IPM Planning Guide

reference

Growth Potential Reference

GCSAA

Golf Course Superintendents Association of America

Growth potentials

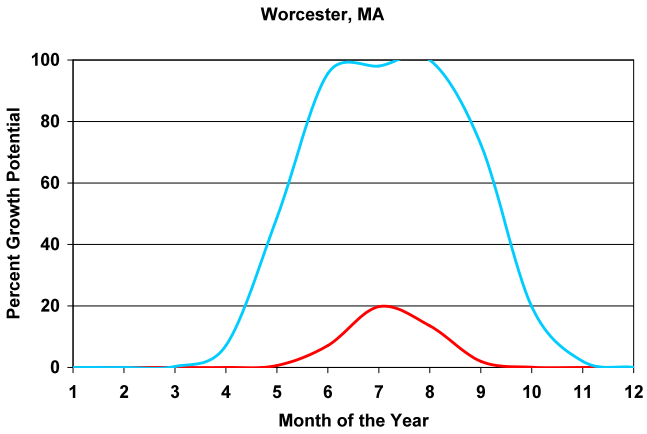
The concept of growth potential was developed to explain the myriad of ways in which weather impacts turf growth. The basic assumptions are that:

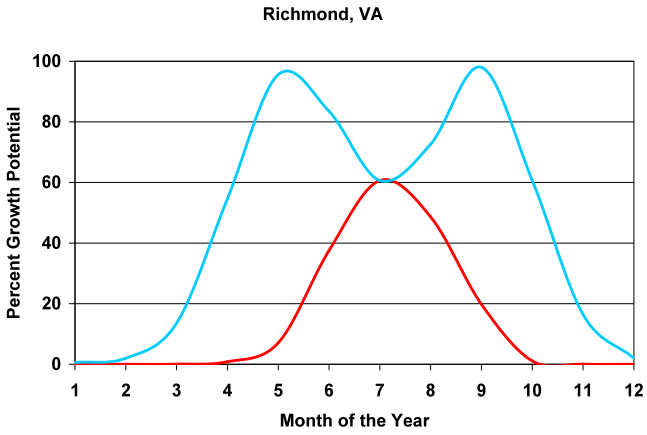
- turf growth is good when the growth potential (GP) is between 50% and 100%
- the best possible growth occurs at a GP of 100%.
- when weather conditions are either too hot or too cold for optimal turf growth, the GP falls below 50%, and turf becomes progressively more stressed. When the GP falls to 10% or lower, growth is extremely limited.
- Based on the scientific literature, cool-season turf grows best between average air temperatures of 60° and 75°F (with optimum growth at about 68F), while warm-season turf grows best at average air temperatures between 80° and 95°F (with optimum growth at about 88F).

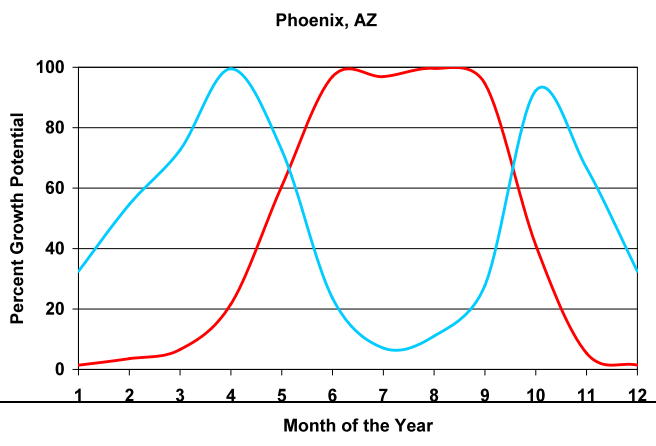
Using the growth potential concept

Growth potential data can be used to educate golfers and managers, to provide a scientific basis for decisions, to predict the performance of different turf types when exposed to different climates, and to forecast the effects of different overseeding and transition practices. Specific examples include:

- Timing application for chemical transition accelerators (Kerb, Revolver, Monument, Manor, Blade, TranXit): Warm-season turf GP should be 50% or higher at the time of application in order to ensure that sufficient warm-season turf cover is present.
- Scheduling aggressive management practices (aerification) or stressful events (tournaments): Turf growth potential should be as high as possible (greater than 50%) and on the rise when stressful events are scheduled. This allows for the greatest recovery potential of the turf.
- Explaining why cool- or warm-season turf is performing poorly (or well): Use growth potential to illustrate how your current weather conditions are affecting turf performance.







WEATHER REFERENCE

Percent growth potential (GP) of cool-season and warm-season turf at different average air temperatures

Air Temp (F)	%Warm GP	%Cool GP
38	0	1
39	0	2
40	0	2
41	0	3
42	0	4
43	0	5
44	0	6
45	0	8
46	0	10
47	0	12
48	0	15
49	1	18
50	1	22
51	1	26
52	1	30
53	2	35
54	2	40
55	3	46
56	3	52
57	4	58
58	5	64
59	6	70

Air Temp (F)	%Warm GP	%Cool GP
60	7	75
61	9	81
62	10	86
63	12	90
64	15	94
65	17	97
66	20	99
67	23	100
68	27	100
69	30	99
70	35	97
71	39	94
72	43	90
73	48	86
74	53	81
75	58	75
76	63	70
77	68	64
78	73	58
79	78	52
80	82	46
81	86	40

Air Temp (F)	%Warm GP	%Cool GP
82	90	35
83	93	30
84	96	26
85	98	22
86	99	18
87	100	15
88	100	12
89	99	10
90	98	8
91	96	6
92	93	5
93	90	4
94	86	3
95	82	2
96	78	2
97	73	1
98	68	1
99	63	1
100	58	1
101	53	0
102	48	0
103	43	0

Air Temp (F)	%Warm GP	%Cool GP
104	39	0
105	35	0
106	30	0
107	27	0
108	23	0
109	20	0
110	17	0
111	15	0
112	12	0
113	10	0
114	9	0
115	7	0
116	6	0
117	5	0
118	4	0
119	3	0
120	3	0
121	2	0
122	2	0
123	1	0

GROWTH POTENTIAL MODEL EQUATION

The growth potential values above were calculated using the equation below:

GP = growth potential

obsT = observed temperature (F)

optT = optimum turf growth temperature (F)

sd = standard deviation of the distribution

(sd warm = 12; sd cool = 10)

e = natural logarithm base **2.718282…**

$$GP := 100 \cdot \left[\frac{1}{e^{\left[\frac{1}{2} \left[\frac{(obsT - optT)}{sd} \right]^2 \right]}} \right]$$

WEATHER REFERENCE: Using growth potentials

Percent warm season and cool season turfgrass growth potential (GP) in selected U.S. locations. Months with 50% or more warm season turf growth potential are highlighted in red, while months with 50% or more cool season turf growth potential are highlighted in blue. Values are based on 30-year normal average monthly air temperatures from the National Oceanic and Atmospheric Administration.

	PERCENT WARM SEASON TURFGRASS GP												PERCENT COOL SEASON TURFGRASS GP											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
PHOENIX, AZ	2	5	11	34	77	100	88	95	99	56	10	2	38	62	87	97	53	12	3	6	19	78	85	41
LITTLE ROCK, AR	0	0	2	11	35	75	90	85	54	12	1	0	2	6	35	86	96	55	35	42	80	90	31	5
FRESNO, CA	0	1	3	9	30	66	90	84	56	18	2	0	9	26	46	82	99	66	35	44	78	97	38	9
LOS ANGELES AP, CA	5	7	8	13	19	33	55	59	52	33	12	5	56	61	64	76	89	98	99	96	97	100	84	57
PALM SPRINGS, CA	3	7	13	31	65	97	94	98	97	58	12	3	46	73	91	99	67	24	5	8	23	75	90	50
RIVERSIDE, CA	2	3	4	8	18	39	69	68	53	22	5	2	34	46	56	78	98	94	62	64	81	100	65	36
DENVER, CO	0	0	0	0	4	23	51	41	11	1	0	0	0	0	2	16	59	100	84	93	87	27	2	0
JACKSONVILLE, FL	1	3	9	23	50	78	89	87	74	34	10	3	32	47	81	100	84	51	37	39	57	97	85	46
TAMPA, FL	7	10	22	40	70	88	91	91	86	57	25	11	75	84	100	93	61	39	33	33	41	77	100	87
ATLANTA, GA	0	0	2	10	31	63	77	74	47	11	2	0	3	8	38	84	99	70	53	57	87	87	35	7
MACON, GA	0	1	4	15	43	75	87	84	60	17	3	1	9	17	57	95	91	55	39	44	74	96	52	17
HONOLULU,HI	48	48	55	62	71	80	84	88	86	81	69	54	86	86	79	71	61	49	43	38	40	48	62	80
CHICAGO,IL	0	0	0	1	6	29	49	42	16	2	0	0	0	0	1	17	69	99	85	92	95	34	2	0
INDIANAPOLIS, IN	0	0	0	1	12	43	60	49	22	2	0	0	0	0	3	32	90	91	73	85	100	44	5	0
DES MOINES, IA	0	0	0	1	11	42	66	53	18	2	0	0	0	0	1	25	87	91	66	81	97	38	2	0
WICHITA, KS	0	0	0	3	19	62	88	79	36	6	0	0	0	0	9	54	98	71	38	50	96	67	7	0
SHREVEPORT, LA	0	1	4	19	46	80	92	91	67	22	4	0	8	19	61	98	88	49	31	34	65	100	56	15
BOSTON, MA	0	0	0	0	5	26	51	43	17	2	0	0	0	0	2	15	65	100	84	91	96	45	9	0
DETROIT, MI	0	0	0	0	5	25	45	37	13	1	0	0	0	0	1	13	66	100	89	96	91	26	2	0
MINNEAPOLIS, MN	0	0	0	0	5	27	51	37	8	1	0	0	0	0	0	11	67	100	83	96	78	17	0	0
JACKSON, MS	0	0	4	16	43	77	88	86	63	16	3	0	6	15	56	96	90	53	38	41	70	96	50	14
ST. LOUIS, MO	0	0	0	4	20	60	81	71	35	5	0	0	0	0	8	56	99	73	47	60	96	66	10	0
LAS VEGAS, NV	0	1	3	15	53	98	96	100	84	28	3	0	9	26	53	94	81	22	6	11	43	100	46	9
RENO, NV	0	0	0	1	4	18	42	33	8	1	0	0	0	1	5	17	55	97	92	98	78	25	2	0
NEW YORK (JFK AP), NY	0	0	0	1	7	32	61	57	25	4	0	0	0	0	3	24	75	98	73	77	100	58	13	1
RALEIGH, NC	0	0	1	6	23	55	74	69	39	7	1	0	2	4	23	70	100	79	57	63	94	76	26	5
AKRON, OH	0	0	0	1	6	26	43	36	14	1	0	0	0	0	1	16	70	100	91	96	93	32	4	0
OKLAHOMA CITY, OK	0	0	1	8	28	67	90	87	48	10	1	0	1	3	23	78	100	65	35	40	86	86	20	2
GUAM, PC	70	69	72	78	81	82	80	78	79	78	79	75	62	62	59	52	48	46	49	51	50	51	50	55
PITTSBURGH, PA	0	0	0	1	7	26	44	37	14	1	0	0	0	0	2	20	73	100	90	96	94	32	4	0
CHARLESTON AP,SC	0	1	5	17	47	75	88	85	65	23	5	1	14	24	64	97	87	56	38	42	67	100	66	26
KNOXVILLE, TN	0	0	1	4	18	49	66	63	35	5	1	0	1	2	18	61	98	85	66	70	97	66	17	2
AUSTIN, TX	1	2	10	33	61	88	97	98	83	39	9	1	17	34	84	98	72	39	24	22	45	94	80	28
CORPUS CHRISTI, TX	3	5	19	46	73	90	96	96	86	53	19	5	46	67	98	88	58	35	25	25	40	81	98	65
HOUSTON, TX	1	2	8	28	56	84	92	91	74	33	9	2	23	40	79	100	78	44	32	33	56	98	81	38
SAN ANTONIO, TX	1	2	10	32	61	91	98	98	79	35	8	1	19	38	85	98	73	34	22	22	50	96	78	31
RICHMOND, VA	0	0	0	4	20	53	73	67	35	6	1	0	1	2	15	59	99	81	58	65	97	67	20	2

WEATHER REFERENCE: Using growth potentials