

Developing a Site-Specific Management Program

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Bottom line: Developing an annual turf management plan allows you to represent, in one document, all of the complex and diverse factors that go into your management decisions – from site-specific weather, to pest biology, to keeping soils healthy. The management plan is useful for business purposes -- planning, budgeting, and more efficient use of products and labor. It is helpful for making and justifying agronomic decisions on cultural practices, pest management and avoidance of turfgrass stress. And it is a valuable tool for communicating with your crew, your management or with other superintendents about the logic and science behind your management activities.

Weather is by far the single most powerful factor controlling turf quality. From turf growth, to damage caused by insects, diseases and weeds, to the success or failure of overseeding – all of these are controlled primarily by weather. Weather that is unpredictable, capricious and frequently unkind to turf managers. Yet despite the unknowability and power of weather, it is possible to be proactive and thus avoid many of the challenges that Mother Nature hurls at you, and at the turf, each year.

With this issue of *PACE Insights*, we will help you build a science-based, comprehensive, year-long turf management program that incorporates the past 30 years of weather data from your site into your planning process. By looking closely at your historical weather patterns, we can try to predict when turf will be most stressed (due to excessive heat or cold, low light intensity, periods of drought, flooding etc.), when pest populations are about to explode, when the turf needs additional nutrition or when preventive cultural practices or pest control measures will be most helpful. Your completed management plan can be used throughout the year as both a planning tool -- for scheduling, purchasing, budgeting and coordinating -- and also as a communication tool that can help you explain to your crew, to your management, golfers and other superintendents the scientific basis for management decisions and turf performance.

The Climate Appraisal Form

The **Climate Appraisal Form** is developed based on 30 years of data (the “30 year normals”) from a weather station that is as close as possible to your golf course. The information in this form will be used to build your site-specific management program. If you don’t already have a Climate Appraisal Form, please visit the PACE Turf website (www.paceturf.org) for instructions on creating your own.

Precaution: In some cases, the closest weather station that we have access to may be up to 10 miles from your location. Furthermore, the weather of the past 30 years can only help to roughly guess what to expect in the coming year. While this data is an exceptionally detailed record of average or normal weather trends over the past 30 years, it always seems as if the year we are currently living in is the weirdest, most abnormal year in history. For these reasons, the

Climate Appraisals and Management Programs we develop together should be used only as rough guidelines for planning the future. Your experience and real time, on-the-spot observations are the fine-tuning tools that will keep your program as accurate and useful as possible.

The Climate Appraisal includes the following data:

Normal average temperature: the average monthly air temperature at your site, based on the past 30 years of air temperature data

Normal precipitation: the average monthly precipitation (rain and snow), based on the past 30 years of precipitation data

Turf growth potential: we have calculated the growth potential for cool season turf (“cool season GP”) and warm season turf (“warm season GP”). Explained in greater detail in *PACE Insights* (March, 2000), the turf growth potential values are estimates of the relative growth of cool or warm season turf based on air temperatures. Values range from 0 – 100%, and the higher the value, the greater the turf growth. When air temperatures are either too high or too low for optimal growth, the growth potential will decrease. **When growth potential values are less than 50%, the turf is considered to be under stress.** We have highlighted those stress periods in yellow on your appraisal form.

Maximum nitrogen requirements: Maximum monthly nitrogen requirements have been calculated based on the projected growth potential of cool or warm season turf. When making these calculations, we assume that the maximum amount of nitrogen that should be applied per month is 0.7 lb/1000 sq ft.

Getting ready

For this stage of the planning process, you will need the following tools:

- **Climate Appraisal form**
- A blank **Management Plan**. If you need extra blank management plans, you can either call us for more, or you can find them on our website (www.paceturf.org) by searching for “Sheet1 Management Plan”. The file can either be saved on to your computer for future use, or printed (ideally on 11X17 paper).

- **Pest Worksheet:** This worksheet will be used to pencil out key pests at your location, potential control measures and their timing. The exercise of filling out this worksheet will help you to finalize a pest management plan that can then be transferred to your Management Plan. Blank pest worksheets can be found on the PACE website by searching for "Pest worksheet".
- **PACE Turf Management References:** The PACE Member website contains a large body of technical information on soil and water management, as well as the biology and management of key turf insect, disease and weed pests. Type the appropriate pest name or topic into the "Search" box to find necessary information on pest management, soil and water guidelines.
- **Sample Management Plan and Pest Worksheet:** To give you an idea of how we want you to fill out these forms, we have completed a sample Management Plan and Pest Worksheet, based on a hypothetical location in San Diego, CA. Refer to these periodically for an illustrated version of the process that we will describe below.
- **Yellow highlighter**
- **Pencil and eraser**



We're going to walk through this process with you with a focus on golf course greens, but we strongly suggest that you repeat the process for fairways, tees and roughs as well.

Mapping turf stress vs. cultural practices

Understanding when turfgrass is likely to be stressed – as the result of heat, cold, excessive rainfall or drought, high soil salts, tournaments, etc. can help you better schedule your management practices. For example, potentially stressful management practices (aerification, herbicide applications, etc) can be avoided during periods of decreased turf growth and stress, and practices geared towards encouraging turf growth can be substituted.

On your Management Plan:

1. Use the yellow highlighter to indicate periods of turf stress for cool season turf and warm season turf. These periods are highlighted in yellow on your **Climate Appraisal** form. If you are managing only cool season turf on your greens, then you can ignore the warm season turf data (and vice versa)
2. High rainfall and/or overcast conditions can produce turf stress due to disease and/or lack of sufficient solar radiation. If there are months where persistently overcast, cloudy or rainy weather (more than 5 inches per month) results in stress to your turf, highlight them in yellow on the warm season or cool season turf stress line (if they aren't already highlighted due to sub-optimal air temperatures).

3. Using a pencil, mark a "T" to indicate tournament dates on either the cool or warm season stress lines.
4. Using a pencil, mark an "X" to schedule the following cultural practices. Remember to avoid aggressive cultural practices (aeration, heavy topdressing vertical mowing) during the highlighted periods of stress/slow growth:
 - Tree maintenance: trimming, lacing and/or removal should be scheduled during months of low light intensity (typically, fall/winter) to increase solar radiation in areas that are stressed due to shade.
 - Renovation
 - Overseeding
 - Aeration (specify type used: deep tine, Vertidrain, etc): recommended at least 1X per year
 - Heavy topdressing
 - Venting (recommended: 1/4" solid tines, monthly during periods of active turf growth)
 - Grooming
 - Vertical mowing
 - Light topdressing
 - Traffic control

Nutrition

On your Management Plan, use a pencil to mark an "X" to schedule the following:

1. Soil testing (2X per year in spring and fall)
2. Using the cool or warm season monthly N requirements listed on your Climate Appraisal, determine the frequency and rates of nitrogen to be applied each week of the year. When looking at the nitrogen requirements on your Climate Appraisal, keep these things in mind:

Maximum monthly elemental N: The N rates shown on your Climate Appraisal are the **maximum** elemental nitrogen rates for optimal turf growth during each month.

Exception to the rule: areas with heavy rainfall. In areas that experience heavy rainfall (more than 5 inches per month), maintaining nitrogen levels at adequate levels is a challenge. Under these conditions, the maximum rates of elemental N/1000 sq ft/month may need to occasionally be exceeded. Consider the use of granular, long-chain ureaformaldehyde nitrogen sources such as Nitroform 38-0-0. These microbial-release fertilizers are less likely to be leached by rainfall than other N sources. If these products are used, higher rates (2 - 4 lbs nitrogen/1000 sq ft or more) are optimal. Because these rates are higher than those listed on your Climate Appraisal, application will be less frequent. Re-application should occur based on turf performance and color.

Elemental nitrogen rates vs. product rates: The nitrogen requirements on your Climate Appraisal are for lbs elemental nitrogen/1000 sq ft per month. You

will therefore need to convert these elemental N rates to rates of product. This will in turn depend on the percentage of elemental nitrogen in the fertilizer product that you select. In the Sample Management Plan that we have provided, we've selected urea, 45-0-0, as our nitrogen source. And we have selected, for this example, to never apply more than 0.72 lb/1000 sq ft elemental N/monthly (0.18 lb/1000 sq ft/week). Therefore, to calculate the amount of product needed to deliver 0.18 lb/1000 sq ft elemental N per application, we have divided 0.18 lb by 45% (0.18/0.45) to obtain a rate of 0.4 lb/1000 sq ft of urea per application.

Overseeded turf: If you are managing both cool and warm season turf in an overseeding situation, select the nitrogen rate based on the turf type whose growth you are trying to encourage. For example, if you are trying to promote growth of cool season turf during the wintertime, then use the nitrogen rates for cool season turf that are suggested on the Climate Appraisal. If you are trying to encourage both types of turf to grow, then use the higher of the two nitrogen rates shown on your Climate Appraisal.

3. On the nitrogen lines on the Management Plan, indicate the name of the nitrogen product you plan to use, and the desired product rate per 1000 sq ft/application. Use a separate line for each different nitrogen product and/or each different application rate that you plan to use.
4. Schedule monthly applications of potash as a potassium source at 1 lb K₂O/1000 sq ft when turf is growing actively (a growth potential of 30% or higher). Remember to include the amount of potash applied via your nitrogen source in your calculations to determine whether additional potash is necessary. On the Sample Management Plan, we have selected potassium sulfate, 0-0-50, as our potassium source. Since the urea fertilizer we selected as an N source contained no potassium, the full pound of potash must come from the 0-0-50. Since the 0-0-50 contains 50% potash, we will need 1 lb/0.50 = 2.0 lbs/1000 sq ft of 0-0-50 to meet the requirement for 1.0 lb potash per month.
5. Schedule any other nutrient applications that your soils require in blank lines on the management plan. Type "Soil Nutritional Guidelines" into the search box on the PACE website for more information.

Water management

On your Management Plan:

1. On the lines "Leaching" and "Salinity Monitoring", use a yellow highlighter to indicate those months with less than 0.5" rainfall (monthly precipitation can be found on the Climate Appraisal). These months represent additional times of stress for the turf.
2. During these months, you should schedule weekly salinity monitoring (using a TDS-4 meter, as

described in PACE's salinity monitoring reference), which can be indicated with an "X" on the "Salinity Monitoring" line.

3. Schedule leaching events during these low rainfall months in order to avoid salt accumulation to turf damaging levels. Use your past history to determine the frequency of leaching for the coming year, and indicate with an "X" on the "Leaching" line. If there are no records of past leaching schedules available, then assume that you will need to leach roughly every 14 days during low rainfall months.
4. Schedule irrigation water testing at least once per year. A higher frequency of testing may be required if the water source is of variable quality (i.e. recycled or reclaimed water).
5. Schedule monthly maintenance of the irrigation system: level heads, check pressure, use catch cans to identify problems
6. Schedule drainage improvements in poorly drained areas during time periods compatible with other management and golfer oriented events.
7. Schedule hand watering during heat stress periods
8. Schedule annual aerial photographs during the times of heaviest stress. These can be useful for identifying problem areas, as well as recording changes in overall turf quality over time.

Insects

On your Pest Management Worksheet:

List the top 5 insect pests that you deal with on greens, in order of importance. The first insect listed (I-1) should be your most important insect pest, while I-5 represents the least important. For each insect:

1. **Determine control strategy:** Decide whether you want to use preventive control (treatment BEFORE the insect appears) or curative control (treatment AFTER the insect appears). Use a "P" or "C" in the column next to each insect's name to indicate whether you plan to use preventive or curative control.

NOTE: For some insects (for example, billbugs or black turfgrass atenioides), either preventive or curative control is a viable option. If you deal with an insect like this and are uncertain about which strategy to use, a good rule of thumb is to focus on preventive control if you have had a history of problems with the insect in question. If you are merely trying to protect yourself against the possibility that this insect might occur, then curative control is probably your best option.

2. **Determine when insects are likely to appear:** Now consult our Pest Threat Temperatures listing (type "Pest Threat Temperatures" into the search box on the PACE website) to determine the **threat temperatures** for each insect.

NOTE: The threat temperatures are rough guidelines that we have proposed to try to predict when pests are

likely to first begin causing damage on golf course turf. But we want to emphasize the word “rough”. We have used the best information available from scientific publications, texts and our own experience to come up with these temperatures, but predicting the behavior of insects, diseases or weeds is very complex. For this reason, the threat temperatures provided are at best very fuzzy, so try to incorporate whatever experience you have to bolster this information. And please, let us know if you these temperatures don’t apply to your situation – we hope to constantly refine them as time goes on.

3. Using your **Climate Appraisal**, determine which month(s) those threat temperatures exist for. Now, on your **Pest Worksheet**, use the yellow marker to highlight the threat periods for each insect. See the **Sample Pest Worksheet** for an illustration of how this should be done.
4. Determine target life stage: Determine whether your control measures will target larvae (“L”) or adults (“A”) or both. Indicate the target life stage with an “L” or “A”.
5. Time control measures: Using the “Pest Threat Temperatures” reference on the PACE website once again, determine when control measures for each insect should begin. Mark an “X” to indicate potential dates for starting chemical or cultural control measures.

Transfer the info to your Management Plan

Now it’s time to begin translating the information on your pest worksheet into decisions that will appear on your Management Plan. Remember to consult the Sample Management Plan for an illustration of the process we describe below.

1. Select control measures for preventively controlled insects: Begin by focusing on the most important of the preventively controlled insects that you have listed on your Pest Worksheet. Go through the entire process described below for one insect at a time.
 - a) Determine the optimum practice(s) or product(s) for each preventively controlled insect that you have listed.
 - b) List the names of these products or practices on the Management Plan.
 - c) Use the most current product labels to determine the rate that you plan to use, and indicate this rate on the Plan as well.
 - d) Use the letter “X” to indicate the timing of application for each of the products or practices. Consult your Pest Worksheet for information on when to initiate applications. Consult product labels for frequency of follow-up applications, and indicate these applications with additional “X”s.
 - e) Go through the same procedure for the remaining preventively controlled insects.
2. Curatively controlled insects: For these insects, it is almost impossible to predict exactly when control

measures will be necessary – their timing will be based on when the insects are detected in your monitoring program. For this reason, the most important activity you can schedule for curatively controlled insects is monitoring.

- a) Using the “Pest Threat Temperature” reference, determine at which temperatures monitoring for each insect should occur (note that monitoring isn’t absolutely necessary for those insects that are habitual problems and are preventively controlled).
 - b) Using your **Climate Appraisal**, determine when those monitoring temperatures begin.
 - c) Now, on your **Management Plan**, write the name of the monitoring practice in the left hand column, and place an “X” at the time the practice should begin. Place additional “X”s roughly every two weeks during the insect’s threat period.
 - d) Follow steps 1. a) -1. c) above for each curatively controlled insect.
 - e) For purposes of budgeting and/or planning, you may want to make some rough guesses on when control measures for curative insects will be made. Your records from previous years may be the most helpful in this respect – you can mark a tentative “(X)”, in parentheses to indicate it’s based on last year’s data, on the dates when you performed control measures last year.
 - f) Go through the same procedure for the remaining curatively controlled insects.
3. Identify target insects: Put the number of the insect pest (I1-I5) next to each management or monitoring practice that it addresses. Some practices will probably target multiple insect pests.
 4. Refine your program: Now take a look at your insect management program. Can you streamline the program any further by targeting two or more insects with the same product or practice? By moving application dates around by one or two weeks? Are you targeting the right insect life stage with the right product? Have you taken into account resistance management guidelines, which recommend that you rotate among insecticide classes (see the “Insecticide Resistance Management Table” on the PACE website)? Don’t become frustrated if you do a lot of erasing during this step – the idea is to get you to try out on paper several scenarios, and then judge which is the most efficient, most economically attractive, and most effective.
- When developing your insect, weed or disease plans, always consult the most current version of all product labels and confirm that your plan is within the manufacturer’s labeled guidelines.**

Diseases

On your Pest Management Worksheet:

List the top 5 diseases that you deal with on greens in order of importance. The first disease listed (D-1)

should be your most important disease, while D-5 represents the least important. For each disease:

1. Determine control strategy: Determine whether you want to use preventive control (treatment BEFORE the disease appears) or curative control (treatment AFTER the disease appears), and use a “P” or “C” in the column next to each disease name to indicate your preference. If you are uncertain, a good rule of thumb is to focus on preventive control if you have had a history of problems with the disease in question, and curative control to deal with less serious problems as they arise.
2. Determine when diseases are likely to appear: Consult the “Pest Threat Temperatures” reference on the PACE website to determine the **threat temperatures** for each disease. Using your **Climate Appraisal**, determine which month(s) those threat temperatures exist for. Now, on your **Pest Worksheet**, use the yellow marker to highlight the threat periods for each disease.
3. Determine when to begin control measures: Mark an “X” on your Pest Worksheet to indicate potential dates for starting control measures (chemical or cultural). For preventively controlled diseases, begin treatment 2-4 weeks before the threat period begins (4 weeks for root infecting diseases such as summer patch, take-all patch, spring dead spot, Bermuda decline). For curatively controlled diseases, place an “X” at the beginning of the threat period.

On your Management Plan:

1. Select control measures for preventively controlled diseases: Begin by focusing on the most important of the preventively controlled diseases that you have listed. Go through the entire process described below for one disease at a time.
 - a. Select the optimum practice(s) or product(s) for each preventively controlled disease that you have listed on your **Pest Worksheet**.
 - b. List the names of these products or practices on the **Management Plan**.
 - c. Use the most current product label versions to determine the rate that you plan to use, and indicate this on the Plan as well. If there is a choice in spray interval frequencies, the 14 day interval (with the 14 day rate recommendation) is usually optimal.
 - d. Use the letter “X” to indicate the timing of application for each of the products or practices. See your **Pest Worksheet** for information on when to initiate applications. Consult product labels for frequency of follow-up applications, and indicate these applications with additional “X”s.
 - e. Determine optimal product placement. For each product, write an “S” for soil applications or an “F” for foliar applications. Foliar or crown placement relies on low volume applications of 1-2 gallons/1000 sq ft, while soil (root) placement relies on higher volume applications of 2 – 4 gallons/1000 sq ft (or low

volume applications watered in with approximately 0.1 inches of irrigation).

- f. Go through the same procedure for the remaining preventively and curatively controlled diseases. Remember that the timings for curatively controlled pests are going to be rough guesses at best – you will want to use monitoring to confirm that curatively controlled diseases are present before beginning control measures.
3. Monitoring: Write the name of the monitoring practices that you want to implement in the left hand column of your **Management Plan**, and place an “X” at the time the practice should begin. Place additional “X”s roughly every two weeks during the disease’s threat period.
4. Identify target diseases: Put the number of the disease (D1-D5) next to each management practice that it addresses. Some practices will probably target multiple diseases.
5. Refine your program: Now take a look at your disease management program, and refine it as you did your insect program. Also, make sure that the disease threat periods are sufficiently covered by your control measures. Remember that in many cases, preventive control practices will also control diseases that are listed for curative control. Have you taken into account resistance management guidelines, which recommend that you rotate among fungicide classes.

Weeds

On your Pest Management Worksheet:

List the top 5 weeds that you deal with in order of importance. The first weed listed (W-1) should be your most important weed, while W-5 represents the least important of the five. For each weed:

1. Determine control strategy: Determine whether you want to use pre-emergence control (BEFORE the weed appears) or post-emergence control (treatment AFTER the weed appears), and use a “Pre” or “Post” in the column next to each weed name to indicate your preference.
2. Determine when weeds are likely to appear: Consult the threat temperature listing on the PACE website to determine the **threat temperatures** for each weed. Using your **Climate Appraisal**, determine which month(s) those threat temperatures exist for. Now, on your **Pest Worksheet**, use the yellow marker to highlight the threat periods for each weed.
3. Determine when to begin control measures: Mark an “X” on your Pest Worksheet to indicate potential dates for starting chemical or cultural control measures

On your Management Plan:

1. Select control measures for weeds that are controlled pre-emergence: Begin by focusing on your most important pre-emergence weed. Go through the entire process described below for each weed.

- a) Select the optimum practice(s) or product(s) for each preventively controlled weed that you have listed on your Pest Worksheet. Remember to take into account the sensitivity of your specific turf type to each weed control product
 - b) List the names of these products or practices on the Management Plan.
 - c) Use the most current product label versions to determine the rate that you plan to use, and indicate this on the Plan as well.
 - d) Use the letter "X" to indicate the timing of application for each of the products or practices. Consult your Pest Worksheet for information on when to initiate applications. Consult product labels for frequency of follow-up applications, and indicate these applications with additional "X"s. Make sure that product residual activity is long enough to control each target pest.
 - e) Go through the same procedure for the remaining pre- and then post-emerge controlled weeds. Remember that the timings for post-emergence weeds are going to be rough guesses at best – you will want to use monitoring to confirm that these weeds are present before beginning control measures
2. Monitoring is especially important for weeds that are controlled post-emergence. Once the average air temperatures are greater than 50F , weekly visual monitoring should begin. Use your **Climate Appraisal** to determine when visual monitoring begins, and mark with an "X" on the **Management Plan**.
 3. Identify target weeds: Put the number of the weed (W1 – W5) next to each management practice that it addresses. Some practices will probably target multiple weeds.
 4. Refine your program: Now take a look at your weed management program and refine it. In addition, make sure that you have taken overseeding timing and turf sensitivities into account. Have you incorporated resistance management guidelines, which recommend that you rotate among pesticide classes

- Can products that are scheduled for application at similar times be safely mixed in the spray tank?
- Are all label rates and recommendations being complied with?
- If you overseed, are products and practices timed to avoid any scheduling conflicts with renovation and overseeding procedures?

The Management Plan: A dynamic tool

The **Management Plans** that you will come up with are based on the historical weather patterns at your location, averaged over the past 30 years. This average represents some years with very hot or dry weather, others with very cold or wet weather, and some years that are in-between. These averages can give you some idea of what to expect in the coming year, but obviously they can be quite far off the mark in years, like this one, that are shaping up to have some extreme weather. For this reason, it is very important to review, fine tune and update your management plan periodically (we suggest monthly), and to re-write it on a blank Management Plan form when reality deviates significantly from your original predictions. The Management Plan is not a static document to be filed away – it should instead be a dynamic planning tool that reflects changes in weather, turf performance, budget constraints, and management expectations as the year progresses.

Almost done!

The next-to-final step in this process is to look over your entire Management Plan and make the necessary adjustments. Some of the questions you should be asking include:

- Are cultural practices being taken full advantage of in order to maximize turf health and potentially reduce pesticide applications?
- Are there stressful practices (aeration, products with risks of phytotoxicity, products that cause damage when air temperatures are high) scheduled during especially stressful periods of time for the turf? Can you re-schedule the procedure and/or substitute gentler products?