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Customer Satisfaction of New Herbicide Technology in Southern Illinois and Southern Indiana

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PRODUCER SATISFACTION OF NEW HERBICIDE TECHNOLOGY IN SOUTHERN ILLINOIS AND SOUTHERN INDIANIA

by

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A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
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RESEARCH PAPER APPROVAL

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TITLE: PRODUCER SATISFACTION OF NEW HERBICIDE TECHNOLOGY IN SOUTHERN ILLINOIS AND SOUTHERN INDIANA

MAJOR PROFESSORS: Dr. Dwight Sanders & Dr. Ira Altman

As the globe around us continues to demand more food to feed the ever-growing population it possesses, producers, input suppliers, and end-users are all coming together to create new ways to break barriers in agricultural food production. One of largest and fastest-growing barriers would be the adaptation of weed species to become resistant to current herbicide applications. For reasons such as these, farmers and companies such as Syngenta® are fighting a tough battle to maneuver around this herbicide resistance problem. Syngenta and other companies alike are constantly creating new chemistries that will hopefully break down some of the walls that are being built in row crops. New products such as Acuron, were developed after many years of trial, testing, and large amounts of money spent to help producers combat their toughest weed species in their crops. This study explores the first year of Acuron's performance in the marketplace in Southern Illinois and Southern Indiana. This study was compiled by the members of Syngenta's East Heartland Retail Sales Representatives. After the completion of my summer internship with Syngenta, I received approval from the company to use this data that was collected by them for their market researching needs. In this paper, I will be discussing customer willingness to adopt new technology and the performance of that new technology" focused mainly on adoption of new chemicals in the Agriculture Industry.

Throughout the summer of 2015 data were collected via a survey from current and potential users of Syngenta's new corn herbicide, Acuron. This survey attempted to gauge customer's adoption of the new technology as well as satisfaction with the new product that they used. Expected results were of the highest hopes that customers would be open to trying this new product as well as satisfied with the results they received at the end of the summer.

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This research paper was completed with the help of Syngenta in order to gauge Midwestern customer willingness to use new products and technologies and the satisfaction of those customers with the new products used. I greatly thank the members of my team in the East Heartland Region-Southern Illinois and Southern Indiana that helped in order so this research and data could be collected and I could then use it in my research, and for my time working with them. It is greatly appreciated and with humbling gratitude that this study is made available to Syngenta for review and corporate use.

A special and great thank you to those in the Department of Agribusiness Economics at Southern Illinois University for becoming a family of mine for the last four years. I owe you all great thanks for helping me to reach this point in my academic career.

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INTRODUCTION

As the role of the domestic and foreign farmer has begun to expand over the years, so have the technologies that these farmers rely on daily. While the global population continues to grow and create new mouths to feed, the amount of land that can be used for production agriculture continues to dwindle (Foley 2012). This concept is further reinstated when Owen (2011 p.1), said "Global demands to produce more food have increased dramatically, and the ever-increasing global population has placed incredible demands on agriculture to produce sufficient yields in order to avoid disasters in the future." As the problems that producers face continue to grow on a daily basis, industry professionals and researchers are constantly creating new technologies and accessibilities to make everyday life on the farm more manageable. When new technologies are assembled and new products released, it is up to those companies to gauge their customer's satisfaction and adoption rates of these new products. Beyond simply quantifying how satisfied a company's customers are, those companies must begin to build relationships with those customers to keep them around for many years and product innovations to come. Jyoti Tiwari was quoted saying "According to Bernd (2009) brands are assets. The significance of well-built brand is unquestionable (FARMERS 2015 p.1)."

Today, companies from around the world are vying for the attention and loyalty of American farmers. How did the agriculture industry get to this point; the points at which there are so many companies producing so many products to grab grower's attention? One of the largest answers to that question is the evolution and continued problem of herbicide-weed resistance. "Herbicide resistance has been defined in numerous ways […], but ultimately the definitions agree that a resistant weed is one that survives and reproduces following a herbicide treatment that would normally kill it (Kraehmer 2014 p.1135)." Before diving too deep into the

biological and complex world of herbicide resistance in tough row-crop weeds, one must look back on the history, progress, and adoption of herbicides in the agriculture industry.

As farmers became increasingly frustrated with the current methods of weed and pest control they started looking for more economical and time-saving avenues in which to get to a bountiful harvest. Before the mid-1940s, most substances that were used to control weeds in row-crop systems were inorganic or organic chemicals from substances already found in nature. According to Mchughen (2011 p.295), "Historically, farmers controlled weeds using physical means; tilling, hoeing or rogueing. But such physical methods are problematic in their own right- they are labor intensive, expensive, and environmentally damaging, especially when conducted on commercial sized fields. As result, most commercial farmers- apart from organic farmers- now use synthetic chemical herbicides to control weeds." "The growth in synthetic pesticides accelerated in the 1940s with the discovery of the effects of DDT, BHC, 2ldrin, dieldrin, endrin, chlordane, parathion, captan and 2,4-D," as stated by Unsworth (2010 p.1) with chemicals such as 2,4-D having the greatest impact of its time. Naturally, just as any sector of any industry continues with time, it expands; the agro-chemical sector of agriculture was no exception to this statement. According to Unsworth (2010 p.1), "research into pesticides continued and the 1970s and 1980s saw the introduction of the world's greatest selling herbicide, glyphosate." The introduction of this new, non-selective—defined by (Cummins 1999) as a chemical that kills all plant tissue it comes into contact with and is determined by plant, herbicide, and environmental factors---chemical was about to shake things up in the agriculture industry. "Glyphosate made weed management easy and efficient by controlling all emerged weeds at a wide range of application timings (Green 2014 p.1)." Producers felt as if they had found the one, fool-proof method to controlling weeds in their crop production. However, as the saying goes, sometimes

too much of a good thing can become a bad thing. Glyphosate became so intensely used over such a broad geographical rage of land and other herbicides were being used less and less that a problem was created. Tough weeds such as Waterhemp (*Amaranthus rudis),* Giant Ragweed (*Ambrosia trifida)* and Common Cocklebur (*Xanthium strumarium)* that farmers are facing became resistant to applications of glyphosate due to the constant over-use and lack of variety in chemicals used (Green 2014 p.1). Although the aforementioned features of the use of glyphosate are deemed negative and problem-creating, the manufacturing, use, and over-use of glyphosate have opened two important doors in the agriculture industry: the discovery of glyphosate-tolerate (Round-Up Ready) technology as well as the establishment of new herbicides to be used.

Norsworthy (2012 p.31) was quoted saying "Herbicides are the foundation of weed control in commercial crop-production systems." With that being said, it is at the cross-roads and current state of herbicide resistance, new chemical formulation, and weed management issues where the purpose and of this research aims to begin. As the industry that feeds, fuels, and clothes this country are being faced with issues which forty years ago would have been unfathomable; as the growing resistance to herbicide applications is occurring at an alarming rate, scientist', chemical companies, and industry professionals alike are combatting forces to create new ways and products for farmers to fight this tough war on weeds. American producers, in particular, producers in Southern Illinois and Indiana are working diligently to not only manage their production systems but also to alleviate some of the stress for weed resistance issues in the future. This would not be possible without the guiding hand of companies who create new products for producers to use. The agriculture industry leading crop protection company, Syngenta, is no exception to the list of companies helping to combat the current resistance issues. Syngenta was created when the two chemical powerhouse companies of the

world, AstraZeneca and Novartis, merged in November of 2000 to create the Bozel, Switzerland based company that operates in over 90 countries with over 28,000 employees (Syngenta 2016). In May of 2015, Syngenta released its newly labeled corn herbicide Acuron to the open market. With the high hopes that Acuron could solve some of these tough resistance problems in weeds like Common Cocklebur (*Xanthium strumarium),* Giant Ragweed (*Ambrosia trifida),* Marestail (*Conyza canadensis*), and Waterhemp (*Amaranthus rudis),* Southern Illinois and Southern Indiana were deemed as great test locations for this product's first year out of the gate. The research collected in this study was gathered over the summer of 2015 by Syngenta for in order to gauge customer satisfaction and adoption as well as product performance of this new, ground-breaking herbicide that had recently breached the market. Syngenta collected this data to ensure that their product was meeting their customer's standards and for their own market research. It is of the utmost importance to companies like Syngenta that their customer's needs are handled and their products have done the job they were designed to accomplish. It is also vital to build customer-brand loyalty in order keep customers for generations to come. The need to build this connection with their customers through products that work is the reason Syngenta, and other companies alike, collect performance and satisfaction data.

REVIEW OF LITERATURE

In regards to weed resistance authors, researchers, and scientists have been scratching their heads for years in order to solve this problem. “Weed resistance is the evolved capacity of a previously herbicide-susceptible weed population to survive and complete its life cycle when the herbicide is used at its normal rate in an agriculture situation” (Heap 2014, p.283). Resistance in row crop weeds is costing producers heavily at the end of the day--according to Redbond (2015) an estimated $100 billion dollars globally in crop losses is occurring every year due to weeds. According to Green (2014 p.1), “Current herbicide and herbicide trait packages are changing in response to the rapid spread of glyphosate-resistant [and many more] weeds.” “The first glyphosate-resistant weed (*lolium rigidum)* emerged in Australia in 1996 from canola and fence line applications” (Benbrook 2012, p.6). This resistance problem can be created by using the same herbicide, or herbicides with the same site of action for continued years (Redbond 2015). This constant overuse and abuse of the same herbicide forces the agriculture industry to develop new technologies in combating herbicide resistance.

The lack of ability of current chemicals on the market to control certain weeds in desired conditions is driving the market to create other technologies. “Understanding the genetics of resistance [has] made great progress but good resistance breeding is costly,” (Zadoks 2003, p.3).” Beyond the economic considerations of the companies manufacturing these chemicals, the producers themselves have many monetary deliberations as well. “Economic considerations determine the specific herbicides a grower will include in a weed-control program (Gianessi 2005, p.241).” Producers are given the opportunity to control their own herbicide/weed management programs and with those opportunities comes important economic decisions such as one versus two-pass programs as well as how much of a chemical to apply in their operation. As

producers are faced with smaller and smaller profit margins when cashing in their crops from the previous years, some corners can be cut in the way of application rates of herbicides. Michael Renton stated, “Evolution of herbicide resistance in weeds is a growing problem across the world, and it has been suggested that low herbicide rates may be contributing to this problem,” (Renton 2011, p.1). Beyond cutting corners, a producer must decide how many times they would prefer to run across their fields with a sprayer in that season. “When choosing between a one-or two-pass weed control program, it is important to consider the density and types of weeds in a field and to carefully and accurately weigh the cost savings of a one-pass program with the weed control opportunities of a two-pass program,” (Monsanto 2011, p.1). Graigmyle (2013, p.1) was quoted saying “Two pass programs resulted in the highest levels of weed control (90%).” However, choosing between a one and a two-pass program can also depend on the herbicide used. Certain herbicides perform better if they are applied in two time settings while others have the efficacy to sustain a weed population throughout an entire growing season. According to Muhammad (2012, p.1), “Different types of pre and post emergent herbicides are available in the market but their accurate dose, time and method of application are still needed to be determined under different ago-climatic [and agronomic] conditions.”

Although agronomic performance is necessary for a product to make a stake in the marketplace, customer satisfaction is another large piece of the puzzle that is getting a product to market. Churchill, (1982, pg.491) says “the concept of customer satisfaction occupies a central position in marketing thought and practice.” The idea of keeping customers happy not only with premium products but also with customer support greatly plays into the concept of customer satisfaction. According to Duft, “Attracting sales and maintaining customer satisfaction cannot be taken lightly” (2006, pg.1). Knowing what people want and making it readily available is the

"simple" basis on which customer satisfaction stands (Duft 2006). Agriculture's, like many other industries participants, are driven by long-term, meaningful relationships with sales people "too often […] the agribusiness industry forgets that people buy for not only the products themselves, but for the service those products perform and the images they create" (Duft 2006, pp.1-2). As aforementioned, companies are constantly looking for ways to adapt to keep up with their clientele, in a Purdue Extension service brochure, the authors were quoted saying "in this competitive atmosphere, the challenge for ag retailers is not simply to adapt to change, but to become exceptional" (Purdue Extension 2010, p.4).Becoming exceptional in the area of customer satisfaction yields high rewards for companies.

RESEARCH QUESTION

Highlighting the future problems with herbicide-resistant weed species that producers are highly likely to encounter, the creation of new chemicals to combat these tough weeds lie at the foundation of exonerating this growing problem. The number of herbicide-resistant weeds has increased rapidly over recent years and new chemistries must breach the market in order to help producers in their weed management programs. After the registration and release of Syngenta's new corn herbicide, Acuron, it was pertinent to properly gauge if customers were satisfied with this new product. This study was performed in order to see if customers were pleased with the performance of this new herbicide and how they felt it presented itself in the field next to other chemical technologies.

DATA AND METHODS

The research methods and procedures used within this study required the use of a survey that was asked to sixty-two respondents. Respondents were asked these questions in a face-to-face setting to ensure a high response rate of data. Products are released into the market on many occasions and only the few that stand above and beyond the competition are the ones that prosper. This research will investigate how customers responded to the use of this new herbicide, Acuron, and their satisfaction with its use in order for Syngenta to position the product on the market for future growing seasons. By understanding customer's satisfaction with this new product, Syngenta can then use these same steps and procedures to ensure customer satisfaction on future products.

After the completion of the data and survey results tallied, the results were analyzed and a regression model was ran on a portion of the data to see if there was a relationship between customer satisfactions with the product, application timing, what rate the customer's field was sprayed at, what specific weed problems each customer had, if those problems were addressed, along with what issues that "kept the customer up at night." Some of the data lacked variability, which for sake of the product and its performance was a good thing, however making it to where those variables could not be used in the regression model. The aforementioned partial model used for this portion of the study can be expressed by the following:

(1) $\text{Customer satisfaction}_i = \beta_0 + \beta_1(\text{Application Timing}) + \beta_2\ (\text{Specific Weed Problems}) + \beta_3$ (If the specific weed problem was addressed) $+ \beta_4\ (\text{Application Rate}) + \beta_5$ ("What keeps you up at night)

Using this equation (1) data were collected via a survey for each of the five independent variables (along with others not utilized in this model):

1. Application timing of the product
2. The customer's specific weed problems
3. If those specific weed problems were addressed or not
4. The application rate of the product,
5. What "keeps the customer up at night"

All of these aforementioned variables were set as a potential explanatory variable of customer satisfaction.

RESULTS

Descriptive statistics were ran in order to gauge customer levels of satisfaction based purely on the survey responses. 95.1% of customers sampled rated the product, Acuron, a 9 out of 10 or above. When customers were asked if they preferred a one or a two-pass program, 100% of respondents preferred a one-pass herbicide management program. 48 out of 62 responses indicated that fields were sprayed pre-weed emergence in their fields. When referring to specific weed problems in customer's fields, 29% of growers indicated that Giant Ragweed was their largest weed problem within their field, along with 21% indicating Morning Glory Species, 19.4% indicating Waterhemp and Common Cocklebur, and 11.3% indicating Palmer Amaranth. Those respondents were asked if their weed problems were addressed and 47 of 62 replied that their problems had been resolved. Only 7 respondents reported adding any extra materials into the chemical mix when Acuron was applied and those add-ins included one pound of Atrazine. In regards to application rates, 39 of 62 respondents possessed fields that were sprayed at a rate of 3.0 qt./acre and 23 of 62 respondents replied with fields being sprayed at 2.5 qt/acre. When customers were asked what issues kept them up at night, 4.8% replied with plant disease issues, 8.1% responded with commodity prices, and 54% responded with weed resistance/ herbicide resistance being their top concern. The next question on the survey asked growers if they would use the product again and 100% of them agreed they would use Acuron again. Finally, the survey was wrapped up by asking growers if they would increase their acreage used of the product; 98% of growers said they would do so.

Table 6 shows the results of the regression model. The R-squared for the total model was .089, (meaning only 8.9% of the variation in customer satisfaction can be determined by the

independent variables that were ran in the regression model) which is well below statistical significance level. The p-values of all of the independent variables in the model were well above the alpha level of 0.05. All of the intercept coefficients (the value of the dependent variable, customer satisfaction, when the independent variable values are kept at zero) for the independent variables were rather small. The t-statistics of each of these independent variables were quite small and all deemed statistically insignificant. The results of this model (1) were not conclusive and show no relationship between customer satisfaction and the aforementioned variables.

DISCUSSION

Both descriptive statistics and a regression model with customer satisfaction as the dependent variable were ran on this data. Beyond the regression model there are a couple of descriptive statistics that stand out above the rest: one of them being that on average, customers surveyed this product with a 9.5 out of 10 rating. Beyond that, all respondents expressed smooth mixing, loading, and handling of the product. 100% of growers said that they would use the product again—getting over sixty farmers and retailers to agree on an issue, let alone whole-heartedly agree on an issue, is rare. Finally, the last item that stuck out most greatly to me would be that 98% of customers said they would not only use the product again, but increase their acreage used of the product. Moving forward towards future growing seasons, Syngenta could now use the data that was collected along with visuals aids in the form of photos to share with current and future customers the great performance of Acuron in the field. Syngenta is now able to push the product as a front-runner of its, already strong, chemical portfolio.

The results of the regression model (1) in Table 6 did not show any prevalent, distinct relationships between customer satisfaction and the various independent variables. One of the variables, entitled "APRate" was asked of customers to see if they had applied the product at 2.5 qt/acre or 3.0 at/acre. Compared to those customers who applied the product at 3.0 qt/acre use rate, those who applied at a rate of 2.5 qt/acre showed a .033154 increase in the dependent variable of Customer Satisfaction. Although the magnitude of this change is not statistically significant, there is room for further investigation into the use rate of products in correlation with customer satisfaction. The methods and data that were used failed to accentuate any statistical significance in correlation between the variables and customer satisfaction with Acuron. However, some of the reasons for this can be explained by the lack of variation in the results for

customer satisfaction. All customers scored the product at a 7 out of 10 or higher which is great for the company and good news in moving forward with its launch; but it makes using in it a regression model challenging. Another factor in the lack of significance in the model could come from some variables having to be left out due to, yet again, a lack of variability. An additional factor that could be hindering the statistical significance of this data could be sample size. The data in this study was only collected in Southern Illinois and Southern Indiana, rendering a smaller sample size. Without providing solid, concrete and statistically significant connections there needs to be other avenues taken in order to explore customer satisfaction with this product. Perhaps brand loyalty plays a significant role in customer's perceptions and satisfactions with the product. The data and methods used within this this study does not prove that relationships do not exist between the variables, however, the results show that the methods used to analyze this data lacks the statistical veracity to prove such relationships.

Looking forward, future surveys should considering adding additional variables to lend themselves to better quantitative analysis. Some of these variables could include, but are not limited to: price of the product, more detailed questioning on previous programs used by customers, soil type, and potentially organic matter of the soil. This study stands to be utilized and expanded in further studies to come with the addition and clarification of variables.

TABLE 1:

Acuron Grower Questionnaire

1. On a scale of one to ten, what was your satisfaction with the product?
2. Do you prefer a one or two pass program?
3. Was your field sprayed pre or post emergent?
4. What are your specific weed problems?
    a. Was the problem addressed?
5. How does the product compare to your previous programs?
6. What was added to the tank when the product was applied?
7. What rate was your field sprayed at?
8. What top three issues “keep you up at night?”
    a. Disease, weeds, commodity prices?
9. Would you use the product again?
10. Would you increase your acreage used of the product?

TABLE 2: EXPLANATION OF VARIBALES

Variable	Explanation
-Customer Satisfaction	-One a scale from 1-10, how satisfied with the product is the customer
-One or two pass preference	-Does the customer prefer a one or a two-pass herbicide management program
-Pre or Post Emergent App	-Was the customer's field applied pre or post-crop emergence –Response assigned a 1 if Pre-Emergence and A 2 if Post-Emergence application
-What are you specific weed problems?	-Customers responses varied from (1) Giant Ragweed (2) Morning Glory Species (3) Waterhemp (4)Common Cocklebur (5) Palmer Amaranth (6) Shattercane
-What was added to the tank mixture	-Were any other products added to the tank before the product was applied (i.e. extra Atrazine)
-What rate was the field sprayed at	-Was the field sprayed at 2.5 qt/acre or 3.0 qt/acre— Responses assigned a 1 if 2.5 qt/acre and a 2 if 3.0 qt/acre
-What issues keep you up at night?	-Customers were asked if plant disease, weed resistance issues, or commodity prices "kept them up at night"
-Would you use the product again?	-The customer was asked whether they would use the product again based on its performance thus far in their operation.

Table 3-Satisfaction:

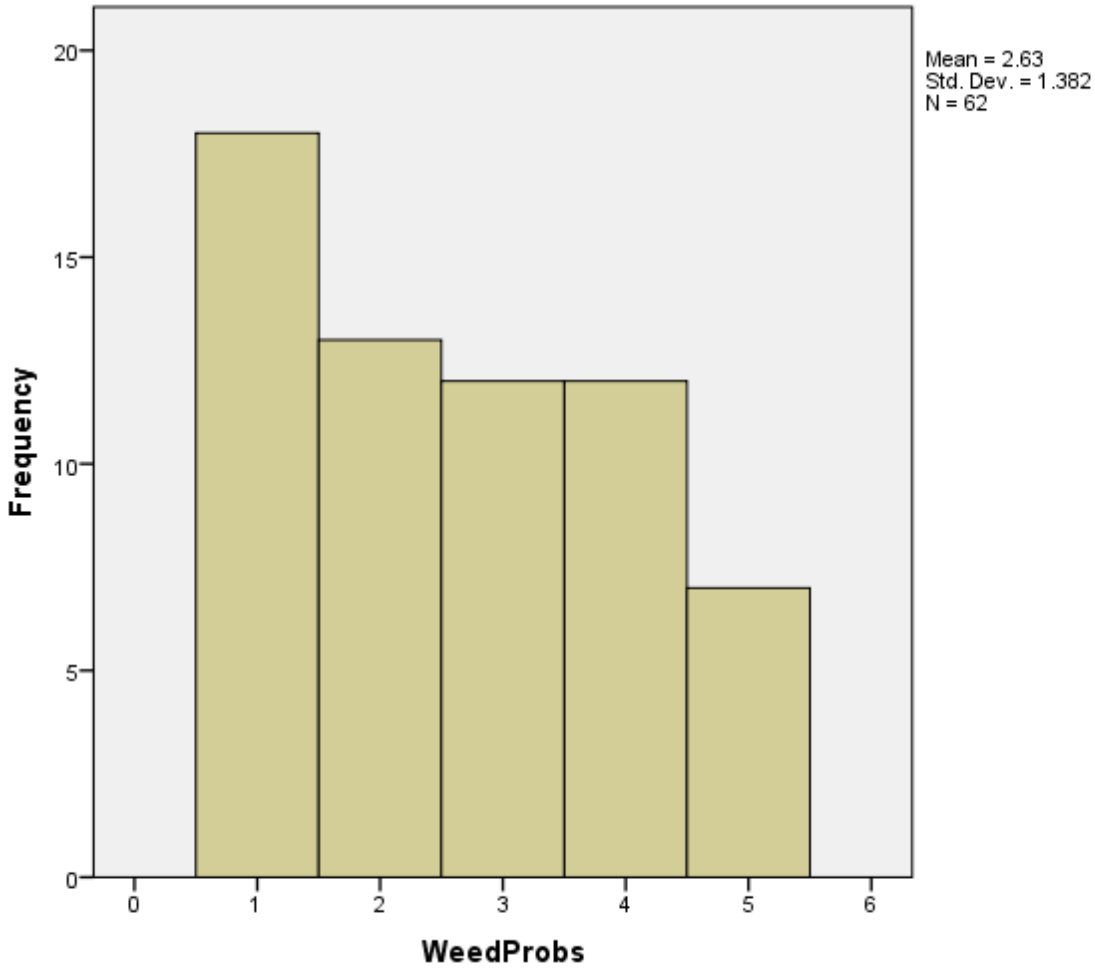
Frequencies of satisfaction levels from respondents

Customers relayed values on a scale form 1-10

Satisfaction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	7	1	1.6	1.6	1.6
	8	2	3.2	3.2	4.8
	9	2	3.2	3.2	8.1
	9	17	27.4	27.4	35.5
	10	16	25.8	25.8	61.3
	10	24	38.7	38.7	100.0
	Total	62	100.0	100.0	

Table 4: Specific Weed Problems



1= Giant Ragweed

2= Morning Glory Species

3= Waterhemp

4= Common Cocklebur

5= Palmer Amaranth

6= Shattercane

Table 5: “What keeps you up at night”

UpAtNight

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disease	3	4.8	4.8	4.8
	Weed Resistance/Herbicide Resistance	54	87.1	87.1	91.9
	Commodity Prices	5	8.1	8.1	100.0
	Total	62	100.0	100.0	

Table 6: Regression Results Chart

Method of estimation= Ordinary Least Squares

Variable	Coefficient	Estimated Standard Error	T-Statistic	P-Value
C	9.35563	0.602693	15.5231	0.000
Time1	0.062836	0.622632	0.009168	0.921
Time2	0.00584992	0.630926	0.00927196	0.993
Prob1	-0.506256	0.37279	-1.35802	0.181
Prob2	-0.310769	0.402267	-0.772543	0.443
Prob3	-0.340338	0.386226	-0.881188	0.382
Prob4	-0.0493394	0.391475	-0.126175	0.900
Prob6	0.25576	0.810305	0.315635	0.854
FIXED	-0.035095	0.231828	-0.151384	0.880
APRATE	0.033154	0.20073	0.165165	0.896
NOSLEEP	0.046243	0.539016	0.085791	0.932
NOSLEEP2	0.325771	0.370041	0.880365	0.383

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