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Western Bean Cutworm Infestation Rates in Relation to their Location of the Platte River

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INTRODUCTION

According to DuPont Pioneer, Western Bean Cutworm (WBCW) larval infestations can reduce the corn yield by 15-20%. Western Bean Cutworm can be found throughout the Corn Belt and are destructive because their feeding may cause a variety of molds to be introduced to the ear, which reduces the grain quality and negatively affects yield. Genes such as Herculex may provide suppression, but a timely insecticide treatment will provide more control of the WBCW.

Insecticide treatments can be applied aerially or by chemigation and are typically applied to prevent insect infestations or to control an infestation that is higher than desired. The type of insecticide used varies between producers, as well as what insect is being controlled. In this study, the WBCW is the insect that is under examination.

Previous studies have examined economic injury levels and economic thresholds in corn as they relate to insects. Using proprietary data and comparative analysis, this study examines Western Bean Cutworm (WBCW) egg and larvae infestation counts in corn fields in Kearney, Phelps, and Dawson counties of Nebraska. The data was collected from corn fields within five miles of the Platte River, as well as from corn fields outside of the five mile range of the Platte River (referred to as Non Platte fields). The fields under examination were treated if the WBCW infestation was equal to or greater than 10%. The next section reviews previous studies in relation to this study.

REVIEW OF LITERATURE

Previous studies examine the yield loss incurred from WBCW infestations and show how to transplant WBCW egg masses into fields to create and examine different infestation rates. Also, studies have examined Gibberella ear rot following an infestation of WBCW. The following discussion reviews these studies.

Dyer et al. (2013) examine the effect of toxins and the WBCW tolerance to them. The authors concluded that there were no significant mortality rates when the toxins were used, as the WBCW were able to survive. This study is important, as it shows the tolerance to the Herculex gene and that the Herculex gene only provides suppression rather than total control. Dyer et al. (2013) points out other researchers have noted the WBCW overwinters as a prepupae in the soil with best survival in sandy soils. This is relevant to my study because it shows an increased amount of WBCW pressure along the Platte River fields, which are in sandy soil, thus strengthening the results of previous studies. Other than yellow corn, no brand or other in-plant traits were considered when completing this study. It is important to note the WBCW has a tolerance to the Herculex gene, but it is difficult to measure and therefore was not considered prior to taking the infestation counts.

Moraes et al. (2013) examine the WBCW in larval stage in both the lab and actual corn fields. The WBCW were hatched and transplanted into the corn at different infestation rates in different locations across the state in the North East, South Central and Clay Center regions of Nebraska. Researchers examined the number of egg masses that hatched and monitored the number of larvae that infested the ears later on. The temperatures throughout the entire WBCW life cycle were recorded in each of the locations, as researchers hypothesize a correlation between the hatching rate and the temperature. At harvest, the damage to the ears was measured, grain shelled, weighed, and corrected to 15.5% moisture in all of the locations. The final weights showed a mean yield loss of 15.08 bushels per acres.

Parker et al. (2016) examined the presence of WBCW larvae feeding in corn and its effect on Gibberella ear rot on field corn. The researchers conducted several trials over two years examining corn with and without a WBCW infestation. To better understand the likelihood of corn contracting Gibberella ear rot, the researchers left a portion of the corn untreated, inoculated ears with the disease, and placed WBCW larvae in their plots. Data was collected two times, once in August to determine the amount of damage from feeding and another time to determine how the Gibberella ear rot was progressing. The damage from each period was measured and calculated as a percentage of the entire ear of corn and then was assigned a severity rating. The authors concluded the presence of WBCW had a negative effect on corn yield and was a contributing factor in the presence of Gibberella ear rot. This study indicates there are other harmful diseases associated with WBCW infestations.

Lastly, research shows the importance of utilizing integrated pest management (IPM) once the infestation threshold has been reached. Ostrem et al. (2016) evaluate the WBCW susceptibility to the Cry1F protein gene commonly used in corn hybrids today. In the past, this gene controlled the WBCW and thus offered suppression. However, over time, the WBCW have evolved and are tolerant of it today. The researchers administered different amounts of the Cry1F protein to different infestation locations throughout Nebraska, Iowa, Colorado, and New Mexico. Their research showed a 5.2-fold increase in the amount of Cry1F the WBCW could tolerate now vs. ten years ago. This study shows that the Cry1F protein administered in many corn hybrids today is not very effective in controlling the WBCW in the larval stage prior to entering the ear. This is important to note because the corn fields used in my study did not account for the presence or absence of the Herculex gene. Based off of the previously mentioned research, I do not feel that it would have any impact on my research if these hybrids were to be considered.

DATA AND METHODS

Using proprietary data and comparative analysis, this study examines WBCW egg and larvae infestation counts in corn fields in Kearney, Phelps, and Dawson counties of Nebraska. Within this section the economic theory, empirical methods, and data are discussed.

Method

Insect feeding has a negative impact on corn yields because they feed on the grain, and after the insect has left ear mold can begin to develop around the injury to the ear, further reducing grain quality. A method to prevent yield loss from WBCW is by applying an insecticide in a timely manner to decrease the insect pressure. The highest success rates have been realized when approximately 95% of the corn has tasseled. Insecticides are considered a technological advancement in production agriculture. Being an advancement, one would expect the yield would be positively affected when insecticides are applied as the insect infestations are reduced. The corn yield is negatively impacted when insect pressure is present versus when the insects are nonexistent and not causing yield loss and reduced grain quality.

With the use of comparative analysis, the actual WBCW infestation in the egg or larvae stage can be determined by examining fields where infestation rates were taken in both fields along the Platte River and fields at a distance of five miles or greater from the Platte River. First, we conduct an F-test to test whether the variances in counts differs by locations. The results of the F-test determine what test statistic is needed when conducting the t-test. The hypotheses of the F-test are as follows:

$$H_0: \sigma^2_{NP,i} = \sigma^2_{P,i}$$
$$H_1: \sigma^2_{NP,i} \neq \sigma^2_{P,i}$$

σ^2_{NP} denotes the variance in counts on those fields that are not along the Platte River, and σ^2_{P} denotes the variance in counts on those fields that are along the Platte River. In this instance, I suspect the alternative hypothesis will be correct. There should be a difference in the variance of the counts between fields along the Platte River to those fields not considered near the Platte River. The *i* denotes the specific counts being analyzed in the data. The three counts are egg masses, larvae, and unsatisfactory. Unsatisfactory was defined by having an egg stage infestation rate less than the 10% treatment threshold; however, at the larvae stage, major infestation had occurred.

The t-test was used to compare the mean counts on fields that were along the Platte River to those fields not along the Platte River. The t-test hypotheses are as follows:

$$H_0: \mu_{NPi} \geq \mu_{Pi}$$
$$H_1: \mu_{NPi} < \mu_{Pi}$$

μ_{NP} denotes mean counts in the fields not along the Platte River and μ_P denotes mean counts in fields within five miles of the Platte River. *i* denotes the specific counts being analyzed in the data. The three counts are egg masses, larvae, and unsatisfactory. The alternative hypothesis suggests the mean counts in non-Platte fields are less than the mean counts in fields along the Platte River. In other words, I expect lower infestation rates among fields more than five miles from the Platte River compared to fields within five miles of the Platte River. The following section discusses the data analyzed.

Data

The proprietary data from Cornhusker Agronomics Inc. was compiled from WBCW egg and larvae counts taken throughout the growing season in 2016. Data was compiled from 100 fields. WBCW egg counts were taken by examining 20 corn plants in a row and counting any sign of WBCW egg masses on the leaves or stalks. For example, one egg mass out of twenty plants equals a 5% infestation. It is believed to be economically feasible to treat fields that have at least a field average of 10% infestation. All fields within the data set at or above the 10%

threshold were treated with an insecticide when 95% or more of the corn in that field reached tassel.

The larvae counts were taken in the same 100 corn fields several weeks following the egg mass counts. In the same manner, 20 ear tip checks were taken by peeling back the husk and examining the silks and ear tips for WBCW larvae. One larvae out of 20 ear tip checks equals a 5% infestation, the same as the egg counts. WBCW cannot successfully be treated with an insecticide once they are in the ear under the husk, as the husk will protect them from the insecticide.

Unsatisfactory results were defined by taking 20 plant counts in multiple locations throughout the field. In the egg stage, infestation rates were below the treatment threshold of 10%. The infestation rates were considered unsatisfactory if the infestation rate in the ear tips had increased beyond the 10% threshold once in the larvae stage. The following section discusses the results after completing the comparative analysis.

RESULTS

Table 1 presents the descriptive statistics, as well as the comparative analysis results. The first section in the table shows the data from the egg mass infestation rates taken within five miles of the Platte River, as well as the infestation rates taken from fields that are greater than five miles away from the river. The mean infestation rate in Platte River fields (9.907%) was greater than the mean infestation rate in fields outside of the five mile cutoff (7.029%). The results of the F-test of the variance show a significant difference in the variation of egg masses found in the different locations under observation. The egg mass count variation was greater in fields near the Platte River. Moreover, the t-test results indicate the average egg infestation rate is significantly higher in Platte River fields than in non-Platte River fields (p-value = 0.046), which is consistent with expectations.

The second section of Table 2 shows the larvae infestation rate results based on the same fields along the Platte River and those greater than five miles away from the Platte River. The mean larvae infestation rate is 2.729% in non-Platte fields and 8.312% in the Platte River fields. Similar to the egg infestation results, the variation in larvae infestation rates is significantly different between the locations. Also, the t-test results indicate the average larvae infestation rate is significantly higher in Platte River fields than in non-Platte River fields (p-value = 0.000), which again is consistent with expectations.

Lastly, we examine the number of times an “unsatisfactory” situation occurred. An unsatisfactory situation is when the egg mass counts were less than the 10% threshold and thus no treatment was recommended. However, after returning to the field to check the ear tips, it was found there were more larvae in the ear tips than anticipated. This unsatisfactory situation occurred in 6.9% of the fields in the non-Platte River locations and in 21.4% of the fields in the Platte River locations. Essentially, this means the larvae counts had increased above the 10% threshold 6.9% of the time in non-Platte River fields and 21.4% of the time in Platte River fields. The results are alarming, as there is significant damage when the WBCW levels are equal to or greater than a 10% infestation. Given the unsatisfactory situation occurs more often in Platte

River fields, a lower threshold should be considered in order to decrease the unsatisfactory results in these fields. It is important to note that all of the egg and larvae counts were taken in multiple locations throughout the field based on field size and in different locations throughout the growing season. So no 20 plants were ever counted twice. This study could be strengthened by having a larger sample size to examine.

Table 1. Non-Platte vs. Platte, WBCW infestation in egg and larvae stages.

	Egg Infestation Rate		***Larvae Infestation Rate***		***Unsatisfactory Infestation Rate***	
	Non Platte	Platte	Non Platte	Platte	Non Platte	Platte
Mean	7.029	9.907	2.729	8.312	6.9	21.4
Variance	98.618	48.331	17.301	80.658	6.5	17.2
Observations	58	42	58	42	58	42
df	57	41	57	41	57	41
F	2.040		0.214		0.379	
p-value	0.009		0.000		0.000	
t Stat	-1.704		-3.748		-2.009	
p-value	0.046		0.000		0.024	

SUMMARY AND CONCLUSIONS

The purpose of this study was to examine different WBCW infestations and the relationship with the fields located within five miles of the Platte River. The results show that infestation rates were significantly higher in the Platte River fields compared to the Non Platte River fields. The unsatisfactory results were also higher in Platte River fields. That is, 21.4% of the fields initially had egg infestation rates lower than the 10% threshold; however, after return to these fields, there were more larvae in the ear tips than anticipated. This research also shows Non Platte fields have unsatisfactory results 6.9% of the time. Based on the findings of Dyer et al. (2013), the difference in the Platte River vs. Non-Platte River results may be partially due to the WBCW overwintering better in sandy soils, such as those soils along the Platte River. One way to combat this insect is to lower the threshold in fields, such as those within five miles of the Platte River. For example, if the threshold were set to 5% instead of the 10% used for this study, Platte fields would have unsatisfactory infestation rates over 16% of the time. Based off of the findings, one would assume it would be of great benefit to consider lowering the threshold to 5% or less in areas such as these near the Platte River, as the infestations have been historically greater in sandy soils.

Some limitations of this study are the number of acres, different tassel times, longer than usual WBCW moth flight, and the overall number of observations. I believe all of these factors to be important if one considers strengthening this research.

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