From: Interagency Nutrient Management Committee, January 10, 2019

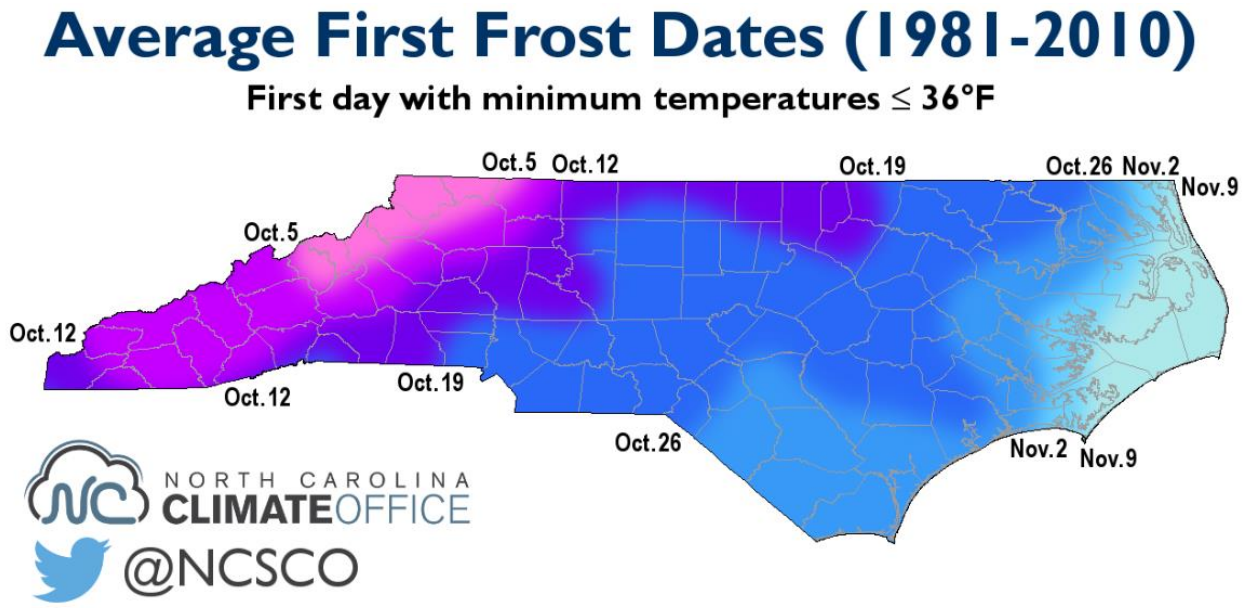
Subject: Request to move fall Bermuda application window

A request has been made to move the fall Bermuda application window further into the fall based on the perception that the freeze date is later. At this time, the INMC does not believe a blanket extension of the Bermuda window is warranted based on available data.

In the appendix find information regarding first Frost Dates published by a now retired Agricultural Meteorologist in the Horticultural Science Department: https://content.ces.ncsu.edu/average-first-fall-frost-dates-for-selected-north-carolina-locations

While the data is old, what is important is the document gives you the +/- window where you might see First Frost. Per the CES publication, first frost in Sampson County is Oct 29 (+ or - 11 days).

Below is more recent data from the State Climate Office (SC). It does not have the "error bars" around the average so it was suggested to use the CES +/- days and the State Climate Office average.



An example of extending the window is as follows. The current Bermuda window closes on September 30. If we extend to October 20, as was the case in the one-time allowance this year, AND the State Climate Office frost (October 26) arrives in the minus 11 day window (i.e., early), then the date will be before the last application of animal waste and the nitrogen may not be utilized. If the Bermuda is overseeded, we might be fine. If the Bermuda is not overseeded, then there is no active growing crop until April and we are just leaving nitrogen in the environment to be lost by all the usual pathways. If we do extend to October 20 and we hit the average frost date of October 26, it is improbable that the crop can take up the majority of the nitrogen in six days.

There also is a concern about physiological response to the late application. The nitrogen will encourage another flush of growth and that growth would be tender thus making the Bermuda much more susceptible to winter kill (which could result in large patches of no-grass come spring).

At this time, the INMC does not believe a blanket extension of the Bermuda window is justifiable given the climate date presented in the map above and the appendix below, nor is it advisable given the limited window for N uptake that will follow. These are permitted non-discharge systems, which can be changed on a site-by-site basis by regional agronomist.

Appendix: Average First Fall Frost Dates for Selected North Carolina Locations
Horticulture Information Leaflets

Frost forms on solid objects when the water vapor in the atmosphere changes from its vapor phase to small ice crystals. Frost is not frozen dew. If you see frost than you know that the temperature of the object it is on reached 32°F or lower. However, the air temperature, measured at five feet above ground in the vicinity of this object, is likely several degrees higher. Conversely, not every air temperature recorded at or below 32°F means frost formed on solid objects in the area. In spite of this, the average date of the last spring air temperature of 32°F has traditionally been called the last frost date. The dates presented in this leaflet are the average date of the last recorded air temperature at 32°F or lower for the period 1951 - 1980. The standard deviation is an important statistic to consider along with the average date. The standard deviation tells the amount of dispersion around the average. The average date minus one standard deviation gives the date before which there is only a 16% chance of frost. A frost will occur before this date about twice in every 10 year period. For example, in Albemarle a frost will occur before October 13 (the average date of October 25 minus one standard deviation of 12 days) about twice in every 10 year period. The average date minus two standard deviations gives the date before which there is only a 2% chance of frost. A frost will occur before this date about twice in every 100 year period. For example, in Albemarle a frost will occur before October 1 (the average date of October 25 minus two standard deviations of 12 days) about twice in every 100 year period.

For information on how to protect plants from frost and freeze damage see HIL-705, *Frost/Freeze Protection for Horticultural Crops*, and consult the references listed below.

Below the first fall frost data are listed by Station Name (Table 1) and by County (Table 2).

There are several published references for North Carolina climate data. These references are available from the North Carolina State University Department of Communication Services, Publications, Box 7603, Raleigh, NC 27695-7603; (919) 515-2861.

- Weather and Climate in North Carolina AG-375 ($2.50)
- Probabilities of Dry Periods in North Carolina AG-411 ($2.00)
- Risk of Frost and Freeze Damage for North Carolina Fruit Crops AG-403 (free)
- Low-Temperature Probability Data for North Carolina AG-403S ($3.00)
- Growing Degree Days in North Carolina AG-236 ($3.00)

Table 1. Average first fall frost date for North Carolina by station (1951-1980)

Average first fall frost date and its standard deviation for selected North Carolina locations listed by station name. Data are for the period 1951 - 1980.

Station Name	County	Average Date	Standard Deviation (days)
Albemarle 4 N	Stanly	October 25	12
Andrews 2 E	Cherokee	October 10	10
Asheboro 2 W	Randolph	October 31	12
Asheville	Buncombe	October 23	11
Banner Elk	Avery	October 2	11
Bent Creek	Buncombe	October 9	11
Black Mountain	Buncombe	October 17	10
Blowing Rock	Watauga	October 11	9
Brevard	Transylvania	October 8	9
Burlington	Alamance	November 1	11
Canton 1 SW	Haywood	October 10	9
Celo 2 S	Yancey	September 27	18
Chapel Hill 2 W	Orange	October 23	10
Charlotte WSO AP	Mecklenburg	November 5	13
Clinton	Sampson	October 29	11
Concord	Cabarrus	November 2	12
Coweeta Exp Station	Macon	October 7	8
Cullowhee	Jackson	October 11	9
Durham	Durham	October 24	10
Edenton	Chowan	November 11	12
Elizabeth City FAA AP	Pasquotank	November 7	12
Enka	Buncombe	October 20	10
Fayetteville	Cumberland	October 31	9
Franklin 1 SSW	Macon	October 12	8
Gastonia	Gaston	November 1	14
Goldsboro 1 SSW	Wayne	October 30	9
Greensboro Pump Station	Guilford	October 28	10
Greensboro WSO AP	Guilford	October 27	10
Greenville	Pitt	October 30	10
Hamlet	Richmond	October 24	8
Hatteras	Dare	December 11	15
Henderson 2 NNW	Vance	October 23	9

Average first fall frost date and its standard deviation for selected North Carolina locations listed by station name. Data are for the period 1951 - 1980.

Station Name	County	Average Date	Standard Deviation (days)
Hendersonville 1 NE	Henderson	October 12	9
Hickory	Burke	October 30	11
Highlands 2 S	Macon	October 22	12
High Point	Guilford	October 30	12
Hot Springs 2	Madison	October 21	10
Jackson	Northampton	October 26	8
Kinston 5 E	Lenoir	October 29	13
Laurinburg	Scotland	November 1	11
Lenoir	Caldwell	October 21	11
Lexington	Davidson	October 31	12
Lumberton 6 NW	Robeson	October 28	12
Marion	McDowell	October 31	13
Marshall	Madison	October 15	10
Maysville 6 W	Jones	October 24	13
Monroe 4 SE	Union	October 25	10
Morehead City 2 WNW	Carteret	November 19	13
Morganton	Burke	October 18	9
Mount Airy	Surry	October 15	9
Nashville	Nash	October 30	11
New Bern FAA AP	Craven	November 9	13
New Holland	Hyde	November 11	11
Oxford 2 SW	Granville	October 28	12
Pisgah Forest 1 N	Transylvania	October 10	7
Plymouth 5 E	Washington	October 25	11
Raleigh-Durham WSO AP	Wake	October 27	9
Raleigh 4 SW	Wake	November 1	14
Raleigh NCSU	Wake	November 5	13
Reidsville 2 NW	Rockingham	October 27	11
Rocky Mount 8 ESE	Edgecombe	October 25	10
Rowan Research Station	Rowan	October 20	8
Salisbury	Rowan	October 26	10
Sanford 8 NE	Lee	October 22	10
Shelby 2 NNE	Cleveland	October 25	9

Average first fall frost date and its standard deviation for selected North Carolina locations listed by station name. Data are for the period 1951 - 1980.

Station Name	County	Average Date	Standard Deviation (days)
Siler City 2 NW	Chatham	October 15	10
Smithfield	Johnston	October 25	10
Southport 5 N	Brunswick	November 12	14
Statesville 2 NNE	Iredell	October 19	12
Tarboro 1 S	Edgecombe	October 28	11
Transou	Ashe	October 1	10
Tryon	Polk	October 29	11
Wadesboro	Anson	November 4	12
Waterville 2	Haywood	October 26	12
Waynesville 1 E	Haywood	October 8	10
Whiteville 7 NW	Columbus	October 31	11
Willard 4 SW	Pender	November 1	12
Williamston 1 ENE	Martin	November 3	12
Wilmington 7 N	New Hanover	November 3	12
Wilmington WSO AP	New Hanover	November 14	13
Wilson 3 SW	Wilson	October 29	10
.	.	.	.

Table 2. Average first fall frost date and its standard deviation for selected North Carolina locations listed by county. Data are for the period 1951 - 1980.

County	Station Name	Average Date	Standard Deviation (days)
Alamance	Burlington	November 1	11
Anson	Wadesboro	November 4	12
Ashe	Transou	October 1	10
Avery	Banner Elk	October 2	11
Brunswick	Southport 5 N	November 12	14
Buncombe	Asheville	October 23	11
	Black Mountain	October 17	10
	Bent Creek	October 9	11
	Enka	October 20	10
Burke	Morganton	October 18	9
	Hickory	October 30	11
Cabarrus	Concord	November 2	12
Caldwell	Lenoir	October 21	11
Carteret	Morehead City 2 WNW	November 19	13

Average first fall frost date and its standard deviation for selected North Carolina locations listed by station name. Data are for the period 1951 - 1980.

Station Name	County	Average Date	Standard Deviation (days)
Chatham	Siler City 2 NW	October 15	10
Cherokee	Andrews 2 E	October 10	10
Chowan	Edenton	November 11	12
Cleveland	Shelby 2 NNE	October 25	9
Columbus	Whiteville 7 NW	October 31	11
Craven	New Bern FAA AP	November 9	13
Cumberland	Fayetteville	October 31	9
Dare	Hatteras	December 11	15
Davidson	Lexington	October 31	12
Durham	Durham	October 24	10
Edgecombe	Rocky Mount 8 ESE	October 25	10
	Tarboro 1 S	October 28	11
Gaston	Gastonia	November 1	14
Granville	Oxford 2 SW	October 28	12
Guilford	High Point	October 30	12
	Greensboro Pump Station	October 28	10
	Greensboro WSO AP	October 27	10
Haywood	Canton 1 SW	October 10	9
	Waynesville 1 E	October 8	10
	Waterville 2	October 26	12
Henderson	Hendersonville 1 NE	October 12	9
Hyde	New Holland	November 11	11
Iredell	Statesville 2 NNE	October 19	12
Jackson	Cullowhee	October 11	9
Johnston	Smithfield	October 25	10
Jones	Maysville 6 W	October 24	13
Lee	Sanford 8 NE	October 22	10
Lenoir	Kinston 5 E	October 29	13
Macon	Coweeta Exp Station	October 7	8
	Highlands 2 S	October 22	12
	Franklin 1 SSW	October 12	8
Madison	Marshall	October 15	10
	Hot Springs 2	October 21	10
Martin	Williamston 1 ENE	November 3	12

Average first fall frost date and its standard deviation for selected North Carolina locations listed by station name. Data are for the period 1951 - 1980.

Station Name	County	Average Date	Standard Deviation (days)
McDowell	Marion	October 31	13
Mecklenburg	Charlotte WSO AP	November 5	13
Nash	Nashville	October 30	11
New Hanover	Wilmington WSO AP	November 14	13
	Wilmington 7 N	November 3	12
Northampton	Jackson	October 26	8
Orange	Chapel Hill 2 W	October 23	10
Pasquotank	Elizabeth City FAA AP	November 7	12
Pender	Willard 4 SW	November 1	12
Pitt	Greenville	October 30	10
Polk	Tryon	October 29	11
Randolph	Asheboro 2 W	October 31	12
Richmond	Hamlet	October 24	8
Robeson	Lumberton 6 NW	October 28	12
Rockingham	Reidsville 2 NW	October 27	11
Rowan	Salisbury	October 26	10
	Rowan Research Station	October 20	8
Sampson	Clinton	October 29	11
Scotland	Laurinburg	November 1	11
Stanly	Albemarle 4 N	October 25	12
Surry	Mount Airy	October 15	9
Transylvania	Pisgah Forest 1 N	October 10	7
	Brevard	October 8	9
Union	Monroe 4 SE	October 25	10
Vance	Henderson 2 NNW	October 23	9
Wake	Raleigh NCSU	November 5	13
	Raleigh 4 SW	November 1	14
	Raleigh-Durham WSO AP	October 27	9
Washington	Plymouth 5 E	October 25	11
Watauga	Blowing Rock	October 11	9
Wayne	Goldsboro 1 SSW	October 30	9
Wilson	Wilson 3 SW	October 29	10

Average first fall frost date and its standard deviation for selected North Carolina locations listed by station name. Data are for the period 1951 - 1980.

Station Name	County	Average Date	Standard Deviation (days)
Yancey	Celo 2 S	September 27	18

Author: Katharine Perry, Horticultural Science

Publication date: Dec. 31, 1996