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Ray Garnett Climate and Crop Letter

Volume 9, Number 02
August 22, 2013

Highlights Since the Last Letter

** Heavy rains continue to cause wheat quality problems in China;*

** Cool, dry weather has become somewhat problematic for corn and soybean states in recent weeks;*

** The USDA in August estimated global wheat, coarse grain and rice production in 2013 as being up 8, 10 and 2% respectively over 2012; and*

** ACC correctly forecast extremely wet July moisture conditions over the Canadian last February (Please see Forecast Verification section.)*

Canadian Prairies

Spring Wheat, Barley & Canola Regions

Summary: Warm temperatures in mid August will have helped maturation.

Except for the Peace River zone and near Loydminister, August 13-19 brought less than 40% of normal rainfall with slightly warmer than normal temperatures assisting ripening. From mid-June to mid-August, most of the prairies received 115-200% of normal supporting record yields.

Based on growing degree-days above 5ºC, the spring wheat crop will now be mature in most of the Palliser Brown and much of the Eastern Prairie zones with harvesting activity likely underway.

Based on July moisture conditions, ACC estimates spring wheat yield at a record 3.00 t/ha with protein content of milling grade wheat likely lower than the average 13.5%.

U.S.

Corn and Soybean Regions

Summary: Drier and cooler weather in recent weeks has reduced yield prospects.

Except for above normal rainfall in Nebraska, very dry slightly cooler than normal temperatures prevailed over the Corn Belt August 10-20.

At August 18th, the crop was 11% dented compared to the average compared to the average of 30%. The crop is now through the most weather sensitive silking pollination phase however crop development is behind normal.

Iowa, for example, has experienced colder than normal weather for the past month. Average dates of first autumn frost are as follows: southern Minnesota and central Nebraska-October 1st; central Iowa- October 7th; central Illinois and southern Indiana October 15 th. The corn crop can handle frost once the crop is fully dented.

Assuming no frost damage, ACC continues to forecast a crop of 14.2 billion bushel, which assumes a yield of 160 bu/ac and a harvested area of 89.2 mln acres.

In early August the USDA forecast the yield at 154 bu/ac. At August 18, the crop was rated in 61% good to excellent condition down from 64% the week before. Dryness since June 1st and recent cool weather is reportedly delaying maturity and affecting yield potential.

A month of cool weather has slowed development of the soybean crop such that pod setting was 9% behind average of 72% at August 18th. The crop was in 62% good to excellent condition down from 64% a week earlier.

ACC has lowered the yield forecast to 41.9 bu/ac for a crop of 3.2 bln bushels. Drier and cooler than normal weather in recent weeks is reportedly reducing yield potential.

Other Global Impacts

Europe: Wheat Regions

Summary: Despite production problems in the UK, EU wheat production looks to be 6% higher than a year ago.

August 11-20 brought dry weather amidst normal temperatures to the major wheat producing countries of France, Germany and the UK prompting the latter stages of the winter wheat and barley harvests. Dryness since March 1st has been problematic in the UK and Benelux regions and wheat production in the UK has dropped by 1.4 mln tones likely the result of dryness at planting. Heavy rainfall in late July and early August will have favored France's corn production prospects.

FSU: Spring Grain Regions

Summary: *Wheat production in 2013 may rebound by close to 30 mln over a year ago thanks largely to timely rains and cool weather in the Siberian sector.*

August 11-20 brought mostly dry and warmer than normal weather to spring grains in the Siberian Sector favoring the ripening and early harvest of crops.

Since April 1st, agricultural drought remains widespread throughout the Ural region and Kazakhstan which has been offset by cooler than normal weather during June and July. Spring wheat and barley will now be at early harvest.

In European sector, warmer and drier than normal favored the maturation of the corn crop that normally passes through the teaseling stage in July. The rainfall pattern in the Ukraine has been mixed geographically with both extremely dry and wet conditions prevailing since April 1st.

In the North Caucasus region, 25-50mm once again slowed any winter or spring grain harvesting. Rainfall in this region has been over 200% of normal since April 1st causing the usual problems associated with excessive rainfall.

India: Rice Region

Summary: A flood monsoon is underway.

August 15-21 brought 126% of rainfall to the subcontinent. Similarly, since June 1st,

rainfall has been 114% of normal putting the monsoon in the flood category. These rains are the heaviest in recent memory and are most likely favoring autumn and winter rice production.

China: Wheat Region

Summary: Heavy rains plague the spring wheat harvest.

August 11-20 brought 50-150 mm of rainfall to the spring wheat harvest in Heilungchiang, Jilin and Inner Mongolia provinces that produce close to 10% of China's wheat. While production has been unaffected, these rains will further down grade quality. Quality problems have recently been linked to increased imports.

Forecast Verification

February 28, 2013 we wrote, "Figure 2 is an update of a composite sent to clients in early January. If there are to be climatic extremes leading up to August of 2013 PNA, PDO and MJO predictors suggest they will be of the wet variety comparable to 1991, 1996, 1999 and 2007."

What happened?

Based on 13 July PDSI values for the prairies as a whole, the average July PDSI value was 1.60. This would have been the second wettest for the period 1979-2009 and comparable to 1996 and 1991. Spring wheat yields in those years were 0.15 t/ha and 0.10 t/ha above trend respectively implying a yield of 2.88 t/ha in 2013 matching the record of 2.90 t/ha set in 2011.

Appendix: What's up with solar activity?

An August 15th release from NASA notes that the likes of the current 11 year sunspot cycle number 24 has not been observed in 200 years. Cold periods like the Little Ice Age were proceeded by low sunspot activity. The Little Ice age that occurred between 1350-1850 brought cooler temperatures and wet seasons across Europe that lead to massive crop failures, famines and civil unrest. A one degree Celsius cooling could greatly reduce the grain growing area on the Canadian prairies. ACC uses the AP index described in the Glossary for seasonal weather forecasting. The AP index is a proxy variable for solar activity and a more representative of solar activity than sunspot data.

Agro-Climatic Consulting (ACC) Plans

ACC is looking into creating a blog to facilitate weekly updates for clients pertaining to Prairie and Global Weather and Crop Conditions and the various drivers of climatology.

Comment on biofuels

A source in Iowa reports that Iowa, the leading corn producing state in the U.S., has become a net corn importing state because of the high demand for producing ethanol. Producing fuel for automobiles has become more important that producing food for hogs and humans. This could easily be considered immoral.

Following is a map showing the makeup of four Agro Ecological Zones:

- Peace River: Agro-Eco region #14
- Palliser North: Agro-Eco regions #13, 10 and 11
- Palliser Brown Soil: Agro Eco region #12
- Eastern Prairies: Agro Eco region #2 and #3

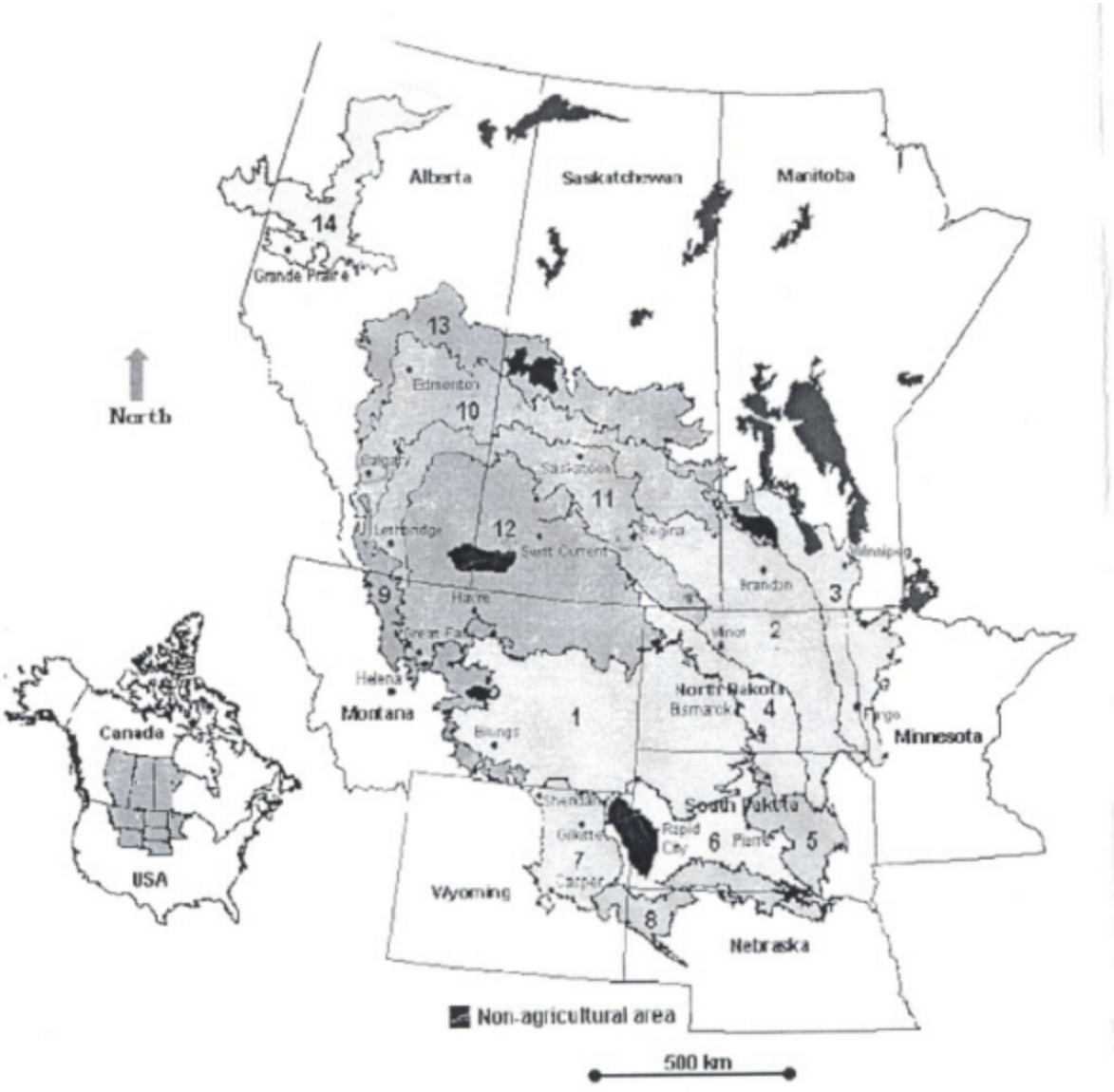

Figure 1. Agro-ecoregions of the northern Great Plains (Padbury et al. 2002, reprinted with permission).

Glossary of Terms Used

Agricultural Drought: The U.S. Centre for Climate and Environment Assessment defined drought as less than 50% of normal rainfall during two consecutive months of the active growing season in unirrigated areas. Using the Canadian prairies as an example, areas that receive less than 50% of normal rainfall during June-July typically would be considered drought affected. One cannot ignore the significance of July precipitation in defining agricultural drought on the Canadian prairies. Also, when yield departures from trend are greater than 10% below trend, ACC considers it an Agricultural Drought.

AO: The **Arctic Oscillation (AO)** consists of 1000 mb height anomalies centred over the Bering Sea and northwest of Spain with an associated trough over the Arctic. When the oscillation is strong (Blue or of a negative sign as seen on the Climate Prediction website) there are increased and more intense cold air incursions into the Canadian prairie region. The reverse is true when the index is positive.

AP: The **AP Index (AP)** is a proxy variable that tells us how active the sun is and is a measure of the general level of geomagnetic activity over the globe for a given day. It is more suitable for reflecting all solar activity that sunspot data. An observatory in Niemegh, Germany calculates official values of the AP index twice a day derived from measurements made at a number of stations worldwide of the variation in the geomagnetic field due to currents in the earth's ionosphere and to a lesser extent, in the earth's magnetosphere.

Bermuda High: Has been described as an extension of the Azores High a key aspect of the North Atlantic Oscillation (NAO), which is more expansive when the NAO is positive. Agro Climatic Consulting (ACC) contends that a positive NAO tends to prevent moisture from entering North America through the Gulf of Mexico.

Dalton Minimum: A period of low solar activity, which lasted from 1790 to 1830 and was named after the English meteorologist John Dalton. Like the Maunder and Sporer minimums, it coincided with a period of lower-than-average global temperatures. The Oberlach station in Germany cooled by 2.0ºC over 20 years. The 1815 Tambora volcano assisted in bringing 1816 the year without a summer.

Eastern Prairies (EP): East of a line between Coronach, Saskatchewan and Swan River, Manitoba

ENSO: **El Nino/Southern Oscillation (ENSO)** in combination with the Indian monsoon system constitutes the largest single source of inter annual climatic variability on a global scale with effects that are wide-ranging and often severe. The Southern Oscillation is the difference in sea level pressure between Darwin and Tahiti. A positive (negative) SOI is indicative of La Niña (El Niño) conditions colder (warmer) than normal sea surface temperatures in the east equatorial Pacific. The Nino 3.4 region is most commonly used.

Bjerknes in the late 1960s fused the southern oscillation (SOI) concept with that of

warmer or colder than normal sea surface temperatures in the east equatorial Pacific. Hence, the phenomenon is called the El Nino/Southern Oscillation. Research has shown that El Niño (La Niña) conditions during the spring and summers months are favourable (unfavourable) for rainfall on the Canadian prairies.

MJO: The **Madden Julian Oscillation (MJO)** is a 30-60 day intra seasonal oscillation (a six week cycle) which travels eastwards at approximately 13 mi/hr (6 m/sec) through the atmosphere over the Indian and Pacific Oceans. A wet phase of enhanced precipitation follows a dry phase where thunderstorm activity is suppressed.

The proposed mechanism is complicated. It is hypothesized, for example, that a positive MJO in February at 120° W. (near the North American west coast) appears to suppress June-July precipitation over the Canadian prairies months related to a six-week periodicity. The wettest time of the year over the prairies is around June 21st at high sun when a trough normally occurs on the west coast as part of the annual cycle. A repetition of the MJO six-week cycle around June 21st would serve to force a ridging pattern that acts against normal troughing associated with the annual cycle resulting in drier June-July.

Modified PNA Accumulation Approach sums only statistically significant months of December, January and May are summed. The sign of the May PNA values is reversed in the summation consistent with capturing sustained forcing.

NAS: The **North America snow cover (NAS)** represents the areal extent of snow cover in North America.

NAO: The **North Atlantic Oscillation (NAO)** is calculated as the difference in surface pressure between The Azores High (which is about 50 degrees latitude west of Gibraltar) and Iceland. A positive index shows a stronger than usual high near the Azores Island and a deeper than normal Icelantic low.

NP: The **North Pacific Index (NP)** is the area weighted sea level pressure over the region 30ºN -65ºN, 160ºE-140ºW. When this pressure is lower than normal December to August it is conducive to drought.

PDO: The **Pacific Decadal Oscillation (PDO)** operates through a change in the location of warm and cold water in the Pacific. When the PDO index is positive (negative), waters in the north central Pacific Ocean tend to be cool (warm), and waters along the west coast of North America tend to be warm (cool) which alters the path of the jet stream. The effects of the PDO are most drastic in the Pacific Northwest whereby positive PDO, generally correlates with lower (higher) than average rainfall and higher (lower) than average air temperatures. A positive (negative) PDO is seen as more conducive to meridian (zonal) flow and drier (wetter) conditions similar to the PNA influence. The positive or negative phase of the PDO can persist a decade or more. The PDO index has been negative since 2006.

PDSI: The **Palmer Drought Severity Index (PDSI)** is often used as a measurement of

dryness and is based on a supply and demand model of soil moisture. Minus 2 is moderate drought, minus 3 severe drought and minus 4 severe drought. Categories are as follows:

Extremely wet	> 4
Very wet	3.00 to 3.99
Moderately wet	2.00 to 2.99
Slightly wet	1.00 to 1.99
Incipient wet	0.50 to 0.99
Near Normal	0.49 to -0.49
Incipient Drought	-0.50 to -0.99
Mild Drought	-1.00 to -1.99
Moderate drought	-2.00 to- 2.99
Severe drought	-3.00 to - 3.99
Extreme drought	< -4.00

The **Palliser Brown Soil Agricultural Acological Zone** is bounded by Lethbridge, Red Deer, Regina and the Canada-U.S. border. It is found well within the 'Palliser Triangle' and is traditional considered the driest zone of the Canadian prairies.

The **Palliser North Agricultural Ecological Zone** is located in the northwestern prairies, essentially north of the Palliser Brown Soil zone. It is found west of Lethbridge, north of Red Deer and Regina and northwest of Regina and Swan River. Its delineation is based on the work of Padbury et al in 2002 and is one of four Ag Eco Zones defined in the NRI-MRAC research project.

PNA: The **Pacific North American Teleconnection Index (PNA)** is a derivative index of the El Niño/Southern Oscillation index and is typically positive during El Nino and negative during La Nina. A positive (negative) PNA pattern is indicative of a strong (weak) Aleutian Low influence, which in turn forces a ridge (leads to Siberian expresses) over the prairie region. A positive (negative) PNA pattern is associated with mild (cold) winters over the Canadian prairies. During the April to July period research has shown that zonal flow is associated with wetter cooler weather while meridian flow is associated with drier hotter weather over the North American Great Plains.

QBO: **The Quasi-Biennial Wind Oscillation (QBO)** often referred to as the stratospheric wind reversal was discovered in the early 1960s. Measured at Singapore it is a reversal in winds at the top of the atmosphere blowing one direction for about 13 months and then reversing. It is an important factor in foreshadowing Indian monsoon rainfall and recently demonstrated as a factor determining Canadian prairie rainfall. The strength of the QBO is measured at various levels of atmospheric pressure with the 30 and 50mb levels most commonly used.

SOI: The **Southern Oscillation Index (SOI)** represents the difference in sea level pressures between Darwin and Tahiti, which are the central points in a planetary seesaw of sea level pressures discovered by Sir Gilbert Walker in the early part of the 20th century. When the index is positive (negative) it is an indication of La Nina (El Nino). La Nina (El Nino) describes cooler (warmer) than normal sea surface temperatures in the

central and east equatorial pacific.

SSTA: Sea Surface Temperature Anomaly

SSA: Solar Influence (SSA) represents sunspot anomaly and is the departure from normal in sunspot activity. For example SSAJAN stands for the sunspot anomaly in January Sunspot activity modulates the solar influence whereby low (high) sunspot activity increases (decreased) cosmic rays, ions, condensation nuclei and clouds on a global scale. Solar irradiance is reduced (increased) with low (high) sunspot activity and surface temperatures tend to be lower (higher). It has been demonstrated that cloudiness over the over the oceans can vary up to 5% between low (20 sunspots per month) and high (150 sunspots per month) sunspot activity. A cloudier earth is shinier, cooler and wetter earth. Solar irradiance is also reduced (increased) with low (high) sunspot activity and surface temperatures tend to be lower (higher).

SD: **Standard Deviation (SD)** is a measure of the 'spread' of values in a frequency distribution. In a normal distribution, the probability that a value will be between the limits of one standard deviation is 68% with a 32% probability of it being in one of the tails of the distribution.

WP: **Western Pacific (WP) Teleconnection Index** is a primary mode of low-frequency variability over the North Pacific in all months in which during winter and spring, the pattern consists of a north-south dipole of anomalies, with one centre over the Kamchatka Peninsula and another broad centre of opposite sign covering portions of southeastern Asia and the western subtropical North Pacific. A third anomaly centre is located over the eastern North Pacific and southwestern U.S. in all seasons. Therefore, strong positive or negative phases of this pattern reflect pronounced zonal and meridional variations in the location and intensity of the entrance region of the Pacific (or East Asian) jet stream.

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The Ray Garnett Climate and Crop Letter is published 23 times per year (twice monthly) by Agro-Climatic Consulting, 767 Garfield St N, Winnipeg, Manitoba R3G 2M4. Tel: 204-775-3614; E-mail: ergarnett@shaw.ca

Subscription rate for the Ray Garnett Climate and Crop Letter is $195 per year or $65 for three months.

Subscription services, editing and distribution provided by:
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