HEAT UNITS FOR CORN IN THE MARITIME PROVINCES

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Introduction

Successful production of hybrid corn for grain or silage in the Maritime provinces is highly dependent on available Corn Heat Units(CHU) during the growing season. Moderately cool and relatively short growing seasons limit the number of CHU available for corn development so that only early-maturing hybrids are suited for production. Grain production is restricted to areas with highest heat unit accumulations such as the Annapolis Valley and the lower Saint John River Valley.

A previous publication (ACA 79-1) presented the average CHU available for silage corn based on 1941-70 climatic normals. Hybrids recommended for production in 1980 were also rated in terms of their CHU requirement. Since that time, new and earlier-maturing hybrids have been developed for which CHU ratings are required. Additional climatic data have become available within the region which has facilitated a more detailed evaluation of CHU available for corn production. This bulletin incorporates these new data and in addition provides information on the variability of available CHU over space and time in the Maritime region for both grain and silage corn production based on the 1956-1985 period. Information is presented which allows the available CHU to be determined at various probability levels to help growers evaluate the climatic risk factor in corn production. The CHU requirements of hybrids recommended for production in 1990 are presented. This information will help producers to evaluate the potential for silage and/or grain production and to select hybrids which are most appropriate for their area.

Availability of Corn Heat Units in the Maritimes

Average CHU available for silage corn in the Maritimes are shown in Figure 1. Yearly CHU were calculated from 1956-85 using daily maximum and minimum air temperatures and then averaged. CHU were accumulated from estimated seeding dates in each year based on temperature and precipitation during May. Average seeding dates corresponded to the date when the average mean daily temperature reached 11.0°C in spring (Figure 3). CHU accumulated for silage corn were ended on the date of first fall frost (0°C), but never after Oct. 10. The average ending dates were estimated using the date when the mean daily minimum temperature dropped to 6°C or lower (Figure 4).

Average CHU for silage production range from over 2600 in the Annapolis Valley around Kentville and the Saint John River Valley below Fredericton, to less than 2000 in northwestern N.B. and south-eastern N.S. Parts of P.E.I also have an average of 2600 CHU available. However, CHU are less effective for maturing corn in P.E.I. and other coastal areas than more inland locations and therefore hybrids require more CHU to reach maturity at these locations.

Average CHU available for grain corn production are shown in Figure 2. CHU were accumulated from the same estimated seeding date as for silage (Figure 3), to the date of first occurrence of killing frost (-2°C), but never later than Nov. 30. The average ending dates for grain corn were estimated using the date when the average mean daily minimum temperature dropped to 3.5°C or lower in autumn (Figure 5). Average CHU for grain corn range from over 2800 in the Annapolis Valley around Kentville and the Saint John River Valley below Fredericton, to less than 2200 in northeastern New Brunswick and southeastern Nova Scotia.

Local factors such as direction and degree of slope, soil moisture, soil type, soil management and shelter influence the heat units available to the corn crop. For example, south-facing slopes tend to be warmer than north-facing slopes and therefore accumulate slightly more heat units. Well-sheltered fields tend to have higher daytime temperatures and thus have more available heat units than exposed fields. Coarse-textured, well-drained soils warm up earlier in the spring than fine-textured, poorly-drained soils and have more heat units available per season due to earlier planting. In frost-prone fields, freezing temperatures in the fall may end the growing season earlier than usual for a given region and thus reduce the heat units that are available. For these reasons, CHU cannot be estimated any closer than the nearest 100 units for any location on the map.

Adjustment for planting/harvesting dates

Actual average dates of planting and of killing frost may differ significantly from those in Figures 3, 4 and 5 due to local farm conditions. In these cases, the CHU values shown in Figures 1 and 2 can be adjusted using the average CHU accumulated per day as shown for various regions in Table 1. For example, if on average, corn can be seeded in the Annapolis Valley by May 12 (8 days before the average date of May 20 shown in Figure 3), then an average of 8×10 = 80 CHU must be added to obtain the adjusted CHU value for the Valley.

Seasonal Variation

The CHU shown in Figures 1 and 2 are based on a 30-year average. Thus, about 50% of the years will have fewer than this amount and the other 50% will have more. The risk of experiencing extremely bad years (low heat unit summations) or good years (high heat unit summations) can be estimated by adjusting the average CHU values in Figures 1 and 2 by the amounts shown in Figure 6. For example, there is a 5% risk that accumulated CHU will be 300 CHU or more below the average value. Therefore, if an area is rated at 2400 CHU average (for either silage or grain), then 1 year in 20 (5%) will have less than 2100 CHU. Similarly, there is a 10% probability that CHU will exceed the average by 220 CHU. Thus 1 year in 10 will have 2620 CHU or more available in the same area.

The adjustments given in Figure 6 are averages based on 8 locations in the Maritime Provinces. Individual locations may have adjustments which deviate from the average. For CHU available at 37 specific locations and at selected probability levels, see Agriculture Canada, Research Branch Technical Bulletin 1991-8E entitled: "Risk analyses of heat units available for corn production in the Maritime provinces".

Table 1(a) Approximate average heat unit accumulation per day during 6 time periods in spring for different regions.

Region*	CHU accumulated/day					
	May 1-10	May 11-20	May 21-31	June 1-10	June 11-20	June 21-30
1	6	10	12	15	18	20
2	5	8	11	14	17	20
3	4	7	9	12	14	17
4	7	10	13	16	18	20
5	5	8	11	13	16	18
6	4	7	10	13	15	17
7	6	10	13	16	18	20
8	4	7	10	13	16	19
9	3	7	8	11	14	17

Table 1(b) Approximate average heat unit accumulations per day during 6 time periods in fall for different regions.

Region*	CHU accumulated/day					
	Sep. 1-10	Sep. 11-20	Sep. 21-30	Oct. 1-10	Oct. 11-20	Oct. 21-31
1	16	12	10	6	4	2
2	17	13	11	7	5	3
3	17	13	11	8	5	3
4	18	14	13	9	6	4
5	17	14	13	9	6	4
6	17	14	13	10	6	5
7	18	15	14	10	7	5
8	18	14	13	9	5	4
9	17	14	12	9	6	4

*See Table 2 for definition of regions

Table 2. Regions in Table 1 for adjusting accumulated CHU's for planting and harvesting dates.

Region	Description
1	Upper Saint John River area north of Centreville, N.B.
2	Bay of Chaleur and eastern N.B. down to Bouctouche.
3	Southern N.B. along Bay of Fundy shore.
4	Lower Saint John River area south and east of Centreville, N.B.
5	Southeastern N.B., northern N.S. and Truro-Stewiacke area.
6	Coastal areas of western and southern N.S.
7	Annapolis Valley.
8	Prince Edward Island.
9	Cape Breton Island.

Heat unit requirements of corn hybrids

Most corn hybrids have CHU ratings assigned to them at the time of licensing. However, these ratings are generally based on performance of grain corn at locations outside of the Maritimes (e.g. Ontario, Manitoba). Locally, their performance may or may not agree with the ratings and the requirement for silage corn will certainly differ from that of grain.

Corn Heat Unit ratings for hybrids recommended for corn production in 1990 are shown in Table 3 based on performance in the Maritimes. Ratings for any new hybrids that are introduced can be estimated by comparing their moisture content at harvest time to the moisture content of these hybrids

Table 3. Estimated Corn Heat Unit requirements for corn hybrids recommended for silage and grain production in 1990 in the Maritimes.

Hybrid**	CHU rating* for silage (30-35% whole plant dry matter)
Pickseed 2444	2300
Co-op 6312	2350
DK-291 (Dekalb)	2350
G-4017 (CG)	2350
K730 (Pride)	2350
3979 (Pioneer)	2400
Bishop 30-30	2450
Co-op S259	2500
3957 (Pioneer)	2500

Hybrid**	CHU rating* for grain (35% grain moisture content)
G-4017 (CG)	2300
K610 (Pride)	2350
Co-op 2335	2400
Co-op 2325	2400
DK-235 (Dekalb)	2400
3979 (Pioneer)	2450
Co-op 6312	2450
Pickseed 2477	2550
3954 (Pioneer)	2550
Hyland HL2219	2650
Co-op S259	2650
T778 (Dekalb)	2650

* For P.E.I. and other coastal regions, add 150 heat units to the above ratings.

** The list of recommended hybrids may change each year as newer and better hybrids are introduced. See bulletin 100A published by the Atlantic Field Crops Committee or bulletin 140 published by the Atlantic Corn Hybrid Evaluation Committee for an up-to-date listing of recommended hybrids.

in regional trials. Hybrids with similar moisture content at harvest will have similar heat unit requirements. About 150 heat units must be added to these CHU ratings for P.E.I. and most other coastal regions. Field trials at Charlottetown have shown that these additional CHU are required to bring a hybrid to a given level of maturity in comparison with other Maritime locations.

The CHU ratings for silage corn are based on achieving approximately 30-35% dry matter in the whole plant, which is considered optimum for silage production. Whole plant dry matter increases or decreases by about 3.5% for each 100 CHU accumulated above or below the rated requirements. In areas of the Maritimes where corn production is marginal, currently available hybrids commonly produce only 20-25% dry matter. Such levels are achieved at about 300 CHU below the requirements in Table 3.

The CHU rating for grain corn represents the number of accumulated heat units required to mature the hybrid to the stage where there is only 35% moisture remaining in the grain. This is a reasonable level to be achieved for high moisture grain corn production, but is normally not reached in this region until after the plant has been killed by frost. The grain moisture content will decrease or increase about 3.3% for each 100 CHU accumulated above or below the rated requirement. For example, about 100 to 150 fewer heat units than shown in Table 3 are required to achieve a maturity level of 40% moisture in the grain.

The heat unit ratings for a hybrid may change slightly in future as more information is obtained. Also, the heat units required to bring a particular hybrid to maturity will vary somewhat between locations and seasons. This is because there are factors other than heat units which influence corn maturity. Hybrid requirements are therefore only accurate to about ±100 heat units.

Potential for corn production

Areas with the highest heat unit rating (i.e. the Annapolis Valley and portions of the Saint John River Valley) have the greatest potential for both silage and grain corn production because of favourable climate. With the earliest hybrids presently available, silage corn is only recommended in regions having, on the average, more than 2100 CHU. This is the minimum CHU's required to achieve whole plant dry matter levels of about 25% before frost in an average year, which can make acceptable silage. Areas with an average of 2500 CHU or more, should, in most years, produce hybrids with whole plant dry matter levels of 30-35% before frost.

CHU required for grain corn are influenced by the type of storage used. Minimum CHU required for shelled grain corn production using earliest hybrids is estimated to be about 2300 (about 2500 CHU in P.E.I.) (Table 3). Figure 7 shows that the probability of having 2300 CHU or more is 1.0 (or 100%) in the Annapolis Valley and part of the Saint John River Valley. Thus, in these areas grain corn with acceptable maturity can be produced almost every year. The probability of receiving sufficient CHU for grain drops to only 0.4 (or 40%) in northwestern N.B. and parts of N.S. At present, production of shelled corn is generally only advisable in areas having a probability of 80% or more.

High moisture or cribbed ear corn is possible in areas having at least 60% or more probability of 2300 CHU (2500 CHU for P.E.I.) using available early hybrids.

For the purpose of recommending specific hybrids, the Maritime provinces have been divided into four zones for corn production (see publication 140, Atlantic Corn Hybrid Evaluation Trials - 1989 Accumulated Performance Data and 1990 Recommendations). These zones correspond approximately to the following heat unit ratings in Figure 1, except for P.E.I.

Zone	Available Corn Heat Units (Figure 1)
1	2400 or more
2	2200 - 2400
3	2100 - 2200
4	2100 or less

Summary

The information in this bulletin can be used to estimate the Heat Units available for silage and/or grain corn anywhere in the Maritime provinces. Adjustments can be applied to account for variations in planting and harvesting dates and to accommodate different levels of risk. More detailed information on availability of CHU for specific locations in the Maritimes can be found in Agriculture Canada, Research Branch Technical Bulletin 1991-9E entitled: "Risk Analyses of Heat Units Available for Corn Production in the Maritime Provinces"

Acknowledgments

Thanks is expressed to the members of the Atlantic Committee on Agrometeorology and the Advisory Committee on Corn for helpful suggestions and for data on corn performance in the Maritimes.

We also acknowledge the contribution of many weather observers in the region who faithfully record data over many years for Environment Canada, Atmospheric Environment Service. Cartographic services were provided by Agriculture Canada, CLBRR Cartographic Unit and data processing by the EDP services unit of CLBRR.

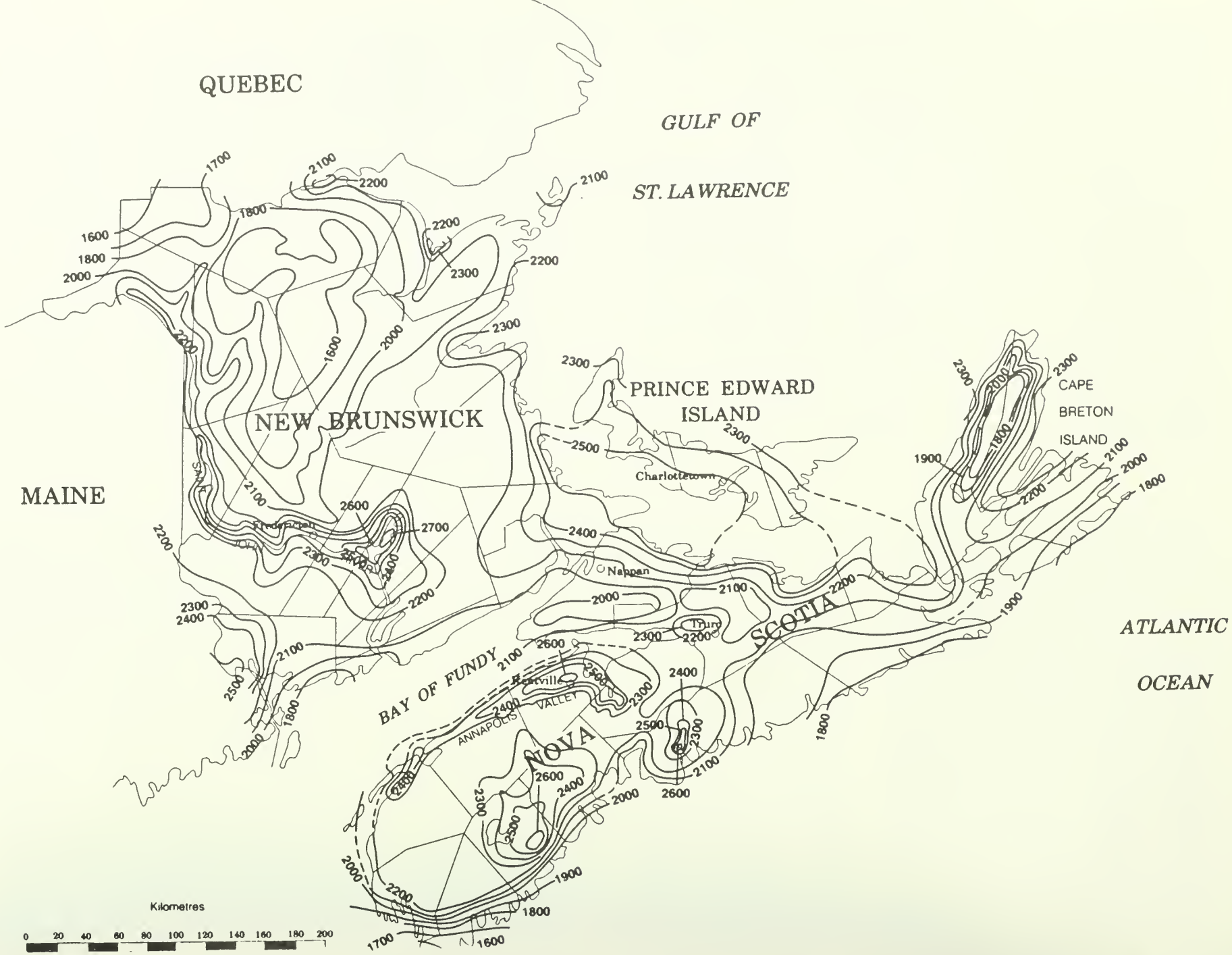

Figure 1. Average Corn Heat Units available for silage corn in the Maritime provinces (1956-1985 period).

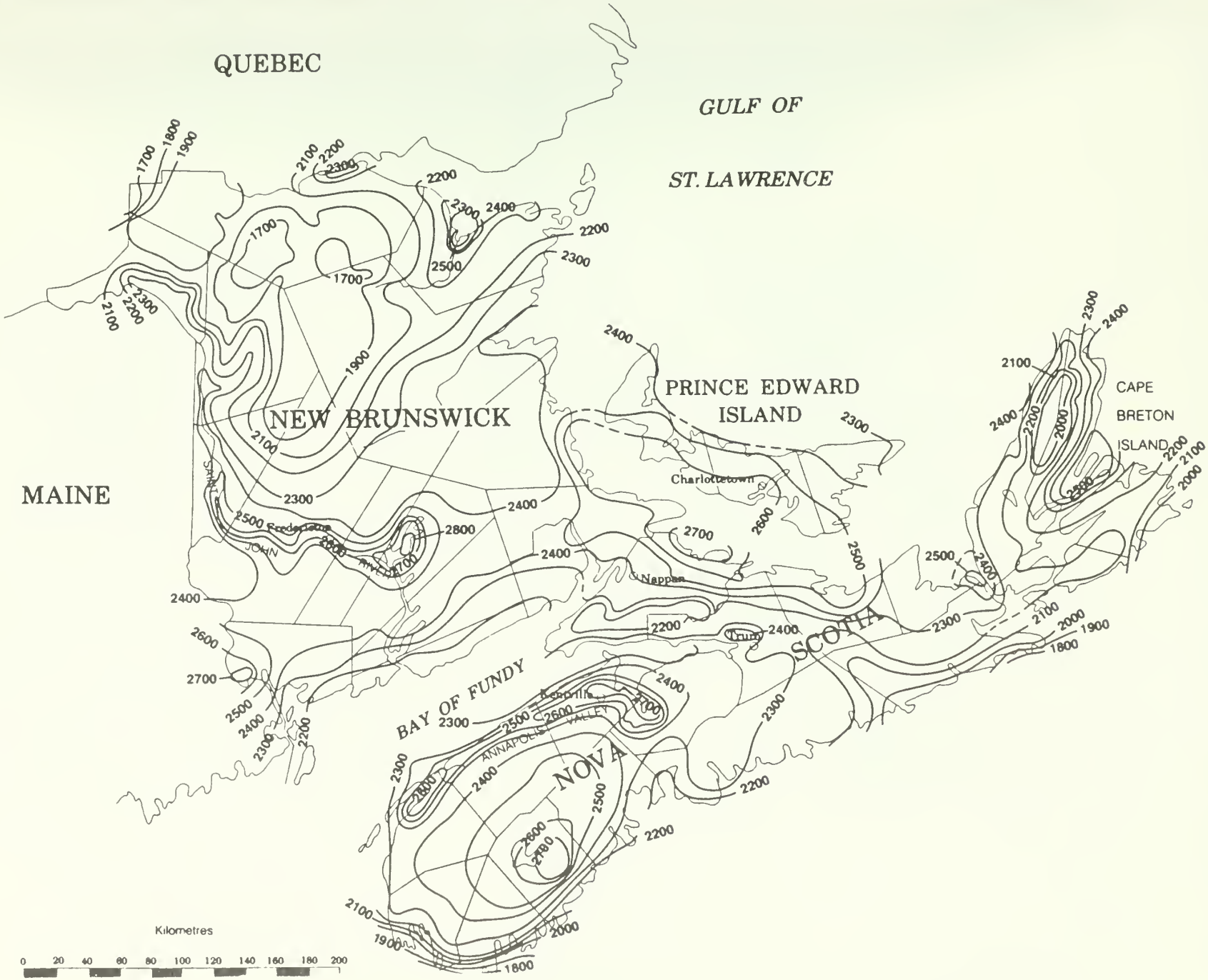

Figure 2. Average Corn Heat Units available for grain corn in the Maritime provinces (1956-1985 period).

Figure 3. Estimated mean date of planting corn in spring (date when the average mean daily temperature reaches 11.0°C).

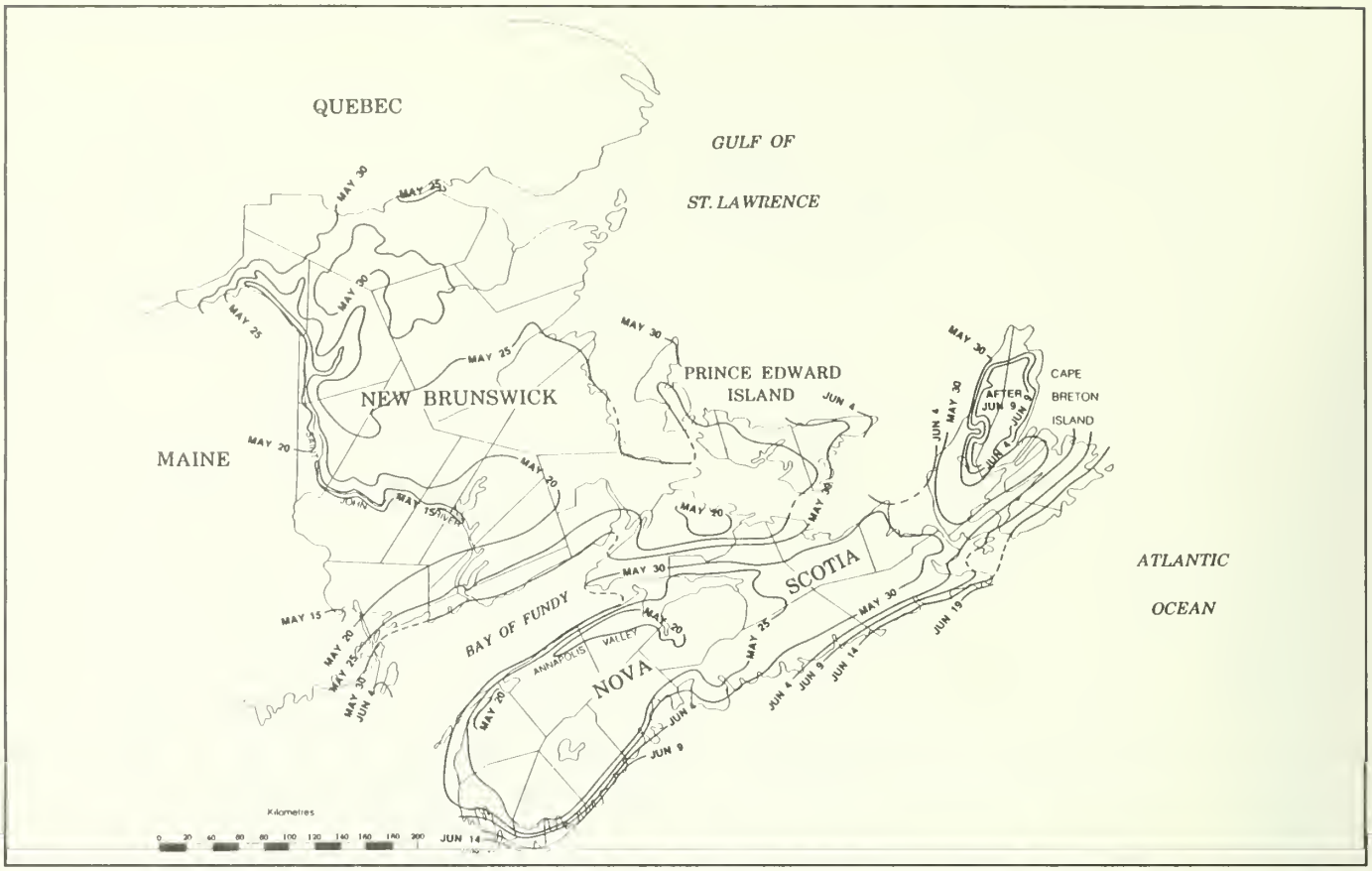

Figure 4. Estimated mean fall date for ending CHU's accumulated for silage corn (date when mean daily minimum temperature ≤6°C).

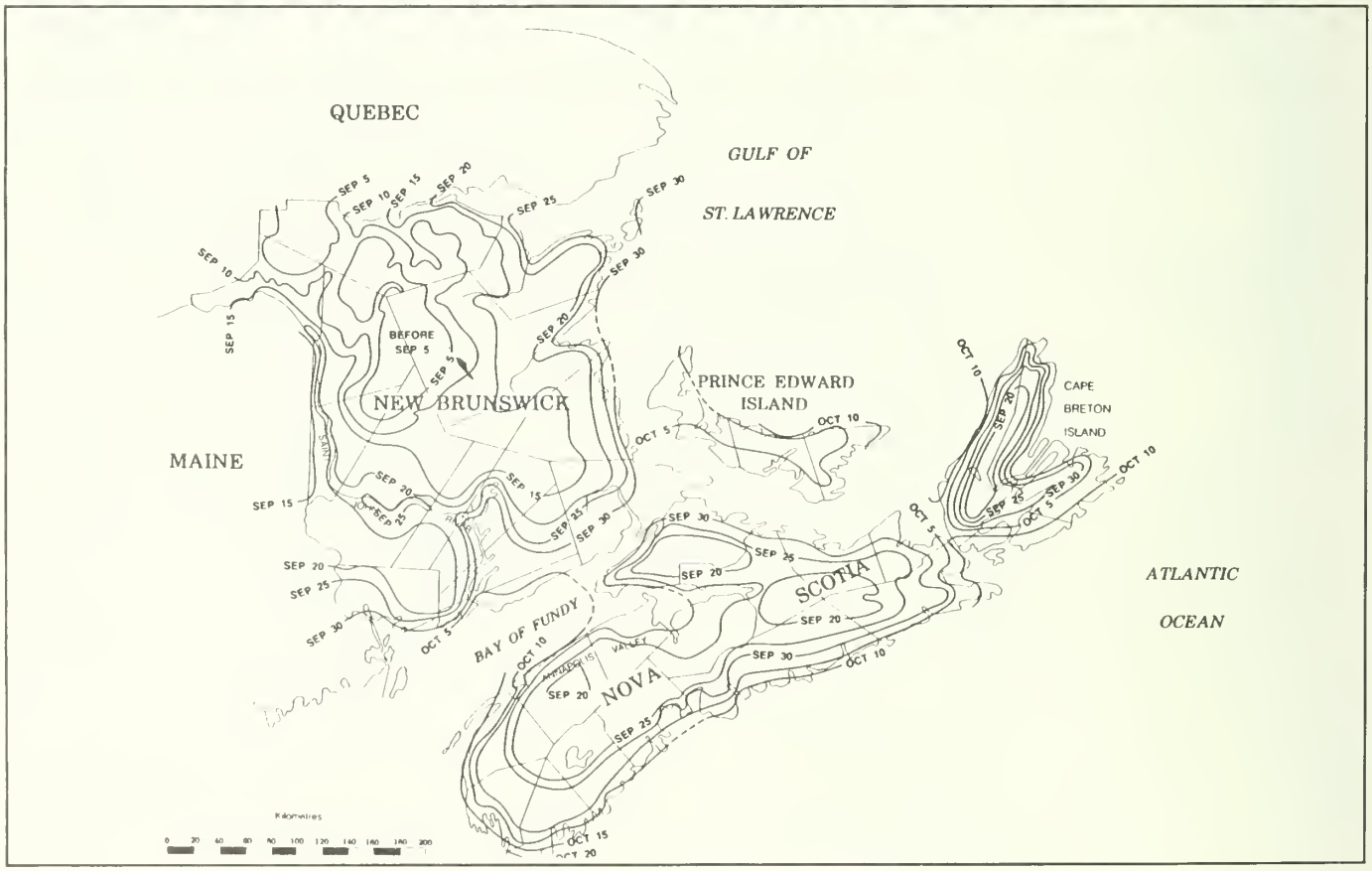

Figure 5. Estimated mean fall date for ending CHU's accumulated for grain corn (date when mean minimum temperature ≤3.5°C).

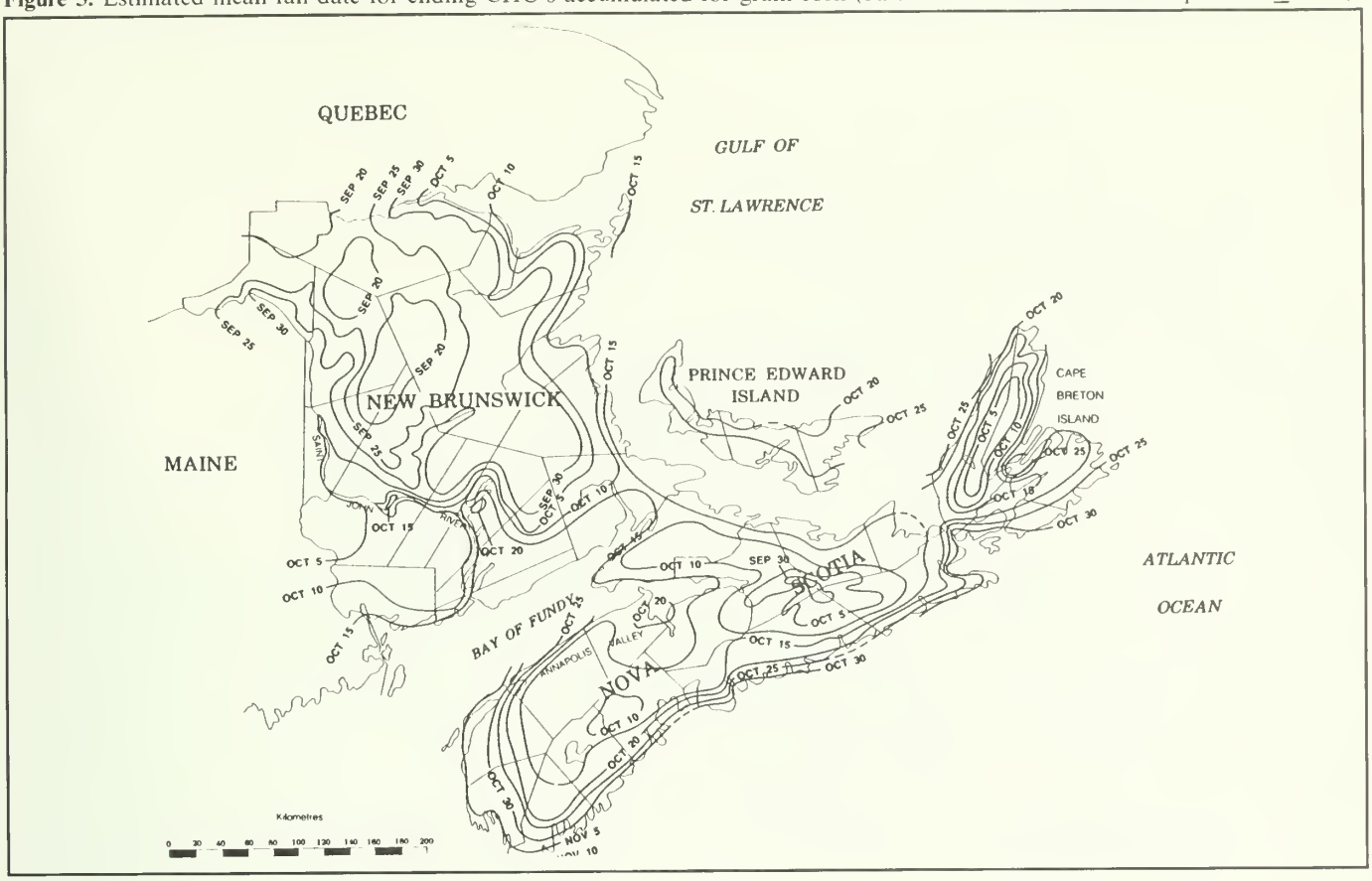

Figure 6 Adjustment required to determine CHU available at selected probability or risk levels from the average value.

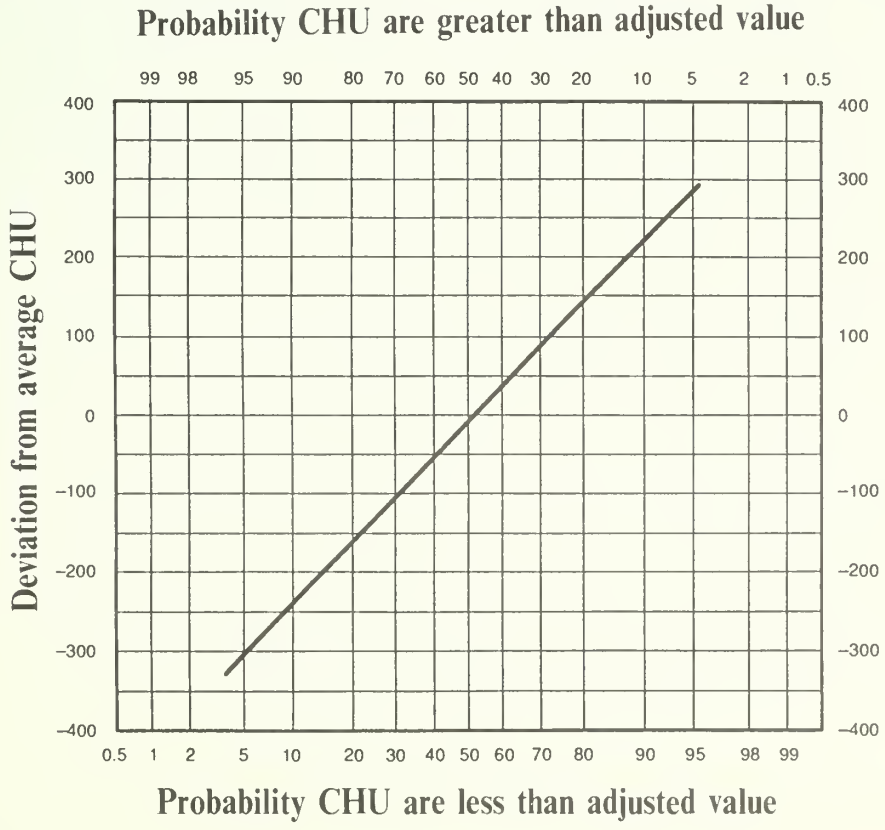

Figure 7. Probability of receiving the minimum CHUs required for grain corn production in the Maritimes.