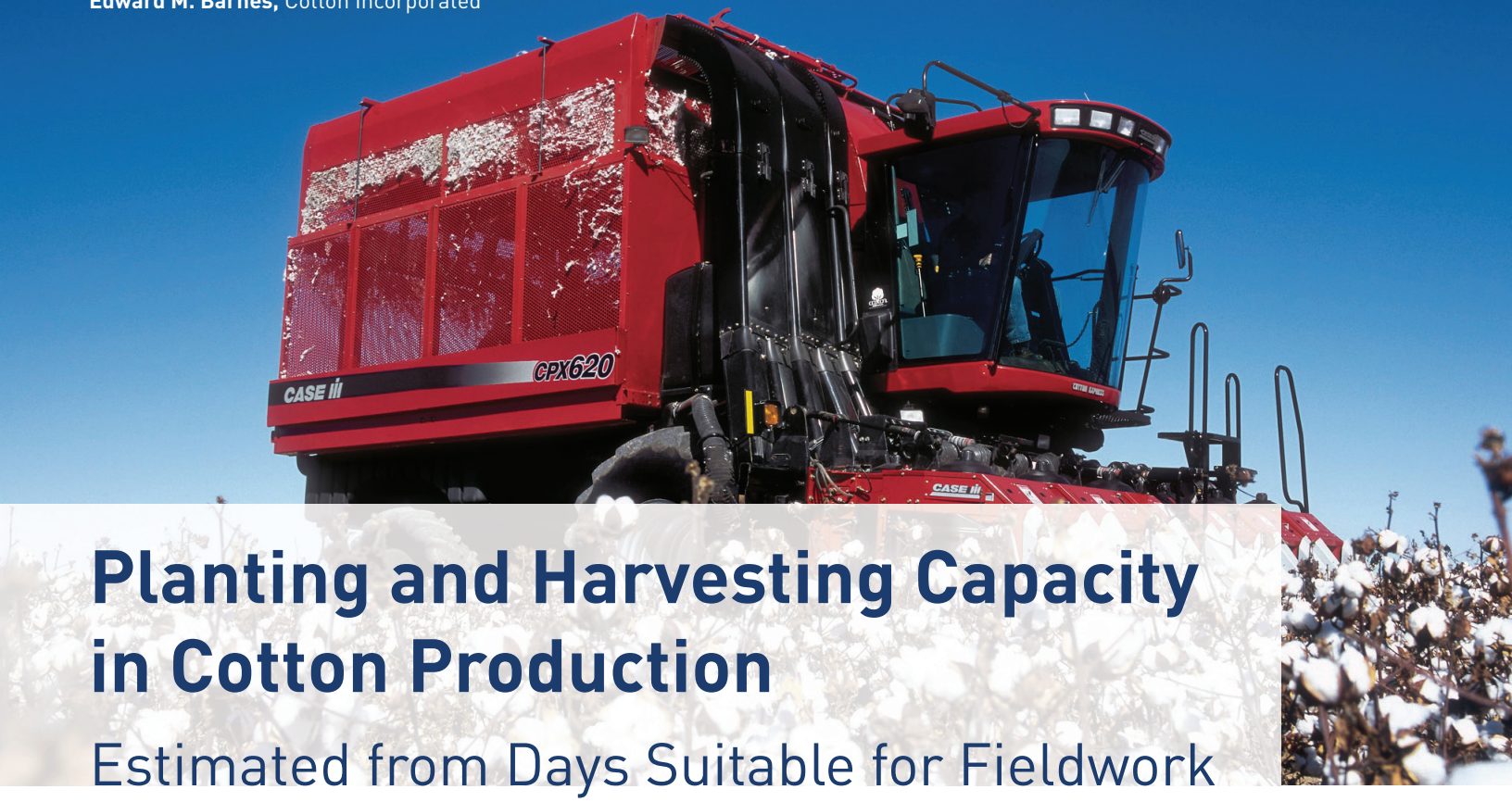
Terry W. Griffin, Ph.D., Kansas State University
Michael J. Buschermohle, University of Tennessee
Edward M. Barnes, Cotton Incorporated

December **2015**



Planting and Harvesting Capacity in Cotton Production

Estimated from Days Suitable for Fieldwork

INTRODUCTION

Machine capacity information is crucial for making machinery management decisions. Machine capacity is used to predict how equipment will perform for a specific farming operation and it determines the timeliness of that operation. Machinery capacities have improved over time, however optimal decisions for planting and harvesting equipment selection remain heavily dependent upon climate conditions. Days suitable for fieldwork (DSFW) were evaluated during cotton planting and harvest windows for 13 cotton-producing states. Additionally, scenarios for different planting and harvest equipment configurations were analyzed to give an approximate indication of how many acres cotton producers can realistically expect to cover for each state under various equipment configurations. These results are usable to farmers, practitioners, and researchers for decision making including determining the number of acres that can be planted and/or harvested in a given year. These results are also important for farm decision makers to make machinery selection and acreage allocation decisions.

METHODS

Days suitable for fieldwork data were collected from USDA National Agricultural Statistics Service (NASS). Data were generally available from 1996 to 2013 although a few states (Arkansas, Missouri, Mississippi, and Kansas) had 30 plus years of data. DSFW is determined by weather conditions such as rainfall and temperature that influence the condition of the soil surface thereby affecting the ability of machinery to conduct fieldwork. Weekly DSFW were collected for 13 of the 17 cotton-producing states. Arizona, California, Florida, and Texas do not have historical DSFW data available. USDA reports DSFW at the Crop Reporting District (CRD) level for only Kansas and Missouri, and only state-wide DSFW for the remaining 11 cotton-producing states. Since cotton production only occurs in relatively small areas of Kansas and Missouri, DSFW for southeastern Missouri and south central Kansas were chosen rather than state-level data. The relevant planting and harvest dates for each state were selected from the 2010 USDA NASS Agricultural Handbook Number 628 listed as 'most active'. Griffin et al. (2015) provide additional details on how DSFW was calculated.

Tables 1 and 2 represent the parameters used for the different planter and harvester configurations evaluated. Field efficiency represents the percent of the time the machine is in the field[1] actually planting or harvesting (as opposed to turning at the end of the field, or time spent loading seed or unloading cotton). The "field capacity" indicates how many acres per hour could be covered by the specific machine configuration. A 10-hour day was assumed for planting and reduced to an eight hour day for harvest as dew often limits when harvest can start and end each day in many states.

1 Note that field efficiency does not take into account travel time between fields.

Table 1. Ground speed, field efficiency, and field capacity for typical planting systems

Planter Configuration	Speed Miles per Hour	Planting Field Efficiency %	Field Capacity Acres per Hour
12 Row Seed Tender*	5	74	17
18 Row Center Fill	5	66	23
24 Row Center Fill	5	61	28

**Seed refilled by individual row unit*

Data source: Buschermohle et al. (2016)

Table 2. Ground speed, field efficiency, and field capacity for typical cotton harvest systems

Harvester Type	Speed Miles per Hour*	Picking Field Efficiency %	Field Capacity Acres per Hour***
Six Row Round MB**	4.2	83	8.0
Six Row Basket	4.2	75	7.3
Six Row Basket (old)	3.6	75	6.2

**Speed based on first gear picking speed*

Primary data source: Willcutt et al. (2009).

***MB = Module Building*

***Based on data from Faulkner et al. (2011), 8 acres per hour is also a reasonable estimate for an eight row stripper with a field cleaner under medium yielding conditions (2 bales per acre, 4 mph). For higher yielding conditions (3 bales per acre, 3 mph), the stripper harvester capacity drops to 6.5 acres per hour. Under low yielding conditions, an eight-row stripper can exceed 12 acres per hour, so values for the six-row round in Table 4 would need to be multiplied by 1.5

RESULTS

Tables 3 and 4 present the planting and harvesting DSFW, respectively, for an average year measured as the 50th percentile or median[2]. Also included in the tables are estimates of how many acres could be covered for a specific machine configuration during a typical (median) weather year. Note that additional data analysis has shown that days for fieldwork definitely vary on a yearly basis, and that in worse case scenarios (20th percentile of DSFW), expect a reduction of approximately 300 acres or more in a season for a given machinery configuration.

2 It should be noted that 'field capacity' is reported for the median DSFW and should be interpreted as an upper limit on the number of acres that can be planted or harvested during the season. Planning for a median weather year is overly optimistic; and machinery selected based on the median year would not be able to complete field operations 50% of the time. Decision makers should plan for a year worse than the median — additional research is in process to define an optimal worse case scenario.

Table 3. Days suitable for fieldwork (DSFW) in a median year during typical planting times in the state listed and estimated acres a given machine configuration could cover per season.

						Acres per Machine for Planters Described in Table 1 Assuming 10-hour Work Day		
State	Begin Planting	End Planting*	Calendar Days	Median DSFW	% Days Suitable	12-Row	18-Row	24-Row
AL	24-Apr	24-May	31	21.9	71%	3,723	5,037	6,132
AR	30-Apr	23-May	24	13.8	58%	2,346	3,174	3,864
GA	2-May	31-May	30	23.9	80%	4,063	5,497	6,692
KS	20-May	15-Jun	27	18.5	69%	3,145	4,255	5,180
LA	24-Apr	17-May	24	16.1	67%	2,737	3,703	4,508
MO	29-Apr	23-May	25	13.6	54%	2,312	3,128	3,808
MS	27-Apr	19-May	23	13.8	60%	2,346	3,174	3,864
NC	1-May	20-May	20	16.1	81%	2,737	3,703	4,508
NM	20-Apr	10-May	21	19.8	94%	3,366	4,554	5,544
OK	11-May	10-Jun	31	20.6	66%	3,502	4,738	5,768
SC	1-May	20-May	20	17.4	87%	2,958	4,002	4,872
TN	1-May	25-May	25	17.7	71%	3,009	4,071	4,956
VA	25-Apr	11-May	17	9.6	56%	1,632	2,208	2,688
Average					70%	2,914	3,942	4,799

*For both planting and harvesting dates reported by USDA and especially for planting dates, the 'most active' planting date windows are likely much longer than any typical farmer would plan for or actually plant. Metrics reported by USDA NASS as the 'most active' dates reflect statewide trends and local harvest or planting activity is likely to be only during a subset of these dates.

Table 4. Days suitable for fieldwork (DSFW) in a median year during typical harvest times in the state listed and estimated acres a given machine configuration could cover per season.

						Acres per Machine for Harvests Described in Table 2 Assuming 8-hour Work Day		
State	Start Harvest	End Harvest	Calendar Days	Median DSFW*	% Days Suitable	Six Row Round	Six Row Basket	Old Six Row
AL	20-Sep	20-Oct	31	23.3	75%	1,491	1,361	1,156
AR	29-Sep	6-Nov	39	33.8	87%	2,163	1,974	1,676
GA	10-Oct	2-Dec	54	45.4	84%	2,906	2,651	2,252
KS	25-Oct	15-Dec	42	28.5	68%	1,824	1,664	1,414
LA	23-Sep	23-Oct	31	22.8	74%	1,459	1,332	1,131
MS	27-Sep	9-Nov	44	28.9	66%	1,850	1,688	1,433
MO	27-Sep	29-Oct	33	26.8	81%	1,715	1,565	1,329
NM	10-Oct	15-Nov	37	26.5	72%	1,696	1,548	1,314
NC	25-Oct	30-Nov	37	31.8	86%	2,035	1,857	1,577
OK	15-Oct	9-Dec	56	30.1	54%	1,926	1,758	1,493
SC	15-Oct	13-Nov	30	24.3	81%	1,555	1,419	1,205
TN	30-Sep	10-Nov	42	32	76%	2,048	1,869	1,587
VA	8-Oct	20-Nov	44	32	73%	2,048	1,869	1,587
Average					75%	1,901	1,735	1,474

*For both planting and harvesting dates reported by USDA and especially for planting dates, the 'most active' planting date windows are likely much longer than any typical farmer would plan for or actually plant. Metrics reported by USDA NASS as the 'most active' dates reflect statewide trends and local harvest or planting activity is likely to be only during a subset of these dates. This is particularly true in a state like Georgia, where the active cotton harvest time is extended to shared labor with peanut harvest.

As a planting example using Table 3, a producer in Alabama could expect to cover up to 3,723 acres per season with a 12-row planter or 6,132 acres with a 24-row machine. Similarly, from Table 4, a producer in Tennessee with a round module building picker could expect to cover 2,048 acres in a season, or 1,587 acres with an older machine. Note that farms employing higher capacity equipment are subject to larger loss of acres in bad weather years (for example, when a day is lost with a 24 row planter, 280 acres are not planted as opposed to being 170 acres behind schedule when using a 12 row planter). These machine capacities are not meant to be exact, but should be useful in setting expectations on how many acres can be covered by a given machine in a season.

REFERENCES

Buschermohle, M.J., S. Smith, C. Boyer, R. Bowling and C. Buschermohle. 2016. Determining the Influence of Planter Width and Seed Loading Methods on Planter Efficiency for Cotton Production. Beltwide Cotton Conferences, New Orleans, LA, January 5-7, 2016.

Faulkner, W.B., J.D. Wanjura, R.K. Boman, B.W. Shaw, and C.B. Parnell. 2011. Evaluation of modern cotton harvest systems on irrigated cotton: harvester performance. Applied Engineering in Agriculture 27(4): 497–506

Griffin, T., A. Sharda, T. Mark, G. Ibendahl, M. Buschermohle, and E. Barnes. 2015. Optimal Cotton Acreage Allocation for Machinery Complements under Weather Uncertainty. ASABE Paper No.2185015. St. Joseph, Mich.

Willcutt, M.H., M.J. Buschermohle, E. Barnes, F. To, J. Field, and P. Allen. 2009. In Field Time in Motion Comparisons of Conventional, John Deere 7760 and Case 625 Module Express Cotton Pickers. 2009 Beltwide Cotton Conferences, San Antonio, Texas, January 5Ð8, 2009. Pp. 462–476.