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G96-1312 Autumn Freeze Probabilities

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Autumn Freeze Probabilities

Autumn freeze probabilities based on 47 years of data are examined for 48 locations in Nebraska.

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The potential of an early autumn freeze is of great concern to farmers, gardeners, and other plant growers. A climatological analysis of autumn freeze events across Nebraska can provide a measure of the risk involved with planting different hybrids, varieties and cultivars.

Freezes are generally classified as light, moderate, or hard. A light freeze occurs when the minimum temperature falls within the range of 29°F to 32°F; a moderate freeze when the minimum temperature falls within the range of 25°F to 28°F; and a hard freeze when the minimum temperature falls to 24°F or below.

Radiation and Advection Freezes

There are two types of freeze events: radiation freeze and advection freeze.

Radiation Freeze

During the nighttime hours, heat is radiated from the earth's surface into the atmosphere. As the surface temperature drops, the layer of air next to it cools. Since cold air is heavier than warm air, the coldest air collects near the surface. This layer of cold air grows deeper as the night progresses. If the air is sufficiently cool to begin with, freezing temperatures may result from this cooling process.

Conditions necessary for a radiation freeze include clear skies, air with a dew point near or below 32°F, and calm or nearly calm winds. Such conditions are typically found near the centers of cool high pressure systems. In Nebraska, radiation freezes are usually the type of freeze that occurs last in the spring and first in the autumn.

Advection Freeze

These types of freezes result from cold air being transported into an area by wind. The winds, typically blowing from the north or northwest, are normally associated with the passage of a cold front, the leading edge of a cold air mass (high pressure system).

The most damaging type of freeze occurs when an advection freeze and radiation freeze occur in tandem. This can occur with the passage of a strong cold front during the daylight or evening hours, followed by clear calm conditions during nighttime hours as the center of high pressure moves overhead.

Location Specific Freeze Considerations

Slight variations in local terrain are important to consider particularly when conditions are conducive to radiation freeze. As previously mentioned, colder air is heavier; thus, the cold air will drain into depressions such as river valleys and low spots between hills. Therefore, any vegetation growing in these depressions is more susceptible to freeze damage.

Another consideration during radiation freezes is that the coldest air collects near the surface. Thus, temperatures at or near ground level may be as much as 5° to 10°F colder than at the official measuring height of 5 feet. This difference in temperatures could have dire consequences for tender, low-lying vegetation.

Effect of Autumn Freeze on Corn and Soybean

Plant species, stage of plant development, and the intensity and duration of cold temperatures are three of the most important factors that determine the severity of an autumn freeze. In its early stages of development, winter wheat is highly resistant to freezes of about -5°F. For some fruit trees, such as apple, autumn freezes begin the vernalization process that stimulates growth in the coming spring. Most row crops, however, are susceptible to freezing temperatures, the extent of damage depending heavily upon the stage of crop development.

Corn

Substantial frost damage of leaf, stalk, and husk tissue will occur when temperatures remain below 32°F for four to five hours or when temperatures decline to 28°F or lower for even a few minutes before increasing to about 32°F. In the case of radiation freeze, frost damage can occur when air temperatures are several degrees above 32°F if the air is clear and still. Under these conditions, leaf temperatures can drop below the actual air temperature and upper plant parts, that are farther from the radiation source than lower parts, are more likely to incur frost damage.

The influence of frost damage on final grain yield depends on how much leaf tissue is killed and the stage of development. Generally, a freeze during the early dent stage, can reduce corn yields by 25-40 percent. Once the crop has reached the fully dented stage a freeze will only reduce yield 5-10 percent. If the crop is physiologically mature no yield loss will occur.

Soybean

Compared to corn, soybean is more susceptible to freezing temperatures, particularly leaf tissue. Like corn, the impact of frost on final yield is highly dependent on stage of development. Since approximately 40 percent of the yield occurs in the 20 days prior to maturity, even freezes relatively late

in the growing season can reduce yield significantly. Studies have found that yields may be reduced by as much as 81 percent if a freeze occurs during early seed fill (R5), 20-40 percent during the full seed stage (R6), and minimal yield loss when beans have reached physiological maturity.

Autumn Freeze Probabilities in Nebraska

Table I provides the earliest, median (middle), and latest date of occurrence for 32°F and 28°F freezes for 48 locations in Nebraska, based on 47 years of data 1949-1995.

Figures 1-6 identify dates related to the first occurrence of an autumn freeze (32°F and 28°F, respectively). Each figure is based on 47 years of data, 1949-1995. The probability of the first autumn freeze (32°F) occurring on or after the date identified in *Figure 1* is 80 percent (i.e., a freeze on or after these dates is likely to occur in four out of five years). *Figure 2* identifies the median for "typical" date on which the first autumn 32°F minimum temperature occurs. The probability of the first autumn freeze (32°F) occurring on or after the dates identified in *Figure 3* is 20 percent (i.e., a freeze on or after these dates is likely to occur in one out of five years). The probability of the first autumn freeze (28°F) occurring on or after the dates identified in *Figure 4* is 80 percent (i.e., a freeze on or after these dates is likely to occur in four out of five years). *Figure 5* identifies the median or "typical" date on which the first autumn 28°F minimum temperature occurs. The probability of the first autumn freeze (28°F) occurring on or after the dates identified in *Figure 6* is 20 percent (that is, a freeze on or after these dates is likely to occur in one out of five years).

No one can predict when the first autumn freeze will occur. However, the information provided here is intended to assist producers to better assess the probability of autumn freeze risks around their general vicinity.

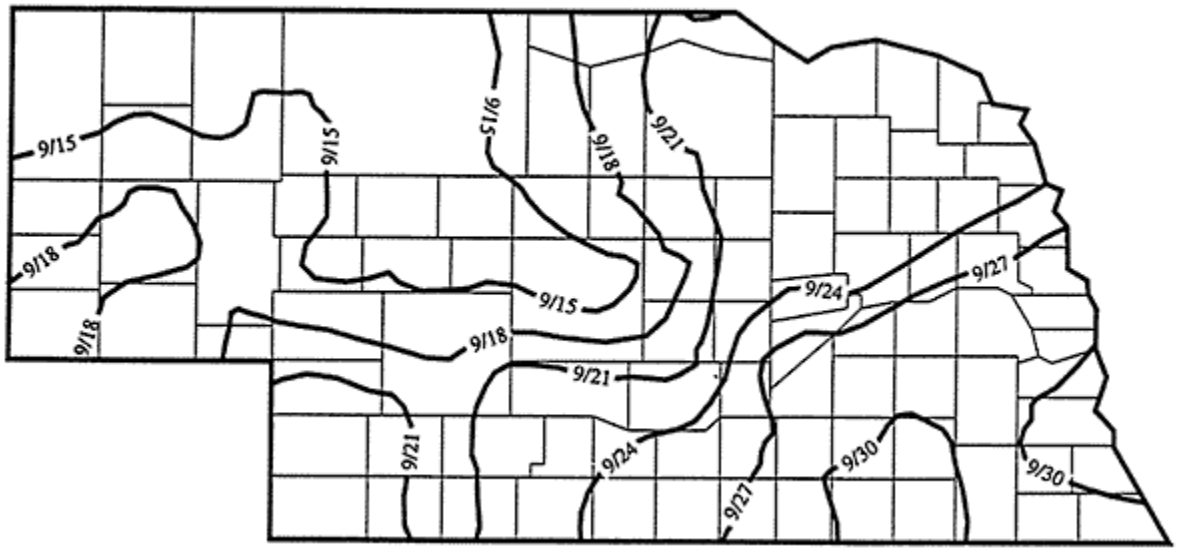

Figure 1. There is an 80 percent probability of an autumn freeze (32°F) occurring on or after the dates shown on this map (based on 47 years of record, 1949-1995).

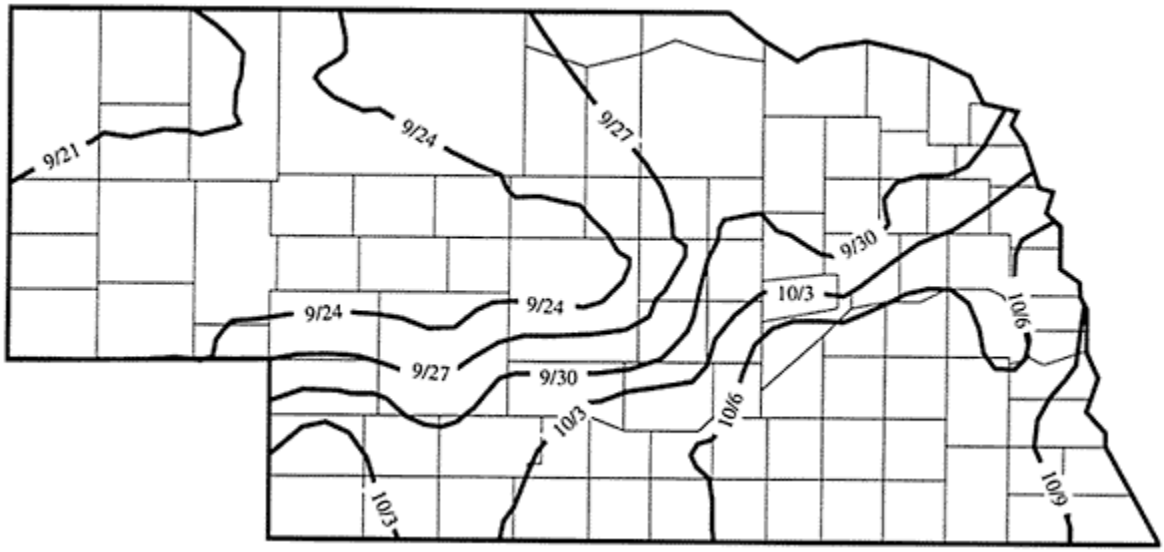

Figure 2. Median autumn freeze (32°F) date. Half of all autumn freezes will occur before the dates shown on this map and half will occur after (based on 47 years of records, 1949-1995).

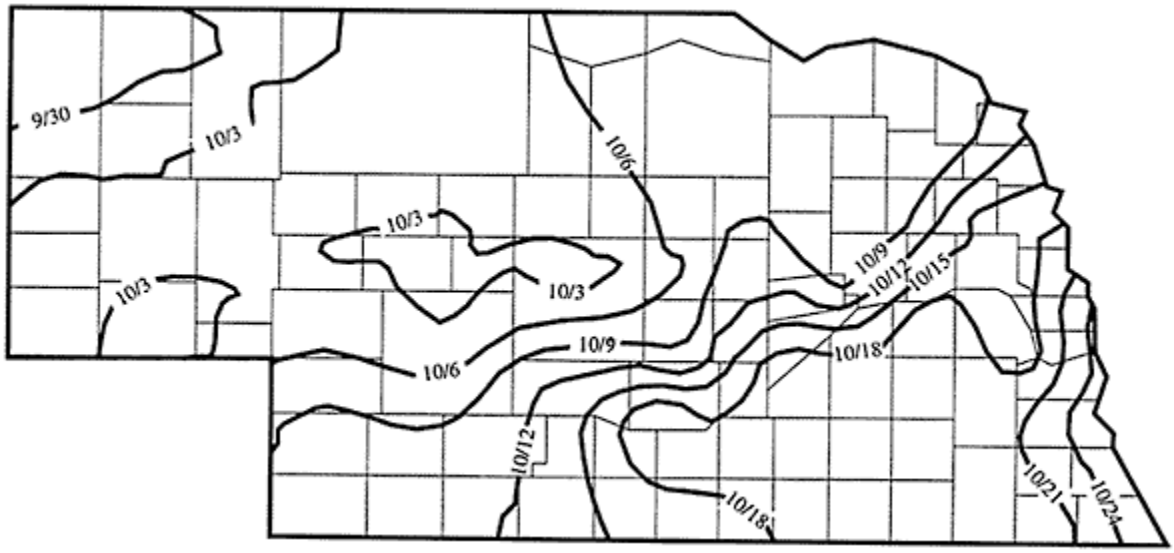

Figure 3. There is a 20 percent probability of an autumn freeze (32°F) occurring on or after the dates shown on this map (Based on 47 years of record, 1949-1995).

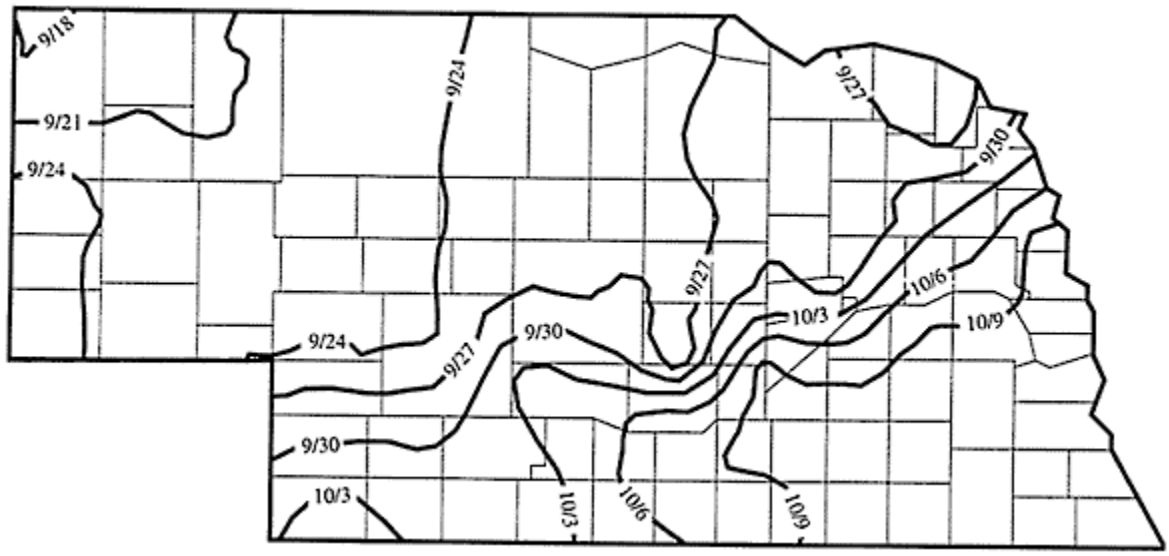

Figure 4. There is an 80 percent probability of an autumn freeze (28°F) occurring on or after the dates shown on this map (based on 47 years of record, 1949-1995).

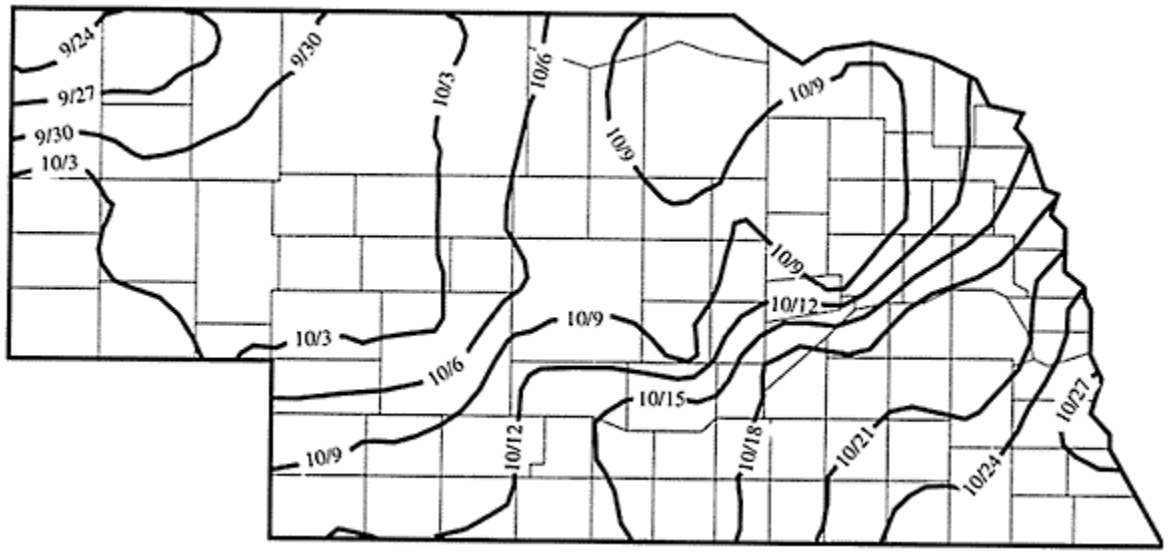

Figure 5. Median autumn freeze (28°F) date. Half of all autumn freezes will occur before the dates shown on this map and half will occur after (based on 47 years of record, 1949-1995).

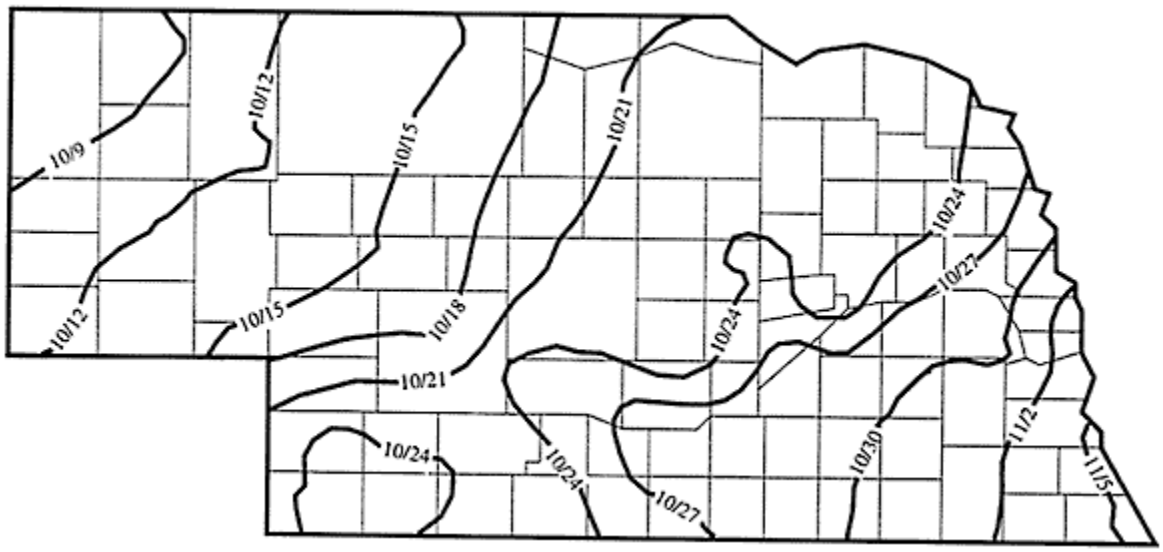

Figure 6. There is an 20 percent probability of an autumn freeze (28°F) occurring on or after the dates shown on this map (based on 47 years of record, 1949-1995).

Table I. Earliest, median, and latest date of the last occurrence of a light (32°F) and moderate (28° F) autumn freeze for 48 locations in Nebraska (based on 47 years of data, 1949-1995).

Location	First Autumn 32°F Minimum Temperature			First Autumn 28°F Minimum Temperature		
	Earliest	Median	Latest	Earliest	Median	Latest
Ainsworth	9/11	10/4	10/28	9/22	10/14	11/9
Albion	9/3	9/30	10/28	9/19	10/7	10/31
Alliance	9/3	9/23	10/17	9/9	10/6	11/2
Arthur	9/5	9/21	10/24	9/10	10/1	10/28
Ashland	9/13	10/5	10/29	9/19	10/20	11/11
Atkinson	9/12	9/29	10/26	9/12	10/12	11/2
Benkelman	9/3	10/5	10/28	9/21	10/12	11/4
Blair	9/16	10/8	10/31	9/26	10/22	11/10
Bridgeport	9/2	9/24	10/18	9/9	10/1	10/28
Broken Bow	9/3	9/22	10/14	9/3	9/30	10/28
Cambridge	9/3	10/3	10/28	9/21	10/12	11/3
Central City	9/13	10/9	10/29	9/22	10/18	11/10
Crete	9/19	10/9	11/3	9/19	10/22	11/11
Culbertson	9/3	10/1	10/28	9/18	10/11	11/3
David City	9/18	10/9	10/29	9/19	10/20	11/14
Ewing	9/3	9/25	10/28	9/6	10/3	10/29

Fairbury	9/19	10/8	11/3	9/22	10/25	11/11
Falls City	9/15	10/12	11/8	9/19	10/25	11/18
Franklin	9/3	10/5	10/29	9/22	10/16	11/10
Fremont	9/17	10/5	10/30	9/23	10/19	11/5
Genoa	9/3	10/1	10/29	9/19	10/7	10/29
Gothenburg	9/3	10/1	10/28	9/21	10/12	11/4
Grand Island	9/19	10/7	10/28	9/19	10/18	11/7
Harrison	9/3	9/18	10/26	9/9	9/23	10/26
Location	**First Autumn 32°F Minimum Temperature**			**First Autumn 28°F Minimum Temperature**		
	Earliest	**Median**	**Latest**	**Earliest**	**Median**	**Latest**
Hayes Center	9/13	10/9	10/28	9/20	10/21	11/10
Hebron	9/19	10/9	10/29	9/22	10/22	11/14
Holdrege	9/13	10/9	11/3	9/22	10/23	11/13
Imperial	9/13	10/5	10/28	9/21	10/16	11/3
Kearney	9/13	10/6	11/3	9/19	10/18	11/6
Kimball	9/9	9/23	10/27	9/9	10/4	10/28
Lincoln	9/15	10/7	11/7	9/22	10/19	11/10
Madison	9/3	9/29	10/28	9/19	10/6	10/29
Minden	9/13	10/6	11/3	9/22	10/17	11/7
Mitchell	9/9	9/22	10/27	9/9	10/6	11/1
Nebraska City	9/19	10/11	11/10	9/29	10/29	11/23
North Platte	9/3	9/24	10/24	9/3	10/3	10/31
Oakdale	9/3	9/28	10/28	9/19	10/6	10/29
Omaha	9/19	10/9	11/7	9/29	10/25	11/14
Oshkosh	9/1	9/22	10/9	9/10	10/1	10/28
Pawnee City	9/18	10/7	11/11	9/22	10/25	11/15
Ravenna	9/3	9/30	10/29	9/13	10/7	10/29
Seward	9/19	10/12	10/31	9/22	10/24	11/14
Sidney	9/9	9/24	10/16	9/9	10/4	11/3
Stanton	9/13	10/1	10/29	9/19	10/9	10/31
Valentine	9/3	9/26	10/28	9/6	10/3	10/28
Wakefield	9/3	9/28	10/28	9/11	10/5	10/29
West Point	9/3	10/3	10/29	9/19	10/13	11/4
York	9/19	10/10	10/29	9/22	10/24	11/14

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