B.4 GENERAL INFORMATION:

B.4.1. THE NCA MISSION: The National Cemetery Administration honors veterans with a final resting place and lasting memorials that commemorate their service to our Nation.

B.4.2 National Cemeteries are national shrines for our nation's heroes, the veteran(s) and their family. The standards of maintenance, appearance and operational procedures performed at national cemeteries must reflect this nations concern for those interred there.

B.5 GENERAL REQUIREMENTS:

B.5.1 The contractor shall provide all supervision, labor, equipment, tools, and supplies necessary to: (1) provide herbicide and fertilization, (2) provide other turf maintenance to include disease control(turf pathogen) and other pest control for Fort Mitchell National Cemetery located at:

Fort Mitchell National Cemetery
553 Highway 165
Fort Mitchell, AL 36856

B.5.2 All work shall be performed during the normal working hours (8:00 a.m. to 4:30 p.m.), Monday through Friday, except with the written permission of the COR(s). The contractor is not required to work on Federal Holidays. The Federal Holidays are:

New Year Day	Martin Luther King Jr.'s. Birthday	**Washington's Birthday**	Memorial Day	Independence Day
Labor Day	Columbus Day	Veterans Day	Thanksgiving Day	Christmas Day

B.5.3 In the event climate or weather conditions become unsuitable for work or may induce an environmental hazard, the entire work shall be rescheduled to a date and time satisfactory to the contractor and Cemetery Management. Postponement due to climate or weather conditions will not be cause for penalties to the contractor nor additional costs to the government.

B.5.4 The contractor shall phase all work in such a manner as not to impact on or interfere with cemetery operations. Contractor shall cease work within 100 yards of any committal service in progress while performing under the contract. Contractor and contractor's employees shall cease work upon arrival of the funeral party at the committal shelter and will not start back to work until the funeral service is completed while performing under the contract. The COR may direct and arrange the contractor's performance in specific areas of the cemetery to coordinate with the cemetery's mowing operations and/or committal services.

B.5.5 Contractor(s) shall provide a "Site Manager" (Supervisor, Foreman, or Work Leader) to be at the work site whenever work is being performed. The contractor shall furnish a copy of the specifications contained in this contract to the site manager to ensure complete familiarity with

the requirements stated herein. The "Site Manager" will ensure all specifications are being met, ensure contract work does not conflict with ceremonies and funerals, and ensure employees are adequately supervised and proper conduct is maintained. At all times when any performance of the work at the site is being conducted by any employee of the Contractor or his subcontractors, the Contractor shall always have the "Site Manager" present who has the capability of receiving instructions in the English language, fluently speaking the English language, and explaining the work operations to persons performing the work in the language that those performing the work are capable of understanding. The Contracting Officer shall have the right to determine whether the proposed representative has sufficient technical and bilingual capabilities, and the Contractor shall immediately replace any individual not acceptable to the Contracting Officer.

B.5.6 Contractor's employees shall wear all required safety equipment such as, but not limited to, goggles or face shield, hearing protection, hard hats, respirators, if required, and uniforms identifying them as an employee of the contractor. The contractor shall be responsible for training and safety precautions prescribed by OSHA standards.

B.5.7 The contractor and contractor's employees shall observe all traffic, parking, directional signs and regulations when using the cemetery roadways. Contractors and contractor employees shall park only on cemetery roads or area as directed by the Cemetery Director or his/her representative. At no time shall the contractor's vehicles block any roads within the cemetery enclosure. Vehicles shall never be parked on a gravesite.

B.5.8 The contractor agrees to leave all work areas free of debris and in the same condition as before the work commenced. The contractor agrees to take all necessary precautions to protect vegetation, as appropriate, in the immediate work area(s).

B.5.9 The contractor shall be liable for any damage to headstones, markers, monuments, buildings, trees, shrubs, and any other structures with the cemetery enclosure caused by contractor personnel arising out of or resulting from performance under the contract.

B.6 TURF MANAGEMENT: FERTILIZING, HERBICIDES AND OTHER PEST CONTROL

Contractor shall be responsible for maintaining the established turf area of the cemetery in a healthy condition by proper application of fertilizers, chemicals (to control weeds, insect pest-fire ants, disease and etc.) and to include lime (if soil tests indicate it as needed). Approximately 27.0 acres of turf will be treated.

B.6.1 The intent of the work is to maintain a well-established, healthy stand of turf throughout the cemetery, which is generally weed free and generally free of bare areas. Turf area at Fort Mitchell Cemetery covers approximately 27 acres. All turf area is to be treated. This shall include all turf areas within the cemetery enclosure which will be all burial sections as well as all non-burial areas. All turf within the cemetery will be treated. Cemetery grounds map is attached.

B.6.2 All work to be accomplished in accordance with guidelines established by Federal, State and local ordinances, and the Contractor's procedure manual and quality control manual. Contractor shall conform to all regulations for examining and licensing of herbicide control operators, performance of herbicide control; use of approved herbicide control fertilization while working at Fort Mitchell National Cemetery. All herbicide management service shall be accomplished to meet the guidelines as shown in the National Herbicide Control Association's good practice.

B.6.3 Contractor to furnish the contracting officer and Cemetery Management a copy of Certification of Herbicide/Fertilization applicator operator prior to performing tasks at the Fort Mitchell National Cemetery complex.

B.6.4 General Requirements:

(a) Inspection to determine type of weed control management that is required and that is appropriate. This shall be conducted by the contractor and COR prior to initiation of application plan.

(b) Herbicide control shall include, but it is not limited to the following weeds: Dandelion, Chickweed, Knotweed, Purslane, Plantain, Clover, Ground Ivy, Violets, Onions, Bahia, Crabgrass and any other Broadleaf, Stubborn, or Grassy weeds found during inspections. See attached Protocol # 1.

(b) Contractor to perform evaluation of weed control measures through follow-up inspections. Actively growing weeds present two weeks post application will be retreated at contractor's expense. The contractor will respond with a corrective action plan within 3 days of notification by the Contracting Officer's Representative (COR) of any unsatisfactory results from weed control application. Unless precluded by inclement weather, the corrective action plan will be completed within 7 days following plan submission.

(c)Chemicals used for this contract shall be safe for use around cemetery employees and the general public as well as labeled for Alabama.

(d) The contractor shall be responsible for taking all precautions to prevent damage to the cemetery in any manner, including headstones, markers, monuments, flower beds, irrigation heads, trees and other structures during application operations.

(e)Fertilizer: shall be applied based on the results and recommendations of a soil test for each section. The soil test will be conducted by the director with copies going to the Contractor. Only 40% slow release shall be used. See attached Protocols 4

(f)Lime: When soil tests indicate a need for lime, it shall be applied at the rate indicated in those tests (Only pelletize lime will be used). Time of application shall be in late fall or early winter, unless local practice indicates more favorable time.

(g)Weed and Insect Control: All weed growth and insect shall be controlled by means of spray/granular broadcast or any other method approved by the Director/COR. All personnel using such sprays shall be properly trained and the person in charge shall be duly licensed by the State of Alabama to use pesticides. Signage will be provided by the contractor and be sufficient as to warn workers, contractors, and visitors of the presence and hazards of chemicals in use. Treatment for weeds will be accomplished to maximize herbicide effectiveness.

(h)Control of Fire Ants and other Pest: Contractor shall apply necessary chemical applications to control fire ants and/or other pest, specific attention should be given to Grub Worms and Army Worms. See attached Protocol #3.

(i)Control of Crabgrass and Bahia, : The entire established turf areas will be treated with sufficient amount of pre-emergence to prevent germination of crabgrass and Bahia. See attached Protocol #2

(j)Contractor will notify the Director, Fort Mitchell National Cemetery, 48 hours prior to any of the above applications. This is to insure that coordination can be made so that the treatments do not conflict with any interment or cemetery maintenance activity.

B.6.5 Disposal of Hazardous Wastes: The contractor shall not dispose of any excess herbicide containers or other materials contaminated by herbicides at any location on the cemetery premises except as authorized by the Cemetery Director.

B.6.6 No weed control or equipment shall be stored or kept at the cemetery when the contractor's operator is not working without written approval of the Cemetery Director.

B.6.7 Required Contractor Reporting:

a. The contractor shall be responsible for supplying, completing and submitting all reports required or requested by Federal, State and/or local ordinances which pertain to any duties in the contract.

b. The contractor shall be required to furnish Cemetery Management, prior to applications of herbicides and fertilizers, the trade names (if any), and chemical names of the chemicals and fertilizers proposed for use and label showing the contents, the use strength of the chemical and fertilizers that applies and the antidote thereto. Contractor shall furnish the same

information each time the chemicals, fertilizers, or products are used at the Fort Mitchell National Cemetery.

B.6.8 All chemical Applications will be made during each contract year. Please see Attachment "Chemical Application" and the results of the soil test provided.

B.7. CONTRACTOR DUTIES AND RESPONSIBILITIES:

1. Site Manager: A "Site Manager" shall be provided by the Contractor for not less than eight (8) hours a day whenever work is being performed - other than trash and debris pick-up. The "Site Manager" must have not less than five (5) years experience as a direct supervisor of employees supervising and performing all tasks set forth in the scope of work and provide a statement of qualifications with the proposal.

2. The "Site Manager" will ensure all specifications are being met, ensure contract work does not conflict with ceremonies and funerals, and ensure employees are adequately supervised and proper conduct is maintained.

3. In the absence of the COR and/or Project Manager, the Contractor shall meet with the Alternate COR and/or Project Manager of this contract. The Contracting Officer's Representative (COR and/or Project Manager) for this contract shall be __ at ___*___; Alternate CORs and/or Project Manager, __ and __ at ___*___.
(*) Phone numbers to be provided upon award of contract.

4. Invoices shall reference the appropriate purchase order number and be sent to the designated address for certification and payment processing.

B.8. CONTRACTOR-FURNISHED ITEMS:

B.8.1. The contractor is responsible for supplying all equipment, personnel, tools, supplies and materials to perform these services.
B.8.2. Contractor-furnished items necessary to perform work as required under this contract shall be provided, maintained in good operating condition and operated by the Contractor and shall be consistent and fully compliant with all applicable Federal, State, County, City laws, ordinances and regulations. The contractor will inspect all equipment prior to bringing it on cemetery grounds to ensure it is clean and free of debris from other sites to prevent bringing weeds and pests from other sites.

B.8.3. Materials and supplies procured for the performance of the contract by the contractor shall be consistent and fully compliant with all applicable Federal, State, County, and City laws, ordinances and regulations.

B.8.4. The contractor is responsible for the supply, maintenance and repair of all contractor-owned equipment. This includes, minor maintenance/repair and minor operating parts for equipment such as lubrication, oil changes, spark plugs, gaskets, cotter pins/keys, electric extension cords, etc., to keep all equipment in good operational condition throughout the period of performance of

this contract. Repairs to contractor provided equipment, other than repairs that can be completed within one hour, shall not be done on site. The Contractor is to insure that there are no major fluid leaks that would stain the road, headstones, or kill or stain the turf. The Contractor is required to clean up any leak stains which may include replacing the turf. Repairs will not be made on site of Contractor employee vehicles.

B.8.5. The Contractor is responsible for ensuring that all of his/her motor vehicles and equipment meet State of Alabama inspection, safety, licensing, registration, and insurance requirements.

B.8.6. When the Contractor requires water and/or electricity to perform these services, the Contractor shall provide and maintain at his/her expense, the necessary service lines from the Government outlets to the site of work in order to accomplish these services. The "hook-ups" to the work site may require the Contractor to run electrical cords/hoses. Contractor should provide their own electrical generator.

B.8.7. The contractor is required to dispose of all debris and other waste materials generated by his/her work at a licensed off-site landfill unless otherwise directed by the COR(S). The Government shall not provide receptacles for disposal of debris as a result of the services provided under this contract

B.9 CONDUCT

B.9.1 Contractor personnel shall adhere to the following standards of dress, conduct, guidance and training while performing work in the national cemetery. It shall be subject to immediate enforcement action by the contracting officer if these standards are not adhered to during the performance of the contract.

B.9.2 Contractor personnel shall be fully clothed at all times, to include upper garment to cover body from the waist to the neck and long pants or slacks. Garments that have a message, slogan or printing of any kind other than the contractor's business attire are prohibited. If caps are worn, they must be free of any questionable message or design. Other clothing in question shall require Cemetery Management's written approval.

B.9.3 Contractor personnel shall not engage in loud or boisterous behavior or use profane or abusive language nor play radios and/or electronic games/devices, smoke or chew tobacco products, except at designated work areas, during the performance of this contract. Due to the sensitive mission of the cemetery, contractor employees may come into daily contact with grieving individuals, therefore contractor employees will exercise and exhibit absolute decorum, courtesy and respect while within the cemetery or at its perimeter or entrances. Inquiries from cemetery visitor shall be politely referred to cemetery staff. Gratuities of any kind are strictly prohibited.

B.9.4 Contractor personnel shall consume food and beverages only within areas designated by the COR(s). Use or sale of intoxicating beverages and/or drugs is strictly prohibited. Firearms or other weapons are strictly forbidden on Federal property at any time. The cemetery shall provide

the contractor and contractor employee's restroom facilities between the hours of 8:00 am - 4:30 pm as designated by the Cemetery Director or COR.

B.9.5 Contractor personnel shall take breaks/rest periods and lunch breaks at areas designated by the COR(s), not in the field. The government will provide restroom facilities at areas designated by the COR(s). Misconduct shall form the basis for immediate contract enforcement action, to include immediate removal from the cemetery.

B.9.6 National cemeteries are National shrines; contractor personnel appearance and conduct shall be professional and unobtrusive at all times. Questions from cemetery visitors shall be politely referred or directed to cemetery personnel.

B.10. OTHER REQUIREMENTS:

b. The contractor shall phase all work in such a manner as not to impact on or interfere with cemetery operations. Contractor shall cease work within 100 yards of any committal service in progress while performing under the contract. The COR may direct and arrange the contractor's performance in specific areas of the cemetery to coordinate with the cemetery's mowing operations. The contractor will advise the foreman of work accomplished at the end of each work day and coordinate the following day's schedule of trimming.

c. A list of scheduled ceremonies will be provided the week prior to the event, and a list of scheduled funerals will be provided the day prior to the service. The Contractor is solely responsible for ensuring that no contract work causes any funeral, ceremony, procession or visitation to be delayed, altered, or otherwise impacted in such a way that the dignity or security of the event is compromised. The Contractor is solely responsible for staying abreast of all such upcoming events and when in doubt, he/she must ask the COR and/or Project Manager. The Contractor shall meet with the COR and/or Project Manager at the end of each day to determine work completed and ensure that work is on schedule.

d. The only designated smoking area for the Fort Mitchell National Cemetery will be designated by the COR. All other areas are designated as NO SMOKING.

B.11. SAFETY: Any actions of the Contractor, must meet all safety requirements of Fort Mitchell National Cemetery's Safety Officer, Department of Veterans Affairs, OSHA, and the State of Alabama. It is incumbent upon the Contractor to be familiar with these requirements. Copies of all referenced safety standards may be reviewed by contacting the Fort Mitchell National Cemetery Safety Officer. "Safety" shall also include the Contractor having a safety representative who maintains regular and routine contact with the Safety Officer of Fort Mitchell National Cemetery.

12. NOTE: ANY VIOLATION OF ANY OF THE ABOVE LISTED, MAY RESULT IN THE TERMINATION OF THIS CONTRACT WITH POSSIBLE REPERCUSSIONS COSTS INCURRED, DEBARMENT, OR FINE.

CHEMICAL APPLICATION SCHEDULE

(*This schedule is subject to change and is contingent upon favorable weather conditions at time of application*):

JANUARY
Post-emergent control for winter weeds and perennials. Glyphosate (various brands) may be used for annual bluegrass, winter annual and perennial broadleaf weed control.
This treatment should be applied to dormant bermudagrass turf at a rate of 0.5 pound of active ingredient per acre. Read the label for surfactant recommendations
FEBRUARY
Pre-emergent for summer annual weeds (Crabgrass species and goose-grass). Benefin+oryzalin (XL 2G) or prodiamine (Barricade) or equivalent. Continue to spray Post-emergent for weeds as needed.
Pest Control: Fire Ant Control-Granules
MARCH
Pest Control: Fire Ant Control-Granules
APRIL/MAY
Apply a complete fertilizer after turf is actively growing such as 16-4-8 or 12-4-8 at 6 lbs. per 1000sq. ft.
Apply pelletize lime as needed (per annual soil test results)
Apply post-emergence herbicide as needed for control grassy weeds. Use various brands of MSMA to control Grasses and Sedges.
Apply post-emergence herbicides for Broadleaf weed control with mixtures containing 2,4-D amine, mecoprop, dicamba, dichlorporp, triclopyr and clopyralide (various brands)
Pest Control: Fire Ant Control-Granules
Aerate and / or Dethatch
JUNE/JULY/AUGUST
Apply Nitrogen fertilizer (slow release) such as 34-0-0 or equivalent in June
Apply post-emergence herbicides as needed for control for summer annual and perennial broadleaf weeds.
Pest Control: Fire ant control (granules), Armyworms and Grubs
SEPTEMBER
Apply High-potassium fertilizer such as potash (K2O) using 70 pounds of muriate of potash (0-0-60) per 1000 square feet or equivalent
Apply Lime only if needed, based on soil test results. If PH is 5.5 or higher no lime is needed.
Pest Control: Fire Ant Control-Granules
OCTOBER
Apply Pre-emergent (Simazine or equivalent) for Winter weeds.
Apply Post-emergent for broadleaf and grassy weed control if needed.
Pest Control: Fire Ant Control-Granules
NOVEMBER/DECEMBER
Post-emergent (Atrazine, Simazine or equivalent) for broadleaf and grassy weeds if needed for control of winter annual broadleaf weeds. Soil Test: Cemetery Staff will submit soil samples via cooperative extension service for soil analysis every two years. The results will be maintained at the Cemetery and provided to the contractor.

NATIONAL CEMETERY ADMINISTRATION
SED
Agronomic Infomation Sheet # 5

Selective Broadleaf Weed Control in Established Stands of Turfgrass

Introduction: Conventional wisdom implies that the best way to avoid broadleaf weed encroachment in a stand of turfgrass is by producing a healthy, vigorous, dense stand of the desired turfgrass species. This of course is the case and the cultural practices recommended for use on NCA properties are designed with minimization of broadleaf weeds as one of their objectives. When however, this approach alone is not completely successful, other methods may become necessary.

Cultural Controls: Utilization of appropriate cultural practices will greatly reduce the necessity of frequent chemical control measures. The most common cultural control technique in turf is the routine mowing (defoliation) that is practiced. Only a limited number of broadleaf weed species are able to tolerate the frequent mowing. That is the good news. The bad news is that a number of the species that can tolerate the mowing are quite competitive once established and often difficult to control with any method.

Other cultural practices that have a significant impact on weed encroachment are fertilization, irrigation and aerification. Proper timing, quantity, and nutrient content of the fertilizer products used on a stand of turfgrass can favor the growth of the desired turfgrass species while not encouraging weed species to develop or thrive. Warm season turfgrass species will benefit most with spring and fall applications of fertilizer. Summer annual weeds on the other hand would be encouraged if mid summer applications were made. Fertilizer analyses low or absent phosphorus also favor the turfgrass species and not germinating weed seedlings. Established stands of perennial turfgrass should be irrigated infrequently, in sufficient quantity to penetrate to a minimum soil depth of 6 inches and then allowed in dry before another irrigation in required. Irrigation that is applied in frequent light quantities will only encourage the germination of weeds seeds located near the soil surface and help them to become established. Core aerification should never be conducted during the spring, which is the primary germination period of most summer annual broadleaf weeds and would provide an ideal opportunity for seedling weeds to emerge in the aerification holes.

Mechanical Control: Hand removal of a few isolated weeds is the obvious method of choice when the number involved is small or the species is not a particularly common turf pest and unlikely to invade in great numbers. A sharp pocketknife or suitable substitute for cutting out the offending plant(s) will discourage many casual weed invaders.

Chemical Control: Occasionally it will be necessary to employ an effective broadleaf herbicide to control an infestation of unwanted weed species. The most difficult species of broadleaf weeds to deal with in turf are those that have a low spreading habit of growth and can tolerate the mowing heights commonly employed for turfgrasses. Species such as clover, black medic, wild violet, ground ivy, knotweed, prostrate spurge, veronica, and chickweed are some of the most troublesome. Scattered small patches of these or other broadleaf weed species can be selectively controlled and removed by spot treating only the affected areas. Small hand held or backpack style sprayers are available that can hold 2 to 4 gallons of spray solution and have a hand held spray wand attached. It is a relatively simple task to uniformly spray the target patches of weeds without any damage to the desired turfgrass species. The most common error made by an untrained user of one of these devices is to apply a significantly greater quantity of spray solution than is recommended or required for effective control. To avoid this occurrence, the spray solution should be delivered in a single pass over the target weeds so that the foliage of the weeds is uniformly wet. Do not pass the wand back and forth several times just for good measure. The proper technique should simulate the delivery from a large spray boom attached to a tractor that is driven over a large area at a constant rate of speed for treatment.

Of course, if a large expanse of turf becomes infested with broadleaf weeds, larger tractor or utility cart mounted spray equipment should be employed to apply the selective herbicide. The process and herbicide employed would be the same as in spot treating but the scale is significantly larger.

Herbicide Selection: Ever since the end of the Second World War, the standard for broadleaf weed control in turf has been 2,4-D or one of its close relatives in the phenoxy family of herbicides. Various two or three way combinations of this class of herbicides are still widely used. MCPP, MCPA, or 2,4-DP are the relatives most commonly included along with another newer material known as dicamba. The development of dicamba during 1960's and its inclusion in mixtures with 2,4-D and MCPP created a minor revolution in herbicide performance. These three way combination products provided very broad-spectrum control of many of the difficult to control weed species. One of the limiting characteristics of such combinations involved the propensity of dicamba to leach downward into the soil and occasionally cause injury to woody shrubs and trees through root uptake of this molecule. This limitation does not create an insurmountable problem as reduced rate treatments and avoidance of the most potentially sensitive areas greatly reduced the likelihood of any damage. Another limitation involves its use in an ester formulation that poses volatility concerns for damage to nearby sensitive plants such as tomatoes and various flowers. Low volatile esters or amine formulations should be used under these circumstances.

2,4-D and several of its woody species active relatives, 2,4.5-T and 2,4,5-TP came under increased environmental and health hazard scrutiny during and following their use in the Vietnam War. Pressures to reduce or eliminate their use resulted in the development and release during the late 1980's and early 90's within the industry of a new class of chemistry, the pyridines. These molecules are very effective on a range of difficult to control broadleaf weed species. Numerous new combination products based on this new chemistry are now available and widely used as replacements for 2,4-D and its relatives. Triclopyr and clopyralid sold as Turflon,

Confront, Millennium and other trade names are the pyridine molecules available for use on turfgrasses. As with all of the herbicide molecules discussed here, these possess excellent levels of tolerance for use on the commonly grown cool season turfgrasses.

Application Timing: Although these selective broadleaf herbicides can be used anytime that the target weeds are present and growing and the turfgrass is mature and actively growing, there are preferential time periods that will deliver the best results.

- **Summer annual broadleaf weeds:** This category of weed species completes its life cycle in less than one year. They germinate during the spring, grow rapidly into early summer, flower and produce seed during the summer and usually die as a result of the first killing frost in the fall. If herbicide treatment is deemed necessary for summer annual species, it should be completed well before the plants have a chance to produce seed and contaminate the soil with a future population of offspring. Common examples of this category include, pigweed, prostrate spurge, black medic and yellow woodsorrel.

- **Winter annual broadleaf weeds:** This category of weed species also completes its life cycle in less than one year. They, however, germinate during late summer and early fall, grow rapidly through the fall, over-winter in a semi-dormant state and resume active growth the following spring, flower and produce seed and die during the warmer temperatures of summer. Treatment to control these species can be made during the initial late summer/fall growing period or the following spring prior to flowering and seed production. Common examples of this category include chickweed, henbit, Virginia pepperweed and corn speedwell.

- **Perennial broadleaf weeds:** This category of weed species is often the most difficult to control as they live two or more seasons and don't need to come back from seed each year. Treatment to control perennials is best made in the early fall when plants are translocating carbohydrates downward into their root systems as storage reserves for winter survival. During this process, the applied herbicides are also translocated into the root system to facilitate a complete kill of the target weed plant. Common examples of perennials broadleaves include Canada thistle, wild carrot, ground ivy(creeping Charlie), white clover, wild violet and dandelion.

NATIONAL CEMETERY ADMINISTRATION
SED
Agronomic Information Sheet # 6

Preemergence Control of Crabgrass and Other Annual Grass Weeds in Turfgrass

Introduction: Crabgrass is without doubt the single most commonly recognized weed pest in established stands of cool season turfgrass. Even the average homeowner with a lawn of any size is aware of this pest and has probably joined the annual battle to control it. The professional lawn care industry in the United States was built on the promise of dark green lawns free of crabgrass. The crabgrass species in question here is most likely *Digitaria sanguinalis*, common name, large crabgrass. There are, however, several other members of the same family that could be involved. Whether they are or not is unimportant. The control tactics discussed here are the same regardless of the actual family members involved. In addition to crabgrass, several other annual weed grass pests are often encountered across the geography of SED. These include foxtail, both yellow and green, barnyardgrass, goosegrass, and annual bluegrass (*Poa annua*). With the exception of annual bluegrass, which is a winter annual and germinates around Labor Day, the others are summer annuals and germinate during the spring.

Herbicide Selection and Factors Effecting Performance: There are a number of commercially available herbicide products that will effectively control the germinating seeds of crabgrass and other annual grass weeds listed above. The best choice for each turfgrass maintenance situation can be made following consideration of a number of factors. These might include cost, formulations available, soil residual properties, turfgrass species tolerance, weed efficacy spectrum and user handling and safety. It is therefore beneficial to have an understanding of the characteristics of the available choices in order to make an informed decision. The list of products from which a user can choose includes, benefin (trade name Balan), trifluralin+benefin (trade name Team and Team Pro), pendimethalin (trade name Pendulum and Pre-M), prodiamine (trade name Barricade) and dithiopyr (trade name Dimension).

Four of the five products listed above belong to the same chemical family, dinitroanalines, and they clearly dominate this category of herbicide usage. Dithiopyr is the only product not a member of this family. All preemergence herbicides must however share the same basic properties in order to perform effectively. They must be soil active materials in order to kill weed seeds as they germinate, they must not be prone to soil leaching so they will remain near the soil surface where the weed seeds germinate and also so they don't come into contact with the principle root mass of the desirable perennial turfgrass species, they must possess sufficient soil residual longevity in order to remain above herbicidal activity thresholds during the primary germination period of the target annual weeds but not so long they impede reseeding or over-seeding operations should those be necessary and of course, they must demonstrate a wide range of tolerance for use on all commonly grown turfgrass species. It is also comforting to know that any pesticide product that has been registered for general use under the very stringent Federal

and State guidelines existing today has successfully cleared all environmental, ecological, and human safety test hurdles. The user marketplace itself will determine whether a pesticide product performs well enough to be a commercial success. All of the products listed above have been in use for some time and have definitely established themselves as highly effective herbicides when properly used.

Application Timing and Formulation Options: The most common error users make when applying a preemergence herbicide involves application timing. Usually, applications are made much earlier than necessary to achieve optimum performance. Crabgrass begins to germinate in the spring after soil temperatures in the top 1 to 2 inches of soil have reached 50 – 55 degrees Fahrenheit. The germination process will not begin just because there have been a few unseasonably warm days in March or April. Soil temperatures are slow to warm in the spring. If the soils have been more moist than normal the warming process will be even slower. Water is a very poor conductor of heat. If the herbicide is applied 4 to 6 weeks before germination begins, you will be wasting a significant percentage of the active ingredient, as it begins to degrade in the soil as soon as it is applied. Ideally, application should be timed one to two weeks prior to the onset of germination. It is also critical however, that the application not be delayed until after germination. Although all of these herbicides will control a recently emerged one to two-leaf stage crabgrass plant, they should not be counted on to reach back any further than that. **Bottom line** -- Don't rely on artificial signals or old wives tales such as when the forsythia blooms. Buy several inexpensive soil thermometers, place them at strategic locations around the property at a soil depth of 2 inches and let science be your guide. When they record in excess of 50 degrees during mid afternoon for 3 to 4 consecutive days, make your application.

All of these products are commercially available from numerous sources and in several different formulations. They can be purchased in several sprayable formulations, true liquids, wettable powders, flowables or dry flowables. Uniform application to the target area is of course essential. Generally speaking, most users will find that a granular or fertilizer combination formulation is easier to apply. Standard fertilizer spreading equipment will do the job efficiently and with less likelihood of error than with a spraying procedure. Fertilizer combination products that have the selected herbicide impregnated on them have become very popular. This approach kills two birds with one stone as they say. It is also easier to uniformly spread the higher volume of product recommended with a fertilizer combination than with a straight granular formulation of the herbicide alone.

In general, a single properly timed application of one the herbicides discussed will control in excess of 90% of any annual weed grass seeds that germinate during a normal spring season across SED. Although it is a common practice among many professional lawn care companies and high dollar golf courses to make two sequential crabgrass control applications to ensure total full season control, this practice is not deemed appropriate or necessary on SED cemetery properties.

NATIONAL CEMETERY ADMINISTRATION
SED
Agronomic Information Sheet # 8

Elimination of White Grubs in Established Stands of Turfgrass

Introduction: The insect pests commonly referred too as "grubs" are technically the immature larval stage of several different species of beetles. They damage turfgrass stands as they feed on the roots of grass during their periods of active growth. This can occur during the spring and the fall and depends on which of the several species of beetle larvae are present in the soil. As a group, white grubs include the immature larval stages of Japanese beetle, European chafer, northern masked chafer, southern masked chafer, Oriental beetle and Asiatic garden beetle. In general, these species complete their life cycle in one year. Adults emerge from the soil, eggs are laid on or beneath the soil surface, hatch, and the larvae feed on the roots of turfgrass during its growing season, potentially causing extensive damage. Another group of white grub species complete their life cycle in 2 or 3 years and are the immature stage of the beetles referred to as May beetles or "June bugs". In the geography encompassed by SED, Japanese beetles, May beetles or one of the chafers are the most likely culprits to be encountered. With the insecticides available today for the elimination of these pests however, it makes little or no difference which specific species is present. The recommended products will control them all.

Control Strategies: The first step in developing an effective control strategy for these common insect pests, is determining whether the soil population of larvae is sufficiently large to warrant application of an insecticide. The presence of a few larvae per square foot does not constitute a population level high enough to cause significant turfgrass damage. At what level does this occur? The answer to this question varies with the nature of the turfgrass area. Golf courses would tolerate higher populations in their roughs than in their close cut fairways or putting greens. The turf in the cemeteries of SED can also tolerate higher white grub populations than a golf course fairway. Generally however, a white grub population in excess of 12 to 15 per sq. ft. would warrant an insecticide treatment. Periodic population counts should be made in areas with a history of previous grub damage, turfgrass bordering wooded areas where high levels of adult beetle activity have been observed, areas where turfgrass injury symptoms appear, in areas where significant mole activity is observed or where skunks or raccoons are seen digging up the turf in search of food.

Counts are best conducted by laying back a section of sod that has been sliced on three sides to expose the soil surface at the root soil interface of the turfgrass. This is best timed in late May or September when beetle larvae are most likely to be actively feeding near the soil surface. In order to get a more thorough accounting of all grubs in the area, prepare a solution of sudsy water and pour it over the entire exposed soil surface. This will drive any grubs not fully visible out of hiding and onto the soil surface.

Recommended Insecticide Treatments: Two approaches for the control of white grubs are in general use by turfgrass managers. The more common employs a moderately residual insecticide applied in a preemptive manner during the spring feeding period. This treatment will control grubs actively feeding then as well as exhibit sufficient soil residual activity to control any larvae that surface for feeding in late August through September. Two newer molecules are being widely used in this approach. Imidacloprid (Trade name Merit) and halofenozide (Trade name Mach 2) are both highly effective for controlling white grubs when used in this manner. Of course, application of these two products can also be made in late summer prior to the heavy fall feeding period of newly hatched beetle larvae. In situations where white grub populations have progressed beyond reasonable expectations of control from Merit or Mach 2 and a rescue treatment is warranted, the choice is trichlorfon (Trade names Dylox and Proxol). Trichlorfon is an organophosphate insecticide and as such should be handled with care to avoid any exposure to applicators or others. Of course as with all pesticides, proper storage, safe handling and application procedures must be adhered to at all times.

It is suggested that annual monitoring for white grub population levels become a routine part of the turfgrass maintenance operation at every SED cemetery property. Detecting and treating when populations warrant will prevent a serious build up to potentially damaging levels.

NATIONAL CEMETERY ADMINISTRATION
SED
Agronomic Information Sheet # 4

Turfgrass Fertilizer Selection

This protocol provides an overview of the current range of product choices that exist within the turfgrass maintenance industry. Although a substantial portion of the fertilizer products utilized by turfgrass managers today is common or Agricultural grade material, the specialty type products developed specifically for turfgrass are of greatest importance and value. Most of these are based on various technologies designed to control the rate at which nutrients are released for use by the targeted plant material. As the showcase nutrient in most fertilizer programs, nitrogen attracts the greatest attention of both suppliers and users.

Voluminous research has been conducted on the nutritional requirements of healthy stands of turfgrass for various uses. There is general understanding of the quantities of essential, secondary and minor elements required for producing healthy turf and the approximate ratio in which the essential nutrients, N(nitrogen)-P(phosphors)-K(potassium) should be delivered. That ratio is in the 3-1-2 to 4-1-2 range for established stands of turf and in the 1-2-2 area for products used during stand establishment.

Fertilizer Technology Alternatives:

Although by its basic nature, fertilizer is fertilizer, the battle for competitive differentiation is waged utilizing unique processes designed to control the release and availability of the plant nutrients the fertilizer contains.

One of the primary differentiating categories for fertilizer is based on the initial source of the nitrogen component, natural organic versus synthetic. The former is based on naturally occurring materials that contain nitrogen such as animal manure, organic materials, etc. These types generally contain only small percentages of nitrogen, generally less than 6%, and are slow to release their nitrogen when applied for plant growth. They are also much more costly per unit of nitrogen than most synthetic sources.

The additional plant nutrients, potassium and phosphorus that are added to nitrogen to constitute a complete fertilizer are naturally occurring minerals and are produced through mining activities. The manner in which the three; N, P, K are combined becomes one of the differentiating qualities that is used by suppliers to entice users to their brand.

The least sophisticated and costly is a simple physical blend of sources of the three nutrients. Almost all agricultural grade complete fertilizers are blended in this manner. Typical analyses might be a 15-15-15 or 20-20-20 or 5-10-10. Although these types are not the primary marketing focus of fertilizer suppliers and distributors serving the T&O

markets, they do constitute a significant percentage of the total tons used annually. Their lower cost obviously drives the use of these fertilizer types.

The next step up the differentiating ladder is the production of a homogenous fertilizer particle. These particles contain all primary nutrients and are sized to meet the turfgrass density demands of the site being fertilized, i.e., golf course fairway, putting green, home lawn, athletic field, cemetery and are screened to have a narrow range of particle sizes in a finished batch. These types of products are considered superior for utilization on highly maintained stands of turfgrass as they provide a more uniform growth response and are generally dust free and much easier to apply. Beyond the three primary nutrients around which the T&O fertilizer market revolves, secondary plant nutrients such as iron, magnesium or sulfur and various micro nutrients (boron, molybdenum) are often added to create additional differentiating features that might sway a potential buyer.

The final step up the differentiation ladder is the use of various processing technologies that result in finished fertilizer particles whose plant nutrients are slowly released for plant use. Urea is the most widely used source of nitrogen for turfgrass fertilization. By itself, urea is a water soluble rapidly available source of nitrogen. When urea is either reacted with various complexing compounds such as formaldehyde or mechanically coated with sulfur or plastic-like polymers, it becomes the basis for the controlled release forms of nitrogen that are marketed at the premium end of the turfgrass and ornamental fertilizer spectrum.

Controlled release forms of nitrogen include urea formaldehyde, various methylene ureas, isobutylidene diurea (IBDU), sulfur coated urea, polymer coated urea, sulfur and polymer coated urea, aminoureaformaldehyde, and stabilized nitrogen.

Urea formaldehyde reaction products were first introduced to the turfgrass industry in the 1960's. They are produced by reacting urea and formaldehyde to create complex chain structured molecules of various lengths. Generally, the more complex the chain structure, the slower the nitrogen release. The rate of nitrogen release for these molecules is determined by microorganism activity in the soil. High temperatures, neutral soils and an adequate supply of moisture and oxygen favor microbial activity and then promote nitrogen release from urea formaldehyde. Urea formaldehyde fertilizer used alone will not release an adequate supply of nitrogen until 2 or 3 years of consecutive use. They have essentially no turfgrass burn potential nor are there any likelihood of nitrogen loss due to soil leaching. Their use as a primary source of controlled release nitrogen has diminished significantly over the last 10 to 15 years.

IBDU was developed as an improvement over urea formaldehyde. It is the reaction product of urea and isobutylaldehyde. It depends solely on water to hydrolyze it to urea. The rate at which this occurs varies with soil ph, temperature, particle size and moisture. IBDU is effective between ph 5 and 8. From a manufacturing and processing perspective, IBDU particle size is used to vary the nitrogen release rate. The finer the granule, the greater the surface area, and the faster the rate of hydrolysis. Thus, varying the sizes of IBDU granular allows nitrogen release to be distributed over a longer period. Particle sizes between 8 and 24 mesh are recommended for turfgrasses. Properly sized and used, IBDU is generally a more efficient source of nitrogen than urea formaldehyde.

Sulfur coated urea is produced by spraying preheated urea with molten sulfur. Release of nitrogen for SCU depends on the time required for microorganisms to break down the sulfur coating. SCU is the least uniform of the slow release nitrogen sources. Imperfections in the sulfur coatings result in each particle having a slightly different rate of release. Coatings can also be crushed in handling and in the bag. An additional benefit eventually results from SCU when released sulfur becomes available to the plant but it can also increase soil acidity. Despite its imperfections, SCU is the most widely used form of CRN in the market. This is driven somewhat by a relatively low cost of production verses some other slow release sources.

Polymer coated urea is produced by applying a plastic like polymer to each urea particle. This results in particles that will only release nitrogen through the process of osmosis. Water from the soil moves through the polymer coating, dissolves the urea within slowly and it then moves outward into the soil for uptake by plant roots. This process is independent of the quantity of water available. Excessive rainfall will therefore not accelerate the release process. The primary determinant of nitrogen release from polymer coated products is temperature. Varying the thickness of the polymer coating is a technique used to tailor these products to delivering their nitrogen content over a desired span of time. This is accomplished by coordinating the coating thickness for the average soil temperatures expected at the use site to achieve the desired span of release. Products ranging from 90 to 180 days are commonly offered.

Combinations of polymer and sulfur coating technologies are also being utilized to provide some of the benefits of each approach.

Stabilized forms of nitrogen (urea) are produced by adding both a urease inhibitor to stop volatilization and a nitrification inhibitor to stop leaching. Since this process does not involve any additional processing/manufacturing or expensive chemical coats, the end product is substantially less expensive to produce than many other controlled release types. This approach to nitrogen release keeps the available nitrogen in the ammonium form, which is also usable for plant uptake.

The most recent technological innovation in the slow release nitrogen category is a new process for producing urea formaldehyde. It adds ammonia to the normal reaction process to stop the urea and formaldehyde reaction at a point that reduces the growth of methylene urea polymers. The new product is called aminoureaformaldehyde and is claimed to contain a higher percentage of hot water soluble nitrogen, a lower percentage of unreacted urea and hot water insoluble nitrogen. This combination results in a more efficient form of controlled release nitrogen.

CONTROLLED RELEASE NITROGEN: TECHNOLOGIES AVAILABLE

Technology Classification	Ingredient Brand Name(s)	Primary Supplier(s)
Urea Formaldehyde (methlylene ureas)	Nitroform, Blue Chip Nutralene	NuGro Technologies
IBDU	ParEx, IsoTek	Lebanon Seaboard
Sulfur Coated Urea	Numerous	Lesco, Purcell Andersons, Lebanon
Polymer Coated Urea	Polyon, MultiCoat	RLC Technologies TRI-Pro
Polymer plus Sulfur Coated	Poly S, Poly Plus TriKote	Lesco, Purcell Andersons, TRI-Pro
Aminoureaformaldehyde	Novex	Lesco
Stabilized Nitrogen	UMAXX, UFLEXX	Agrotain

How does a turfgrass manager make the decision which of these many variations and combinations of slow release technologies is best for his/her circumstances? Obviously, personal experience over time will dictate which fertilizer types provide the performance results any particular user prefers. Despite the extremely broad range of available choices, an educated user can effectively manage the health and vigor of the turfgrass stand using any of the available alternatives in a suitable manner. The sales representative's pitch to his customer is often shaded in dubious claims regarding unique or superior performance for whichever fertilizer type he happens to represent. This blue smoke and mirrors approach must be largely ignored and replaced with a combination of informed awareness based on creditable university test results and hands on use experience.

One new development has occurred which may assist users in comparing competing claims of performance superiority. A new system, the PIN rating, has been developed for sorting out the differences between water insoluble sources of nitrogen. PIN stands for "Performance Index Number", where P is particle dispersion, I is for particle integrity and N is for nitrogen activity index. These three factors are determined using specific tests, and a quantitative measure is assigned to each. The 3 resulting numbers are then totaled to give the PIN rating.

P is a measure of how readily the fertilizer granule breaks down in the presence of moisture. Particle dispersion is expressed as the percentage of a sample that passes the dispersion test. A measured amount of fertilizer is placed in a beaker of distilled water and stirred for a fixed amount of time. The mixture is then passed over a screen. The amount that passes through the screen is the "P" in the PIN rating. The minimum acceptable value for P is 80%.

I is a measure of how hard the fertilizer particle is. This will indicate how well a fertilizer's particles will hold up through the rigors of production, bagging, shipping and spreading. It is also expressed as a percent. Ninety is the minimum acceptable integrity rating but 95 or greater is a far more acceptable value.

N is the nitrogen activity index. It is the percentage of water insoluble nitrogen that is soluble in hot water. The higher the index, the better, because hot water soluble nitrogen provides a response in the second and third month after application. The minimum acceptable index is 65 %.

Adding the 3 numbers resulting from the individual tests gives the PIN number. The theoretical maximum score is 300, but it is safe to say that a fertilizer with a perfect 300 score will never be produced. From the minimums suggested; P=80, I=90, and N=65, will give a 235 score as the lowest acceptable PIN. A suggested target number to achieve the best performance from a slow release fertilizer is **255**. A **255** PIN might realistically be achieved with a P value of 85, an I value of 95, and an N of 75. Of the 3, the N rating is the most revealing as to the product's performance and the total efficiency (or availability for plant use) of the nitrogen package of a fertilizer product containing water insoluble nitrogen.

The **PIN** rating is a collection of basic fertilizer attributes that allows the user to make a sound qualitative and quantitative judgment about water-insoluble nitrogen in fertilizers. If the user knows and understands the PIN rating, he knows a lot more about the fertilizer than he could have in the past.

It is most often the case that the nitrogen source(s) contained in a given fertilizer determines its positioning in the quality hierarchy. Since nitrogen is generally the nutrient that delivers the biggest growth response this preeminence is probably warranted. Potassium on the other hand has often been overlooked until more recently. As the nutrient demanded second only to nitrogen by healthy vigorous turfgrass plants, potassium has started to be recognized for the contribution it makes toward total stand well being. Disease and environmental stress tolerance are two of the key attributes optimum quantities of potassium impart on a turfgrass population.

Recognition of potassium's importance and utilization of its presence in one of the available sources of nitrogen (Potassium nitrate) combined with the polymer coating technology already discussed has encouraged some suppliers to use poly-coated potassium nitrate as an additional item for differentiating their product from the pack. Since potassium use from more traditional sources such as KCL can also be a plant burn risk, the coating approach offers a clear benefit.

Since nitrogen represents the showcase component of almost all turfgrass fertilizers and because the use of various controlled release technologies for nitrogen impacts the finished cost so dramatically, knowledge of the relative costs of these alternatives is helpful. With urea set as the low end cost benchmark, the costs of all other technologies are indicated in the following chart.

COST PER TON – CONTROLLED RELEASE NIROGEN SOURCES

Lowest_____Highest

Urea ($190)*	SCU ($340)	UMAXX ($575)	Polymer Coated ($650)	Nutralene ($760)	UF ($990)	IBDU ($1004)
_____	46-0-0	_____	42-0-0	40-0-0	38-0-0	31-0-0

*The market price for urea fluctuates substantially from year to year and sometimes within a single season. Prices are currently ranging from $185 to 260/ton. These fluctuations do not normally affect the prices charged for the other sources listed. Novex, Lesco's new controlled release nitrogen is only available in complete fertilizer analyses sold to end-users. On a cost per unit of N basis, it falls between Nutralene and UF.