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Using Crop Models and Climate Forecasts to Aid in Peanut Crop Insurance Decisions[1]

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Introduction

Crop insurance is one of the strategies producers can use to reduce risk of income loss due to climate variability. The best approach for reducing risks involves a combination of crop insurance with a pre-harvest marketing plan that includes strategies like hedging and forward contracting. A producer's choice among strategies is often complicated when both price and yield risk are present. However, about 69% of crop failures in the U.S. are because of either drought or excessive moisture (Ibarra and Hewitt, 1999). Are there options for a farmer to reduce these weather and climate-based risks, and can a grower take advantage of climate forecast information to decide about insurance levels? This paper explores this idea for peanuts and provides examples of how to use crop growth simulation models in combination with climate forecasts to decide about coverage levels.

Can Climate Be Predicted?

Weather forecasts are usually fairly accurate in terms of predicting the significant weather features for the coming 1 to 3 days. However, the accuracy of weather forecasts decreases as the lead time increases to 4, 5 or more days. A forecast for 4 days into the future, for example, often needs to be revised as that day approaches, and in some cases the revision may be large. How, then, is it possible to make useful forecasts for some regions for the coming three months, and sometimes even for coming six months?

Climate is the overall trend of the weather for a season or series of seasons. An easy way to see the difference between climate and weather is to compare these questions: “Is it going to rain tomorrow?” is a question about the weather; “Are we going to have a wet winter?” is a question about climate. The ability to predict climate has improved in recent years, and there have been significant and increasing efforts devoted in various parts of the world to apply climate

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information to improve decision making in crop production systems.

Much of the ability in predicting departures from normal seasonal totals or averages has its origin in the slowly changing conditions at the earth's surface that can influence the climate. The most important surface condition affecting climate is the sea surface temperature (SST), particularly the SST of the oceans in the tropical zones. When the SST is higher than normal, it usually remains at that level for several months, and sometimes for as long as a year or more. When the SST in the eastern equatorial Pacific Ocean is higher than normal, the phenomenon is referred to as El Niño. When the temperature is lower than normal, the phenomenon is referred to as La Niña. When the temperature is normal, the event is referred to as Neutral. El Niño effects are strongest during the winter and spring, normally bringing more rainfall and cooler temperatures, while La Niña brings warmer and drier than normal winter and spring. El Niño, La Niña, and Neutral periods are often referred to as "ENSO" phases. ENSO stands for El Niño-Southern Oscillation, and it is the primary reason for climate changes from year to year around the world, and its impact on the climate of the southeastern U.S. is well documented.

In spite of improvements in the ability to predict the seasonal average of the weather, i.e., anomalies of the climate, it is still impossible to predict on which day there will be rain, thunderstorms, or temperature extremes, or on which day a front might pass through and so forth. More details about climate forecast and decision making in agriculture can be found in "Climate Forecast and Decision Making in Agriculture" (IFAS Publication ABE352) by Fraisse et al (2004).

Insurance Products for Yield and Price Risk Protection

Current crop insurance options that are available for farmers fall into two broad categories: those that protect against yield loss only and those that protect against both yield loss and price risks. Yield loss protection includes Actual Production History (APH) and Group Risk (GRP) insurance products.

Actual Production History (APH)

APH is designed to protect the individual farm unit against yield loss. Actual farm production history on a farm unit is used to set protection levels against yield loss due to extreme weather events, such as drought, excess moisture, cold, frost, wind, flood and other unavoidable damages from insects, diseases and other pests. The key word here is unavoidable losses. Farmers must take every precaution to avoid losses.

For APH, yield protection levels range from 50% to 75% of APH (in 5% increments) depending on the crop and area where the farm is located. In some areas up to 85% APH yield protection is available.

Under APH, election prices are set each year by the federal government (USDA-RMA), based on marketing data available prior to sign-up, and are used to determine payments for eligible crop losses. In a way, farmers can set revenue protection levels by selecting from 55% to 100% of the established price and by varying yield coverage levels. In 2005, the peanut insurance price was set at $376/ton ($.188/lb).

Collecting payments on APH insurance depends directly on the level of insurance purchased and whether the peanut yield achieved falls below the yield guarantee level. Low yields are highly correlated with dry weather, especially in the absence of irrigation. In 2003, peanut producers insured their peanuts at the yield guarantee levels shown in Table 1. In Alabama and Florida, peanut producers tended to favor the purchase of 70% of APH, whereas in Georgia, they favored 65% APH insurance.

APH is based on a minimum of 4 and a maximum of 10 years of an individual farm's yield production history. If less than 4 years of APH are available, the rules specify that county average transitional yields (T-yields) be used to fill in the missing years. T-Yields (generally 10-year county average yields) are substituted for the farm if one or more years of records are missing. The substitutions are made according to the following formula:

- 1 years missing – substitute 1 year @ 100% of T-Yield.

- 2 years missing – substitute 2 years @ 90% of T-Yield.
- 3 years missing – substitute 3 years @ 80% of T-Yield.
- 4 years missing – substitute 4 years @ 65% of T-Yield.

T-yields tend to represent area- or county-wide risk but not individual farm yield risk. There are cases where farmers can benefit from the use of T-yields, but they do not represent individual risks well unless the farm mirrors the county average. In case of catastrophic losses year after year, producers can replace any yield in their database with 60% of the county T-yield.

A premium is charged depending on the coverage level and type of insurance taken. Premiums are subsidized by the federal government, ranging from about 67% of the total premium at 50% yield coverage level to 38% at 85% yield coverage level.

Catastrophic Insurance Coverage (CAT), Group Risk Plan (GRP), and Revenue Insurance Products

CAT is a cheap disaster insurance (there is an administrative fee of $100 per crop) which provides coverage at 50% of APH yield level and 55% of the elected price.

GRP insurance is based on average county (or parish) historic yield and not on the yield history of the individual farm. This type of insurance is most useful for farms whose yield history tracks the county average yield or if there is a disaster that affects the entire county (parish). GRP is generally cheaper but does not offer the individual farm protection level provided by APH.

Several insurance products are available to protect against both price and yield risk. These include such products as Crop Revenue Coverage (CRC), Revenue Assurance, and Income Protection. While revenue insurance products such as CRC are rapidly becoming popular, they are not yet available for peanut producers.

How to Use Climate Forecasts to Help Decide on Purchasing Crop Insurance

Climate forecasts are generally presented in terms of probabilities, since it is not possible to predict the exact amount of rainfall or the temperature range for the upcoming growing season. Many times the information is limited to the probabilities of whether precipitation or average minimum/maximum temperature will be below normal, normal, or above normal. This kind of outlook for the coming months can be found at the National Oceanic and Atmospheric Administration Climate Prediction Center (NOAA-CPC) Web site: <http://www.cpc.noaa.gov/>.

Figure 1 shows the NOAA-CPC outlook posted on October 21, 2004 for the temperature in May, June, and July of 2005. According to this outlook, there is a higher probability for above normal temperatures in the southeast U.S. The precipitation outlook for the same period of time indicates equal chances (33.3%) of precipitation levels in the Southeast being below normal, normal, and above normal. Although the NOAA-CPC outlook can be useful in deciding about levels of coverage, especially when they indicate potential anomalies during the upcoming cropping season, they lack the level of details required to further analyze insurance coverage levels. In this study, knowledge of the ENSO phase (Neutral, El Niño, or La Niña), combined with historical weather data, was used to derive detailed data sets at the county level.

Estimating Yield Potential Using Crop Models

Combining crop models with the knowledge of the current ENSO phase allows the estimation of yield potentials for the coming cropping season. Crop models are mathematical models that simulate yield based on the variety that is planted, planting date, and irrigation and soil fertility (N) levels among other management practices. They also account for rainfall amounts, temperature, and solar radiation. However, crop models normally do not account for diseases and

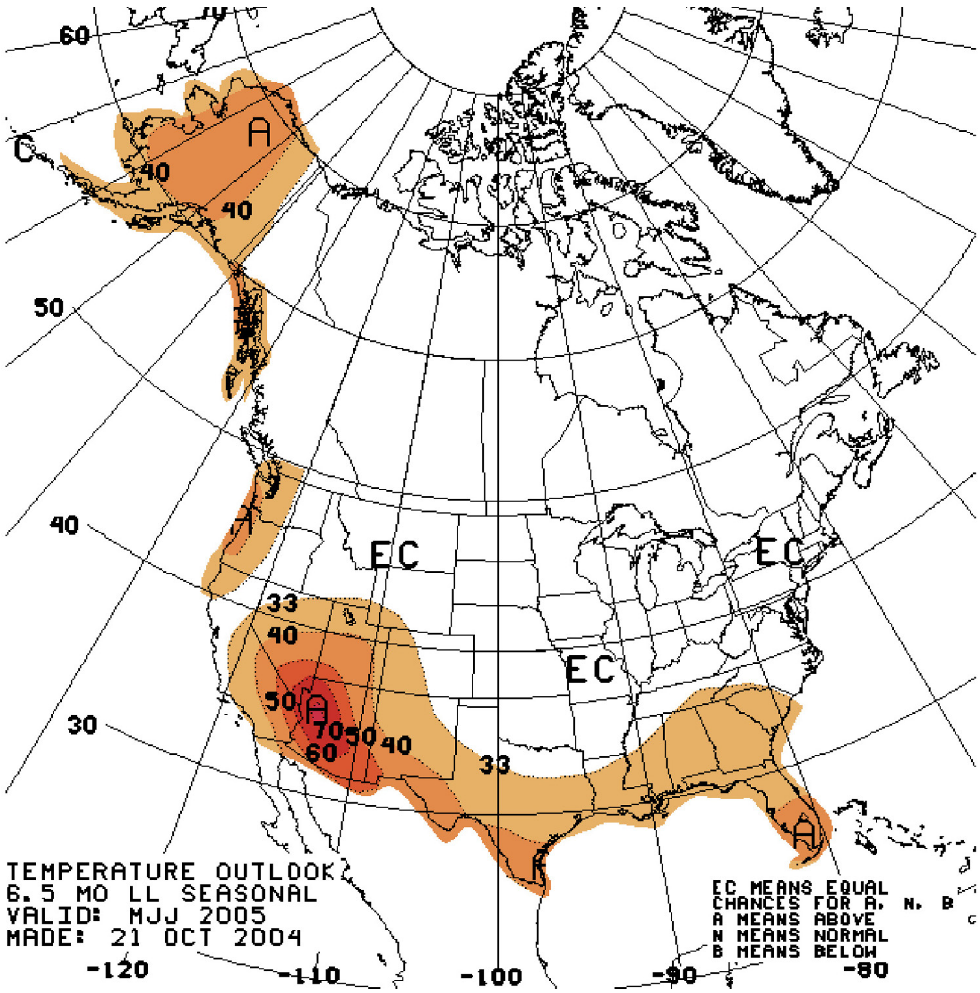

Figure 1. NOAA-CPC temperature outlook for May, June, and July 2005 (posted on October 21,2004).

pests. A peanut growth and development model (CSM-CROPGRO-Peanut, Hoogenboom et al., 1992; Boote et al. 1998; Jones et al., 2003; Hoogenboom et al., 2004) was used in this study to evaluate the impact of climate variability on peanut yield.

Peanut simulations for most peanut-producing counties in the Southeast are being performed by the Southeast Climate Consortium (SECC), composed of six universities in Alabama, Florida, and Georgia. The results become part of a Web-based decision aid system (http://www.agclimate.org) aimed at providing Extension agents, producers and natural resources managers with tools to reduce risks associated with climate variability.

Figure 2 shows the simulated probabilities of collecting peanut crop insurance for different coverage levels (50%-75%) and different planting dates (April 16 – June 12) for three counties: Henry in AL; Jackson in FL; and Mitchell in GA. These counties were chosen because they are important peanut producer counties in the area covered by the SECC. For the purpose of this study, a reference average peanut yield similar to APH was defined for each county, taking into consideration simulated yields for all soil types and planting dates between April 23 and May 15. Table 2 shows the soil types used to simulate peanut growth and development in each county. The emphasis was on evaluating general trends for each county, and soil types were considered to be evenly distributed throughout the counties. Simulations were calibrated for the Georgia Green peanut variety, which is considered a medium maturity variety. Results would be different for early and late maturity varieties. The historical weather data series used to perform simulations included data from 1938 through 2003 for Mitchell County,GA, 1939 through 2003 for Jackson County, FL, and 1950 through 2003 for Henry County, AL. The defined average yield for each county was then used to evaluate probabilities of simulated yields falling below each coverage level.

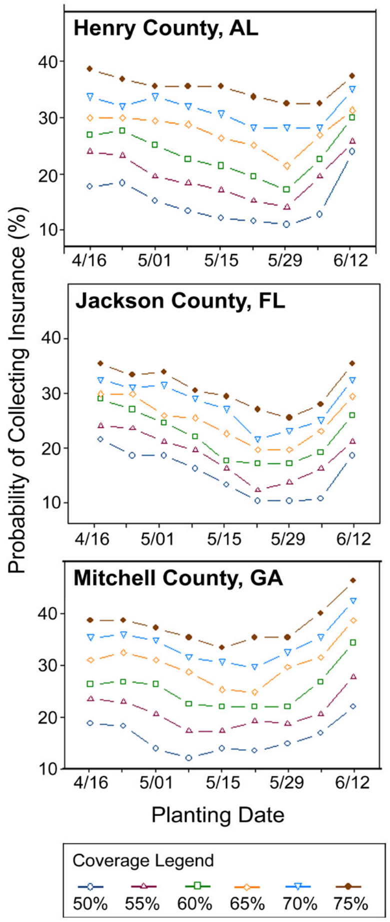

Figure 2. Probabilities of collecting insurance for different planting dates and coverage levels in Henry County (Alabama), Jackson County (Florida), and Mitchell County (Georgia).

The results obtained indicate that peanut growers should consider the following observations when deciding about purchasing crop insurance:

1. Probabilities of collecting insurance vary from 9.2% for peanut planted on May 22 in Jackson County, FL at 50% coverage level to 47.0% for peanut planted on June 12 in Mitchell County, GA at 75% coverage level (see Table 3 for details);

2. In all counties, there is a best peanut planting window in which the probabilities of collecting insurance and of having a crop failure are lower. In general, the lower risk window is situated between the second and third weeks of May;

3. The probability of collecting insurance increases at all levels of coverage when peanuts are planted either before or after the best planting window, with late plantings carrying a higher probability of collecting insurance in Mitchell County, GA;

4. When outside the best planting window, even basic coverage levels, such as CAT, carry probabilities of collecting insurance in the range of 20%;

5. The probability of collecting insurance for a given planting date increases with the coverage level. This increase is more pronounced in Henry County, AL and Mitchell County, GA, meaning that growers in those counties may give more consideration to increasing coverage levels.

Although the observations above can be applied to every year, more can be learned if the simulation results are analyzed for each ENSO phase. Basically the question we want to answer is: If the forecast calls for an El Niño, La Niña or Neutral year, would that make a difference in the probabilities of collecting insurance? Figure 3 shows results for each ENSO phase and two crop insurance coverage levels (65% and 75%).

The analysis of the results for Neutral, El Niño, and La Niña years indicates that growers can take advantage of ENSO phase forecasts to better strategize their purchase of crop insurance products. The following observations can be taken into consideration when the ENSO phase forecast is known:

1. Probabilities of collecting insurance during Neutral years generally follow the same trends observed for all years. This is not a surprise since Neutral years correspond to about 50% of all years in the historical data set;

2. For Henry County, AL, the probabilities of collecting insurance at the 65% and 75% levels for crops planted before May 29 are lower during La Niña years, especially at 75% coverage level. For later planting dates, probabilities of collecting insurance are higher during La Niña years and lower during Neutral and El Niño years;

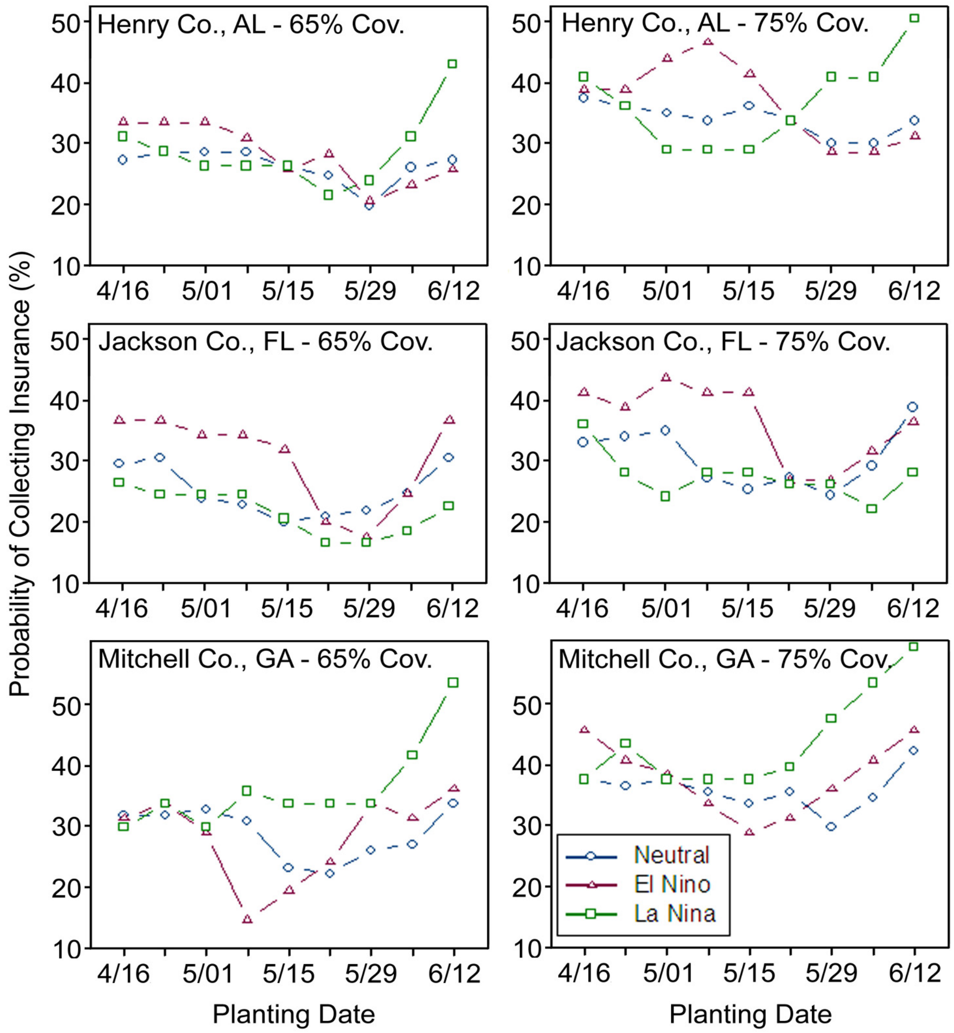

Figure 3. Probabilities of collecting inusrance (65% and 75% coverage levels) for Neutral, El Niño, and La Niña (see legend).

3. For Jackson County, FL, the trend of lower risk during La Niña years for all planting dates can be observed, except during the third week of May, when the risk of collecting insurance at either 65 or 75% is similar for all ENSO phases. El Niño years carry higher risk of collecting insurance for early planting dates and levels similar to Neutral years for late planting dates.

4. For Mitchell County, GA, the probability of collecting insurance tends to be higher during La Niña years, especially for late planting dates. El Niño years present lower levels of risk for planting dates in the second and third weeks of May.

Summary

In this paper, we have presented a method for using climate forecasting and crop modeling to create a decision aid tool for peanut growers in three southeastern U.S. counties. The results presented here are general trends based on averaged simulation results obtained for a medium maturity peanut variety (Georgia Green) and various soil types found in each county. This information is given for illustration purposes only and should not be used as a guide for insurance coverages in 2005. Nevertheless, given specific information, the method could be applied to particular situations anywhere in our study area.

It is important to note that the best strategy to avoid losses is to choose planting dates with low probabilities of collecting insurance, since they also represent low probabilities of yield losses. However, if planting has to occur outside of low probability windows, a higher level of coverage may be advisable. It is important to recognize that crop insurance never protects 100% of the value of the crop. There is always a deductible associated with any indemnity payment. The goal of purchasing crop insurance is to protect a producer's revenue stream so he/she can pay bills, protect investments, and farm another day.

Conceptually, a decision aid tool that allows peanut producers from Alabama, Florida, and Georgia to analyze crop insurance strategies for specific locations and varieties could be made available on the AgClimate Web site. At this time, such a facility does not exist. However, growers will find ENSO phase forecasts on AgClimate along with other information which can help in making more informed decisions about crop insurance. Growers can contact the AgClimate team of researchers and extensionists through the AgClimate Web site to inquire about application of the methods described in this paper to specific locations.

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Table 1. Insurance history for 2003 peanuts.

State	Product	% Total Policies Sold (1)	% Units Indemnified (2)
AL	CAT	5.42	0.05
	50% APH	3.10	0.26
	55% APH	0.13	0.00
	60% APH	1.16	0.21
	65% APH	20.75	2.44
	70% APH	35.43	7.67
	75% APH	34.01	12.51
FL	CAT	20.08	0.11
	50% APH	3.84	0.16
	55% APH	0.58	0.00
	60% APH	1.54	0.63
	65% APH	25.94	3.43
	70% APH	28.43	5.06
	75% APH	19.60	6.96
GA	CAT	17.11	0.09
	50% APH	4.31	0.15
	55% APH	0.69	0.02
	60% APH	2.05	0.15
	65% APH	33.85	7.98
	70% APH	24.33	2.58
	75% APH	17.65	2.84

Source: <www.rma.usda.gov>
(1) Policies sold in category as a proportion of total policies sold. In 2003, total peanut sold were 1,216 for Alabama; 620 for Florida and 4,018 for Georgia.
(2) Number of units for which peanut insurance was collected as a proportion of total farm for which peanut insurance was sold. The number of units for which peanut was sold in 2003 was 4,300 for Alabama; 1,897 for Florida and 8,881 for Georgia.

Table 2. Typical soil types used for running the CROPGRO-Peanut simulation model.

County	State	Soil Type
Henry	AL	Dothan Loamy Sand Orangeburg Loamy Sand Troup Loamy Sand
Jackson	FL	Dothan Loamy Sand Orangeburg Loamy Sand Troup Sand
Mitchell	GA	Wagram Loamy Sand Tifton Loamy Sand Norfolk Loamy Sand

Table 3. Simulated probabilities of collecting peanut crop insurance for different coverage levels (50%-75%) and different planting dates.

County	Cov (%)	Planting Date Apr 16	Apr 23	May 1	May 8	May 15	May 22	May 29	Jun 5	Jun 12
Henry AL	50	17.3	17.9	14.8	13.0	11.7	11.1	10.5	12.3	23.5
	55	23.5	22.8	19.1	17.9	16.7	14.8	13.6	19.1	25.3
	60	26.5	27.2	24.7	22.2	21.0	19.1	16.7	22.2	29.6
	65	29.6	29.6	29.0	28.4	25.9	24.7	21.0	26.5	30.9
	70	33..3	31.5	33.3	31.5	30.2	27.8	27.8	27.8	34.6
	75	38.3	36.4	35.2	35.2	35.2	33.3	32.1	32.1	37.0
Jackson FL	50	21.0	17.9	17.9	15.4	12.3	9.2	9.2	9.7	17.9
	55	23.6	23.1	20.5	19.0	15.4	11.3	12.8	15.4	20.5
	60	28.7	26.7	24.1	21.5	16.9	16.4	16.4	18.5	25.6
	65	29.7	29.7	25.6	25.1	22.1	19.0	19.0	22.6	29.2
	70	32.3	30.8	31.3	28.7	26.7	21.0	22.6	24.6	32.3
	75	35.4	33.3	33.8	30.3	29.2	26.7	25.1	27.7	35.4
Mitchell GA	50	17.7	17.2	12.6	10.6	12.6	12.1	13.6	15.7	21.2
	55	22.7	22.2	19.7	16.2	16.2	18.2	17.7	19.7	27.3
	60	25.8	26.3	25.8	21.7	21.2	21.2	21.2	26.3	34.3
	65	30.8	32.3	30.8	28.3	24.7	24.2	29.3	31.3	38.9
	70	35.4	35.9	34.8	31.3	30.3	29.3	32.3	35.4	42.9
	75	38.9	38.9	37.4	35.4	33.3	35.4	35.4	40.4	47.0