Abstract

Knowledge of the number of days suitable for conducting fieldwork is instrumental to farm management decision making especially for machinery, acreage acquisition and crop allocation decision making. Although each year is unique, understanding historic trends in the number of days that fieldwork can be conducted is useful for farm management decision makers. The steps necessary to obtain historic data from USDA, assemble the data into a usable database and apply the information to a series of farm management decision making problems under planting and harvesting situations are demonstrated.

Acquiring and Applying Days Suitable for Fieldwork for your State

By Terry Griffin, Ph.D.

Introduction

Several sources of risk influence production decisions and impact yields and profits in production agriculture. Weather risk is of concern to farm decision makers for timing of applications, machinery management decisions and whole-farm planning. A first step in the farm management decision-making process is to determine the expected number of days suitable for fieldwork. Although the number of good days to conduct field operations varies each year, the probability of having a certain number of days can be estimated from publically available data from the USDA National Agricultural Statistics Service (NASS). Even with sufficient understanding of the optimum timing to plant each crop, making farm management decisions such as machinery management and acreage allocation without information on the probabilities of suitable days for fieldwork may lead to unsuccessful farming operations. The necessary steps to identify the source of days suitable data for your state, assemble the data into a usable database, analyze data on days suitable for fieldwork and apply the days suitable information to example farm management decision making situations are described in this article.

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Importance of Understanding Days Suitable for Fieldwork

Row crop farm sizes have increased over time, partly as a result of efficiencies associated with larger equipment conducting field operations in a shorter amount of time. Conducting field operations such as tillage, planting, spraying and harvesting in a timely manner are important to obtain optimal yields to maximize whole-farm profitability. Too-early or too-late planting may adversely impact crop yields. Machinery management decisions such as choosing machine sizes relative to farm acreage should be made considering equipment efficiency and the likelihood of having sufficient days suitable to operate the machinery in the field. The farm decision maker has to evaluate the tradeoff between the added cost of machinery and completing field operations in a timely manner. Additional machinery requires increased capital investment while field operations conducted at non-optimal times lead to reduced yield. Debate often arises relative to machinery sizing and being over or under equipped for a particular farming operation.

Data and Methods

The USDA-NASS collects information on days suitable for fieldwork and releases data on a weekly basis during the summer production season on the number of days suitable for fieldwork. The data are summarized in the USDA Weekly Weather and Crop Bulletin (http://www.usda.gov/oce/weather/pubs/Weekly/Wwcb/wwcb.pdf and archives going back to the 1970s at http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1393). More detailed data for individual states are provided by the weekly Crop Progress and Condition Reports published each Monday by NASS State Field Offices (for individual state data, see http://www.nass.usda.gov/Publications/State_Crop_Progress_and_Condition/index.asp). The Crop Progress and Condition Report is released from about late March through the end of November each year and includes information on weather, crop development, progress of field operations and crop condition ratings.

Summaries on the days suitable for fieldwork have been assembled and published by Extension professionals in five states for farm management purposes including Arkansas (Griffin, 2008), Iowa (Edwards and Hanna, 2007), Kansas (Buller, 1992), Mississippi (Spurlock, Buehring, and Caillavet, 1995) and Missouri (Massey, 2007). Similar analyses can be conducted for the remaining states. Some states have data provided for crop reporting districts in addition to the overall state average.

As an example, the days suitable for Arkansas are examined. At this point, the data are not in an electronic database but rather in a summary narrative in the electronic report. The days suitable for fieldwork data must be located in the summary narrative and the data entered into an electronic database. Although data query and data entry are time-consuming steps, it is necessary to make use of the data.

Although USDA data are released on Monday for the previous week, the exact month and day differ from year to year such that the data must be sorted by some standardized procedure. In addition, the date that the first data is reported in a given year may differ from year to year. For instance, data from 1995 to 1998 are presented in Table 1 in its original format. In 1995 and 1996, the date that the first data of the year were released was April 2 and April 7 respectively. These dates are obviously not the same "week" as March 23, the date that the first data observation for 1997 was released. To correctly align the data across time, additional columns were added to the database (Table 2) for the week of year (WOY) such that week number 2 begins on Sunday following January 1, the default definition used by MS Excel as called by the =weeknum function (=weeknum(DATE)). The data columns were then shifted such that the days suitable data were aligned with respect to the week of year (Table 3). Although additional data are available prior to 1995, only the most recent 13 years were included in this analysis.

Once the days suitable data were properly aligned across time, descriptive statistics such as the minimum and maximum number of days, the average and standard deviation were calculated for each week of year (Table 4). The number of days suitable for fieldwork differs each year; however, farm management decisions can be made in the presence of uncertainty based upon historic data. Descriptive statistics for historic days suitable for each of the eight spring and ten fall time periods are summarized in Table 4.

For many farm management decisions, the risk-averse decision maker wishes to plan for a below-average year rather than an average year. For instance, equipment sizing decisions for a given farm size is based on below average years. The minimum number of days suitable may be sufficient in the case where the decision is based on the worst year recorded. Alternatively, rather than planning for the worst year, the decision maker may be interested in understanding a below average year such as 1 or 2 standard deviations below the mean.

Rather than examining each week of year individually, the eight week spring time period and ten week harvest time period can be evaluated as a whole. The spring and fall time periods are summarized for each of the given 13 years in Table 5. The number of days suitable for field work during the 56 calendar days during the April to May planting time period is important for machinery management decisions. On average, 40 or 41 days suitable are expected during this time period. The most days suitable was 47 in 2001 and the least was 32 days in 2008.

Typically, there are more days suitable for fieldwork in the fall than in the spring time. The 70 calendar day period from September 1 to November 6 is important for harvest planning. Half of years will have about 57 or 58 days suitable for fieldwork. As little as 42 days have occurred during the 2001 harvest. Sixty-four days was the most and has occurred twice, in 1999 and in 2005.

Farm Management Application of Days Suitable Information

Based on days suitable for fieldwork data, farm decision makers can estimate the necessary size and capacity of machinery for individual farms, or conversely to choose acreage to fit a given equipment complement in areas with an active farmland market. In some farming communities, farmers who perceived themselves to possess excess machinery capacity, e.g., being over-equipped, have offered their machinery and/or custom services for hire to farmers who perceive themselves as under-equipped for their given acreage. In some parts of the U.S., farmers who were not able to justify equipment ownership based on their farm size have opted to share equipment with one or more local farmers under comparable but complementary circumstances. In other scenarios, professional custom applicators may enter the local market to alleviate equipment capacity shortages. Information on farm size, equipment capacity, days suitable for fieldwork and associated revenue and cost streams impact the optimal farm management decision. Equipment capacity is often measured as the working rate, or the number of acres that machinery can effectively operate in an hour. Two examples are given below; the first discusses spring-time planting and the second a combine harvester in the fall.

Example 1: Spring Planting

A 3,000 acre farm has one 12-row planter that can plant 20.5 acres per hour and can be operated 12 hours per day. The number of acres planted per day is calculated as acres planted per hour multiplied by hours per day:

$$20.5 * 12 = 246 \quad (1)$$

and the number of days to plant the farm is the farm size divided by the number of acres planted per day.

$$3000/246=12.2 \quad (2)$$

In this example, 246 acres are planted in one day and will take 12.2 days to complete planting operations on all 3,000 acres. Assuming that tillage and other field preparation operations are already completed, the farmer wishes to determine how many acres are expected to be planted the last two weeks of April as defined as WOY 18 and 19. The minimum number of days for these WOY are 3 and 4, respectively, for a total of 7 days during this selected time. It will take 5.2 days past WOY 19 to complete planting in a bad year. In a year where each week has average days suitable, 9.5 days are expected for fieldwork, 2.7 days short of the planting goal. The farmer must decide whether planting into the 20th week of the year and incurring a potential yield reduction is acceptable or increasing equipment capacity by purchasing equipment or hiring custom operations.

Example 2: Fall harvest

In keeping with the Arkansas data, a hypothetical 3,000 acre rice farm has one harvester with a working rate of 11.2 acres per hour and 8 hours per day. The five-year average for rice harvest begins in late August and is finished the first week of November (USDA-NASS, AR FO); therefore the goal is to complete harvest by November 6 and assume that harvest will begin September 1. Under the best conditions, 89.6 acres can be harvested each day (11.2 acres per hour multiplied by 8 hours per day). It will take 33.5 days to complete harvest (3,000 acres divided by 89.6 acres per day). The minimum number of days suitable for fieldwork recorded in the 1995 to 2007 dataset was 42.2 days (Table 5), 8.7 days more than needed. In this case, the farm is expected to have excess capacity that can be hired out to neighboring farms if a local market exists for custom operations. Alternatively, if ample machinery capacity exists for planting and tillage operations, this farm is a candidate for leasing additional acreage.

Summary

Knowing basic information on days suitable for fieldwork in your state is important for machinery management, acreage allocation and financing decisions. Data is readily available in several states from extension professionals or can otherwise be collected from USDA

repositories. The techniques used in this article can be replicated to provide days suitable data for the remaining states. Two simple examples of how days suitable data can be applied to farm management issues have been presented. Based on the days suitable for fieldwork, farm decision makers can apply similar analyses to their farm situation in their own state.

Limitations of Days Suitable for Fieldwork

Thirteen years of data are sufficient to estimate probabilities of suitable field days; however, additional years of data may lead to more robust estimates. The estimation procedures assume that each of the 13 years have an equally likely probability of occurring next year and that the days suitable in a given week are independent of the week before and the week after the week in question. Future work includes accounting for the inter- and intra-period correlation of the data and to extract all the days suitable data from USDA archives going back to 1977.

Future Considerations

Although actual number of days suitable for field work varies from year to year, knowledge on historic likelihoods of suitable days can be used to make farm management decisions on machinery management, crop allocation and farmland acquisition. Several other factors may influence days suitable for a given location, farmer or field including soil texture, previous tillage management or machinery configuration. Other technologies that do not influence days suitable for fieldwork may increase the likelihood of completing fieldwork such as GPS-enabled navigation technologies which can increase field efficiency and extend the hours per day that machinery can be operated. Some locations have an active market for excess machinery capacity including custom operations, sharing equipment between farmers and renting equipment. In making decisions, the farm decision maker will usually opt to use assumptions based on a below-average rather than average year.

The data available for states such as Arkansas are reported as aggregate data for the whole state while states such as Missouri, Iowa and Kansas report days suitable for each crop reporting district. Increasing the spatial resolution of the data to at least crop reporting districts would add perceived value by farmers.

Across the Midwest and Midsouth, farmers have successfully planted spring crops earlier than in previous years; even earlier in the year than days suitable for fieldwork data is being collected. For instance, corn is commonly planted during March in Arkansas and days suitable data begins to be collected in the last week of March. In addition, other farming operations associated with cellulosic production may necessitate fieldwork during the winter months when days suitable data has not been collected.

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Table 1. Database excerpt of unsorted days suitable data

Date	Days	Date	Days	Date	Days
4/2/1995	5	4/7/1996	5	3/23/1997	3
4/9/1995	6	4/14/1996	6	3/30/1997	3
4/16/1995	4	4/21/1996	6	4/6/1997	5
4/23/1995	4	4/28/1996	5	4/13/1997	3
4/30/1995	4	5/5/1996	6	4/20/1997	6
5/7/1995	3	5/12/1996	5	4/27/1997	5
5/14/1995	3	5/19/1996	5	5/4/1997	4
5/21/1995	5	5/26/1996	6	5/11/1997	6

Table 2. Database excerpt of days suitable data with addition of week of year

Date	WOY	Days	Date	WOY	Days	Date	WOY	Days
4/2/1995	14	5	4/7/1996	15	5	3/23/1997	13	3
4/9/1995	15	6	4/14/1996	16	6	3/30/1997	14	3
4/16/1995	16	4	4/21/1996	17	6	4/6/1997	15	5
4/23/1995	17	4	4/28/1996	18	5	4/13/1997	16	3
4/30/1995	18	4	5/5/1996	19	6	4/20/1997	17	6
5/7/1995	19	3	5/12/1996	20	5	4/27/1997	18	5
5/14/1995	20	3	5/19/1996	21	5	5/4/1997	19	4
5/21/1995	21	5	5/26/1996	22	6	5/11/1997	20	6

Table 3. Database excerpt of sorted days suitable data

Date	WOY	Days	Date	WOY	Days	Date	WOY	Days
						3/23/1997	13	3
4/2/1995	14	5				3/30/1997	14	3
4/9/1995	15	6	4/7/1996	15	5	4/6/1997	15	5
4/16/1995	16	4	4/14/1996	16	6	4/13/1997	16	3
4/23/1995	17	4	4/21/1996	17	6	4/20/1997	17	6
4/30/1995	18	4	4/28/1996	18	5	4/27/1997	18	5
5/7/1995	19	3	5/5/1996	19	6	5/4/1997	19	4

Table 4. Descriptive statistics for select plant and harvest time periods

Week ending	Minimum	Maximum	Median	Mean	Range	SD	CV
6-Apr	3.0	6.0	5.0	5.1	3.0	0.96	0.19
13-Apr	3.0	7.0	5.0	4.7	4.0	1.31	0.28
20-Apr	3.0	6.0	6.0	5.2	3.0	1.09	0.21
27-Apr	4.0	6.0	5.0	5.1	2.0	0.81	0.16
4-May	3.0	6.8	4.0	4.4	3.8	1.24	0.28
11-May	3.0	6.0	4.1	4.6	3.0	1.24	0.27
18-May	3.0	7.0	5.3	5.4	4.0	1.22	0.23
25-May	3.0	7.0	6.0	5.7	4.0	1.19	0.21
7-Sep	3.8	7.0	6.9	6.3	3.2	0.99	0.16
14-Sep	4.9	7.0	6.1	6.3	2.1	0.75	0.12
21-Sep	3.2	7.0	6.0	5.8	3.8	1.08	0.18
28-Sep	5.0	7.0	6.0	6.0	2.0	0.56	0.09
5-Oct	5.0	7.0	6.4	6.3	2.0	0.73	0.12
12-Oct	4.0	7.0	6.4	6.1	3.0	1.01	0.16
19-Oct	3.0	7.0	6.0	5.8	4.0	1.30	0.22
26-Oct	3.0	7.0	6.0	5.5	4.0	1.34	0.24
2-Nov	3.0	7.0	6.0	5.6	4.0	1.35	0.24
9-Nov	2.0	6.9	5.0	4.8	4.9	1.47	0.31

Source: National Agricultural Statistics Service, Arkansas Field Office: 1995 – 2007

Table 5. Number of days suitable recorded for spring and fall, 1995-2007

Year	Days during planting period	Days during harvest period
1995	35.0	60.0
1996	44.0	53.0
1997	42.0	58.0
1998	44.0	58.1
1999	35.0	64.0
2000	37.0	63.0
2001	46.8	42.2
2002	36.0	58.0
2003	37.4	58.0
2004	40.0	53.3
2005	43.0	64.0
2006	42.0	54.0
2007	41.1	55.5

Source: National Agricultural Statistics Service, Arkansas Field Office: 1995 – 2007

Eight weeks during April and May; Ten weeks including September, October, and the first week of November