# Growing Season Summary for the 1999 Season Water, Water Everywhere! 

John W. Enz and Barbara A. Mahoney<br>Agricultural Climatologist and Research Specialist, Soil Science, NDSU

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## Introduction

Water, water everywhere comes to mind when driving across North Dakota this summer. Nearly everywhere you look potholes and wetlands have inundated large tracts of surrounding farmland. Low lying areas that were cultivated for years have ducks and geese swimming on them. Many nearby roads have already been raised, and others are threatened. The damage to the states' infrastructure is readily apparent. Although better than a drought, at least in our opinion, too much water is still devastating to most agriculture.

Wet conditions during the previous (1998) growing season culminated with 2 to 7 inches of rain (300 to 500 percent of normal) during October 1998. The La Nina winter failed to live up to harsh expectations and snowfall was about average. This spring's snowmelt ran off because all soil, wetland, and depression storage was full from the previous autumn. A warm and mostly dry April showed early promise of a good year, but just as planting started the record breaking May rains began. Wet conditions throughout May and June delayed or prevented normal planting across the entire northern tier of counties and in numerous other areas in central and eastern North Dakota. While the summer was punctuated with a 3 to 5 week dry period in many areas, in some regions the rainfall never really stopped. The result was record breaking rainfall over large areas of the state in May, July, August, and September. Total growing season rainfall (April - September) ranked among the top 5 wettest seasons on record in several areas of north-central, central, and south-central North Dakota. Thankfully, the rains diminished in September and October giving rise to a good harvest season. However, because of the late planting, harvesting is far behind the 5-year average.

## Climatic Normals

The use of the term `normal' in climatology and meteorology is often confusing. Normal is defined by the National Weather Service as a 30-year average for the preceding 3 complete decades and has been used for most of this century to characterize average climatic elements. Unfortunately, its use often implies that varying weather conditions, or deviations from `normal', are somehow abnormal. This is not true. Our continental climate typically causes temperatures, precipitation, and other climatic elements to vary widely from day to day or week to week. Nevertheless, an average is still a valuable mathematical concept that can be used to compare years or locations by masking day to day weather variations. Currently, normal refers only to an average value for the 30-year period, 1961-1990, and is used for comparisons throughout this manuscript. Think of it as a long-term average of the year to year extremes.

## April and May Rainfall

April was favorably dry over much of the state. A wide swath extending from northwest to southeast received only 0.5 to 1 inch of rain and was 2 to 3 F warmer than normal. The southwestern and northeastern corners were wetter with 1 to 2 inches or about 100 to 175 percent of normal precipitation. Soils in the warmer areas dried throughout April, but just when fieldwork got underway in early May it began raining.

May 1999 rainfall was above normal nearly everywhere in the state, but the central one-third was the wettest with amounts of 6 to over 11 inches at Belcourt (Figure 1) which represents 250 to nearly 500 percent of normal (Figure 2). Most totals reported from Towner through Burke Counties, plus McHenry were the greatest ever received at those locations. Record amounts also fell farther south, across Burleigh, Kidder, and parts of Stutsman and Emmons Counties. The 10 greatest May rainfall totals ever recorded and their years of occurrence for selected locations throughout these counties are presented in Table 1. Amounts reported at Granville and Belcourt were about 5 inches greater than the next highest values (Table 1).

In comparison the western and eastern thirds of the state received amounts ranging from 3 to 6 inches (Figure 1) which is 100 to 250 percent of normal (Figure 2). These large amounts of rain over the entire state would cause problems in any year, but this year its effect was magnified by the wet conditions throughout the 1998 growing season and autumn soil water recharge period.


Figure 1. Total Rainfall (inch), May 1999.


Figure 2. Percent of Normal Rainfall, May 1999.

Table 1. Ten greatest May rainfall totals (inch) and rank at selected North Dakota locations.

| Belcourt (51 years)* |  |  | $\begin{aligned} & \text { Granville } \\ & (93 \text { years)* } \end{aligned}$ |  |  | Willow City (108 years)* |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Rank | Year | Prec | Rank | Year | Prec | Rank |  | Year | Prec |
| 1 | 1999 | 11.35 | 1 | 1999 |  | 10.56 | 1 | 1999 | 7.78 |
| 2 | 1965 | 7.70 | 2 | 1941 |  | 5.21 | 2 | 1896 | 5.71 |
| 3 | 1974 | 5.80 | 3 | 1927 |  | 5.01 | 3 | 1941 | 5.48 |
| 4 | 1962 | 4.72 | 4 | 1953 |  | 4.96 | 4 | 1927 | 4.35 |
| 5 | 1982 | 4.17 | 5 | 1974 |  | 4.56 | 5 | 1960 | 4.12 |
| 6 | 1977 | 4.08 | 6 | 1978 |  | 4.41 | 6 | 1903 | 4.04 |
| 7 | 1953 | 3.89 | 7 | 1962 |  | 4.09 | 7 | 1962 | 3.96 |
| 8 | 1960 | 3.86 | 8 | 1912 |  | 3.97 | 8 | 1909 | 3.38 |
| 9 | 1950 | 3.55 | 9 | 1982 |  | 3.87 | 9 | 1912 | 3.87 |
| 10 | 1991 | 3.32 | 10 | 1933 |  | 3.81 | 10 | 1982 | 3.47 |


| Rugby | (51 years)* |  | Steele (106 years)* |  |  | * Wilton (51 years)* |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Rank | Year | Prec | Rank | Year | Prec |  |  | Year | Prec |
| 1 | 1999 | 7.95 | 1 | 1999 |  | 8.62 | 1 | 1999 | 7.68 |
| 2 | 1962 | 4.66 | 2 | 1927 |  | 7.75 | 2 | 1965 | 7.53 |
| 3 | 1974 | 4.06 | 3 | 1919 |  | 7.74 | 3 | 1962 | 6.03 |
| 4 | 1950 | 4.02 | 4 | 1906 |  | 6.68 | 4 | 1985 | 4.83 |
| 5 | 1994 | 3.91 | 5 | 1960 |  | 5.82 | 5 | 1960 | 4.80 |
| 6 | 1965 | 3.86 | 6 | 1962 |  | 5.53 | 6 | 1995 | 4.70 |
| 7 | 1960 | 3.76 | 7 | 1993 |  | 5.41 | 7 | 1953 | 4.10 |
| 8 | 1982 | 3.57 | 8 | 1950 |  | 5.20 | 8 | 1993 | 3.87 |
| 9 | 1995 | 3.55 | 9 | 1953 |  | 4.92 | 9 | 1996 | 3.73 |
| 10 | 1953 | 3.37 | 10 | 1933 |  | 4.89 | 10 | 1972 | 3.69 |

## June Rainfall

Total rainfall during June was a near normal 3 inches at most locations. However, as is common with isolated thunderstorms a few locations received more than 4 inches while others reported less than 2 inches. Often these extremes were found at adjacent stations. For example, Granville reported 6.75 inches while Minot reported only 1.28. Note that Granville also had record rainfall in May (Table 1).

## July and August Rainfall

A wide swath extending from southwest to northeast across North Dakota received below normal July rainfall. The southwest and west-central regions were the driest, reporting only 0.5 to 1 inch which is only $25-45 \%$ of normal (Figure 3). Most of northern North Dakota received above normal rainfall amounts (Figure 3), but unfortunately Granville, and many other locations that received record amounts in May were also among the wettest in July, with 4 to 6 inches. This represents 130 to 200\% of normal (Figure 3). The Devils Lake watershed area and much of southeast North Dakota were also wet. Most of the 6 inches reported in extreme southeastern North Dakota fell on one day with very high intensities. For example, our North Dakota Agricultural Weather Network (NDAWN) station near McLeod reported an astounding intensity of 1.2 inches in 10 minutes, which is equivalent to 7.2 inches per hour. This severe storm continued southeast across Richland County and also produced high intensity rainfall near Wheaton MN.


Figure 3. Percent of Normal Rainfall, July 1999.

During August the northwest, northeast, and east-central regions remained dry; reporting less than 1 inch for the month (Figure 4), but the remainder of the state was well above normal. Once again, central North Dakota was the wettest with 5 to 9 inches (Figure 4) which represents 200 to 400 percent of normal (Figure 5). Wilton reported 9.29 inches, which is the greatest amount recorded at that location in the past 52 years (Table 2). At Bismarck the August 1999 rainfall total of 7.91 ranks second out of 122 years of record behind last years August rainfall of 9.29 inches (Table 2).


Figure 4. Total Rainfall (inch), August 1999.


Figure 5. Percent of Normal Rainfall, August 1999.

Table 2. Greatest total August rainfall (inch) and rank at selected North Dakota locations.

| Bismarck (121 years)* |  |  | Wilton (52 years)* |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Rank | Year | Prec | Rank | Year | Prec |
| 1 | 1998 | 9.29 | 1 | 1999 | 9.29 |
| 2 | 1999 | 7.91 | 2 | 1951 | 8.15 |
| 3 | 1903 | 5.59 | 3 | 1980 | 5.66 |
| 4 | 1944 | 5.05 | 4 | 1985 | 4.47 |
| 5 | 1980 | 5.03 | 5 | 1993 | 4.31 |
| 6 | 1951 | 4.89 | 6 | 1962 | 4.25 |
| 7 | 1880 | 4.82 | 7 | 1968 | 4.01 |
| 8 | 1909 | 4.77 | 8 | 1965 | 3.69 |
| 9 | 1985 | 4.61 | 9 | 1981 | 3.43 |
| 10 | 1968 | 4.56 | 10 | 1966 | 3.18 |

It is noteworthy that the last two years have produced the two wettest Augusts in 121 years of record at the Bismarck National Weather Service Forecast Office (NWSFO). Also interesting is that these two months also produced the two greatest one-day precipitation amounts ever recorded in Bismarck. The 4.48 inches on August 12, 1999 is second only to the 4.63 inches that fell on August 21, 1998, just about one year earlier. Some of the greatest one-day rainfalls ever recorded at the NWSFO are listed in Table 3. Note that the 4 greatest amounts all occurred since 1993.

Table 3. Greatest one-day (24-hour) precipitation totals at Bismarck NWSFO in 121 years of record.

| Rank | Year | Mon | Day | Prec |
| :---: | :---: | :---: | :---: | :---: |
| 1 | 1998 | 8 | 21 | 4.63 |
| 2 | 1999 | 8 | 12 | 4.48 |
| 3 | 1993 | 7 | 15 | 4.32 |
| 4 | 1994 | 9 | 15 | 4.31 |
| 5 | 1894 | 9 | 7 | 3.67 |
| 6 | 1914 | 6 | 26 | 3.36 |
| 7 | 1947 | 6 | 3 | 3.25 |
| 8 | 1909 | 8 | 9 | 3.12 |
| 9 | 1953 | 6 | 15 | 3.07 |
| 10 | 1915 | 8 | 1 | 2.92 |

## September Rainfall

September continued the wet tradition of the 1999 growing season with record setting rainfall in southeastern North Dakota. More than 2 inches fell over a triangular area extending from Grand Forks to Fort Yates. In addition, the southern two rows of counties received 4 to 7 inches which is 200 to 350 percent of normal (Figure 6). Most of this heavy precipitation fell during the first 3 days of September although there were some showers during mid-month. These amounts are unprecedented in several areas as shown once again, by the rankings in Table 3. Amounts received at Fargo and Oakes are the greatest on record for September while Lisbon's 6.75 inch total was 0.02 less than the September, 1978 amount (Table 4). Rainfall across the remainder of the state was fairly uniform totaling 1 to 2 inches or about 75 to 140 percent of normal (Figure $6)$.


Figure 6. Percent of Normal Rainfall, September 1999.

Table 4. Greatest total September rainfall (inch) and rank at selected North Dakota locations.

| Oakes | (71 years)* |  | Fargo (119 years)* |  |  | Lisbon (97 years)* |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Rank | Year | Prec | Rank | Year | Prec | Rank | Year | Prec |
| 1 | 1999 | 7.60 | 1 | 1999 | 6.50 | 1 | 1978 | 6.77 |
| 2 | 1996 | 6.68 | 2 | 1889 | 6.27 | 2 | 1999 | 6.75 |
| 3 | 1977 | 4.89 | 3 | 1957 | 6.13 | 3 | 1973 | 4.84 |
| 4 | 1961 | 4.72 | 4 | 1903 | 5.60 | 4 | 1941 | 4.61 |
| 5 | 1973 | 4.66 | 5 | 1973 | 4.98 | 5 | 1924 | 4.52 |
| 6 | 1978 | 4.59 | 6 | 1881 | 4.75 | 6 | 1920 | 4.35 |
| 7 | 1986 | 4.26 | 7 | 1961 | 4.44 | 7 | 1903 | 4.34 |
| 8 | 1988 | 4.00 | 8 | 1921 | 4.35 | 8 | 1977 | 4.20 |
| 9 | 1957 | 3.97 | 9 | 1971 | 4.30 | 9 | 1911 | 3.79 |
| 10 | 1941 | 3.82 | 10 | 1904 | 4.24 | 10 | 1961 | 3.77 |

## April through September Rainfall and Temperature

It was a very wet growing season for North Dakota. Although there were large variations during individual months, total 1999 growing season rainfall in the state ranged from 10 to more than 27 inches. Even the driest regions in the extreme west and southwest were near normal with 10 to 12 inch totals for the season (Figure 7).


Figure 7. Total Rainfall (inch), April-September 1999.

Roughly speaking, the central one-third of North Dakota was clearly the wettest, receiving 18 to 27 inches (Figure 7) which is 125 to over 200 percent of normal (Figure 8). In most of McHenry County this was the wettest growing season in 93 years of record. For example, Granville's total of 27.61 inches exceeded the next highest total by over 6 inches. Scattered locations within the southeast and south-central regions also ranked in the top 2 or 3 wettest years since records began in 1893 or earlier, often placing second to the 1993 growing
season which was the wettest on record. Those checked include Bismarck, Steele, Wishek, and Oakes, but many nearby locations probably also qualify.


Figure 8. Percent of Normal Rainfall, April-September 1999.

The timing of the rainfall was nearly as important as the amounts in many cases. For example, wet conditions throughout May and June delayed or prevented normal planting across the entire northern tier of counties and in numerous other areas in central and eastern North Dakota. However, in other areas similar wet conditions occurred after most crops had been planted. This often resulted in temporary flooding and overall wet soils for a few weeks. Despite these conditions, sporadic lengthy dry periods lasting 3 to 5 weeks still allowed crops to prosper.

Rainfall timing also caused two distinct growing seasons. Crops planted in April and early May before the heavy rains occurred comprised the first season. The second includes crops planted 6 to 10 weeks later in June and early July. Despite copious early September rain in the southeast, good drying weather followed and autumn harvests went smoothly. Fortunately, September was frost free and most late planted crops all across the state had time to mature. However, this will be one of the later harvest seasons in many years.

Temperature was not much of a factor this year. Average temperature during the growing season was slightly below normal nearly everywhere in the state. There was little deviation from normal during the individual months except for April and September. April was 2-3 F above normal over the driest regions while September was 3 to 5 F below normal across the state.

## Outlook for 2000

Rainfall during late September and most of October has been almost nonexistent across most of the state resulting in good harvest conditions. This is providing time for producers to harvest many of those late planted crops.

Autumn precipitation is usually important because it helps replenish some of the soil water that was consumed by this years crop. However, rainfall was so plentiful this year that it supplied most of the crop demand and little stored soil water was consumed. As a result stored soil water is still plentiful in all but some western regions, despite the low October rainfall. There are no areas that are critically dry and state-wide stored soil water should be adequate next spring.

Recent reports have indicated that the La Nina (opposite of El Nino) condition that existed last winter, but weakened this spring, appears to be strengthening. La Nina's have generally been linked to erratic, highly variable winter conditions in the northern united States. A study last year by the Grand Forks National Weather Service Office indicated a high probability for precipitation extremes during La Nina winters. That is, either a very dry or a very wet (lots of snow) winter is more likely than a normal one. In addition, January was found to be colder than average in most of the La Nina winters this century. Note however, that last winter we had average amounts of snow and January temperatures were near normal.

Incidentally, the Old Farmer's Almanac will not help predict the winter. In our study of the 1996-97 and 97-98 winters the almanac failed to predict almost any facet of the weather accurately. Seriously; are one-line predictions for 6 to 10 day periods over a 7 -state area actually valuable? If you must buy a copy, enjoy the miscellaneous articles and pay little attention to the forecasts.

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