



Post-Harvest, Storage, and Marketing for Winter Profits

February 2016

Paul & Sandy Arnold



OUR 10 KEY FACTORS TO REACHING OUR GOAL OF PROFITABLE FARMING

- *INEXPENSIVE START-UP WITH SMART EXPENDITURES*
- GOOD BUSINESS MANAGEMENT & RECORD KEEPING
- LABOR EFFICIENCIES TO MAXIMIZE PROFITS
- EFFICIENT PRODUCTION SYSTEMS & SOIL MANAGEMENT
- MULCHING AND WEED CONTROL
- PEST AND DISEASE MANAGEMENT
- SEASON EXTENSION-ROWCOVERS & FIELDHOUSES
- YEAR-ROUND HIGH TUNNEL PRODUCTION
- POST-HARVEST HANDLING AND CROP STORAGE
- CREATIVE MARKETING

Post-Harvest & Storage for Year-Round Sales



GROW QUALITY CROPS TO HAVE QUALITY PRODUCTS IN STORAGE



....AND QUALITY COMING OUT OF STORAGE



HARVEST AT PROPER TIME



- Netting for Insects
- 3 types
- Great investment
- Biothrips netting for thrips, flea beetle

**HIGH QUALITY AT
HARVEST MEANS
FASTER PROCESSING
AND HIGHER POST-
HARVEST QUALITY**





**Protek Netting 65 gram for Cabbage Moth
Brussels Sprouts—no spraying & High
Storage Quality**

KEEP WEEDS OUT!



CLEAN CROPS MEAN
FASTER HARVEST
AND HIGHER QUALITY
OF PRODUCE...





STORAGE

Pick the correct storage conditions for the Crop

WALK-IN COOLER FOR SHORT TERM COOLING & LOW HUMIDITY STORAGE



- Winter Squash
- Sweet Potatoes
- Onions
- Garlic
- Brussels Sprouts
- Leeks
- Potatoes
- Brassicas
- Greens

CROPS FOR STORAGE



CLIP STEMS
STACK GENTLY
CLOSE TO
WATCH STEMS
SQUASH

- WINTER SQUASH
- THE FIRST HARVEST
- EASY TO HANDLE
- LOADING



WINTER SQUASH



**SORT FOR
1ST & 2ND**

**WASH
BEFORE OR
AFTER??**



WASHING



Find the right
model of
equipment for
your needs

Roeters in Michigan

<http://www.roetersfarmequipment.com>

UNDER CUTTER BAR



- SOIL TYPE
- UNDER-CUTTER BAR

- SOIL TEMP
- SPACING



SWEET POTATOES



SWEET POTATOES



**BINS
20 BUSHEL**

TYPAR ROWCOVER

- **HEAT**
- **DEER**
- **PLANT SKYDD**



SWEET POTATOES

Pay attention to
details for
maximum profits



BETTER
QUALITY
MEANS A
HIGHER PRICE

CURING SITE #1

Multi-purpose always! "THE SHOP"



**An insulated and heated shop
Storage area for golf carts in winter
Washing area in summer for TEW veg washer machine
Curing/Storing area for crops**



Optimum Curing for Sweet Potatoes:

- 85-90 degrees for 4-7 days at 80-90% humidity
- Longer if cooler
- Taste better with age

STORAGE AREA #3:
When supply down,
move to heated cooler

CURING SITE #2



Optimum Curing for Winter Squash:

- **INDOOR: 80-90 degrees for 7 days with ventilation**
- **OUTDOOR: Field cure in sun for 5-7 days-CAUTION**
- **Longer if cooler**
- **Taste better with age**

Varieties vary for curing times

CURING SITE #2



- Vent-less Propane Heater—Or Electric
- Dehumidifier
- Plastic Bins- Decade \$130
- TEW Vegetable Washer



CURING SITE #2



- **Winnowed**
- **Field Cured**
- **Necks must be dried down well (at least 1 week in sun)**
- **Beware of sun scald**
- **Sorted as crated**

ONIONS

- Harvest time
- New ideas
- Labor saving



ONIONS



ALTERNATIVE
CURED IN
GREENHOUSE
ON RACKS or
ON BENCHES

ONIONS



STORAGE

- TEMP 32
- HUMIDITY 60-70%
- SAME FOR SHALLOTS

ONIONS



HARVEST

- FORK CAREFULLY OR UNDER CUTTER BAR
- CLIP OFF ROOTS
- STACK GENTLY

GARLIC

WASH

- POWER WASH VS NO-WASH
- EASY TO ID
- SECONDS
- REDUCES PREP TIME



GARLIC

RACKING

- BUILD AS
- GARLIC
- COMES IN
- AMPLE
- SPACE
- FAN



GARLIC



RACKING

- Alternative is in the High Tunnel
- Dries faster
- Shade cloth if needed


GARLIC

DRYING

- EASY ACCESS
- READY FOR SELLING!



GARLIC



**GARLIC
STORAGE
WITH ONIONS
32 DEGREES
60-70% HUMIDITY**

**MONITOR TEMPS
ALARMS GREAT**

WINTER STORAGE



- GREAT USE OF SECONDS
- PEEL AND PUT THROUGH FOOD PROCESSOR
- DEHYDRATE ABOUT 12 HRS
- GRIND MEDIUM COARSE
- BAG IN MINI-ZIPLOCK
- SELL AT \$1.50 FOR .03# (Heaping Tablespoon)
- VALUE ABOUT \$30 PER POUND
- STORE IN SEALED GLASS JARS IN COLD ROOM (35 DEGREES)

GROUND GARLIC



- Dig with Fork or Under Cutter Bar
- Sickle or cut off some of roots & very top

LEEKS



- PACK IN GRAIN BAGS
- STORE FEB+
- 32 DEGREES
- 95-100% HUMIDITY
- LIGHT FOR GREEN
- WINTER LEEKS STILL IN FIELD

LEEKs



Equipment
can make
harvesting
fast, fun and
efficient

CARROT HARVEST



- **BREAK OFF TOPS**
- **SORT INTO
GRAIN BAGS**
- **WINNOW BAGS**
- **LOAD BY
VARIETY**
- **STORE 32
DEGREES**
- **95-100%
HUMIDITY**

CARROT HARVEST



- Carrot Harvester
- FMC
- Single row
- Bought Used
- Pros and Cons

CARROT HARVEST



- 1 ROW
- POTATO
- DIGGER
- CHECCI
- MAGGLI
- 1 BUCKET PER
- GRAIN BAG
- LOAD BY
- VARIETY
- GENTLE!

POTATO HARVEST



- CELERIAC
- KOHLRABI
- RUTABAGA

- TRIM TOPS & ROOTS
- PACK IN GRAIN BAGS

**LONG TERM STORAGE
6-8 MONTHS+**

OTHER ROOT CROPS



**MEDIUM TO LONG
TERM STORAGE**

- **TURNIPS**
- **BEETS**
- **RADISHES—
Small round
red & winter**

- **TRIM TOPS**
- **PUT IN 5 GAL
BUCKETS**
- **POUR IN GRAIN
BAGS**

OTHER ROOT CROPS



**LONG TERM STORAGE
4-5 MONTHS**

- **CABBAGE—
RED & GREEN**
- **Storage #4**
- **Reaction**
- **Super Red 80**

- **CUT AT BASE**
- **PEEL EXCESS
LEAVES**
- **PUT IN GRAIN
BAGS**

OTHER CROPS



Efficiency of 20 Bushel Bins



**SHORT TERM STORAGE
6-8 WEEKS**

- **CELERY**
- **SWISS CHARD**
- **ESCAROLE**
- **SPINACH**

- **CUT AT BASE**
- **PEEL EXCESS LEAVES**
- **PUT IN STORAGE BINS**
- **MIST IF NEEDED**

OTHER CROPS



**SHORT TERM STORAGE
6-8 WEEKS**

- **LETTUCE**
- **KALE**
- **CAULIFLOWER**
- **BROCCOLI**

- **CUT**
- **PEEL OFF BAD LEAVES**
- **PUT IN OLDER STORAGE BINS**
- **MIST IF NEEDED**

OTHER CROPS

VEGETABLE	TEMP F.	RELATIVE HUMIDITY	STORAGE LIFE	HIGHEST FREEZING TEMP.
Beet, topped	32	98-100	4-6 mon.	30.3
Brussel sprouts	32	95-100	3-5 weeks	30.5
Cabbage, late	32	98-100	5-6 mon.	30.4
Carrot, mature	32	98-100	7-9 mon.	29.5
Celariac	32	97-99	6-8 mon	30.3
Celery	32	98-100	2-3 mon.	31.1
Garlic	32	65-70	6-7 mon.	30.5
Kale	32	95-100	2-3 weeks	31.1
Kohlrabi	32	98-100	2-3 mon.	30.2
Leek	32	95-100	2-3 mon.	30.7
Lettuce	32	98-100	2-3 weeks	31.7
Onion, dry	32	65-70	1-8 mon.	30.6
Potato, late	38-40*	90-95	5-10 mon.	30.9
Radish, Winter	32	95-100	2-4 mon.	
Rutabaga	32	98-100	4-6 mon.	30.0
Squash, Winter	50*	50-70	Varies	30.5
Sweet Potato	55-60*	85-90	4-7 mon.	29.7
Turnip	32	95	4-5 mon.	30.1

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

Adapted from Knott's Handbook for Vegetable Growers

ROOT CELLAR 20 FEET BY 30 FEET UNDER BARN

- 7 foot Ceilings
- Insulated
- Into bank on 2 ½ sides

ROOT CELLAR





Loaded via
assembly
line into the
root cellar

2016-
Revamp
Root Cellar

ROOT CELLAR



All crops loaded
by variety on
separate pallet
or section of
pallets

Stored
Unwashed

ROOT CELLAR



Root cellar is used all winter for crates ready for market

Enables us to shut off the small cooler & use it for other type storage space

ROOT CELLAR



\$10,000 System: Specialized for high humidity storage

Oversized condensor

Heating cycle to defrost

Adjust through the seasons

Compressor-- 3HP outside



- Capacity is about 24 pallets with 18" walkway
- Approximately 1 ton per pallet when stacked to ceiling
- Total = 24 tons
- Value of produce stored: \$85,000++



2016 PROJECT

- Re-vamp the Root Cellar
- Cement Floor
- 4 foot door
- Bins with Crown pallet jack
- Plastic pallets

WEATHER STATION



SOLAR TEMP HUMIDITY WIND RAIN

REMOTE SENSORS

- TRANSMIT
BACK TO
THE HOUSE
- ALARMS

WEATHER STATION



WEATHER STATION



- Wireless
- 4 Stations
- Computer
- Davis Vantage Pro II
- Repeater

Scientific Sales, Inc.



Store fruits in different facility

Ethylene gas causes maturity and bitterness

Keep Root Cellar Clean and Tidy

Rotting produce also causes maturing

KEEPING QUALITY



Carrots

Potatoes

Beets

Kolhrabi

Turnips

Radishes

Rutabagas

Celeriac

ROOT CROPS

WHAT WE STORE



CABBAGE

LEEKS

BRUSSELS
SPROUTS

CELERY

CAULIFLOWER

Medium
Storage Crops

WHAT WE STORE



Short Term Storage Crops

Lettuce

Kale

Swiss Chard

Spinach

Escarole

Broccoli

WHAT WE STORE

- **ROOT CELLARING & STORAGE OF PRODUCE IS AN INEXPENSIVE WAY TO INCREASE SALES**
- **BENEFITS YEAR-ROUND MARKETING/INCOME**
- **SEPARATE STORAGE FACILITIES IMPORTANT**
- **MONITOR STORING CONDITIONS**
- **CURE PROPERLY FOR QUALITY**
- **KEEP CUSTOMERS HAPPY**

SUMMARY

WASHING STATION



1990 EARLY YEARS: PUTTING \$10,000 EACH YEAR
BACK INTO THE FARM – SPEND \$ TO MAKE \$



MORE WINTER WORK – LOOK AHEAD



**1995 REVISION 2:
Heated Washing Station
Insulated Overhead Doors**



FINAL REVISION!! 2015



FINAL REVISION!! 2015



12x14 cooler-Insulation-Radiant Heat



Drains-Cooler Insulation



American-Slider Doors



ACCESS DOORS-Auto keypad openers



HARVEST CRATE STORAGE



LOADING FOR MARKETS MADE EFFICIENT



Barrel Roots Washer-Winch



Switches-Water, On/Off both ends, Lights



Setup for Efficiency-Drain



**Lights-Platform (Soon!)-Golf Cart storage
POWER WASHER for root crops**



BARREL WASHER-CRATES-OLD SYSTEM



Can wash over 400 pounds of root crops in an hour with 3 workers!

- **\$1000 AND 2 WEEK PAYBACK**

Get more done in less time...can keep price down.



Air heat-Reznor-2 Days



SYSTEMS-READY TO GO FOR WASH/PACK DAY!



HOSE RETRACTOR-NEAT & TIDY



BUBBLER

- **200 gallon**

Milk bulk tank

- **Jacuzzi Motor**

- **Efficient**

- **400 bags spinach
in 90
minutes = \$1200**

- **OR \$800/hour
with 4 workers**

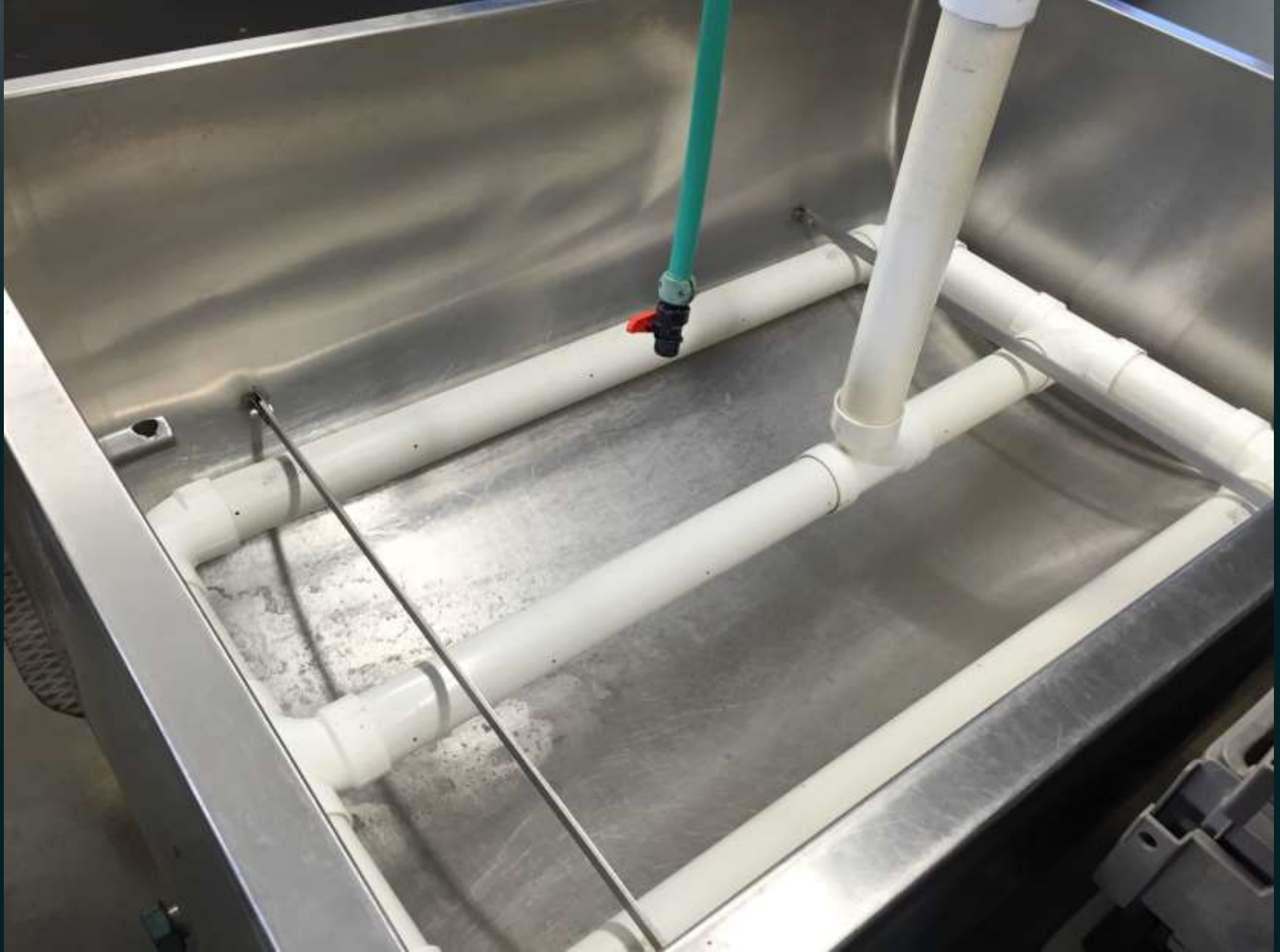


BUBBLER GREENS WASHER



3" PVC PIPE
WITH $\frac{1}{4}$ "
HOLES
FACING UP

SPECIAL BARS
WELDED IN



Motor in attic-Warm water



Liz.Cashman@ecolab.com

\$97 for 5 gal pail shipped

Test Strips

SANITIZE? STORAGE LIFE

BUBBLER GREENS WASHER





Efficient assembly line

**Load
vented
baskets...**

**Then
netted
bags**



- **Washing machine**
- **Spin cycle on switch 8 Sec**
- **Arugula, Salad Mix & baby spinach**



- **Washer**
on wheels
- **Retract-**
able cord



- **Everything at hand**
- **Vented bags**
- **Standard count per crate**
- **Market crates never on floor**





- Wash Greens first
- Cleanest to start

- Use test Strips to retest if more sanitizer needed



- Crates on wheels
- Floor Drains
- Knife racks
- Auto front door
- Cement to cooler



EFFICIENT SYSTEMS IN THE WASHING STATION

- Rubber bands pre-bunched
- Backup Scales
- Two per market





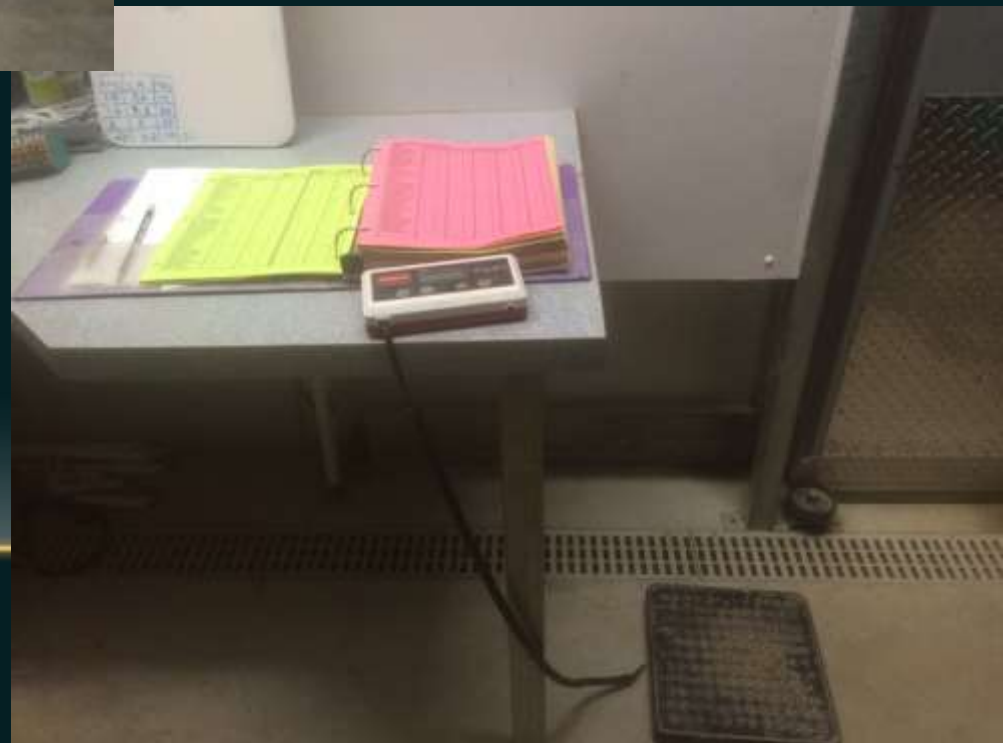
**WARM
WASH
WATER**

Hand-washing Sink-Instant Hot Water-Stiebel



- **WHITEWASH BOARD**
- **LABOR POSTERS**

- **HARVEST/RECORDS**
- **IPAD**
- **SCALE**
- **CAMERA**



HARVEST LIST FOR DECEMBER 2009

ITEM	SAR		GF		SAR		GF	
	12TH	LO	12TH	LO	19TH	LO	19TH	LO
APPLE CEDER								
ARUGULA								
ASIAN GREENS								
BEETS-BULA	40	2						
BROCCOLI	20							
BROCCOLI RAAB								
BRUSSELS SPROUTS	40	2	20					
CABBAGE RED	15							
CABBAGE WHITE	20	15						
CARROT ORANGE	3							
CARROT RED/PURP	1/2		1/2					
CAUL CHEF/WHITE								
CELERIAC	1		1					
GARLIC	150		100					
ICEBERG LETTUCE								
KALE	20		15					
KOHLRAB	1		1					
LEEK	25		25					
LETTUCE ENCRISLE	100	20	100	15				
MESCLIN	20		15					
POTATO ADAK RED								
POTATO BLUE	1		2					
POTATO FINE RED/PEL	1		1					
POTATO RED	2		1					
POTATO RUSSETT	1		2					
POTATO YELLOW	2		1					
RADISH	1		1					
RUTABAGA								
SCALLION	20		15					
SHALLOT	1		1					
SPINACH	100		25					
SWEET POTATO	2		1					
SWISS CHARD	25		5					
TURNIP 20-ROW/BLK	1		1					
TURNIP 20-ROW/BLK								
WINTER SQUASH								

Use prior to harvest

Write in what we want the crew to harvest and how much of each

Shows leftover that can be sent after sorting and re-cleaning

Harvest prep list

Year-Round Washing Station for Energy Savings & Efficiency

- STAINLESS STEEL

- NEXT TO ROOT COOLER



GOLF CARTS



- Move lots quickly from field to wash area to maintain produce quality

USE SEPARATE CONTAINERS FOR HARVESTING VS MARKETS





**CRATES FOR EVERY PURPOSE
HIGH QUALITY BUCKHORN CRATES**

WASHING CRATES



- High Pressure Washer
- Clean weekly or bi-weekly
- All harvest & market crates





**CLEAN UP
EACH DAY!**

**•BUBBLER PIPES
BRUSHED OUT
AFTER EACH USE
& PIPES DRY**





Reduce risk of contamination with washable walls, floors, equipment, etc.

- ❖ EMPLOYEE HANDBOOK-MARKET & FARM
- ❖ SAFETY REQUIREMENTS
- ❖ BATHROOM & HANDWASHING RULES
- ❖ SICKNESS
- ❖ WASH STATION PROTOCOL
- ❖ ATTIRE REQUIREMENTS
- ❖ SHOE/BOOT RULES
- ❖ FIRST AID/CUTS
- ❖ POSTERS & REGULATIONS POSTED
- ❖ NEW HIRE SAFETY TRAINING
- ❖ ANNUAL REVIEWS
- ❖ ++++++ FSMA+++GAPS
- ❖ <http://producesafetyalliance.cornell.edu>
- ❖ **HAVE A FARM SAFETY PLAN**

MARKETING – THE FUN PART!



Must be a Better Marketer than Grower

FEEDING FOLKS EVERY WEEK OF THE YEAR





Lots to learn!

22 years ago!

Great tarp system

Wide table for
displays

Color
coordination

Signage

Banana boxes

Inexpensive
system

Messy with
banana boxes



Good and Bad



- Silver Tarps
- White Tarp

Red and White
Awning so we
stand out





**Always work
To be done!**

**Misting the
table
constantly to
keep quality of
produce up**



Color...color...unique varieties



JUNE
Root Cellar crops/Strawberries
Bags hanging & handy



Pile it High and Watch it FLY!



Greet! Have Fun! Smile! Give 110% to Customers!



High Profit... Low Profit



Diversity
Is Our Key for
Marketing...
One stop shopping!



How Does a Brussels Sprout Grow?



**Pre-bagged instead of weighing at market
Vented bags for spinach & salad mix**



EMPLOYEE HANDBOOK FOR FARMERS' MARKET

Customers are always right & everything is guaranteed 100%

LAMINATE THE SIGNS



SIGNS AND INFORMATION IMPORTANT
Homemade wooden bins fit in our Buckhorn crates



Back-stock available...and lots of trials!



- Back-stock baskets ready to go on table
- Hire one person to be full-time stocking
- Have table look full from beginning to end



DRESS UP THE TABLE!



**Build shelves for
multiple levels**

**More display
space**

**Go up rather than out
More visual**





**Customers Buy with Their Eyes!
Diversity of Lettuce...mini and full size heads.**



SPRING DIVERSITY: PLANT FOR COLOR & CUSTOMERS' WANTS-ALL GREENS FROM TUNNELS



High value plant starts—Herbs very popular



High Quality and Good Preparation



DISPLAYS ARE EVERYTHING!



Front & Center to move out!

Change and move displays!

High quality leads to good prices, satisfied customers and loyal customers



WIC, FOOD STAMPS (EBT) & TOKENS For Extra Income



CUSTOMER EMAIL NEWSLETTER



End of regular season

October 31st!

**Dressing up the Display
with seasonal colors!**



WINTER MARKETS NOVEMBER 1ST TO MAY 1ST

Can be inside or
outside after
November 1st...
weather
dependent





**WHAT IT TAKES.....
4 TO 6 MAN-HOURS!**

**Enclosed Vehicle
Necessary for Winter
Markets**

**Load just before
market**



November!!

We don't fit inside yet! 30+ feet long!





**Color
catches their
eye....**

**Flavor brings
them back....**



**Have scales (2) charged & ready
Place basket on & tare for ease**



**Give recipes for unusual items
Cut up samples to try like Kohlrabi**



“Large-Leafed Salad Mix” not Asian Greens



Mixed Kale Bunches Very Popular

**November!!
Still need 5 people
on the table**





**SATURDAY
BEFORE
THANKSGIVING**

**HIGHEST
SALES DAY OF
THE YEAR!!!**





NOVEMBER 22ND 37 DIFFERENT ITEMS FOR SALE!



DECEMBER
BOTH MARKETS
NOW INSIDE
UNTIL SPRING!!

Very Popular:
7 Winter Markets
within one hour



High tunnel fresh produce makes winter markets come alive!!



**WINTER
MARKETS
NOVEMBER 1ST
TO
MAY 1ST**

**DIVERSITY
CAN BE AN
AMAZING
DRAW**



Special events and press releases
Cooking demos with market products



Saratoga Market Jan 7th
35 Vendors-Gym costs \$700 per day



Family member present



**DIVERSITY AND BIG DISPLAYS!
TAKEN IN MID - JANUARY!**



Summary for marketing essentials:

- Misting
- Quality control
- Pile High
- Color coordinate
- Diversity
- Back stock
- Smile
- 110%
- Guarantee
- Learn names
- Take orders
- Tarp
- Signage
- Recipes
- Knowledge

What Farmers Markets Mean to Us

- Year-round income for stability
- Year-round workers
- Providing year-round local produce to our customers
- Work less in the summer-Vacations!
- Have fun farming in all seasons—what we enjoy!





Feel good about serving customers abundant, healthy produce all winter!

NO BETTER WAY OF LIFE: RAISING HEALTHY FOOD YEAR-ROUND AND RAISING CHILDREN ON THE GREATEST PLACE ON GOD'S EARTH: A FARM!!



THANKS AND HAVE A GREAT WINTER & 2016 SEASON!

Hawaii 2006



Alaska, Glacier 2011



- Questions? Email us at : arnold.pvf@gmail.com
- Call us! 518-638-6501
- Come visit anytime! Food and beds available always!
- Come be an intern or work on our farm for any time frame!