Wine Grape Vineyard Site Selection

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2018 Wine Grape Vineyard Establishment Conference

Thanks to

Dr. Ron Perry, MSU Department of Horticulture, East Lansing

and

Dr. Tom Zabadal, Southwest Michigan Research & Extension Center, Benton Harbor

Site selection is probably the most important decision a grower will make, especially in Michigan.

To establish a vineyard, one must consider three very important factors:

1. **Climate**
2. **Topography**
3. **Soils**

Climate

In winter, low temperatures can
result in severe injury.

In late winter and early spring,
injury can occur when fluctuating temperatures in late winter lead to deaclimation and early bud break.

Climate has a tremendous influence on aromatic characters and flavors in grape berries.

Climate

Climate is broken down into:

1. Macroclimate of the region; SW vs Northern Michigan, etc.

2. Mesoclimate of a local region; south facing slope of a hill or mountain range, end of the Old Mission Peninsula

3. Microclimate; the climate immediately around the vine canopy (hot humid summers can accelerate disease pressure).

Macroclimate

The Great Lakes have a tremendous influence on the climate of our region

Large bodies of water moderate temperature extremes

Macroclimate

The Great Lakes moderate our climate to allow Michigan to grow 140,000 acres of fruit crops.

Macroclimate

Within Michigan, many sites have excellent potential to successfully grow grapes as long as there is an understanding as to what grape cultivars adapt best to the region.

Largely, it is resistance to low temperatures which limit cultivar selection for a specific site.

Mesoclimate

Regional landforms, differences in elevation, additional bodies of water, all contribute to variable mesoclimatic conditions in an area

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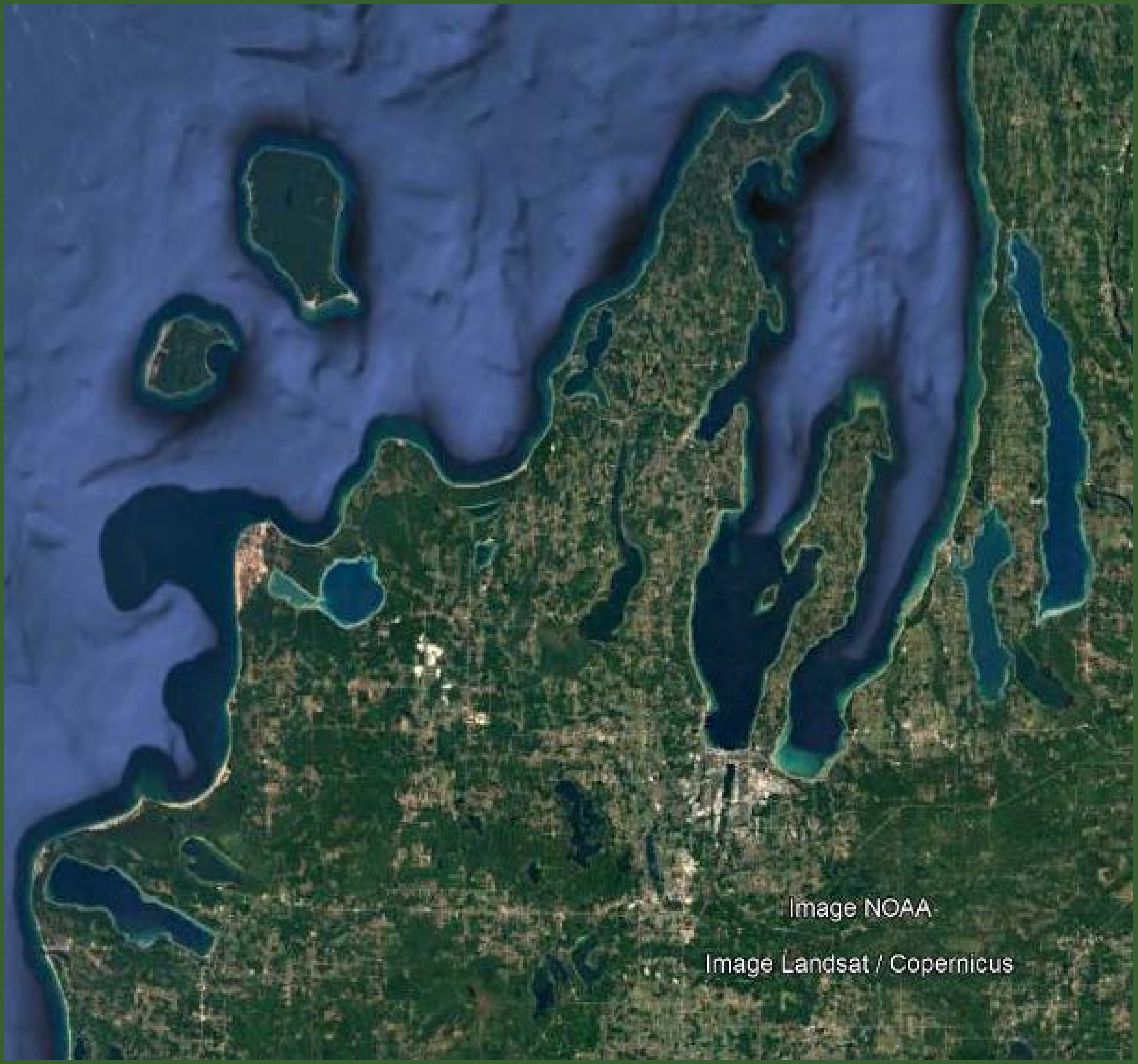
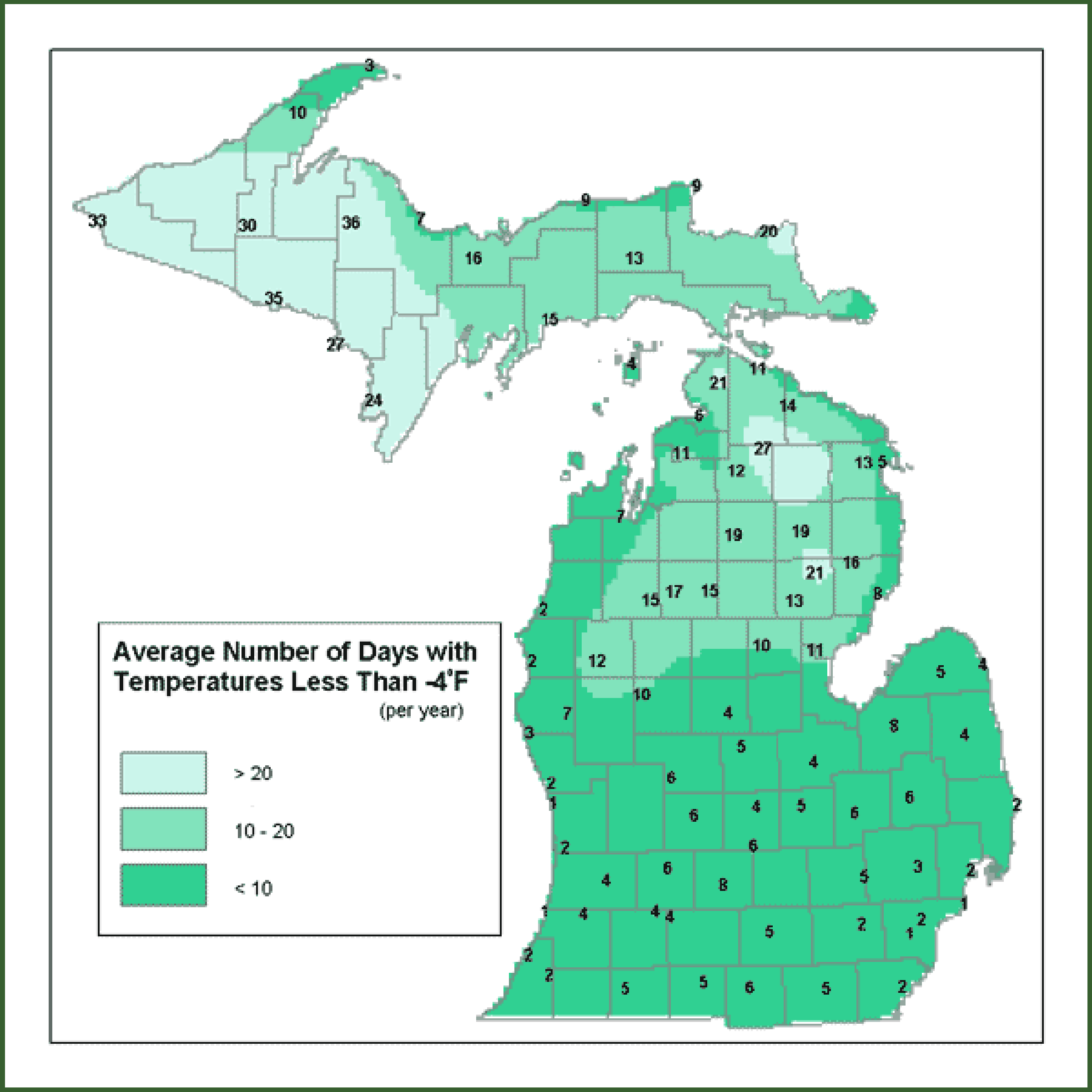


Average Number of Days with Temps Below -4F

Data and maps prepared by Aaron Pollyea, Peter Kurtz, and Tracy Aichele, Michigan Climatological Resources Program, Michigan State University Department of Geography, based on data from the NOAA, 1952-2001.



www.grapes.msu.edu/climate.htm

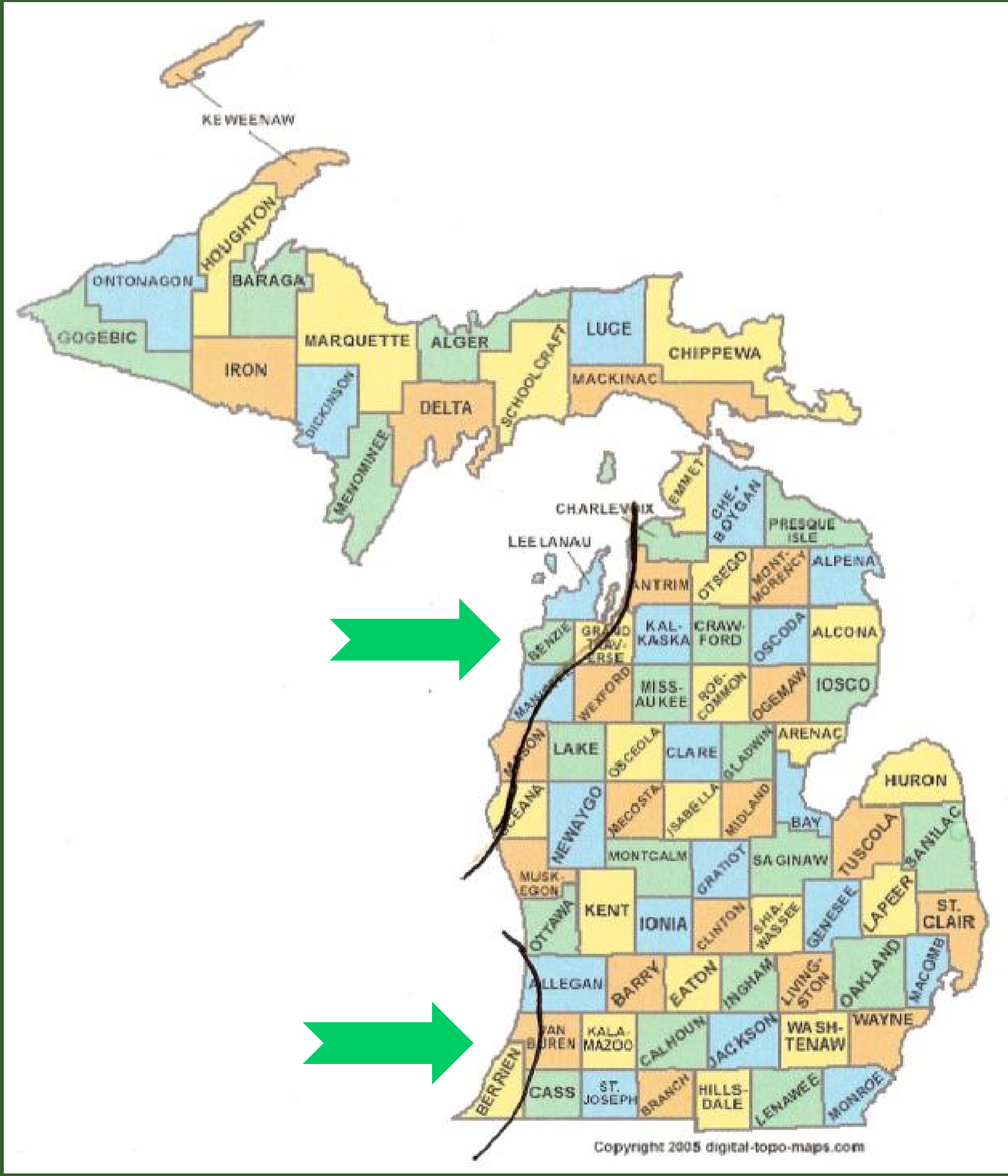
Winter Cold

Table 3. Vineyard site classifications for Michigan and their descriptions, based on winter minimum temperature data.

Vineyard site classification	Classification description	Occurrence of -5° F (yrs/10 yrs)	Occurrence of -10° F (yrs/10 yrs)	Occurrence of -15° F (yrs/10 yrs)	Long-term winter minimum temperature
Excellent	Suitable for cold-tender and hardier varieties, but cold-tender varieties may experience moderate or severe winter injury in 1 to 3 years and 1 year out of 10, respectively.	≤ 6	≤ 3	≤ 1	≥ - 20° F
Good	Suitable for cold-tender and hardier varieties, but cold-tender varieties may experience moderate or severe winter injury in 1 to 4 years and 1 to 2 years out of 10, respectively.	≤ 9	≤ 4	≤ 2	≥ - 24° F
Acceptable	Suitable for moderate or hardier varieties. These vines may experience moderate or severe winter injury in 1 to 3 years and 1 year out of 10, respectively.	≤ 10	≤ 6	≤ 3	≥ - 24° F
Unacceptable	Not suitable for sustained, commercial production of any varieties.	≤ 10	≤ 8	≥ 4	≤ - 25° F

Michigan regions suitable for vinifera cultivars

(still with some risk)



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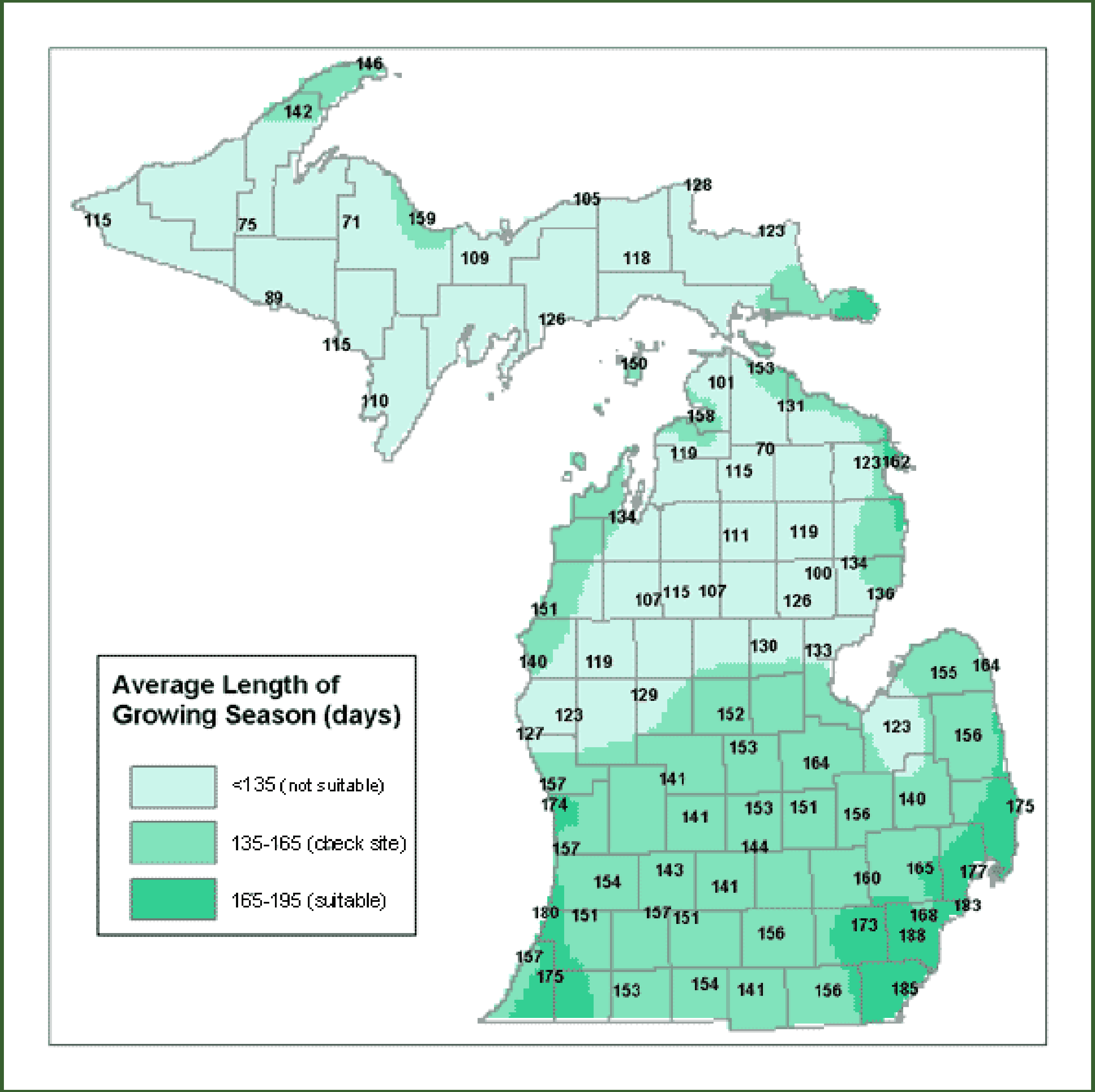
Super cold hardy varieties		≤ 10	≤ 8	≥ 4	≤ - 25° F

Mean Length of Growing Season



Growing Degree-Days (GDD)

- Used in New World grape growing to assess impact of growing season temperatures on wine quality.
- A daily measure of heat that is physiologically useful to a grapevine. Typically calculated as the average temperature of the day above 50 F.
- Developed by A.J. Winkler. 1965, General Viticulture. Univ. of Calif. Press, 633 pp.
- Typically starting April 1, accumulated to Oct 31.

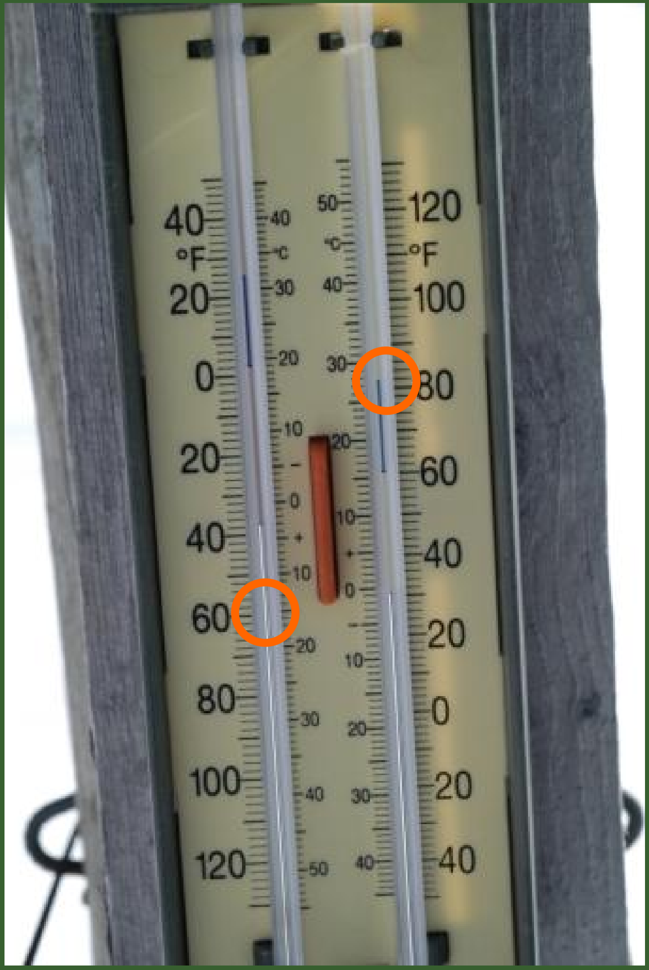
Growing Degree-Days (GDD)

- Example calculation for a day that had a high of 80 F and a low of 60 F.

GDD = ((80 + 60) / 2) – 50

= 70 - 50

= 20 degree days



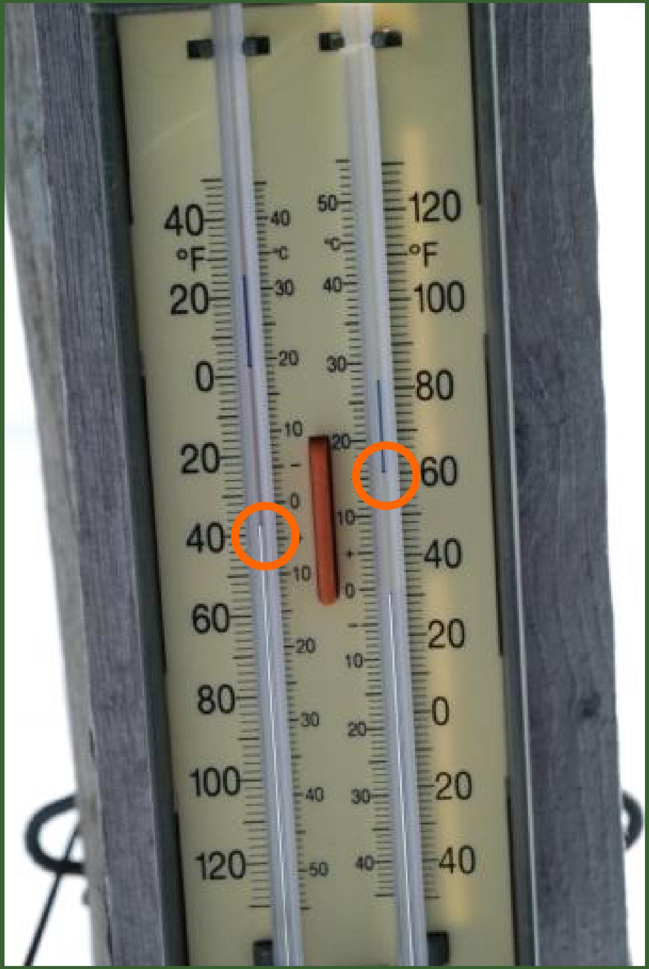
Growing Degree-Days (GDD)

- Example calculation for a day that had a high of 60 F and a low of 40 F.

GDD = ((60 + 40) / 2) – 50

= 50 - 50

= 0 degree days

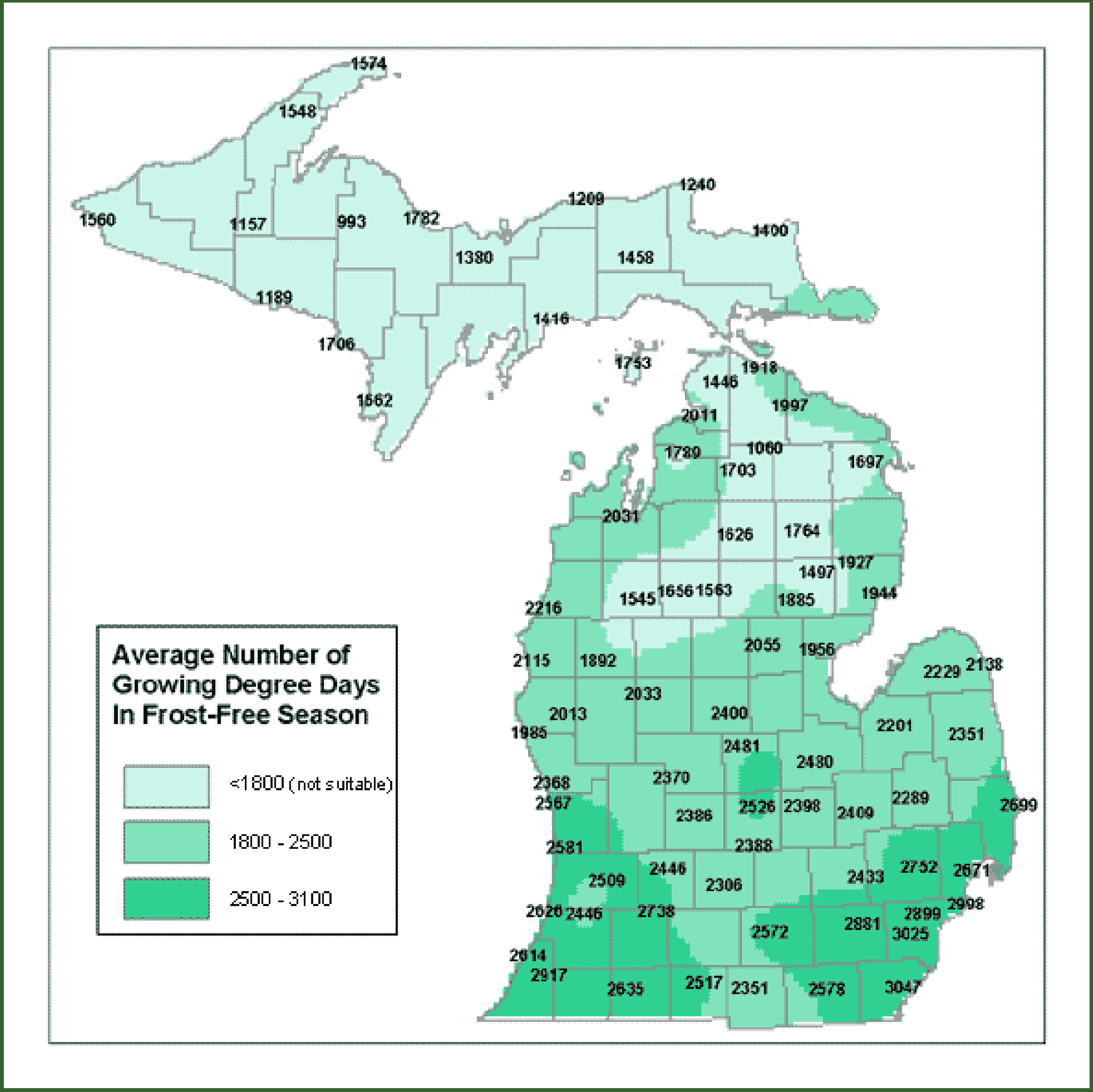


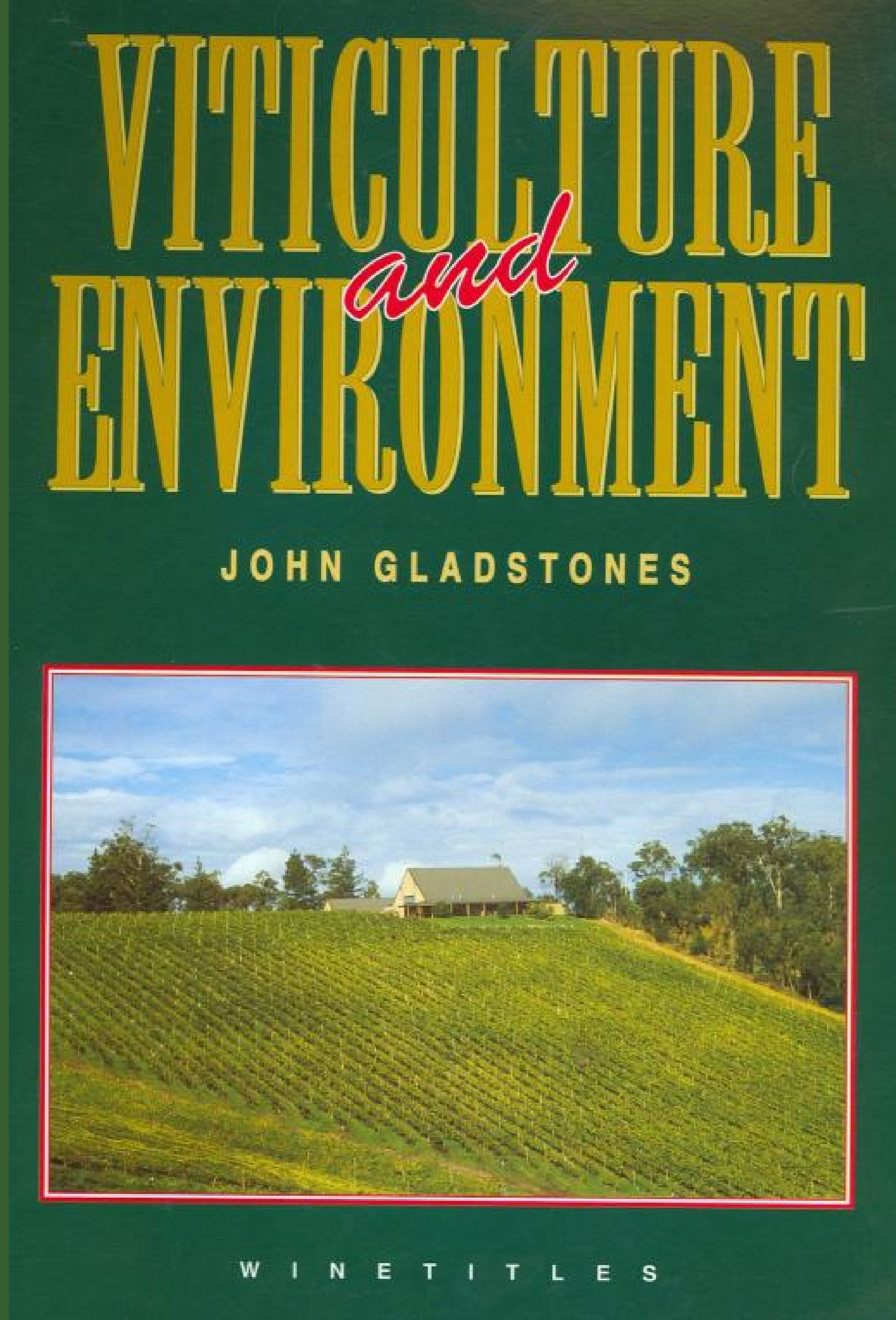
Examples of seasonal degree day accumulation in high latitude vine growing districts.

(Adapted from website information provided by R. M. Pool)…T. Zabadal

	Latitude	Seasonal Degree Day Accumulation (50^{0}F base)
Reims, France (Champagne)	49º 20'	1,756
Dijon, France (Burgundy)	47º 15'	2,084
Bordeaux, France	44º 50'	2,464
Canberra, Australia	36º	2,714
Bolzano, Italy	46º 30'	2,985
St. Helena, California	38º 30'	3,302
Fresno, California	36º 40'	4,684
Watervliet, Michigan (2005)	42º 08'	3,210

Average Growing Degree Days




VITICULTURE
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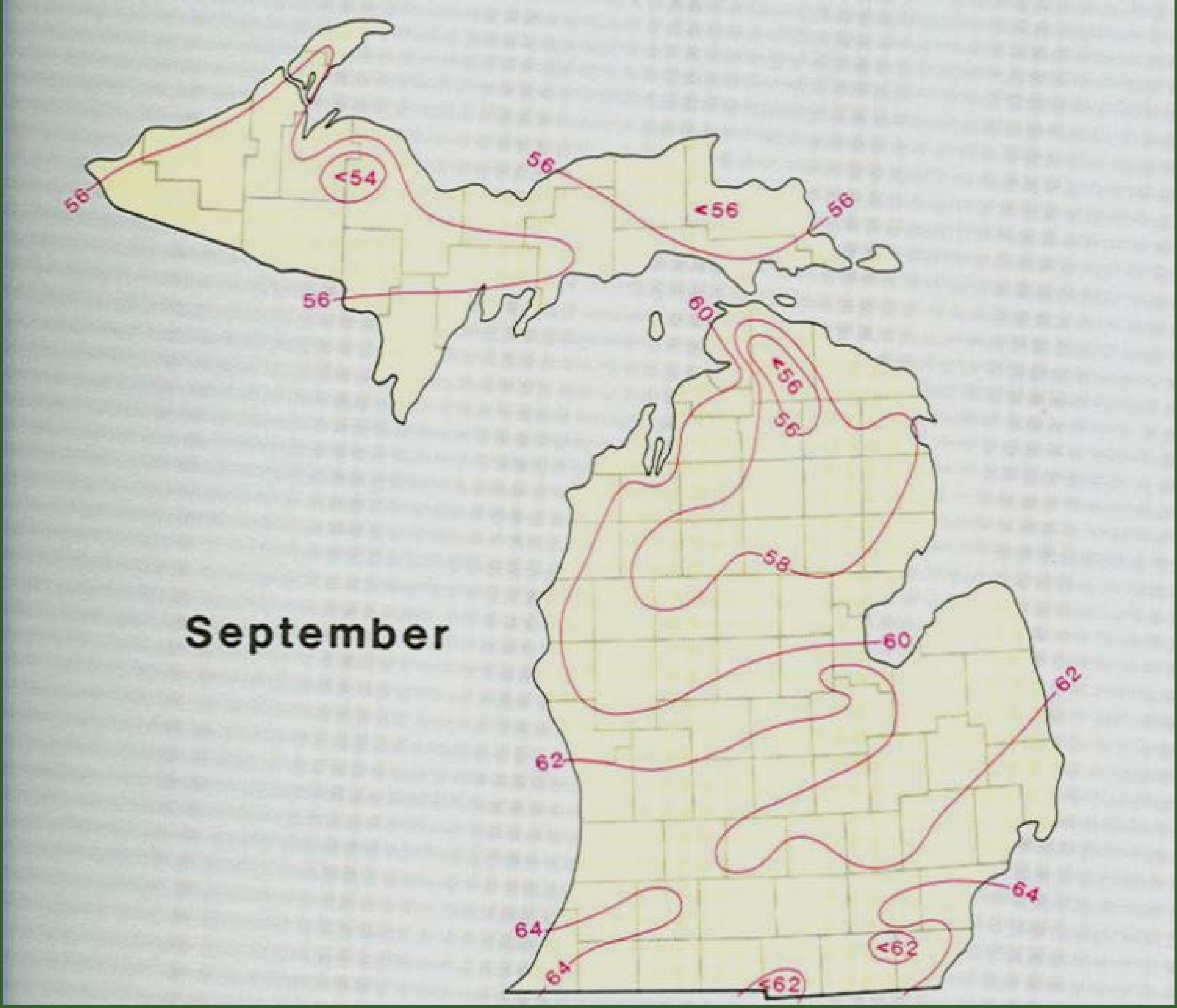
JOHN GLADSTONES
WINETITLES

Influence of the ripening month mean temperature average on wine quality. (Adapted from Viticulture and Environment by J. Gladstones)… T. Zabadal.

Mean ripening month temperature	less than 59º F	59 to 70 ºF	greater than 70 ºF
Wine quality	inferior	***optimum***	inferior
Fruit characteristics	High acid Questionable ripeness Low sugar	Sugar/acid balanced Good fruit character	High sugar Low acid

Mean monthly temperature from 1951 to 1980

(From The Climatic Atlas of Michigan by Eichenlaub et al., 1990)… T. Zabadal



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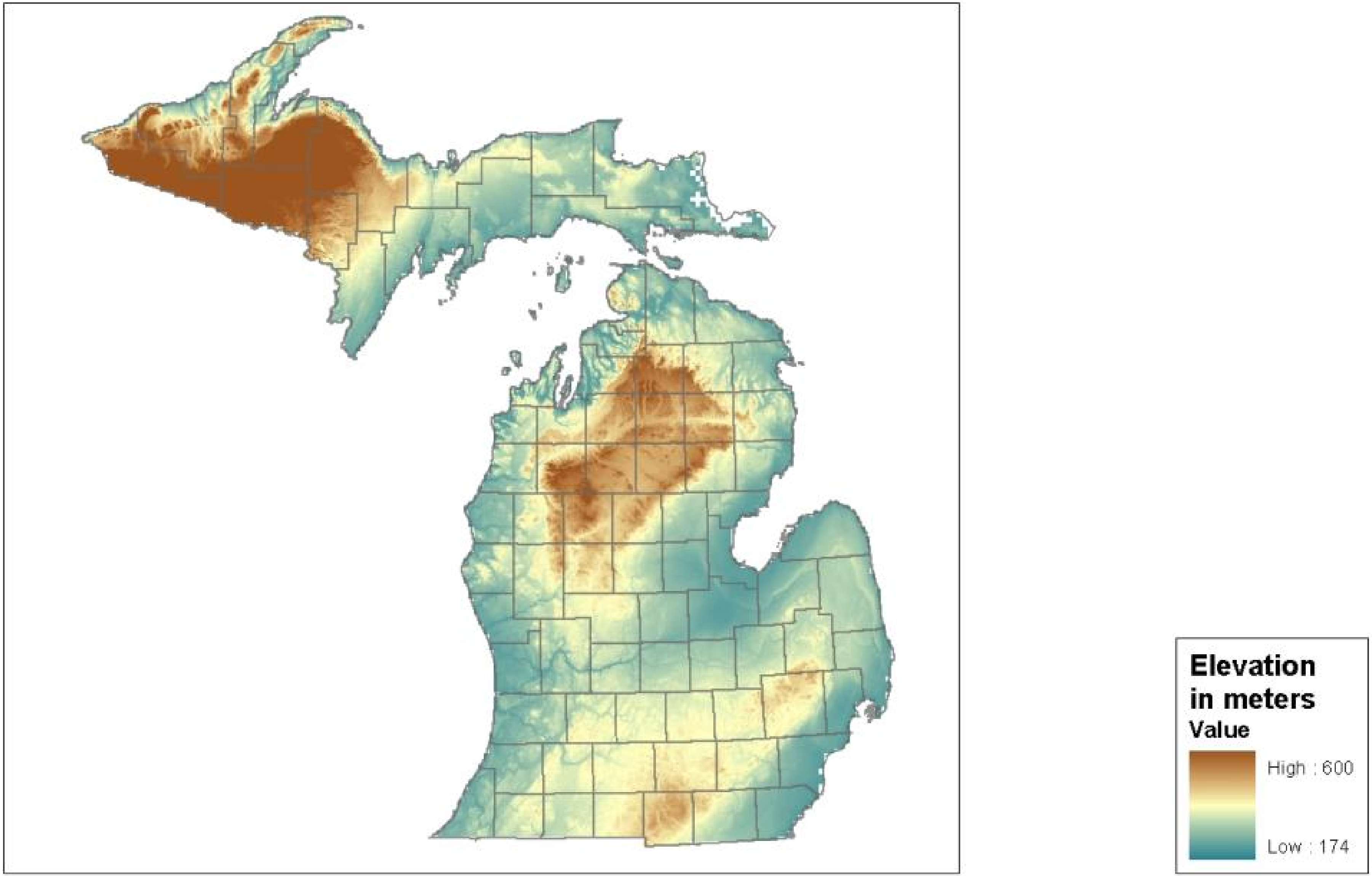
Topography



Local Topography

Influences of Slope on vineyards

- South to southwest facing slopes provide best degree day accumulation and fall ripening conditions
- Slopes provide for movement of cold air out of vineyards
- Slope suitability limited by only by ability to manage the site
- Terraced vineyards are possible

Solar radiation is influenced by slope and aspect for sites in cool climates

(from Jackson, R.S. 2000. *Wine Science; Principles, Practice and Perception.* *Pub. by Academic Press, San Diego, CA. 648 pp.*

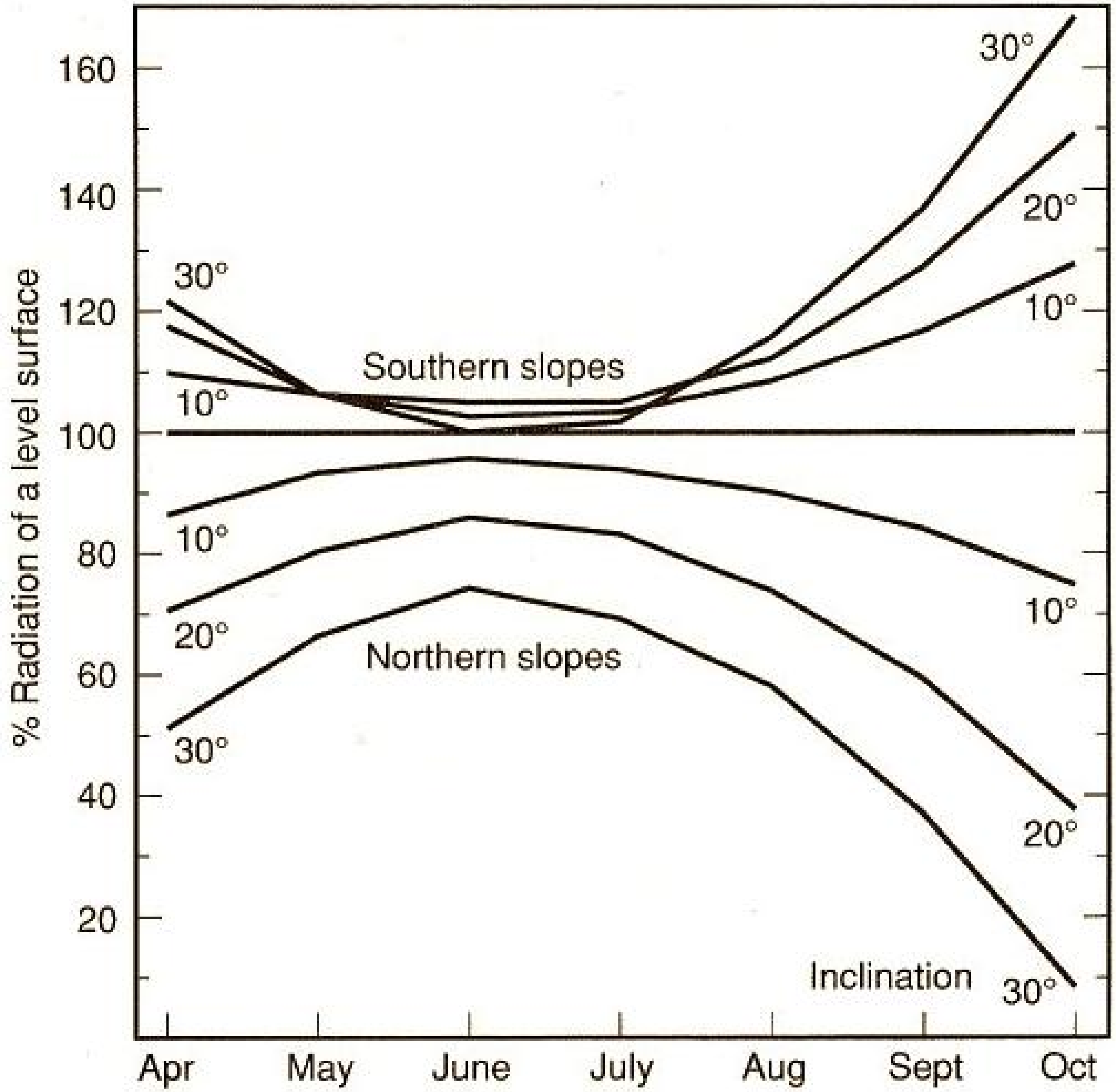
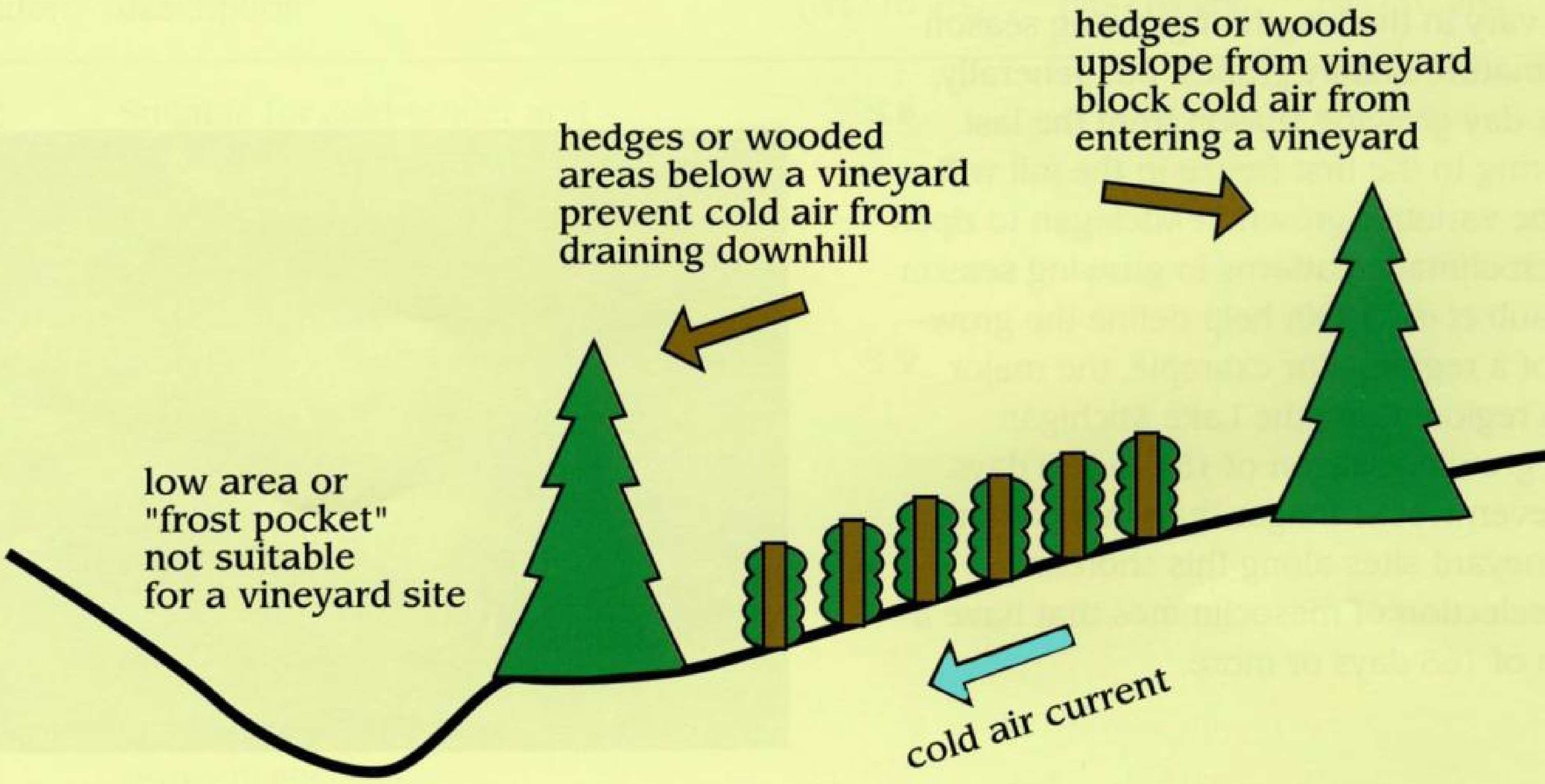


Figure 5.5 Reception of direct sunlight in relation to position and inclination of slope (48°15′N) in the upper Rhine Valley (from Becker, 1985b, reproduced by permission).

Cold Air Sinks and Flows Downhill

- **Very important during spring and fall frosts**



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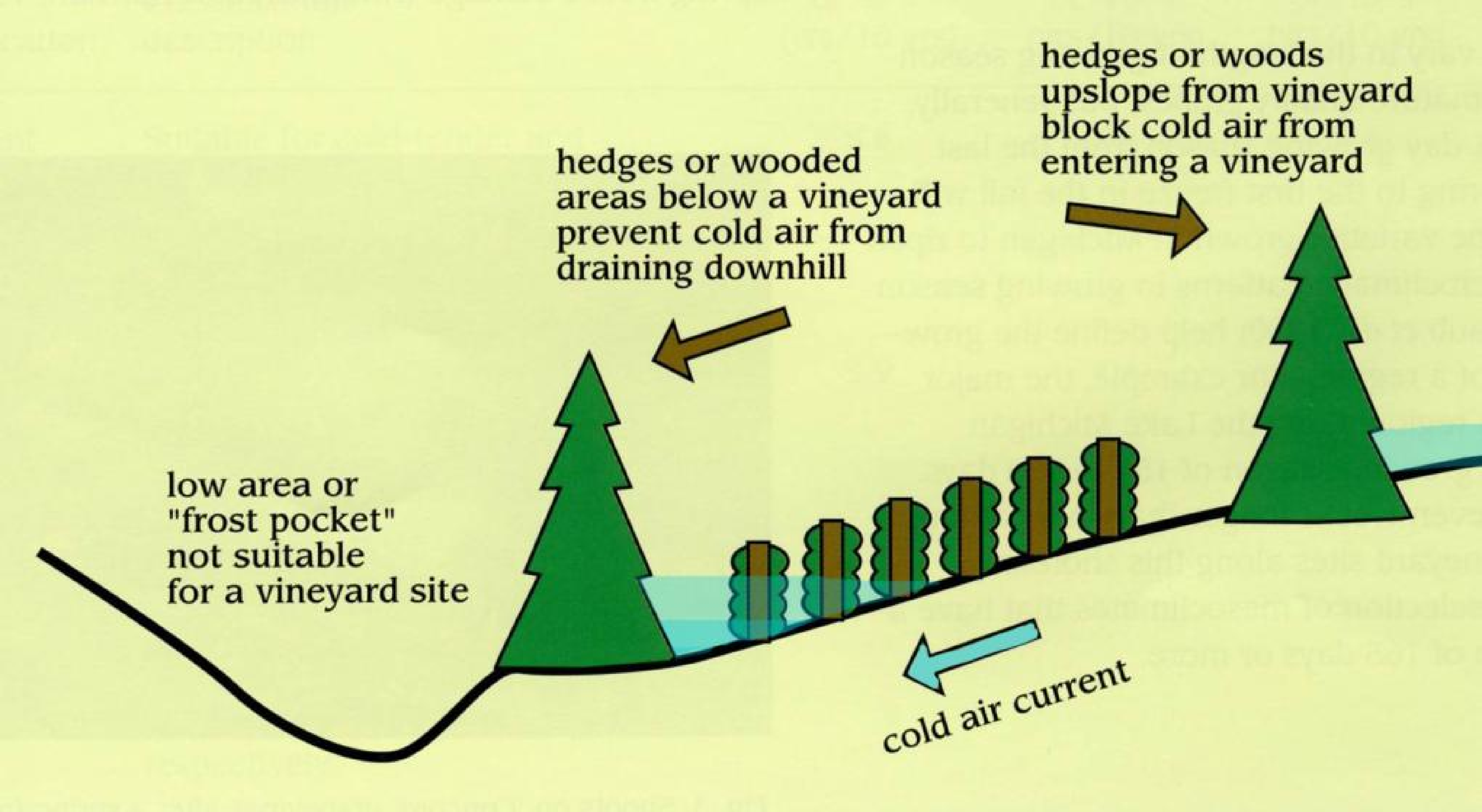

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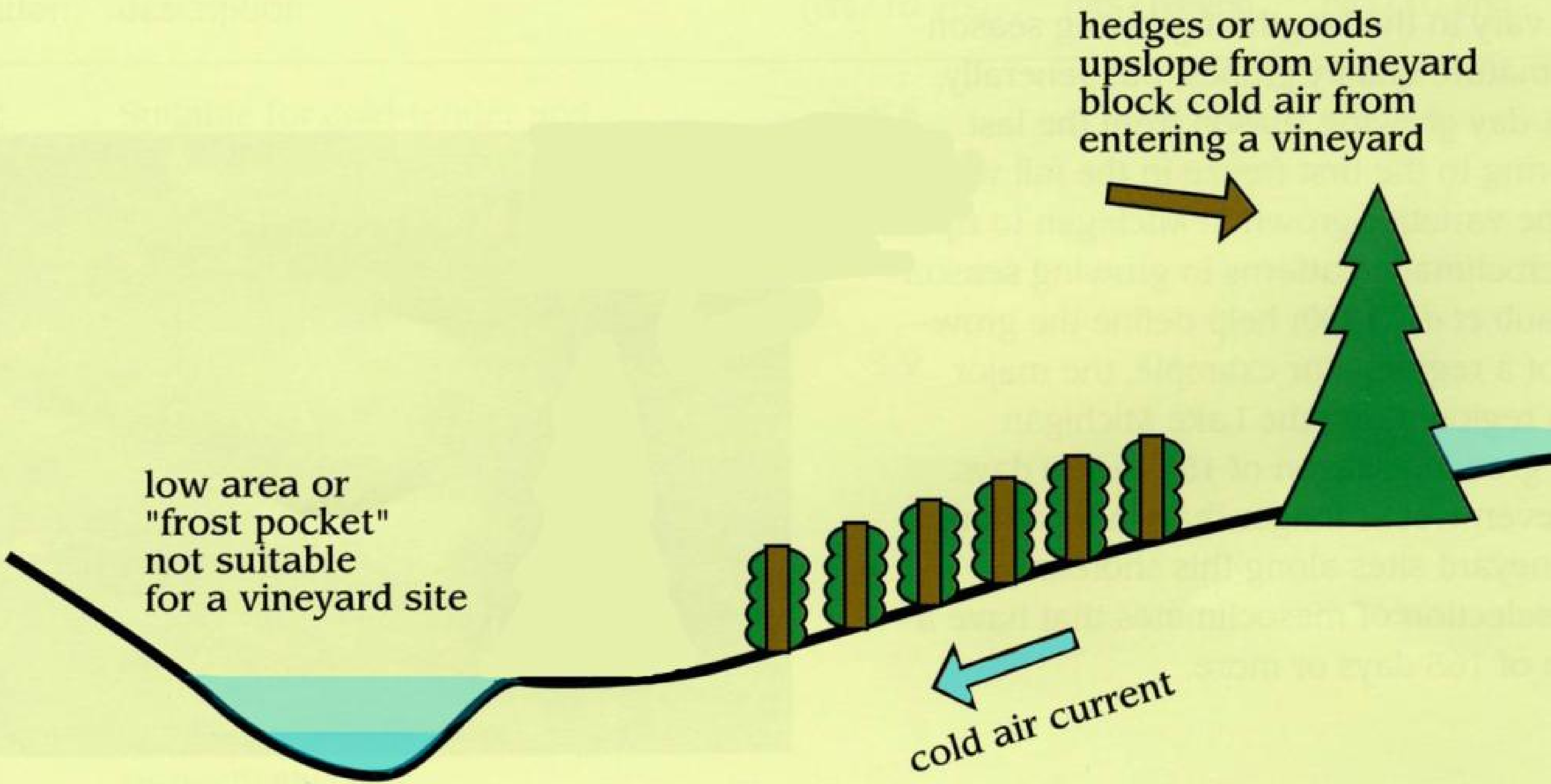


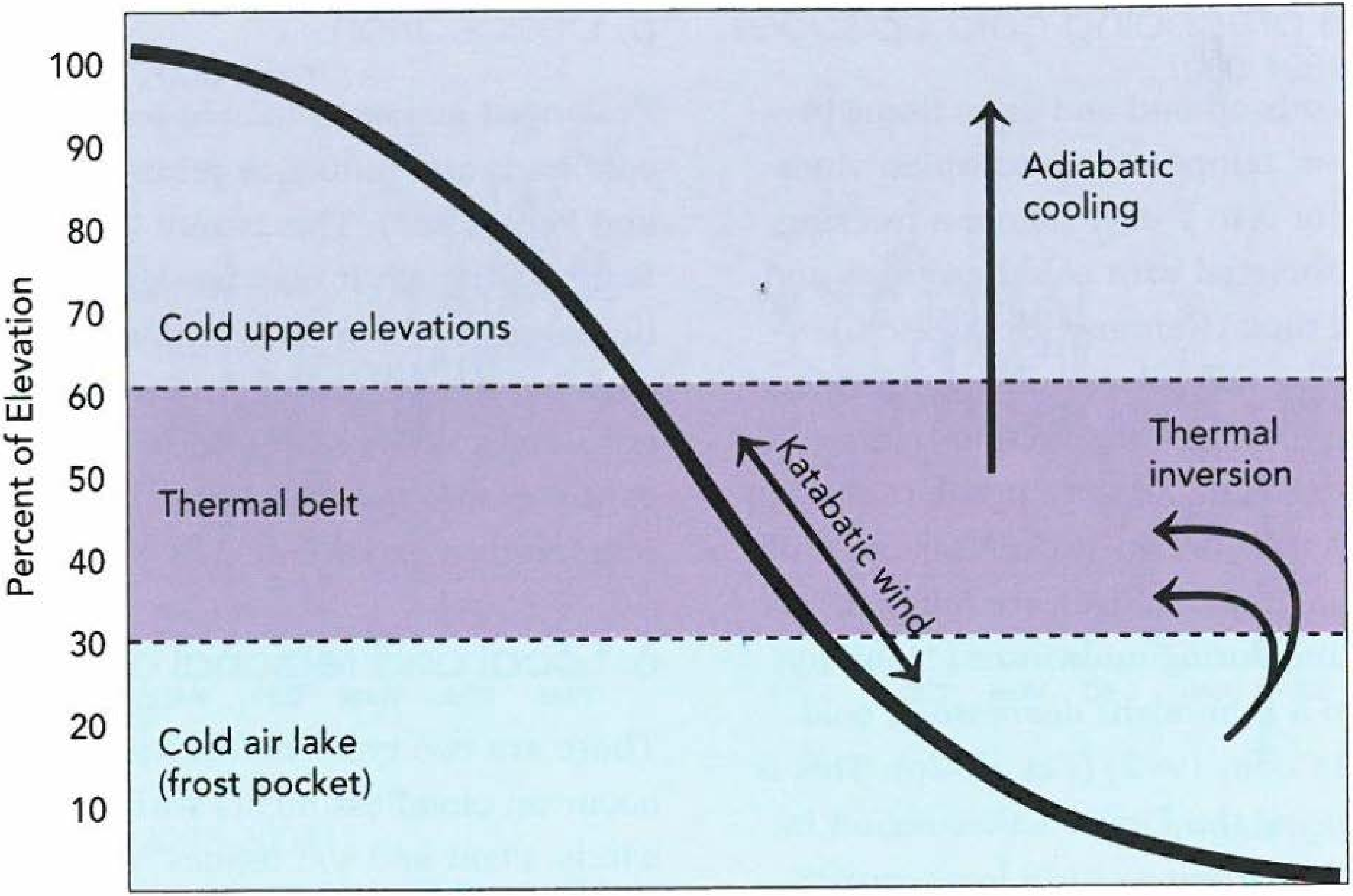


Fig. III-3. A schematic to show the zones of temperature created on a slope as a result of katabatic winds, thermal inversion and adiabatic cooling.

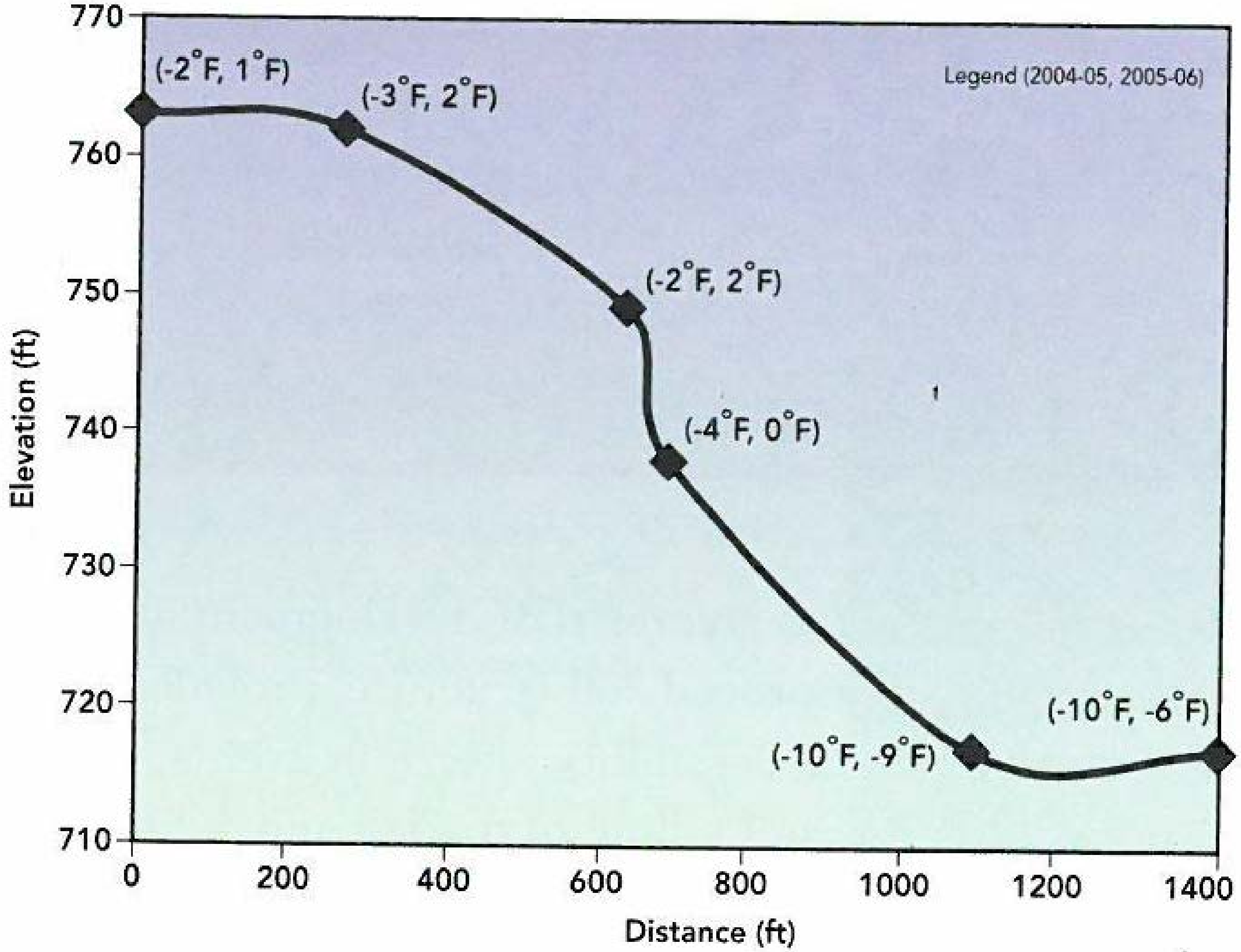


Fig. V-3. The minimum temperature at 60 inches above the ground at six locations along a slope in a small valley in southwestern Michigan in the winters of 2004-05 and 2005-06.

Topography and snow accumulation-

- Snow is a very effective insulator from cold

Topography and snow accumulation-

- Snow cover can protect lower buds

Topography and planting patterns

Degree of slope should not exceed 7-9 %, to avoid problems with equipment used for ground floor maintenance, pruning, harvest, etc.

Soils

- Grapes need well drained soil.

- Traditionally, preference is to soils which yields balance in supporting crop and canopy.

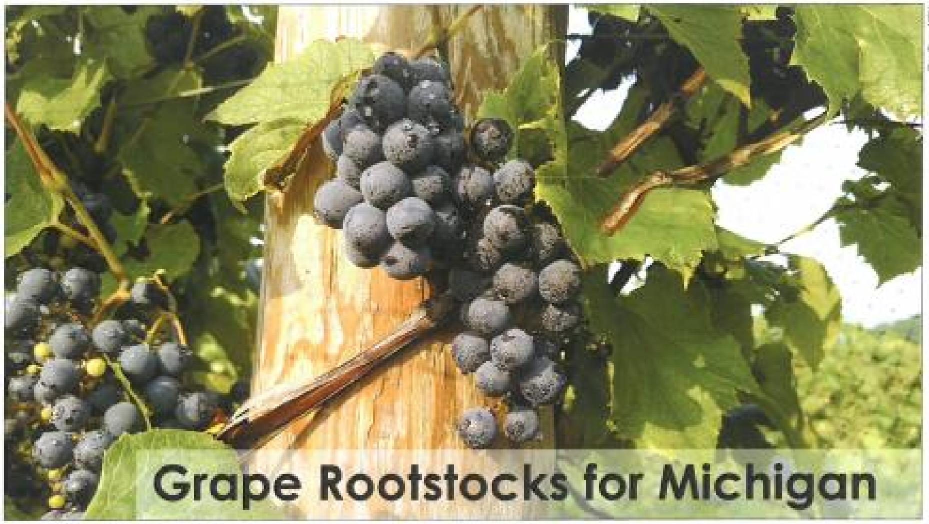
- The term *Terroir* is of French derivation and is a complex interaction among soil, climate, biology and human intervention. The special character or personality of a wine may be confined to just one small block. New world grape production is less confined and restricted to *Terroir.* Many scientists point to no empirical data to support European claims.

Soil Limitations

- Grapes tolerate a wide range of soil textures
- Grapes tolerate a wide range of pH
- Potassium & Magnesium needs
- Good drainage is critical – no “wet feet”
- Grapes are deep-rooted but most feeder roots are within two feet of the soil surface
- Trellis problems in shallow soils

R.Perry, Hort Dept, MSU

Rootstocks can help alleviate soil maladies such as lime induced chlorosis, Phyloxera, nematodes, drought, wet soils and Armillaria



Grape Rootstocks for Michigan

By R.L. Perry and P. Sabbatini
Michigan State University
Department of Horticulture

MICHIGAN STATE UNIVERSITY | Extension
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1. Introduction

This bulletin focuses on using grape rootstocks to control vegetative and reproductive activities of the grapevine through modifying vine physiology. Several studies have focused on scion and root interactions that have specific regulative mechanisms in key physiological processes for roots in general, for example, water and mineral absorption when they operate under limiting conditions due to drought, pests, disease or other factors (Keller, 2010). However, our knowledge of rootstock physiology is limited as evident in commercial viticulture where 90 percent of all the *vinifera* vines of the world are still grafted to fewer than 10 rootstocks.

Moreover, rootstocks are chosen mainly for their tolerance to a limited number of expected soil conditions, particularly related to water availability or soil pH (Keller, 2010). Roots anchor the vine to the soil, take-up water and nutrients, produce and transport plant hormones including abscisic acid, auxins, gibberellins, and ethylene (Rom, 1987). Furthermore, roots serve as a repository of stored carbohydrates (Edson et al., 1995) and nitrogenous compounds (Wermelinger, 1991), both critical to fueling the flush of spring growth prior to full canopy expression.

However, the effect of rootstocks on important quantifiable viticultural parameters is ambiguous largely due to our inability to effectively separate the observables with respect to their cause. This, of course, often makes a determination speculative. Additionally, a genotype's performance is intimately tied to the environment of its evaluation. This relationship can influence the rootstock's performance, as well as the scion cultivar grafted to it, producing yet another limitation on the validity of any conclusion drawn about the rootstock effect.

No matter how we elect to move forward, determining direct responses to root influences requires an initial defining of two key terms (Striegler and Howell, 1991). A *primary rootstock effect* would be one that directly influenced a scion response via well documented aspects of root morphology or physiology. A *secondary root effect* would include an indirect scion response influenced by the rootstock's direct impact on scion vigor. Canopy density is an example of the secondary root effect.

2. History and purpose

The speedy migration of grapevines from their origins in Eurasia to locations around the world occurred principally due to the ease of transporting, rooting and transplanting their hardwood cuttings. The primary advantage of an own-rooted vine is its capacity to annually develop replacement shoots from its below-ground components should trunks or other above-ground structures become seriously compromised or killed and need replacement. Winter injury due to

Very good review of rootstocks and their usage

Key factors to consider for the best sites for vineyards for wine production in Michigan

- Longer, warmer growing season areas are a high priority
- If possible, be near Lake Michigan which moderates the micro and meso climate, especially as it relates to low temperature episodes.
- The site should be sloping with best sites having a southern exposure.
- Best sites have well drained soils.
- Michigan has a long history of growing fruit, confine consideration to areas where fruit has been grown commercially.

Site selection and your business model

- Potential sites for wine grape production in Michigan must include consideration for the type of business interest…
  - Vineyard established for fruit to sell to wineries – seek best growing sites.
  - Vineyard established to support an on site winery -- best sites, but….
  - Vineyard established to support an on site winery, primarily influenced by traffic/customer travel -- site influenced by commerce.
  - Vineyard (small) established to provide an ambience to tasting room -- site established as part of landscape.

Site selection and your business model

Cultivar / Site Selection Tradeoffs

Following list of cultivar groups are ranked in order of market/consumer interest and are in inverse order of cold tolerance:

1. **Vinifera Cultivars**; Chardonnay, Riesling, etc. (Limited to areas above -4 degrees F. Mean low temp = Best Sites).

2. **French Hybrids**; Older cultivars developed in France using species native to America which were crossed with Vinifera cultivars to increase cold tolerance and resistance to pests(Vidal, Seyval, Chamboucin, Foch, etc). Contemporary breeding programs exist in America (NYAES, Geneva) and in Europe, with this goal in mind (Cayuga White, Carot Noir, etc). (Limited to Fruit production areas)

Cultivar / Site Selection Tradeoffs

Following list of cultivar groups are ranked in order of market/consumer interest and are in inverse order of cold tolerance:

3. **American Hybrids**; beginning with the breeder, T.V. Munson, there were many varieties developed such as Cynthiana, Norton, Delaware, Niagara and Concord used for wine and juice production. (Limited to Fruit production areas).

4. **Super Cold Hardy Hybrids** such as Frontenac, Marquette, St. Croix, LaCrescent, etc. (Suitable for many areas in Michigan).

References

- *Wine Science; Principles, Practice and Perception by R.S. Jackson. Pub. by Academic Press, San Diego, CA. 648 pp.*

- *Soils for Fine Wines* by R.E. White, Pub by Oxford University Press, 2003. 279 pp.

- *From Vines to Wines*, by J. Cox, Pub by Storey Communications, Pownal, VT, 1985. 253 pp.

- *General Viticulture*, by A.J. Winkler, Pub by University of Calif Press, Berkeley, 1965. 633 pp.

- *Vineyard Establishment I; Preplant Decisions*, by T. Zabadal and J. Andresen. Pub by MSUE Bulletin E-2644. 23 pp.