

MAINTAINING QUALITY- POSTHARVEST KITS AND REFRIGERATION FOR BERRIES



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DIFFERENCES FROM OTHER CROPS

- **MUST BE ALMOST TO FULLY RIPE**
- **MUST PICK INTO FINAL CONTAINER**
- **NO WASHING**
- **NO MECHANICAL SORTING**
- **CONSUMERS EAT WITHOUT WASHING**
- **RAPID COOLING AND COLD CHAIN CRITICAL**

WHAT IS A COLD CHAIN?

**-KEEP FRUIT AS COOL TO
COLD AS POSSIBLE AT
ALL STEPS**

**MARKET LIFE ALL ABOUT
COOLING, ESPECIALLY IN
THE SOUTH**



WHAT AFFECTS SHELF LIFE?

POSTHARVEST

- HARVEST SYSTEM
- CONTAINER
- RATE OF COOLING
- STORAGE TEMPERATURE
- RELATIVE HUMIDITY
- TRANSIT TEMPERATURE



SMALL FRUITS

- HATE TO BE WARM
- LOSE WEIGHT
- LOSE GLOSS
- CHANGE COLOR
- LOSE FLAVOR
- GAIN MOLD



DISEASES

- **RHIZOPUS (LEAKY ROT)**
>41 F



- **BOTRYTIS (GRAY MOLD)**
>32 F



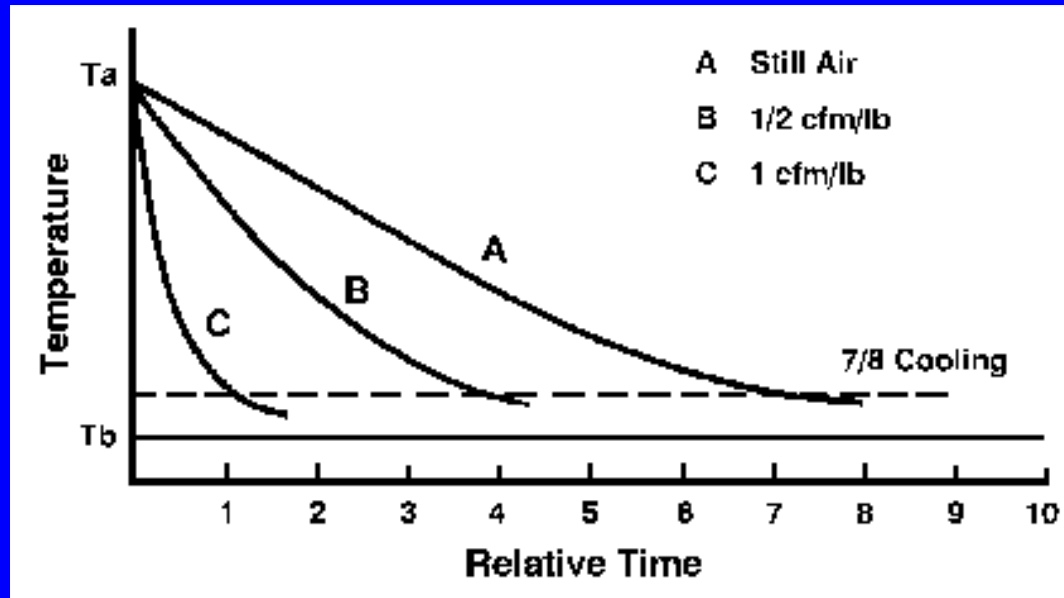
- **ANTHRACNOSE** **>41 F**



TEMPERATURE AND SHELF LIFE

<u>TEMPERATURE</u>	<u>DAYS SHELF LIFE</u>	
	<u>BLACKBERRY</u>	<u>RASPBERRY</u>
32 F	14-20	7-10
41 F	5-7	3-5
68 F	1-2	<1

*IF DELAY COOLING: AFTER 2 H WILL LOSE
20% PER HOUR DELAY*



To Cool to 7/8 of field temp-32F (40F)

FRUIT TEMP HRS TO COOL

80

8

60

4

Note that cooling is much faster when air is blown (1:8 ratio)

HOW TO GAIN ON COOLING

- **HARVEST IN COOL PART OF DAY (EARLY MORNING, LATE EVENING)**
- **KEEP DIRECT LIGHT OFF FRUIT**
- **MOVE INTO REEFER, PACK SHED, COOLER AS QUICKLY AS FEASIBLE**



WAYS TO COOL

- ICE CHEST PLUS GEL ICE
- GOLF CARTS WITH SHADE OR IN BOXES
- REEFER IN FIELD
- MOVEMENT INTO COLD ROOMS FOR PRECOOLING



CONTAINER



TOP COOLING ONLY



NO VENTING, DEEP=HEAT BUILDUP

COOLING



**CLAMSHELL
WITH ROUND
HOLES**

**CLAMSHELL
WITH SLITS**

MASTER FLATS OR CARTONS

**SIDES STACK VERTICALLY
FORCED AIR VENTS**



**MASTER
WITH AIR
VENTS**

**TOP FLAT
GUARD
TO AVOID
WEIGHT
LOSS**



COOLING



- **ROOM/ REEFER COOLING**
- **FORCED AIR COOLING**

AMOUNT OF COOLER SPACE

DETERMINE

- **REFRIGERATION LOAD AND**
- **AMOUNT OF COMMODITY**

**EXPECT 2.5 CUBIC FOOT SPACE PER LB OF
FRUIT**

for cooling or for storage

If both, will be 5 x lbs expected maximum load

ONE PALLET= 12 x 12 x 9 FOOT COOLER

WHAT COOLER SIZE IS NEEDED?

cubic feet needed = $2.5[(\text{max no. lbs cooled at one time}) + (\text{max no. lbs stored at one time})]$

one pallet of blackberries at 6
lbs/carton x 90 cartons per
pallet = 254 lbs + store 1 pallet
= 508 lbs x 2.5 = 1270 cubic feet

1270 cubic feet = 12 x 12 x 9

TYPES OF COOLERS

- **SIZE DEPENDS ON ANTICIPATED HARVEST**
- **REFRIGERATORS HAVE TOO MANY AIR EXCHANGES, TOO SMALL A VOLUME FOR EFFECTIVE COOLING/COLD MAINTENANCE**
- **WALK IN COOLERS NEED TO BE WELL INSULATED TO PREVENT WARM AIR LEAKING IN AND HIGH LOAD ON COMPRESSOR**

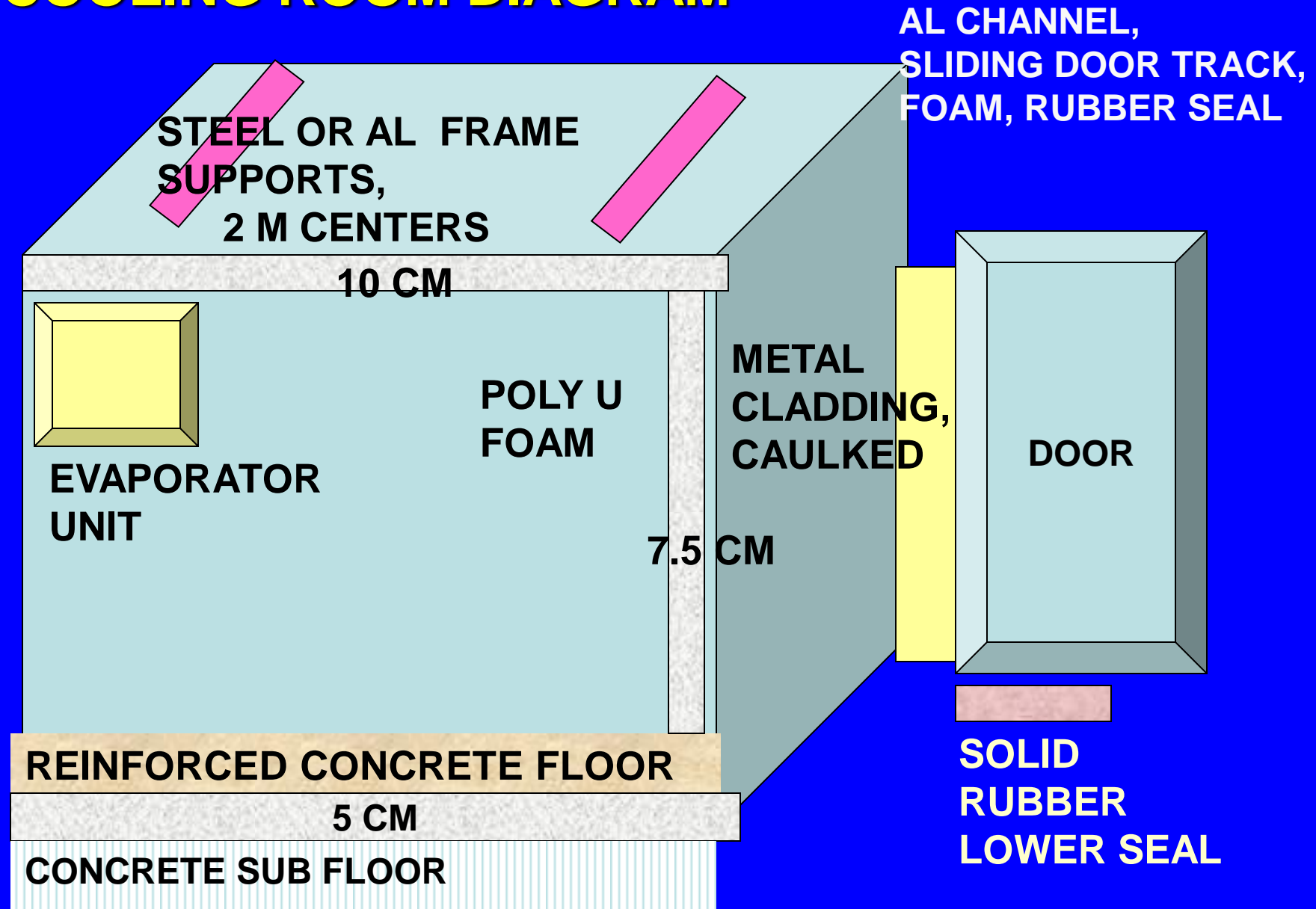
WALK IN COLD ROOMS

- **STATIONARY**
- **CONVENTIONAL ALUMINUM CLAD, 4 INCH THICK INSULATION**
- **HOME BUILD WITH WOOD, INSULATION, WATERPROOFING OF WOOD TO PREVENT WATER LOSS FROM FRUIT, WOOD SWELL (MACROLITE SIDING)**
- **SHIP CONTAINERS**

REFRIGERATION

- **MECHANICAL WITH COMPRESSOR, EVAPORATOR COILS, THERMOSTAT ETC**
- **AIR CONDITIONER (SAME THING ON COMPRESSED SIZE)**
- **CAN ADAPT AIR CONDITIONER TO REPLACE MECHANICAL FOR SMALLER GROWERS**

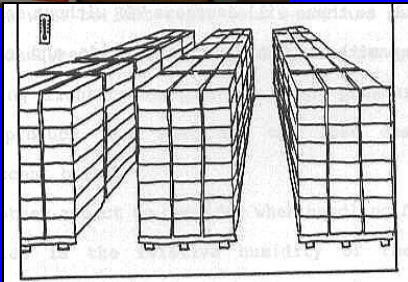
COOLING ROOM DIAGRAM



ROOM COOLING: ALLOW AIR MOVEMENT BETWEEN BOXES AND FLATS



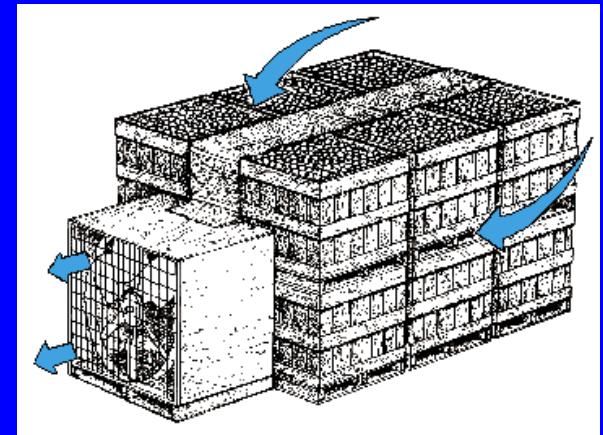
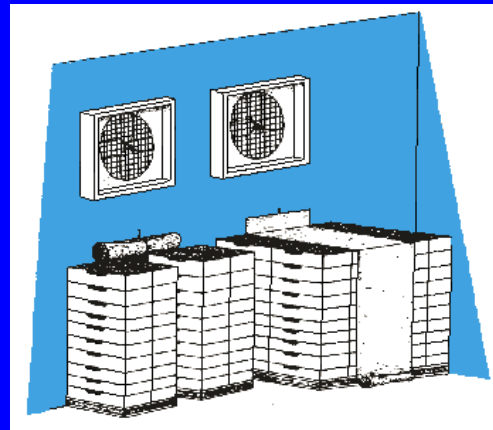
**VENTS IN MASTER FOR AIR
FLOW WITHIN CARTON**



FORCED-AIR COOLING (TUNNEL)

**FORCES COLD AIR THROUGH
DIRECTED PATHS IN BOXED FRUIT**

- CAN BE FIELD PORTABLE
- ROOM PORTABLE
- BUILT-IN



STORAGE AFTER COOLING

- **KEEP NEAR 32 F**
- **KEEP RELATIVE HUMIDITY >90%**
- **HOLD NO MORE THAN 2 DAYS ON SITE**

DIRECT MARKET/FARMERS MARKET

- **IF SMALL VOLUMES: USE ICE CHESTS TO HOLD FRUIT NOT ON DISPLAY**
- **PRECHILL ICE CHEST**
- **USE GEL ICE WRAPPED IN PAPER TOWELS OR NEWSPAPER TO KEEP FROM MELTING**
- **DON'T ALLOW DIRECT CONTACT OF ICE OR WATER WITH FRUIT**

DYI REFRIGERATION

- BUILD A BOX ON A FLATBED TRAILER
- BUILD A BOX OUT OF WOOD AND INSULATION
- BUILD A BOX FROM CONCRETE BLOCKS AND INSULATION
- USE A CARGO CONTAINER AND ADAPT IT FOR COLD STORAGE

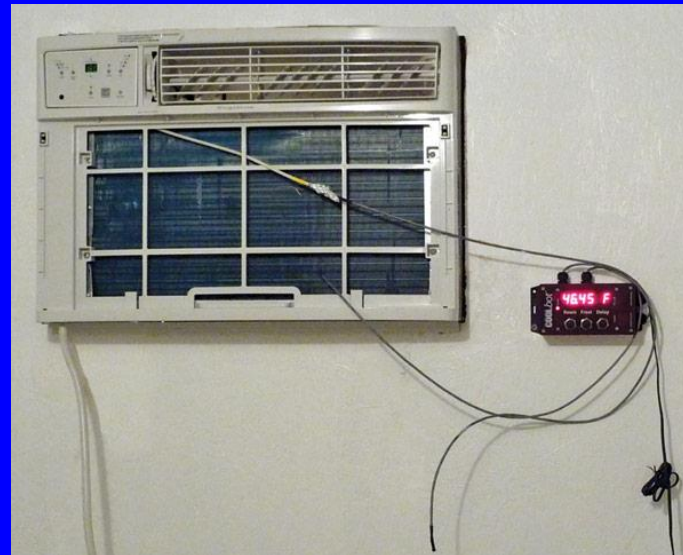
SEE: STOREITCOLD.COM

AC UNITS:

10,000 TO 25,000
BTU (\$300-600)

NOT ALL BRANDS
WORK-CHECK
THE WEBSITE!

COOL BOT



<http://www.storeitcold.com/>

Pack n Cool

- <http://www.cals.ncsu.edu/agcomm/news-center/perspectives/n-c-states-pack-n-cool-provides-farmers-with-mobile-refrigeration-solution/>





PRECOOLING

- **SEPARATE FROM COLD ROOM IS BEST**
- **MOVE FRUIT INTO PRECOOLING, BLOW OUT HEAT WITH FORCED AIR OR KEEP PALLETTS A FOOT APART TO CHANNEL COLD AIR**
- **MOVE INTO COLD ROOM ONCE FRUIT AT DESIRED TEMPERATURE**
- **ADD PLASTIC CURTAINS TO MINIMIZE WARM AIR EXCHANGE**

CONDENSATION

- **GOING FROM AMBIENT TO COLD:**
- **CONDENSATE FORMS WHEN MOVE FROM COLD TO WARM (WATER MOVES FROM WARM TO COLD)**

WHAT TO DO?

- **IF SELLING QUICKLY (WITHIN A DAY)
COOL TO 60 F SO DON'T GET
CONDENSATION**
- **REMEMBER THAT FRUIT ON OUTSIDE
OF PALLET OR CARTON WILL BE 10 F
COOLER THAN CENTER!!**


**CAN PLACE IN PLASTIC BAGS
OR WITH PLASTIC OVER FRUIT
WHILE WARMING TO COLLECT
CONDENSATE; ALLOW TO DRY
BEFORE REMOVING PLASTIC**



COLD CHAIN (CONT)

- **LOAD INTO REFRIGERATED TRANSIT AS QUICKLY AS POSSIBLE**
- **UNLOAD INTO REFRIGERATED STORAGE QUICKLY**
- **MEASURE/MONITOR TEMPERATURE AT EACH STEP AND DURING TRANSIT USING RECORDERS (STOW AWAY)**

POSTHARVEST KIT

- **FUNDED BY NARBA (NORTH AMERICAN RASPBERRY AND BLACKBERRY ASSOCIATION)**
 - **MOST PRODUCTS CAN BE PURCHASED FROM AMAZON, HARBOR FREIGHT, WALMART**
- 



CONTENTS

- **THERMOMETERS-COOLING IS THE KEY**
- **ANEMOMETER (MEASURES WIND SPEED FOR COOLING ESTIMATION)**
- **SIZE MEASUREMENTS (MASS, FRUIT GRADE)**
- **REFRACTOMETER, PH PAPER (MEASURE FRUIT QUALITY)**
- **CHLORINE PAPER TO MEASURE FREE CHLORINE IN WASH WATER**

SOURCES OF INFORMATION

**BRAMBLE PRODUCTION GUIDE
(CORNELL UNIVERSITY)**

NC BRAMBLE PORTAL

<http://www.ncsu.edu/enterprises/blackberries-raspberries>

<http://www.georgiaorganics.org/forfarmers/cropproduction/postharvest/WalkinCoolerConstruction.pdf> James Bartsch , Cornell, WALK IN COOLER 1986 Bull. No. 453

SOURCES-WEB SITES

- **NORTH CAROLINA STATE**

<http://www.bae.ncsu.edu/programs/extension/publicat/postharv/>

- **UNIV CALIFORNIA-DAVIS AND UC-KEARNEYSVILLE**

<http://postharvest.ucdavis.edu/>

- <http://anrcatalog.ucdavis.edu>

- **USDA HANDBOOK 66**

<http://www.ba.ars.usda.gov/hb66/contents.html>

postharvest.ucdavis.edu/Pubs/publications.shtml

- **Postharvest Technology of Horticultural Crops publication 3311 (UC-davis) 2002**
- **Postharvest Technology for Small-Scale Produce Marketers: Economic Opportunities, Quality and Food Safety**

QUESTIONS?





PICK FULL COLOR, FIRM, EASILY DETACHED



BE GENTLE!