone: (604) 556-3109 Fax: (604); 556-3099  
Email: Bert.vanDaltsen@gems4.gov.bc.ca

**RESOURCE MANAGEMENT BRANCH**

Ministry of Agriculture, Food and Fisheries  
1767 Angus Campbell Road  
Abbotsford, BC, CANADA V3R 2M3