What are the causes and timing of loss for insured crops in the U.S. Pacific Northwest?

Scott Auld

Senior Project for Bachelor of Science

Department of Applied Economics

Oregon State University

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Abstract

Climate is one of the primary risks to agricultural production in the United States. Extreme climate events cause billions of dollars in damage and reduce yields for crops across the country. This research examines the causes and timing of loss for insured crops in the U.S. Pacific Northwest (Idaho, Oregon, and Washington). I find that frost/freeze, drought, and heat are the primary causes of loss in the region, and these events primarily take place during the spring and summer season. The major crops that experience loss in the region are wheat, barley, cherries, dry peas, and apples. I find that field crops are most susceptible to drought and heat during the summer and perennial crops are most susceptible to late spring freezes.

Introduction

Variations in climate risk have long been one of the biggest threats to agricultural production. Extreme climate events that damage crops impact agricultural production here in the United States and cause billions of dollars in damage annually. To manage these challenges, the U.S. government has legislated measures that encourage participation in the federal crop insurance program and other ad hoc disaster assistance programs. The enactment of the Federal Crop Insurance Act of 1938, which focused on struggling wheat farmers in the years following the Great Depression and Dust Bowl, launched the groundwork for what would evolve into today's crop insurance program. Research by O'Donoghue (2014) examines the impact of premium subsidies on the demand for crop insurance. As programs expand, such as the enactment of the Federal Crop Insurance Reform Act of 1994 (FCIRA) and the Agricultural Risk Protection Act of 2000 (ARPA), subsidies continue to increase. Greater participation rates induced by larger subsidies discourage adverse selection by reducing moral hazard for high-risk producers. FCIRA introduced the fully subsidized Catastrophic Risk Protection Endorsement (CAT) that covered severe losses of yields greater than 50 percent. Farmers who enroll in CAT are automatically eligible for federal benefits. The turn of the century brought more reforms, with new types of insurance coverage that included a larger number of crops. The Whole-Farm Revenue Protection (WFRP) program, introduced under the 2014 Farm Bill, encourages participation and greater crop diversity by insuring all commodities on the farm under one policy. With the continuous evolution of the federal crop insurance program and climate change, it is valuable to assess the causes and timing of loss for insured crops to provide insights about producers' production risks and ways to improve the design of federal crop insurance programs.

I address this need by analyzing the causes and timing of loss for insured crops in the U.S. Pacific Northwest from 1989-2015.

The U.S. Pacific Northwest (Idaho, Oregon, and Washington) is no stranger to extreme climate events. Unusually dry or wet weather can effect agricultural production during any given time of year. The region is also susceptible to a reoccurring phenomenon known as the El Nino Southern Oscillation (ENSO). During these periods, warm and cool phases around the equatorial Pacific increase variations in the climate. By recognizing the occurrences of ENSO, and the primary causes of loss associated with climate risk, producers could choose better planting strategies based on advanced weather predictions that focus on the largest risks to insured crops. This paper attempts to do this by applying analysis to historical COL data in order to uncover the largest frequencies of reported causes of loss. To examine these climate risks for the Pacific Northwest (PNW) from a historical perspective, we examine the Cause of Loss data (COL) provided by the USDA Risk Management Agency, the agency that administers the federal crop insurance program. This database provides reported cause of loss and month of loss for all insured crops for the years 1989-2015. The data analysis in this paper provides information on the overall causes of loss and months of loss in the PNW, as well as the causes of loss for major crops (wheat, barley, cherries, dry peas, and apples). I find that the primary causes of loss in the PNW are frost/freeze, drought, and heat, and these losses occur most frequently during the late spring and early summer. The three field crops (wheat, barley, and dry peas) experience losses most frequently from drought and heat in May, June, and July. The two perennial crops (cherries and apples) experience losses most frequently from frost/freeze in March, April, May, and June. An examination of this data can be beneficial to development of future policy. Producers will benefit from weather predictions that focus on frost/freeze, drought, and heat, since these three

causes of loss occur most frequently. Insurers will be able to examine the demand for different types of insurance policies, such as specific peril coverage. Researchers will be able to develop models of future causes of loss for insured crops in the PNW based on this cause of loss data by examining climate variations for the region. Producers, insurance companies, and policymakers alike will be able to use this research to improve the application of insurance while raising awareness of potential pitfalls for insured crops in the region.

Literature Review

This study builds on research about crop insurance and extreme weather from OreCal Issues Brief No. 012. Olen and Wu (2014) used the COL data provided by the USDA Risk Management Agency to examine the reported cause of loss for all insured crops in the U.S. West Coast (California, Oregon, and Washington), as well as the 2008 Farm and Ranch Irrigation Survey to predict how producers mitigate damage from extreme weather. Their research looked into the vulnerability of specialty crops to extreme climate events and how irrigations practices adjusted to fit those circumstances. The COL database that Olen and Wu used does not include the timing of loss for insured crops in the West Coast, but it is possible to compare results for the causes of loss for wheat in the PNW and the West Coast. A comparison of wheat in the PNW and crop categories in the West Coast will show if there are connections across abiotic and biotic factors.

Olen et aI. (2015) analyze the major climate risks for agriculture in the PNW using a unique statistical profile of spatial and temporal climate variations for the growing season. They find that precipitation risk, fall freeze risk, and spring freeze risk are greatest near the coast, but temperature risk is lowest in those areas. Overall, they find temperature variation is low across the region. Precipitation risk and fall freeze risk are greatest at higher elevations. Olen et al.

(2015) do not research causes or timing of loss for specific crops in the PNW. An analysis of the spatial and temporal variations of climate and the specific crops in the region exposed to those variations would benefit local producers.

The Rain and Hail Insurance Society (2015) provide insight on crop insurance issues in their annual publication. They examine the reported causes of loss for insured crops in the United State for the year 2014. They identify the most frequent causes of loss to be excess moisture/precipitation/rain (28 percent), decline in price (20 percent), and drought (19 percent). The report also examines the percentage of eligible acres insured and the total value of the protection. The Rain and Hail Insurance Society (2015) does not provide information on the timing of loss for the most frequent causes of loss in 2014 or the causes of loss for insured crops in the U.S. over a period of years. Sherrick et al. (2004) mention that producers make crop insurance decisions based on the maximization of utility by choosing production factors, including crop insurance, that support the highest level of wealth. Utility maximization is only possible if producers recognize the potential risks involved and the timing of those risks.

Cai et al. (2014) find that climate change will increase the frequency of extreme ENSO events, so it is more important than ever to improve climate predictions. The climate patterns in the PNW are partly due to ENSO phenomena. During warm phases of ENSO, otherwise known as El Nino, there is an increased chance of a warmer than average winter and spring in the PNW, while decreasing the chances of a wetter than average winter. During cool phases of ENSO, otherwise known as La Nina, there is an increased chance of a cooler and wetter than average winter in the PNW (Olen et al., 2015). Climate research by Adams et el. (1999) adds insight to the variations caused by occurrences of ENSO. It becomes necessary to improve weather predictions in order to build accurate estimates of future climate risk. Better forecasting methods

can also help researchers predict the potential losses to agricultural production caused by ENSO and other extreme climate events.

It may be necessary to analyze drought and heat simultaneously. Mittler (2006) demonstrates that crops that suffer from both drought and heat have much greater negative growth rates and yields than crops that experienced either factor individually. Years of El Nino could see increased frequencies of drought and heat, as well as greater frequencies of frost/freeze events since warmer temperatures encourage early planting of annual crops and premature flowering of perennial crops. Unlike drought or heat, frost/freeze events are fast killers that can destroy a crop overnight (Brotak, 2014).

Project Statement

This paper addresses the following research question:

What are the causes and timing of loss for insured crops in the U.S. Pacific Northwest?

To address this research question, I achieve the following objectives:

1) Identify the reported causes of loss for insured agriculture in the PNW.
2) Identify the reported month of loss for the primary causes of loss for insured agriculture in the PNW.
3) Identify the reported causes of loss for major insured crops in the PNW.
4) Identify the primary months of loss for the major crops in the PNW.
5) Compare the shares of reported causes of loss for wheat in the PNW to previous research for wheat in the U.S. West Coast.

Approach

This research examines the cause and timing of loss for insured crops in the U.S. Pacific Northwest (Idaho, Oregon, and Washington). The data used for this analysis is the USDA Risk

Management Agency's Cause of Loss Historical Data Files[1]. Specifically, this analysis uses the data for Indemnities with Month of Loss for 1989-2015. The database provides the year of loss, county and state, commodity name, coverage type, cause of loss, month of loss, and indemnity amount for insured crops in the entire United States. The federal crop insurance program is the primary risk management program in the United States, so the cause of loss is the best available representation of agricultural production risks. I analyze the data in Excel using the sorting, filtering, mathematical, and graphing functions. I count each reported cause of loss in the PNW as one observation.

To develop a profile for the reported cause of loss for agriculture in the PNW, I analyzed data for 1989-2015. The observations were broken down by causes of loss and year of loss. The causes of loss are frost/freeze, drought, heat, excess moisture/precipitation/rain, cold wet weather, hail, cold winter, decline in price, wind/excess wind, failure irrigation equipment/supply, plant disease, other causes, insects, wildlife, flood, area plan crops only, fruit set failure, blank observations, cyclone, poor drainage, hurricane/tropical depression, earthquake, and volcanic eruption. Each observation is found by sorting for every cause of loss in the PNW. The total observations for each cause of loss are computed using the summation function. My analysis provides the frequency for each cause of loss by year, as well as a combined total for each cause of loss across all years. I display the cause of loss shares with pie charts to visualize the most frequently reported causes of loss for insured crops in the region. Following this approach, I then analyze the month of loss for the three primary causes of loss in the PNW.

The major insured crops are identified as the crops that experienced loss most frequently. I examine the reported cause of loss for every insured crop from 1989-2014. The year 2015 is

[1] http://www.rma.usda.gov/data/cause.html

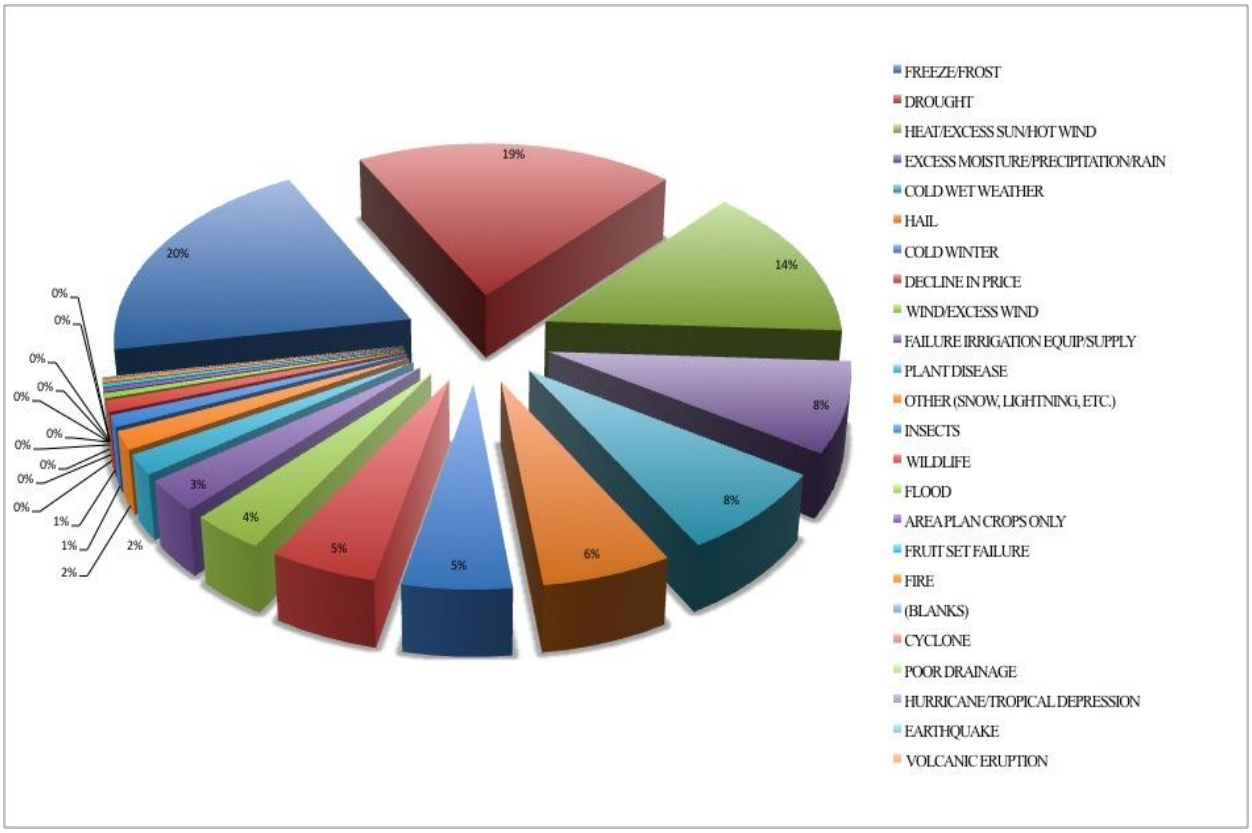
excluded from this analysis because the Whole-Farm Revenue Protection (WFRP) program may bias the results for specific crops in 2015, the first year the program was implemented. The WFRP plan does not provide crop specific information for crops that may have been insured under crop-specific insurance policies in the past. Insured crops that experience loss most frequently are identified for further analysis. The timing of loss for the major crops in the PNW provide a general understanding of when those crops are most susceptible to crop damage. I also compare the timing of loss for major crops with the timing of loss for the three primary causes of loss. The shares of reported causes of loss for wheat are generated into a table for cross comparison with the shares of reported causes of loss for wheat in the U.S. West Coast (Olen and Wu, 2014). Aside from wheat, Olen and Wu (2014) analyze the causes of loss for crop categories. This research analyzes the causes of loss for specific crops to provide more detailed information.

Results

Causes of Loss in the U.S. Pacific Northwest

I found the aggregate reported causes of loss for insured crops in the U.S. Pacific Northwest for the years 1989-2015 to be 48,142 observations. These findings include the 37 blank observations that were not categorized into one of the 23 reported causes of loss. I have identified the most frequent causes of loss for insured crops in the PNW to be frost/freeze, drought, and heat. The share of losses for frost/freeze, drought, and heat are 20 percent, 19 percent, and 14 percent, respectively. Figure 1 provides a pie chart that displays the percentage for each reported cause of loss. The chart shows that extreme climate events cause a larger share of the losses in the PNW than economic and biotic factors.

Figure 1. Reported Causes of Loss for Insured Crops in the U.S. Pacific Northwest for 1989-2015

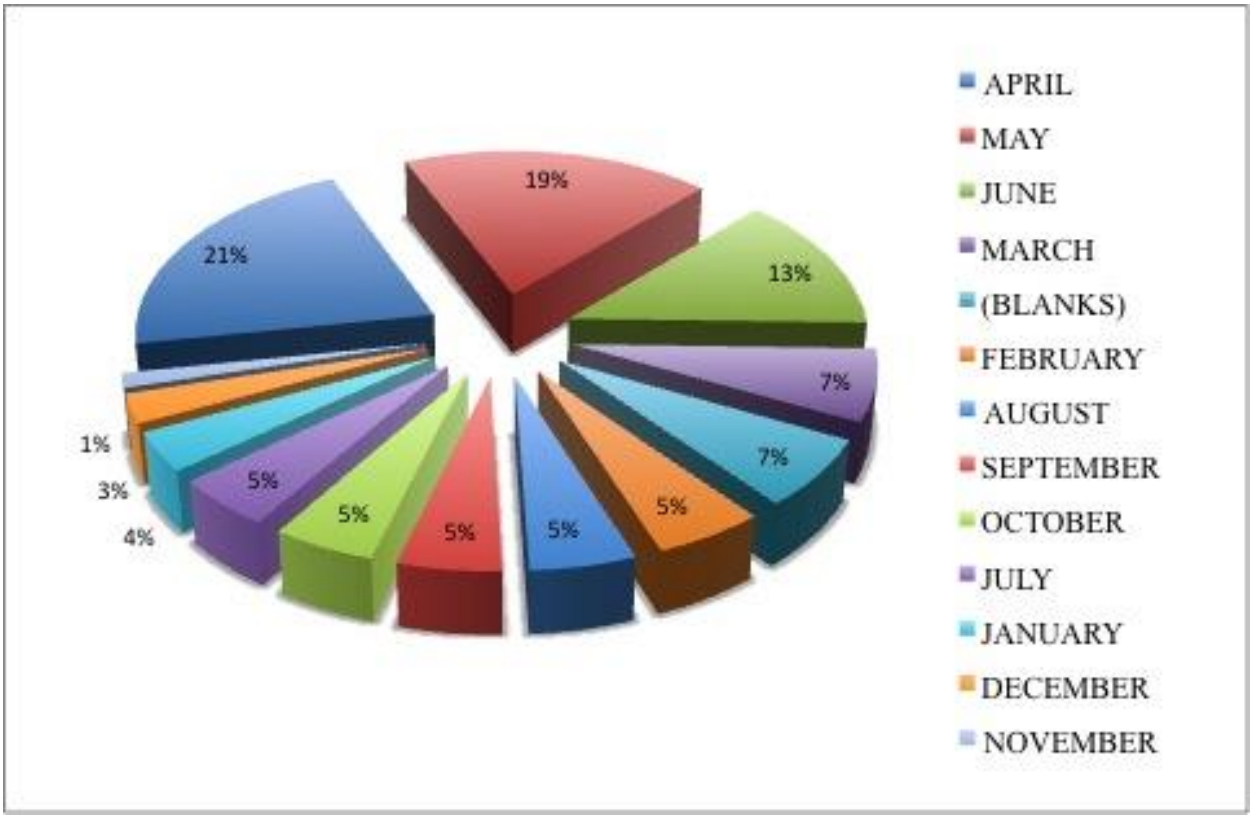


Note: 48,142 total observations

Months of Loss in the U.S. Pacific Northwest

An analysis of the timing of the primary causes of loss for insured crops in the PNW indicates that frost/freeze, drought, and heat cause loss at different times in the growing season. Frost/freeze damage most frequently occurs during the months of April (21 percent), May (19 percent), and June (13 percent). Figure 2 provides a pie chart to display the percentage for every frost/freeze month of loss. The month of loss for 7 percent of the frost/freeze observations were not reported. These findings suggest that late spring freezes are a more frequent problem for agriculture in the PNW than early fall freezes.

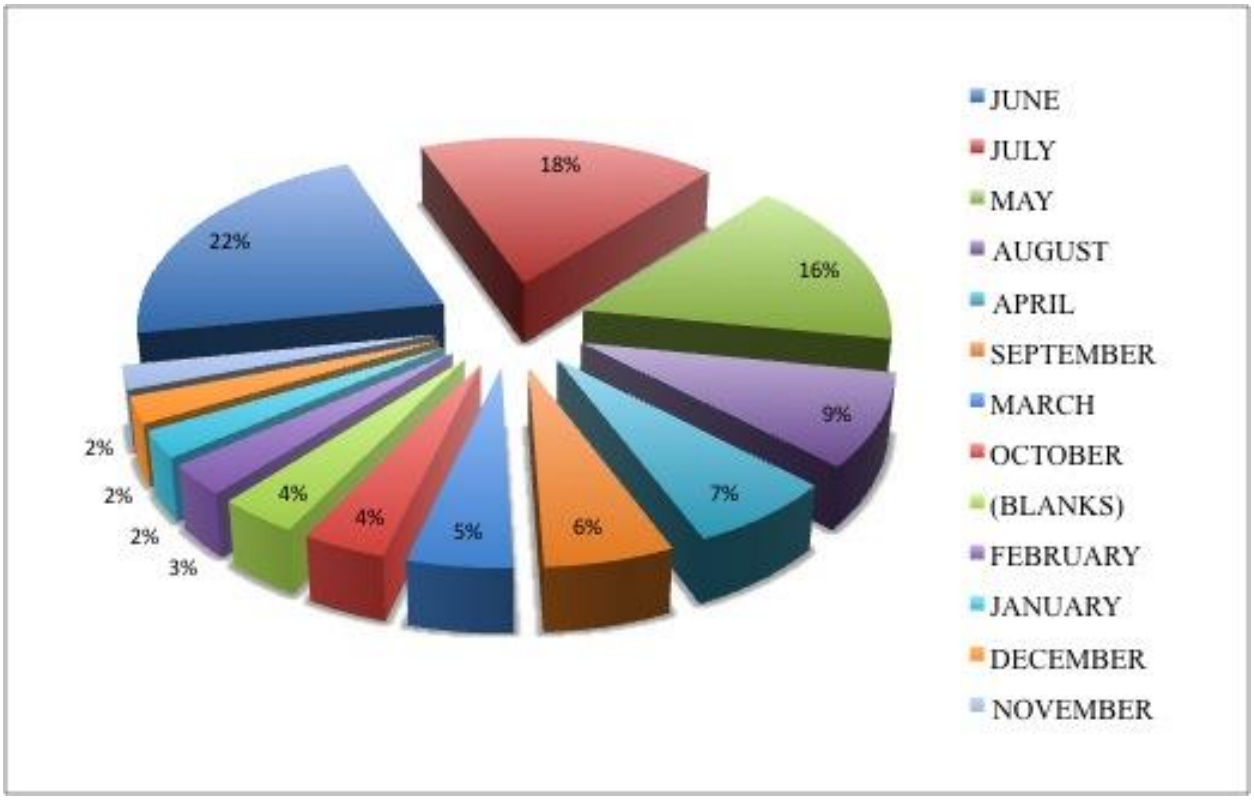
Figure 2. Frost/Freeze Months of Loss for Insured Crops in the U.S. Pacific Northwest for 1989-2015



Note: 9,629 total observations

Drought most frequently occurs during the months of June (22 percent), July (18 percent), and May (16 percent). Figure 3 provides a pie chart that displays the percentage for every drought month of loss. The month of loss for 4 percent of the drought shares were not reported. These findings suggest that crop loss from drought most frequently occur in early summer. This could indicate that crops are more susceptible to loss in the early stages of the growth cycle. Crops may not be as vulnerable to drought conditions at late stages of the growth cycle even though the driest months of the year usually occur towards the end of the summer season.

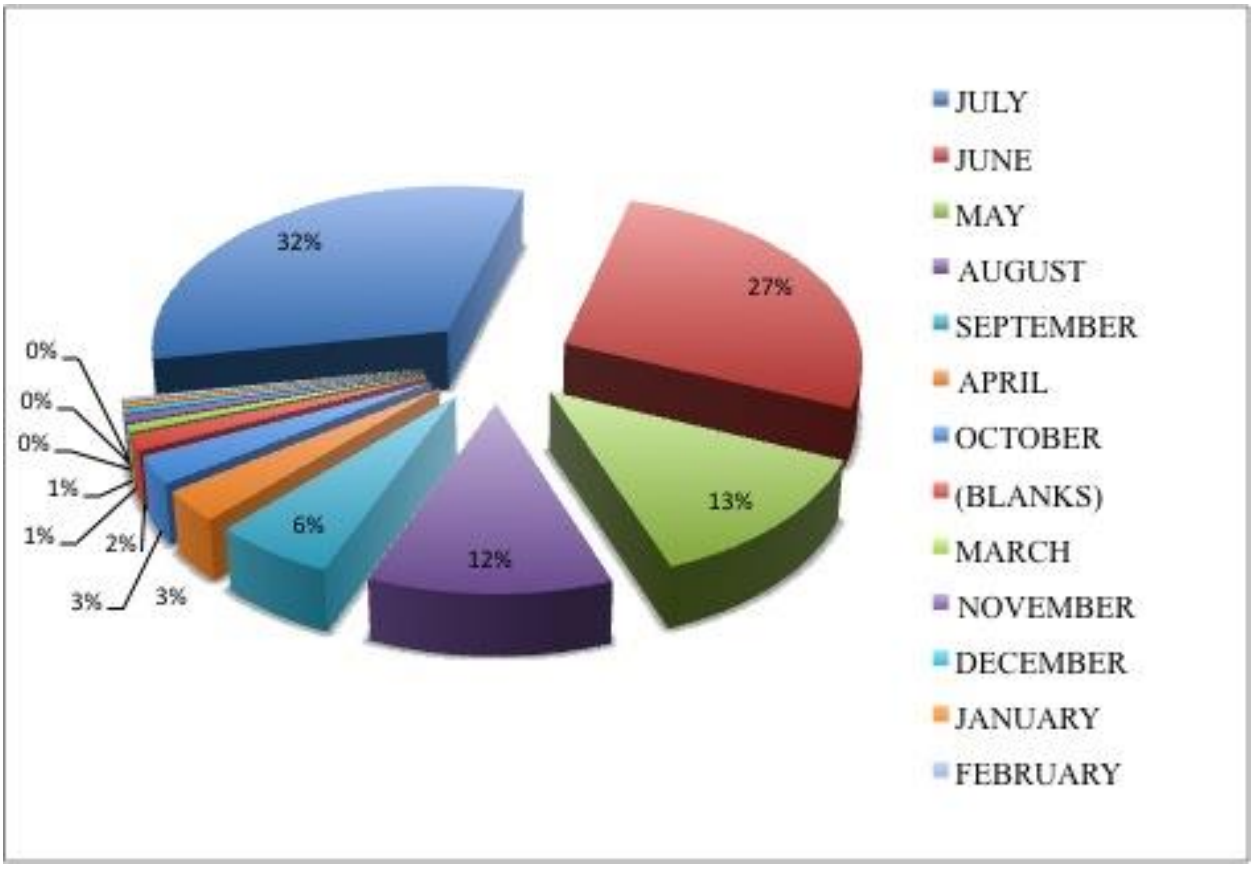
Figure 3. Drought Months of Loss for Insured Crops in the U.S. Pacific Northwest for the Years 1989-2015



Note: 9,333 total observations

Heat stress most frequently occurs during the months of July (32 percent), June (27 percent), and May (13 percent). Figure 4 provides a pie chart that displays the percentage for every heat related month of loss. The month of loss for 1 percent of the heat shares were not reported. These findings indicate that nearly three-fourths of heat related loss takes place during the most frequent months of loss. If August is included, 84 percent of all heat related loss takes place during the hottest months of the growth cycle. It is clear that heat stress has much less variability in timing than frost/freeze and drought. Heat does show a similar timing of loss to that of drought, and as Mittler (2006) suggested, it is common for hot and dry conditions to occur simultaneously. Periods of drought can be induced by extended periods of heat, and periods of heat can intensify already occurring drought conditions.

Figure 4. Heat Months of Loss for Insured Crops in the U.S. Pacific Northwest for the Years 1989-2015



Note: 6,843 total observations

Major Insured Crops in the U.S. Pacific Northwest

For this analysis, major crops in the PNW are identified as the crops that report losses most frequently for the years 1989-2014. Unlike the primary causes and timing of loss analysis, the year 2015 is excluded for major crops because the first year of the Whole-Farm Revenue Protection program does not provide crop specific information for crops that may have been insured under crop-specific insurance policies in the past. In the PNW there are 45,003 observations on the reported causes of loss for insured crops for the years 1989-2014. The five major crops that most frequently experience loss were wheat (35 percent), barley (9 percent), cherries (5 percent), dry peas (4 percent), and apples (4 percent). Appendix A provides a pie chart that displays the percentage for the five major crops that most frequently experience loss.

The five major crops make up 57 percent of total shares, with all other crops accounting for the remaining 43 percent. Thus, the five major crops that we identify account for the majority of the causes of loss for insured crops in the PNW.

Months of Loss for the Major Crops in the U.S. Pacific Northwest

The primary months of loss for the five major crops are dependent on the type of crop. Table 1 displays the shares of reported months of loss for each crop. The three field crops (wheat, barley, and dry peas) most frequently experience loss during May, June, and July. These three months are the same primary months of loss that we found for drought and heat stress. Table 2 shows that all three field crops' most frequent causes of loss include both drought and heat. This suggests that field crops experience most frequent losses from drought and heat during May, June, and July. One difference for wheat from the other two field crops is that there appears to be greater variation in the timing of loss. The frequency of loss for wheat is more dispersed throughout the year, which suggests that winter wheat and spring wheat are grown in the PNW, while losses for barley and dry peas are tightly centered around the month of June. The two perennial crops (cherries and apples) most frequently experience loss from March-June. These months are the same primary months of loss that we found for frost/freeze. Table 2 indicates that the primary cause of loss for both perennial crops is frost/freeze. This suggests that perennial crops experience losses most frequently from frost/freeze in March-June. Brotak (2014) states that frost/freeze damage crops when the internal waters within the plant freeze. This can be a common occurrence for spring blossoming perennial crops since their fruit buds are delicate and highly susceptible to climate variation.

Table 1.

Shares of Reported Months of Loss for the Five Major Insured Crops in the U.S. Pacific Northwest for the Years 1989-2014

Month of Loss	Wheat	Barley	Cherries	Dry Peas	Apples
January	0.06	0.01	0.01	0	0.02
February	0.07	0.01	0.03	0.01	0.02
March	0.07	0.02	0.1	0.02	0.08
April	0.09	0.06	0.28	0.06	0.31
May	0.16	0.19	0.16	0.22	0.2
June	0.15	0.24	0.21	0.23	0.07
July	0.12	0.18	0.11	0.22	0.05
August	0.08	0.13	0.02	0.12	0.06
September	0.06	0.07	0.02	0.07	0.05
October	0.03	0.04	0.01	0.02	0.06
November	0.02	0.01	0	0	0.01
December	0.03	0.01	0	0	0.02
(Blanks)	0.06	0.03	0.05	0.04	0.05
Proportion of All Months	**1**	**1**	**1**	**1**	**1**
Observations	**15824**	**4124**	**2221**	**1872**	**1709**

Note: Primary months of loss indicated in yellow.

Table 2.

Shares of Reported Causes of Loss for the Five Major Insured Crops in the U.S. Pacific Northwest for the Years 1989-2014

Cause of Loss	Apples	Barley	Dry Peas	Wheat	Cherries
Freeze/Frost	0.5	0.15	0.05	0.16	0.38
Drought	0	0.3	0.19	0.27	0
Heat/Excess Sun/Hot Wind	0.06	0.18	0.2	0.12	0.04
Excess Moisture/Precipitation/Rain	0.01	0.1	0.2	0.07	0.18
Cold Wet Weather	0.09	0.04	0.11	0.08	0.13
Hail	0.16	0.08	0.1	0.04	0.04
Cold Winter	0.02	0.01	0.02	0.09	0.01
Decline in Price	0	0.03	0.04	0.06	0.1
Wind/Excess Wind	0.07	0.02	0.03	0.03	0.05
Failure Irrigation Equip/Supply	0	0.04	0	0.02	0
Plant Disease	0	0	0.03	0.02	0.01
Other (Snow, Lightning, Etc.)	0.02	0.01	0.01	0.02	0.04
Insects	0	0.02	0.01	0.01	0
Wildlife	0	0.01	0.01	0.01	0.02
Flood	0	0	0	0.01	0
Fruit Set Failure	0.06	0	0	0	0
Area Plan Crops Only	0	0	0	0	0
Fire	0	0	0	0	0
(Blanks)	0	0	0	0	0
Cyclone	0	0	0	0	0
Poor Drainage	0	0	0	0	0
Hurricane/Tropical Depression	0	0	0	0	0
Earthquake	0	0	0	0	0
Volcanic Eruption	0	0	0	0	0
Proportion of All Causes	**1**	**1**	**1**	**1**	**1**
Observations	**1709**	**4124**	**1872**	**15824**	**2221**

Note: Primary causes of loss indicated in yellow.

U.S. Pacific Northwest and the U.S. West Coast

A comparison of the largest major crop (wheat) by frequency of loss in the PNW to previous research by Olen and Wu (2014) suggests that there are many similarities between causes of loss for wheat in the PNW and the West Coast. Appendix B displays a table identical to the one constructed by Olen and Wu (2014). Extreme climate events in the PNW consist of 88

percent of all reported causes of loss and 87 percent in the West Coast. Natural disasters that led to wheat crop damage made up only 2 percent in the PNW and 3 percent in the West Coast. Economic factors that led to wheat crop damage made up 7 percent in the PNW and 5 percent in the West Coast. All abiotic factors contributing to wheat crop damage consist of 97 percent and 96 percent respectively. Biotic factors that led to wheat crop damage made up 3 percent of loss in the PNW and 4 percent in the West Coast. The similarities between the findings in this research and that by Olen and Wu (2014) suggest that both PNW wheat and West Coast wheat experience comparable climate risks. It is important to note that Oregon and Washington are included in the PNW and West Coast, so the differences will mainly be driven by differences between California and Idaho.

Discussion

Over half of the reported causes of loss in the PNW for the years 1989-2015 are attributed to three distinct climate events: frost/freeze, drought, and heat. An understanding of the primary risks that producers face in the region encourages farmers to make efficient choices throughout the agricultural process. Producers must know the most frequent timing of loss if they are to take the necessary steps to reduce risk. Frost/freeze damage can be reduced in perennial crops through better anticipation of weather variations. The primary months of loss attributed to frost/freeze damage in the PNW are during the spring. Producers who have encountered frost/freeze loss in the past should understand the dangers of early blossoming during unusually warm springs. Producers can also change their irrigation practices during the primary months off loss for frost/freeze to combat risk. Different methods of irrigation will mitigate frost/freeze damage in both annual and perennial crops. My analysis of historical loss data has revealed that the spring freeze season is of higher risk to crops than the fall freeze season. Farmers can choose

to make economically efficient decisions based on the anticipation of risk during both those periods. The goal for producers is to maximize profit, which may include developing an accurate and comprehensive plan to address frost/freeze risk.

This research can provide insights into future weather predictions by centering the focus onto causes of loss that are most frequent in the PNW. Producers that are exposed to drought and heat risk will rely on researchers to assess future risk from historical loss data. Since the primary months for drought and heat take place during the summer season, risk can be anticipated from previous years' causes of loss. Any trends that show losses attributed to excessive precipitation can forecast reduced chances of drought. If researchers are able to recognize potential drought conditions before exposure, they can educate producers on the possible risks going forward. If a researcher expects consecutive years of drought conditions continuing, or even intensifying, they can make suggestions for full-scale changes before crops go into the ground. A farmer's decision to plant drought-tolerant crops will reduce the risk of loss during such conditions. Risk reduction would benefit the producer through lower insurance premiums and the opportunity for greater coverage because of lower costs. Heat risk can be mitigated in a similar way to drought. Planting heat-tolerant crops during hot summers will reduce the risk of loss ultimately reducing cost. Farmers can change irrigation practices to cope with extended periods of heat. Historical loss data will help researchers analyze and anticipate potential climate variations before losses for the producers take place.

Insurers have an incentive to understand the historical loss data in the PNW as well. They can improve rates based on future models of risk developed from previously reported causes of loss. Premium rates and subsidies will be based on the level of risk that they anticipate producers will face. If farmers do not take action against moral hazard, then insurers and policymakers can

push the costs onto them through higher premium rates and lower subsidies since they failed to protect against risk. High-risk producers should not be the only ones able to obtain insurance. High premium rates have priced lower income producers and lower risk producers with low willingness-to-pay out of the market in the past, so it is necessary for insurers to balance risk. Adverse selection has been an unintended consequence of poorly designed programs. Modern insurance portfolios developed from historical loss data can balance risk by offering plans based on the anticipated level of risk participants in the region face. These portfolios will keep costs low by implementing insurance policies built around the chances for specific perils. Insurers can also develop regional based insurance that groups producers by crop type. Indemnity payments would be issued whenever revenue or yields in a region fall below a target point. Overall, insurance providers will have a better understanding of the types of crop insurance consumers demand based on the most frequent causes of loss.

Conclusion

The U.S. Pacific Northwest is no stranger to climate variations that impact agricultural production year round. We can gain a wealth of knowledge about the climate risks in the PNW by examining historical yield loss from the Cause of Loss data provided by the USDA Risk Management Agency, the agency that administers the federal crop insurance program. This database provides reported cause of yield loss and month of loss for all insured crops for the years 1989-2015. This research paper examines the causes and timing of loss for insured crops in the PNW. The data analysis in this paper provides information on the overall causes of loss and month of loss in the PNW, the primary causes of loss and month of loss for those causes, as well as the causes of loss for major crops (wheat, barley, cherries, dry peas, and apples). I find that the primary causes of loss in the PNW are frost/freeze, drought, and heat, and these losses occur

most frequently during the spring and summer seasons. I find that field crops are most susceptible to drought and heat during the summer and perennial crops are most susceptible to late spring freezes. An examination of this data can provide insights about development of the federal crop insurance program, provide insights about the value of better weather predictions, and can be an input for modeling future causes of loss for insured crops in the PNW. As climate risks continue to change, it is important for policy to evolve in order to provide security from risk.

Future research could correlate ENSO patterns with the causes and timing of loss for insured crops in the PNW. This would reveal the variation in causes of loss with the changes in El Nino and La Nina events. It would also be beneficial to look into the spatial and temporal variations in the PNW to examine the location for each cause of loss takes within the region.

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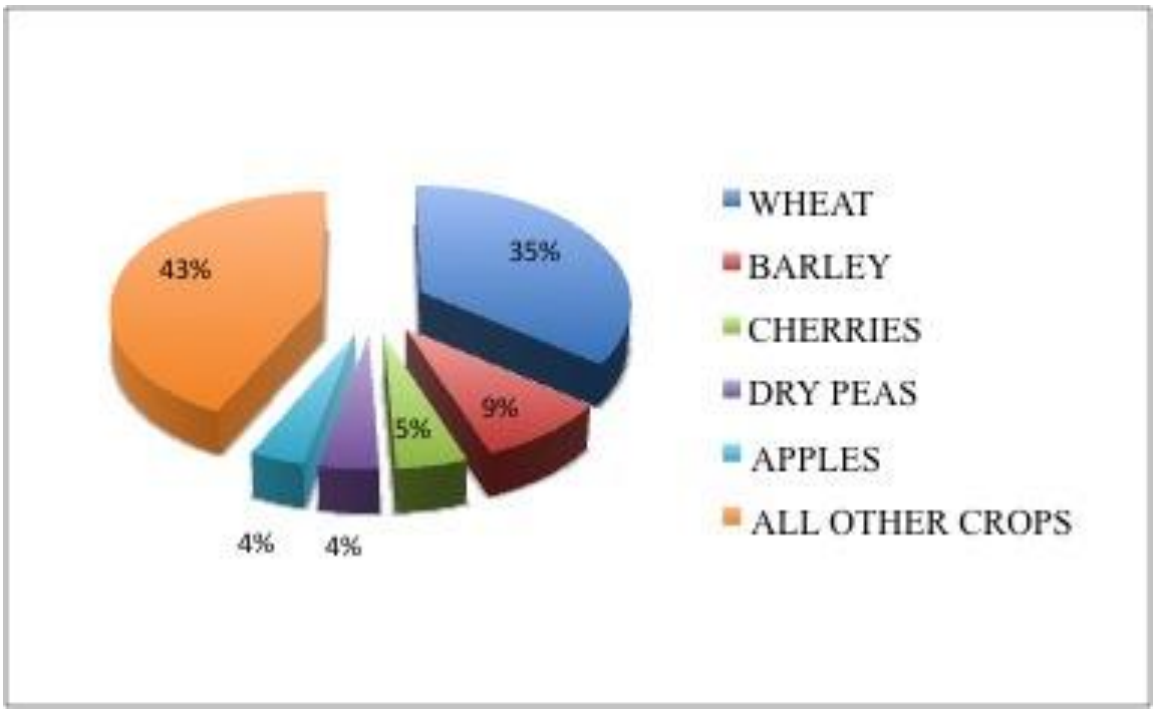
Appendix A



Major Insured Crops Experiencing Loss in the U.S. Pacific Northwest for the Years 1989-2014

Note: 45,003 total observations

Appendix B

Shares of Reported Causes of Loss for Wheat in the U.S. Pacific Northwest and the U.S. West Coast		
Cause of loss	**PNW**	**West Coast**
Abiotic Factors		
Cold Wet Weather	0.08	0.07
Cold Winter	0.09	0.06
Drought	0.27	0.33
Excess Moisture/Precip/Rain	0.07	0.11
Frost/Freeze	0.16	0.15
Hail	0.04	0.02
Heat/Excess Sun/Hot Wind	0.12	0.1
Wind/Excess Wind	0.03	0.02
Other	0.02	0.02
All Extreme Climate Events	0.88	0.87
Flood	0.01	0.01
Other	0.01	0.02
All Natural Disasters	0.02	0.03
Area Plan Crops Only	0	0
Decline in Price	0.06	0.04
Failure in Irrig. Supply	0.02	0.01
Other	0	0
All Economic Factors	0.07	0.05
All Abiotic Factors	**0.97**	**0.96**
Biotic Factors		
Insects	0.01	0.01
Plant Disease	0.02	0.03
Other	0.01	0.01
All Biotic Factors	**0.03**	**0.04**
Proportion of All Causes	**1**	**1**
Observations	**15824**[2]	**9001**[3]

[2] USDA Risk Management Agency's COL Data for the PNW from 1989-2014.
[3] USDA Risk Management Agency's COL Data for the U.S. West Coast from 1989 2012.