DFR Bulletin No. 15
ISBN No. : 978-81-925693-6-6

Lawn Management

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Citation
Tiwari, A.K., K.P. Singh, Shephalika Amrapali and Girish, K.S. (2015). Lawn Management. DFR Extension Bulletin No. 15. ICAR - Directorate of Floricultural Research, College of Agriculture campus, Shivaginagar, Pune - 411 005 (Maharashtra), India.

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Techical Bulletin No. : 15
ISBN : 978-81-925693-6-6

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Acknowledgements
The Directorate acknowledges the contribution of all the scientific/technical/supporting staff of the AICRP (Floriculture) centers for the execution of experiments and compilation of data for the Annual Report. We also acknowledge the help received from all the Scientific and Administrative staff of ICAR-Directorate of Floricultural Research Pune, in successfully bringing out the compiled

Published
June, 2015

Printed at
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19 Laxminagar Commercial Complex-I, Shahu College Road, Pune-411009,
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FOREWORD

Horticulture including Floriculture is growing every year at a galloping speed and the sector has now created enough opportunities for economic growth of India by way of export and domestic turnover. Considering its growth potential in future is now termed as "Golden Revolution". Flowers have always held an aesthetic and mystical significance. Ornamental Horticulture is a branch of Horticulture which deals with commercial growing of flowers ornamental plants and beautification of surroundings. This subject assumes great importance in improving total environment and checks visual pollution by way of beautification. The flowers have been eulogised by poets and artists for generations not merely for their ornamental properties but for their versatile curative properties.

A green and beautiful lawn can help improve your home's curb appeal. Unfortunately, a lot of homeowners tend to ignore the importance of properly maintaining their lawns. Maintenance it is not just about watering and mowing; lawn care is also about choosing the right tools, maintaining your equipment, using eco-friendly landscaping materials, improving your home's energy efficiency, and more. Turf grass is the key to a beautiful tomorrow. It has been the basis for a green India. Turf is considered an anti pollutant unapproached by any artificial means. A thick green lawn prevents soil erosion, and subsequent stream pollution, helps control heat pollution and reduces noise pollution. More important is the fact that it replenishes the oxygen supply in the air we breathe. An average lawn can replenish the air with enough oxygen for eight people. Not only that turf absorbs and detoxifies sulfur dioxide, a critical air pollutant associated with the burning of fossil fuels.

All plants have the same basic requirements. They need a supply of water, a fairly continuous source of nutrients, a certain quantity of light, and proper temperature. Plants make their own food or carbohydrates using carbon dioxide and water in the presence of light to make sugar with oxygen released as a by-product.The Study of turf grass comprises of two parts i.e. the knowledge of growing of plants and their use in beautification programme. The information on above aspect is scattered in different book and a great difficulty was being felt by students, landscapers and scientist. In this context, a need of simple manual on introduction, cultivation and management of turf plants is highly demanded by student of Horticulture and florists of India..

I compliment A.K. Tiwari, Shephalika Amrapali and Girish K.S. who have put in sincere efforts in bringing out this publication.

(K. P. Singh)

Pune
June, 2015

Preface

A lawn is an integral part of a garden or landscape and is primarily for aesthetic and recreational purpose. However lawn serves several other purposes as well. Scientific reports say that lawn grasses have the ability to mitigate runoff from urban environments, absorbs atmospheric pollutants, provide evaporative cooling that translate in to energy savings and improved comfort, remediate contaminated soils, increase property values and enhance mental health. But unfortunately all these beneficial effects of lawn have been ignored. Despite so many benefits the lawn have not received due consideration in the past. However with the increasing awareness about the importance of lawn, scientific interventions have been initiated in the area of lawn management and improvement of lawn grasses.

Establishment of a beautiful lawn is very demanding and depends on proper planning starting right from the selection of suitable grass species, soil preparation, understanding environmental and cultural requirements, planting, aftercare and maintenance practices and management of insect pest and diseases.

This manual is an outcome of the teaching, research and field experiences and is mainly brought out to guide the academicians, researchers and students as well as for amateur, corporate, industrial houses, turf and golf industry who are involved in the management of lawn and improvement of lawn grasses.

Authors will appreciate the help of Dr. M. Kannan, Professor (Hort.), Department of Floriculture and Landscaping, Horticultural College and Research Institute, TNAU, Coimbarote and Dr. S. L. Chawla, Associate Professor, Department of Floriculture and Landscaping, ASPEE College of Horticulture, Navsari Agricultural University, Navsari by providing the photographs and valuable information of different lawn grass species to be included in this bulletin.

A. K. Tiwari
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1. Introduction

Plants are important to humankind not only economically, environmentally and industrially but also spiritually, historically and aesthetically, they sustain human life through direct and indirect gains by providing a wide range of products for survival and prosperity. With the advancement in agriculture and increase in population, large settlements developed, marking the beginning of urbanization. More and more people moved to urban areas for comfortable life. Increasing human needs resulted in large-scale exploitation of natural resources, great reduction in forest cover and extinction of many species of flora and fauna. The extent of forest cover is a good indication of the health of the land. The large scale deforestation in recent decades has rendered the sensitive catchment areas and hilly areas particularly vulnerable to soil erosion. In search of the sun, space and verdure, man drifts from the ancient town and establishers himself, in garden suburbia. A lawn has always been an integral part of any garden or landscape and is considered one of its most important features. A well kept lawn adds to the aesthetic value of a garden. Maintenance of lawn requires little patience and care, however the final result is always worth waiting for as it gives very beautiful and soothing effect to the landscape.

A lawn is an area of land of closely mowed grasses primarily for aesthetic and recreational purpose. It is composed of thousands of individual plants crowded and forced into an unnatural growth habit which gives the appearance of a beautiful green carpet amidst colourful flowers in a garden. It is basically an area of land planted with grass and other low lying plants. Lawn can be called as turf, pitch, field or green depending upon its plantation, usage and continent. Selection of lawn grass depends upon its use and season of plantation.

Importance of Lawn

Lawn besides its aesthetic and recreational value serves other purposes as well. Scientific reports say that lawn grasses have ability to mitigate runoff from urban environments, absorb atmospheric pollutants, provide evaporative cooling that translates into energy savings and improved comfort, remediate contaminated soils, increase property values, and enhance mental health. The details of importance are as under:-

1. **Climate Control:** Turf serves as a natural air-conditioner. On a hot day, compare the difference between standing on pavement and standing on turf. The difference in temperature and comfort is measurable. The turf on eight average-sized healthy front lawns has the cooling effect of 70 tonnes of air conditioning, enough for 16 average homes.

2. **Dust filter:** Turf traps dust and smoke particles from the air and acts as a filter for the air we breathe. This is particularly important in urban areas where dust generated by cars and trucks can be trapped and washed down into the soil, preventing further movement.

3. **Erosion control:** Grass offers a very efficient and inexpensive erosion control function. Turf intercepts raindrops before they disturb the soil. Turf promotes water percolation rather than

runoff. Our streams and drainage infrastructure would be absolutely overwhelmed if not for turf's water-retention capabilities. Our fertile soil would be lost if the turf biomass was not so efficient at slowing water runoff.

4. **Business and economic improvement:** Lawns increase the value of a property by 15 to 20 per cent. It improves curb appeal. In real estate homes with well-maintained landscapes and turf sell quicker and for higher values. The well-maintained landscapes increase tenant satisfaction and lower vacancy rates.

5. **Golf courses:** The people play golf for exercise and relaxation. Turf is an integral part of this enjoyable activity.

6. **Environmental benefits:** Turf capture and use greenhouse gases, thereby counteracting climate change. Turf also traps air pollution and generates much of the oxygen we breathe. A 50- by 50-foot lawn produces enough oxygen for a family of four to breathe for one year. Turf also acts as a barrier that deters chemicals from entering the soil profile. The natural shedding of turf stems and leaves, as well as mowing clippings left on the lawn contribute large amounts of valuable organic matter to the soil over a number of years.

7. **Injury reducer:** Well-maintained turf areas serve as excellent sports surfaces. Turf helps to absorb physical impact and reduce injuries. As a playing surface it is safer than artificial grass or bare soil. It provides traction and cushioning.

8. **Garbage prevention:** Garbage is less likely to be thrown on a landscape that is well maintained.

9. **Therapeutic benefits:** Turf provides mental health benefits. The Horticultural Therapy Association exists to promote therapeutic benefits of green space as a technique for rehabilitation. It has been shown that looking at images of landscapes and plants helps to reduce stress. Grassy areas in golf courses, cemeteries, parks and homes can create feelings of peacefulness and remind us that the earth is alive.

10. **Noise reducer:** Grassy areas can decrease noise by eight to 10 decibels. This is especially important in an urban location.

11. **Water filter:** Research has demonstrated that storm water runoff from a healthy lawn rarely occurs. Not only does grass slow down water and soil runoff, but it also protects surface water quality as it filters and cleans the water percolating into streams, drainage systems and aquifers.

2. Types of Lawn Grasses

Lawns primarily are made up of grasses. Though there is certain grass like plants species viz sedges, low herbs and some wild flowers which can be used as an alternative to these grass species. Here we will be focusing on grasses only. There are several species of grasses which can be used for developing lawns. Some of these prefer warm and humid temperature while others require cool and dry weather. These are known as Lawn grasses and can be categorized in several ways. However, most commonly the lawn grasses are categorized as cool season and warm season grasses on the basis of the season of foliage.

Table 1: List of lawn grasses on the basis of season of their foliage-

Common Name	Botanical Name
A. Warm-Season Grasses	
Bahia grass	*Paspalum notatum*
Bermuda grass	*Cynodon dactylon*
Buffalo grass	*Buchloe dactyloides*
Carpet grass	*Axonopus affinis*
Centipede grass	*Eremochloa ophiuroides*
Kikuyu grass	*Pennisetum clandestinum*
Seashore paspalum	*Paspalum vaginatum*
St. Augustine grass	*Stenotaphrum secundatum*
Japanese lawn grass	*Zoysia japonica*
Mascarene grass	*Zoysia tenuifolia*
B. Cool-Season Grasses	
Annual blue grass	*Poa annua*
Annual rye grass	*Lolium multiflorum*
Chewings fescue	*Festuca rubra spp. rubra*
Colonial bent grass	*Agrostis tenuis*
Creeping bent grass	*Agrostis palustris*
Creeping red fescue	*Festuca rubra spp. rubra*
Hard fescue	*Festuca ovina spp. duriuscula*
Kentucky blue grass	*Poa pratensis*
Perennial rye grass	*Lolium perenne*
Rough blue grass	*Poa trivialis*
Tall fescue	*Festuca arundinacea*
Velvet bent grass	*Agrostis canina*

A. Warm Season Lawn Grass

Warm season lawn grasses are mostly drought tolerant grasses and some of these can survive as high as 45°C where as low temperature (-15 °C) can kill most of the warm season grasses. These requires a minimum temperature of 10°C for its growth. However the sitable range for the temperature requirement is around 25°C-35 °C. It requires one long growing period over spring and summer and stay dormant in cooler season. Low temperature result in discolouration of foliage turning tits shades to tan/brown. Important warm season grasses are described as under-

1. Bermuda grass (*Cynodon* spp.)

Bermuda grass which is also known as Doob grass is a major turf species for sport fields, lawns, parks, golf courses and general utility turfs in India, Australia, Africa, South America and the Southern region of the United States. It is found in over 100 countries throughout the tropical and subtropical areas of the world. The genus *Cynodon* comprises nine species with *C. dactylon* being the most widespread. These grasses can easily be grown from their seeds. Common Bermuda grass, *C. dactylon*, is naturalized throughout the warmer regions of the India. Bermuda grass has numerous turf uses. It is a tetraploid species with broad genetic variability serves to explain its widespread distribution. Other *Cynodon* species have a more limited natural distribution and are often restricted to one particular habitat. *C. dactylon* is highly fertile, whereas the diploid species such as *C. transvaalensis* rarely produce viable seed.

2. Bahia grass (*Paspalum notatum*)

Paspalum notatum, is also known as Bahia Grass, Common Bahia or Pensacola Bahia, is a tropical to subtropical perennial grass (family Poaceae). Bahia grass is native to Mexico and South America. It prefers sandy soils and is tolerant to shade. Bahia grass is a warm season lawn and pasture grass and can survive period of drought. It involves moderate maintenance and mowing and is prone to less diseases and insect problems when compared to other warm lawn grass types. There are several varieties of Bahia grass of which Argentine and Pensacola are more popular. It is a hardy grass for lawn purpose.

3. Carpet grass (*Axonopus* spp.)

Grasses of genus *Axonopus* is a generally known as carpet grass. They are native to the tropical and subtropical regions of America. They are sometimes rhizomatous and many are tolerant of periodic submersion. Selected species:

- *Axonopus affinis* – narrow leaf carpet grass
- *Axonopus aureus* - golden carpet grass
- *Axonopus compressus* - broadleaf carpet grass
- *Axonopus fissifolius* - common carpet grass
- *Axonopus furcatus* - big carpet grass

Carpet grasses are warm season grasses that grow well on poor and wet soil where other grasses do not even grow. They are shallow rooted and hence do not tolerate drought condition. These are cold tolerant and are ideal for shady, damp and moist area.

4. Centipede grass (*Eremochloa ciliaris*)

Centipede grass of all warm season grass types, involves least maintenance. They are uniform growing, thick sod forming and have a medium to light green coloured grass. It is a creeping perennial grass that adapts itself well to sandy and acidic soils of low fertility grade.

5. Zoysia Grass (*Zyosia* spp.)

It is native to China, Japan and other parts of Southeast Asia. The species was named to commemorate an 18th century Austrian botanist, Karl von Zois. *Zyosia* grass a highly versatile species, make ideal lawn grasses in some situations and can be used on golf courses, parks and athletic fields. They can be grown in all kinds of soils ranging from sandy to clay soils, both acid and alkaline in reaction. *Zoysia* grass is extremely drought tolerant. it turns straw colored under severe drought conditions and has the capacity to respond quickly to subsequent irrigation or rainfall. Its water requirements are similar to those of Bermuda grasses. The leaf blades of *Zoysia* grass are among the first to roll under drought conditions, hence conserve moisture more effectively than other species. *Zoysia* grass also has deep root system which helps extracting water from greater soil depths more effectively. *Zoysia* grass is nearly as salt tolerant as Bermuda grass. It is widely grown along sandy seashores where drainage is adequate. *Zoysia* grass does not tolerate poorly drained soils irrespective of soil pH reaction. *Zoysia* grasses are among the most wear tolerant turf grasses. However, these are slow growing with very poor recuperative potential. Therefore, they perform only satisfactorily on lawns, golf course fairways and baseball fields.

B. Cool Season Lawn Grass

Cool season grasses are for temperate condition and require a minimum temperature of 5°C for its growth. The suitable temperature range for their proper growth is 10°C-25°C. These require cool summer with two growing periods of rapid growth in summer and spring. These grasses retain their colour at extremely low temperature. These generally develope into dense carpet like lawns with very little thatch. Some important cool season lawn grasses are described as under-

1. Bent grass (*Agrostis* spp.)

Bentgrass (*Agrostis*) is a large genus with over 100 species. In Europe and parts of Asia, the grass is native and commonly found in lawns, pastures and sport fields. It is considered the most beautiful of lawn grasses owing to its texture, deep green colour, thick density and low growing habit. They thrive in cool climates and are called luxury grass that involves high maintenance. Colonial, creeping and velvet are its varieties that differ in growing habits and texture owing to

climate and environments. Bent grass can be planted either by seed or sod. They are preferred in the gardens because of their deep green colour and low growing habit. They are also called as velvet grasses. Bent grass tolerates acid soil conditions and prefers full sun. Used primarily for golf courses, putting greens, baseball fields and very elegant lawns. It has the ability to grow in a wide range of soil types and can tolerate very acid soils.

2. Bluegrass (*Poa pratensis*)

They require medium amount of lawn care and are ideal for home as well as for sports areas. They are very beautiful with their dense, high quality deep bluish appearance or bright green appearance. They are deep bluish or bright blue green in appearance. It is a highly variable species, with cultivars that differ in color, texture, density, vigor, disease resistance and tolerance to close mowing.

3. Rye grass (*Lolium multiflorum*)

Rye grass grows well and fast from seed. It is not as aggressive as some other types of turf because it spreads by growing larger clumps, rather than sending out rhizomes or stolons. Therefore, the seeding rate is higher than for some other grasses.

3. Raising Lawn Grasses

Lawn quality is dependent on its successful establishment which is further influenced by proper planning including soil preparation, understanding environmental and cultural requirement, planting and after care and maintenance practices and pest management. Fertilization is one of the most important lawn procedure required for growing perfect lawn and improving as well as maintaining its high quality. Other activities include irrigation, aeration, mowing etc. All these activities vary under different conditions according to soil type and grass species.

Establishment of Lawn and after care

Establishment phase is critical and require a number of practices to ensure uniform dense growth of the turf. Mulching in combination with irrigation is the key factor in successful establishment of lawn. Proper monitoring for shading of grass seedlings is requied for shading in case straw mulching is done.. If new seedling shows sign of yellowing, the mulch should be raked away lightly.

1. **Selection of suitable lawn grass for particular condition:** All grass species and cultivar are not equally suitable for all conditions. Therefore, for successfull establishment of a lawn this is considered as one of the most important factor.

2. **Preparation of land:** This is is the key aspect in establishing a lawn successfully. It includes soil testing for pH reaction and nutrient availability, cleaning and grading, tillage for establishment of subsurface if needed and topsoil and finally fertilizer application and liming followed by final grading.

3. **Planting:** Grasses are generally propagated vegetatively, though there are grass species which can be propagated through seeds as well. The methods generally used are seeding, sodding, plugging, dibbing, turfing, plastering etc. The factors affecting establishment of lawn through seeding are - planting procedures, mulching and post germination care. The seeding methods used, range from planting by hand to using mechanical equipment. Time of sowing, seed rate seed depth and other issues related to seeding mainly depends on grass species its growth habit and seed size. For example grass species with lateral growth through rhizome, stolons or both are planted at lower seed rate. Also smaller the seed lower will be the seed rate as the number of seed per gram will be more.

   Vegetative planting is simply the transplanting of large or small pieces of grass. Solid sodding covers the entire seedbed with vegetation. Spot sodding, plugging, sprigging or stolonizing refer to the planting of pieces of sod or individual stems or underground runners called stolons or rhizomes. Most warm-season turfgrasses are established by planting vegetative plant parts. Exceptions to this include centipedegrass, carpetgrass, common bermudagrass and Japanese lawngrass (*Zoysia japonica*), which can be established from seed.

4. **Sodding:** Sodding is an expensive method of vegetative propagation. However, it can enable establish an instant lawn. This method is recommended where quick cover is desired for some specific purpose *viz*., checking soil erosion or aesthetic reasons. Establishment procedures for sod include soil preparation, obtaining sod of high quality, transplanting and postplanting care. Soil preparation for sodding is identical to that for seeding. The primary objective in sod transplanting is to achieve as quick rooting into the underlying soil as possible. Factors that influence quick rooting include: proper soil preparation, adequate soil moisture in the underlying soil and transplanting techniques that will minimize sod drying.

5. **Sprigging:** Sprigging is another method of vegetative propagation where stolons or rhizomes are planted in furrows or small holes. A sprig is an individual stem or piece of stem of grass without any adhering soil. A suitable sprig should have two to four nodes from which roots can develop. Soil preparation for sprigging should be the same as for the other methods of planting. Sprigs are planted at a depth of 1-2 inches, 4-6 inches apart in the furrows. However, shallow planting can also be practiced provided adequate moisture is available.

   Another method of sprigging is to place the sprigs on the soil surface at the desired interval end-to-end, about 6 inches apart, and then press one end of the sprig into the soil with

a notched stick or blunt piece of metal like a dull shovel. A portion of the sprig should be left above ground exposed to light. Regardless of the planting method, each sprig should be tamped or rolled firmly into the soil Sprigs planted this way require frequent light watering once or twice a week until roots become well established and may be required for sever weeks.

6. **Stolonizing**: Stolonizing is the broadcasting of stolons on the soil surface and covering by topdressing or pressing into the soil. Stolonizing requires more planting material but produces a quicker cover than sprigs.

7. **Plugging:** The planting of 2- to 4-inch diameter square, circular or block-shaped pieces of sod at regular intervals is called plugging. Three to ten times as much planting material is necessary for plugging as compare to sprigging. The most common turfgrasses that are started by the use of plugs are St. Augustine grass, *zoysia* grass and centipede grass. These plugs are planted into prepared soil on 6- to 12-inch centers. The closer the plugs are planted together, the faster the sod will cover. However, the closer the plugs are planted together, the more sod it will take to provide plugs to cover the lawn area.

8. **Overseeding:** Overseeding into thin turf or small patches of bare soil can be done in late winter, spring or early fall. Spring and early fall overseedings can be made following aeration (six to eight passes over the lawn), dethatching, or by using a disk-type seeder that drops seed into slits in the soil. When overseeding, it is especially important that the seed is in contact with the soil and has enough space to germinate and develop.

9. **Fertilization:** Fertilization does more to improve poor quality turf or maintain good quality turf than any other single management practice. Grass plants normally need nitrogen, phosphorus (phosphate), and potassium (potash) in greater amounts than can be supplied naturally from soil. The only way to determine how much phosphate (P_2O5) and potash (K_2O) is required by turf is from a soil test.

   In most cases, turfgrasses require nutrients in the ratio of approximately two parts nitrogen to one part phosphate and one part potash. These needs can be met for most lawns by application of a 10-6-4 fertilizer having 35 percent or more of the total nitrogen as water insoluble nitrogen (WIN) or controlled release nitrogen (CRN) in late summer/early fall. Other fertilizers having approximated 2-1-1 ratios and containing one-third or more of the total nitrogen as water insoluble nitrogen or controlled release nitrogen may be used at rates to supply equivalent amounts of nutrients. If only one fertilizer application is made annually, apply it in late summer to early fall.

9. **Liming:** Most turfgrasses prefer a soil pH ranging from 6.0 to 7.0. If the soil is too acidic for proper turfgrass growth, lime may be applied. Lime should be applied in accordance with a

soil test recommendation. The lime requirement should be met by applying ground agricultural limestone. Fall applications are preferred as rain, snow, and freezing/thawing of the soil during the winter aid in working the limestone into the soil. Late winter is also a good time to apply lime.

10. **Mowing:** Most lawns should be cut at two inches or above and mowed on a regular basis as long as the grass is growing. Frequency of cut should be based on the growth rate of the grass. No more than one third of the total leaf surface should be removed at a given mowing. Thus, if the turf is cut at two inches, it should be mowed when it reaches a height no greater than three inches. Clippings do not need to be removed provided the frequency of mowing is adequate. All mowing equipment must be kept sharp and in proper adjustment.

11. **Dethatching:** Thatch is the tightly intermingled layer of partially decomposed grass stems and roots which develops beneath the actively growing green vegetation and above the soil surface. Thatch decreases the vigor of turfgrasses by restricting the movement of air, water, plant nutrients, and pesticides into the soil. Also, turfgrass roots grow into the thatch and become desiccated as the thatch dries. Thatch should be mechanically removed with dethatching equipment with vertically rotating blades or aeration equipment. This operation should be performed when thatch is greater than or equal to one inch in depth and only during periods of cool weather and adequate moisture. Thatch should not be removed during periods of high temperatures, drought, or during late fall when winter desiccation may occur. Maintaining a soil pH between 6.0 and 7.0 will favour microbial activity and hence, break down of thatch. It is not necessary to dethatch every year, rather, only when thatch build-up becomes excessive.

12. **Aeration:** Aeration is the process of removing plugs of soil from the turf area, thereby creating an artificial system of large pores by which moisture or plant nutrients can be taken into the soil. Aeration is employed to alleviate soil compaction and can significantly reduce thatch.

    Aerators are equipped with hollow tines (usually 3–4 inches in length and ¼ to ¾ inches in width) or open spoons to remove plugs from the soil. Equipment having solid tines or spikes should not be mistaken for aerating equipment. Aeration should be done during periods of cool weather (early to mid-spring or late summer to early fall) to facilitate rapid recovery of the grass. Sometimes spring dethatching will bring large numbers of weed seeds to the soil surface and create voids for weeds to germinate and grow. Adequate moisture is necessary for penetration of the aerator tines and for removal of the plugs. The plugs can be broken apart once they have dried.

13. **Irrigation:** It is important to ensure that the soil is always moist while germination of seeds or when seedlings are growing. The soil should be irrigated frequently to keep it moist but not saturated until the plants can develop sufficient root systems to take advantage of deeper

and less frequent watering. Irrigation requirement reduces if mulching is done. Irrigation frequency reduces as grass seedlings starts maturing.

Newly transplanted sod is irrigated to a depth of 4 inches immediately after transplanting to promote deep root growth. Daily, if possible or frequent watering is recommended in the absence of adequate rainfall, during the first week and in sufficient quantities to maintain moist soil to a depth of at least 4 inches. The sod should be irrigated lightly during midday hours until rooting has taken place into the underlying soil. As the roots begin to penetrate the soil, deeper, thorough watering is recommended.

14. **Weed management:** Once seeds have germinated, mode and timing of weeding becomes critical. Most herbicides are toxic to newly germinated plants. Therefore application of post emergence herbicide should be delayed as long as possible. The first step in weed control is the development of a dense, properly managed turf. If this approach fails to prevent weed infestation, herbicides are available that will control most turfgrass weeds.Annual grass weeds, such as crabgrass, can be controlled with pre-emergence herbicides. These chemicals should be applied prior to weed seed germination in early to mid-spring depending on the location. Broadleaf weeds, such as dandelions and ground ivy, are usually controlled with broadleaf herbicides. It is especially important to identify the weed(s) present and select the herbicide that will provide the best control of the weed(s). Broadleaf herbicide applications should be made when weeds are actively growing in spring or early fall.

Apart from interfering with the growth of garden plants weeds rob the soil of its rich nutrients. This makes it utmost necessary for to take due care and ensure that weeds do not get a chance to grow in lawn. In case they manage to sneak into lawn, even after the protective measures, we should get rid of them as soon as possible, trying to stick to the natural methods and avoiding the chemical-based products. Vigorous, healthy turf properly maintained provides the best means of weed control in Bermuda grass turf. But, where turf thins due to environmental stress, pest problems or poor management, weeds rapidly invade grass. Some of the common methods to manage weeds in the lawn is as under:-

1. Mulching

Using mulch is one of the best and safest methods of killing the weeds in lawn. It has been seen that covering the garden soil with mulch, up to 5-7.5 cm, blocks weeds. For this purpose, we can make use of shredded bark, wood chips, straw, cocoa bean hulls, gravel and rocks. Apart from killing the weeds, mulch will also help the soil retain moisture, thus reducing the frequency of watering.

2. Pouring boiling water

Exposing the weeds to boiling water helps a great deal in killing them. Pour boiling water on the roots of the weeds. The only drawback of this method is that it may require several applications.

3. Washing with soap

Using soap on the weeds cleans them thoroughly, in other words makes lawn free of them. For this purpose, we need to put one quart (4 cups) of water in a bowl and add 5 tablespoons of liquid soap (such as dishwashing liquid). Now, mix it thoroughly and pour into a spray bottle. Coasting the weeds with this solution will help get rid of them, especially on a hot day.

4. Application of salt

In case we want to try another method of killing the weeds in our lawn, rock salt will be the best bet. We can get large areas of weeds (and even plants) by putting rock salt on them. However, do make sure that there are no garden plants in close proximity of the weeds. This is because the salt spreads when it rains, harming the plants in the vicinity, if any.

Broad leaved weeds including clover, chickweed, dandelion, henbit, dichondra and others can be controlled with the hormone type herbicides such as 2,4-D, MCPP, dicamba. Grassy weeds including crab grass and dalli sgrass can be controlled with several applications of MSMA in spring or early summer. Annual grasses including crabgrass and annual bluegrass can be controlled with pre-emergence herbicides. However, all of these herbicides must be used together with good management to effectively reduce weed populations.

Raising of the warm season grasses for quality turf

1. Bermuda Grass

Bermuda grass is one of the most popular grasses that grows well in warm seasons. They can easily be maintained by moderate lawn care, and mowing practices. Low winter temperature is the factor that limits the hills distribution of Bermuda grass. Bermuda grass is a perennial species adapted to tropical and subtropical climates. It grows best under extended periods of high temperatures, mild winters and moderate to high rainfall. Research has demonstrated that Bermuda grass will continue to grow at night temperatures as low as 1°C if day temperatures are near 21°C. However, when average temperatures drop below 10°C growth stops and the grass begins to discolour. At low temperature Bermuda grass shows discolouration and certain biochemical changes *viz.*, change in protein fractions composition and increase in carbohydrates reserve in the stems and rhizomes. Bermuda grass stay dormant at extremely low winter temperatue. The roots and rhizomes of Bermuda grass continue to grow several weeks after the leaves and stems stop growth. In warm frost-free climates Bermuda grass remains green

throughout the year, but growth is significantly reduced at the onset of cool nights. The species grows well where average daily temperature is above 23°C. Optimum daytime temperature for Bermuda grass ranges between 35 and 37°C.

Soil temperature, as influenced by air temperature, is also important for the growth and development of Bermuda grass turf. Soil temperature above 18°C is required for significant growth of rhizomes, roots and stolons. Optimum soil temperature for root growth is around 26°C. It has a requirement of bright sun light and does not grow well under shaded conditions. The duration of the light period (day length) also influences growth and development of this grass. Both increased light intensity and day length promote rhizome, stolon and leaf growth in Bermuda grass. At low light intensity (less than 60% full sunlight) Bermuda grass develops narrow, elongated leaves; thin upright stems; elongated internodes and weak rhizomes. Consequently, it develops a very sparse turf under moderately shaded conditions.

Bermuda grass is found in tropical and subtropical climates with 62 to 250 cm of annual rainfall, but it also survives in arid climates along waterways and in irrigated areas. Where annual rainfall is below 50 cm per year, Bermuda grass requires irrigation for its survival. Bermuda grass undergoes semidormant state during very dry conditions, but can survive extreme droughts. Rhizomes of Bermuda grass can lose 50% or more of their weight and still recover when favourable moisture condition is available. Generally, common Bermuda grass, or tetraploid species of *C. dactylon*, have the deep root and rhizome penetration and withstand prolonged drought periods in a better way. Common Bermuda grass also has the characteristic of producing seed heads under stress conditions such as drought. Thus, the seeds provide another method by which the species can survive extreme drought. Some natural biotypes of *C. dactylon* produce numerous seeds. ICAR-DFR have identified four mutants viz., DFR-C-440, DFR-C-444, DFR-C-446 and DFR-C-448. All mutants are under evaluation for further validation of quality traits.

Bermuda grass grows well on a wide variety of soils from heavy clays to deep sands, provided fertility is not a limiting factor. It tolerates both acidic and alkaline soil conditions and is highly tolerant to saline conditions. Bermuda grass survives some flooding but does best on well-drained sites. Although it may persist under low fertility, Bermuda grass has high nitrogen requirement for good quality turf.

A dense Bermuda grass turf tolerates moderate wear and compaction and recovers rapidly. Under moderate fertility, and adequate moisture with frequent mowing Bermuda grass forms a dense, fine-textured turf. The only situation where Bermuda grass cannot be used is under moderate to heavy shaded condition.

Bermuda grass seed should be planted at a rate of 450-500 g of seed per 1,000 sq. ft. Hulling is recommended for spring and summer plantingfor faster germination however it is not needed for Late fall and winter plantings in order to delay germination for until more favorable

conditions occur in the spring. Unhulled bermudagrass seed might be planted together with annual ryegrass in the fall to provide temporary cover . Annual ryegrass will delay the development of a bermudagrass turf, but it may be needed for cover and protection.When planting in the fall and winter on areas subject to severe erosion, wheat or rye can be drilled with unhulled bermudagrass seed. The wheat or rye will establish quickly and provide some cover during winter months. The small grains also provide less competition than ryegrass to seedling bermudagrass in late spring.

Bermuda grass sprigs or stolons for planting should be freshly harvested and protected from desiccation by wind and sun. They should not be subject to excessive heating which occurs when moist planting material is tightly packed or covered for several days. Sprigs are usually distinguished from stolons in that sprigs consist of stolons with roots and rhizomes; whereas stolons consist of above ground parts only. Sprigs are produced by shredding harvested sod or by sprig harvesters. Stolons are generally harvested with a vertical mower or a flail mower set close to the ground. Sprigs will tolerate slightly more environmental stress during planting and establishment because of the energy reserves in the roots and rhizomes. Sprigs or stolons should be planted at 5 to 15 bushels per 1.00 sq. meter depending on the rate of cover required. Higher planting rates up to 25 or more bushels per 1.00 sq. meter will provide a faster grass cover. A minimum planting rate should be 5 bushels per 1.00 sq. meter or 200 bushels per acre. Sprigs or stolons should be broadcasted on a clean seedbed and pressed into moist soil with a roller or covered lightly with soil or mulch. Moist conditions must be maintained for 2 to 3 weeks after planting to obtain a good cover.

Seed or sprigs should not be planted before soil temperature is above 18°C. Planting too early may retard development of a turf and extend the critical establishment period for several weeks. Soil temperatures of 20 to 23°C are ideal for germination and rapid development of bermuda grass.

Fertilizer, as determined by a soil test, should be incorporated into the soil during seedbed preparation. Nitrogen fertilizer can be applied to the soil surface immediately prior to planting or at the time of planting at a rate of 500g per 1,00 sq. meter Nitrogen should be applied 3 to 4 week intervals until a cover is obtained.

Mowing should begin several weeks after planting to control weed growth and promote spreading of grass. If additional weed control is needed selective post emergence herbicides can be applied 3 to 4 weeks after planting. Preemergence herbicides should not be applied to bermudagrass turf during the first growing season. Weed control will greatly enhance bermudagrass growth and coverage.

Bermuda grass respond readily to irrigation. In general, water requirement of Bermuda grass depends on turf use and climatic factors such as temperature, wind, humidity and light intensity. Water requirement increases with increasing levels of maintenance (golf green > sports field > lawn > roadside), higher temperatures, higher wind speed, lower humidity and greater light intensity. The longer the growing season the greater the water requirement for the year. Water use rates may range from less than 0.25 cm per day to 0.75 cm per day depending on the environmental conditions. The frequency of irrigation is dependent on water use rate and soil type. Clay soils, for example, hold more water than sandy soils and, consequently, require less frequent irrigation. The depth of the root zone also influences the frequency of irrigation. Grass roots can grow to a depth of 2 meter or more depending on soil profile.. However, the majority of the root system, 80% or more, is found in the top 15 cm of soil. Where roots extend several meters into the soil, thorough and infrequent irrigation produces the most drought tolerant turf. Light, frequent irrigations such as practiced on golf greens produce shallow-rooted grass that shows drought stress very rapidly.

Bermuda grass does not tolerate poorly drained soil. On compact and heavy clay soils, irrigation must be closely controlled to avoid waterlogged conditions. Hard, compacted sites can often be improved with respect to water penetration by core aeration and top dressing with sand or an aggregate material. The presence of a heavy thatch layer will also interfere with water penetration. Thatch removal by vertical mowing and core aeration also improves water penetration and reduces the frequency of irrigation Mowing requirements for Bermuda grass turf are dependent on variety, use and the level of maintenance. Common Bermuda grass and other medium textured varieties produce dense, wear tolerant turf when mowed at heights between 1 and 2.5 cm. The lower height being good for golf and sports turf and the tall height for lawns. At mowing height more than 2.5 cm Bermuda grass develop turf with an acceptable appearance but with poor wear tolerance. Fine-textured hybrid Bermuda grasses such as Tifway should be mowed at a height of 2.5 cm or less. Taller mowing heights with these grasses produce puffy, stemmy turf that is easily scalped during mowing. As a general recommendation to maintain good turf density and color, no more than 40% of the leaf tissue should be removed at any mowing. Thus, the shorter the mowing height, the more frequent the turf must be mowed. Reel mowers produce the best cut on Bermuda grass turf. However, the number of blades per cutting reel determines the smoothness of cut. Common Bermuda grass mowed at 2.5 cm or higher can be cut with a reel with 5 or 6 blades. Common and hybrid Bermuda grasses mowed at 1 to 2.5 cm should be cut with a reel containing 7 blades. At heights below 1 cm, 9 to 11 blades per reel are required for a smooth cut.

Bermuda grasses have a relatively high fertilizer requirement to maintain a high level of turf quality. The amount and frequency of fertilizer required depends on the desired appearance and growth rate of the turf, length of growing season, soil type, Bermuda grass variety and the use of the turf. Where high quality is of critical importance and the turf is mowed frequently, 450 to 600 g of nitrogen per 1,00 sq. meter per month may be applied during the growing season. The lowest

rate of nitrogen that can be applied and still maintain acceptable Bermuda grass turf for sport fields and golf courses is about 225 g of N per 1.00 sq. meter per month. Soil types also influence fertilizer requirements Sandy soils require light but frequent applications of nitrogen because of low nitrogen retention. Sandy soils are also typically low in other nutrients such as phosphorus and potassium and these nutrients must also be provided through fertilization. Soil tests are required to determine phosphorus, potassium, calcium and other nutrient deficiencies. Potassium is particularly important because of its contribution to root growth, environmental stress tolerance (heat, cold and drought) and wear tolerance. Potassium has also been found to reduce susceptibility of Bermuda grass to leaf spot diseases. Bermuda grass tolerates a wide range of soil reactions, but performs best between pH 6.5 and 8.0. At pH levels below 6.5 limestone should be added according to soil test recommendations.

Turf use has a significant effect on the amount of fertilizer required. Golf greens, bowling greens and tennis courts have very high nitrogen requirement; sport fields and golf course fairways have intermediate requirement and lawns, and other low maintenance areas have low nitrogen requirement.

Hybrid Bermuda grasses require regular cultivation practices - vertical mowing, aeration and topdressing - to maintain high quality turf. Bermuda grass golf greens may require weekly vertical mowing and monthly topdressing under heavy use conditions. Sports fields and golf fairways may need these cultural operations on an annual basis. Without cultivation Bermuda grass turf tends to develop thatch, grain and spongy conditions that result in scalping and a non-uniform appearance.

2. *Zoysia* grass raising for turf

There are three principal species of *Zoysia* grass used for turf: *Zoysia japonica*, *Zoysia matrella*, and *Zoysia tenuifolia*. These species are differentiated by texture, cold tolerance and aggressiveness. *Zoysia japonica*, often called Korean or Japanese lawn grass is more cold tolerant than the other species, but is also the most coarse textured of the three species. *Zoysia japonica* is the only species that can be established from seed. *Zoysia matrella* (Manilla grass) is chiefly a tropical and subtropical grass, but can grow well in moderate shade and forms a thick mat in full sun. The leaf blades of *Zoysia matrella* are narrow, sharply pointed and wiry. In tropical climates the grass remains green year around. But, in cooler climates it turns brown after severe frosts and remains brown until late spring. *Zoysia matrella* is propagated through sprigs and is quite slow to establishe. *Zoysia tenuifolia* is the finest textured, least winter hardy of the *Zoysia* grasses. It has very fine, short, wiry leaf blades and forms a dense, fluffy turf. It is extremely slow to spread and is most often used as a ground cover.

Emerald *Zoysia* grass is a hybrid between *Zoysia japonica* and *Zoysia tenuifolia*. Emerald combines the fine texture of *Zoysia tenuifolia* with the cold tolerance and faster rate of spread of

Zoysia japonica. Emerald is similar to *Zoysia matrella* in appearance and habit. *Zoysia* grasses can be established from seed, sprigs or sod. *Zoysia japonica* is the only species that can be established from seed. Emerald *Zoysia* grass, Manila grass and *Zoysia tenuifolia* is propagated vegetatively from sprigs, plugs or sod. The seedbed should be finely pulverized, smooth, firm, and weed-free prior to planting. *Zoysia* grass sod may be shredded or torn apart to provide sprigs or it may be cut into 5 cm sod plugs for planting. A sprig should consist of a section of stem or rhizome with 2 or more nodes. Leaves may not be present on sprigs. Sprigs should be planted no more than 5cm apart in rows spaced 90 cm apart, or broadcast over an area at a rate of 10 bushels per 1.00 sq. meter If planted in rows sprigs should not be completely covered with soil. At least one node should be above soil level. If sprigs are broadcasted over the surface, they should be rolled to insure good soil contact. Freshly sprigged *Zoysia* grass must be kept moist for several weeks after planting. Special attention should be given to weed control since *Zoysia* grass is lesser aggressive than Bermuda grass and some of the common turf weeds.

A newly planted *Zoysia* grass turf should be fertilized with a 1-2-1 or similar fertilizer at a rate of 500 g of nitrogen per 1.00 sq. meter of area at the time of planting. Monthly applications of nitrogen at 500 g per 1.00 sq. meter will promote the spread of zoysia grass. Sprigging is the least expensive method of planting zoysia grass and usually gives a faster rate of cover than plugging. However, keeping the soil moist during the establishment period is most critical with sprigs. Small plantings of *Zoysia* grass sprigs can be covered with a clear polyethylene tarp to maintain adequate moisture and increase soil temperature in the early spring. The cover can be left in place for several weeks, or until temperatures get too hot. The plastic cover can increase the rate of spread of *Zoysia* grass and reduce the time required to obtain a complete cover. The best time for planting *Zoysia* grass is late spring and early summer.

Zoysia grasses grow from early spring through late fall when moisture and nutrient requirements are met. Although *Zoysia* grass is considered to be a drought tolerant species, it ceases growth and begins to discolor during extended dry periods. Water should be applied 2 to 3 times per week depending on temperature and soil conditions. Sandy soils require more frequent irrigations than heavier clay soils; and, as temperature increases, irrigation frequency also increases. During prolonged droughts when it is impractical to water enough to maintain growth, weekly applications of as little as 0.5 inch of water are adequate to keep the grass alive. During dry winter months, *Zoysia* grass requires occasional irrigation to prevent desiccation and serious loss of stand even through the grass may be dormant.

Zoysia grass lawns tend to build up a thatch layer, a layer of undecomposed organic residues just above the soil surface. Proper mowing is essential to prevent the accumulation of thatch in *Zoysia* grass turf. Frequent mowing at recommended heights and clipping removal help prevent thatch accumulation. Avoiding excessive applications of nitrogen fertilizer also helps prevent thatch accumulation. Occasionally, thatch removal by mechanical means is required to prevent

serious deterioration of *Zoysia* grass turf. Vertical mowers or flail mowers may be used to remove excess thatch from *Zoysia* grass turf. Thatch removal should be done well before fall to allow ample time for re-growth. Scalping the lawn in early spring to remove accumulated growth will also help prevent thatch accumulation.

Zoysia grasses are relatively free of serious pest problems. Brown patch, rust and leaf spot diseases can cause problems in *Zoysia* grass turf, but the grass usually recovers when environmental conditions change. In intensively maintained lawns, fungicides may be needed to prevent these diseases. In the fall, applications of Banner, Daconil or Bayleton are required to prevent rust in *Zoysia* lawns.

Raising some of the important cool season grasses

1. Bentgrass (*Agrostis*)

Bentgrass (*Agrostis*) has the ability to grow in a wide range of soil types and can tolerate very acid soils. A good seed bed is essential for establishing a good stand of bent grass from seed. Till the soil 8 to 10 cm deep, remove all sticks, rocks, and other debris. Continue tilling until the soil is free of all clumps. Level and smooth the area to prepare a suitable seed bed. Using an over the shoulder or hand held spreader, spread 450 g or 900 g of bent grass seed per 100 sq. meter. Rake the seed into the seedbed very lightly then roll firm with a lawn roller. Care should be taken not to cover bentgrass seed more than 1 cm with soil. Water the area to moisten the top 5 cm of soil. In the absence of rain, water the seeded area lightly each day to keep the top 5 cm of soil moist. Continue water applications daily until the bent grass seedlings are three weeks old. Reduce watering to three times per week for the next thirty days unless there is adequate rainfall.

2. Bluegrass

Bluegrass is best adapted to well-drained, moist, fertile soils with a pH between 6.0 and 7.0. It does best in full sun but will tolerate light shade. It will not perform well on shallow, compacted soils, or where the pH is excessively high or low. Under the right conditions and with proper management, Kentucky bluegrass can make a beautiful lawn.

3. Rye grass

Rye grass grows well and fast from seed. It is not as aggressive as some other types of turf because it spreads by growing larger clumps, rather than sending out rhizomes or stolons. Therefore, the seeding rate is higher than for some other grasses.

General lawn care in summers

- ➢ Fertilizer application: In the summer season, it is always advisable to keep the fertilizer use to a minimum. This is because they contain nitrogen, which, when combined with

the soaring temperatures of the summers, can lead to burning up of entire lawn. As far as possible, we should go for a slow-release fertilizer, which has lower nitrogen content than the usual.

- Irrigation: One of the most common mistakes that people tend to make, while taking care of their lawn in summers, comprises of inadequate watering. It needs to keep in mind that even though watering as usual, in summers, the evaporation is much more. So, it is advisable to keep on watering till the time the moisture gets 15 cm into the soil.
- Pest management: It has been seen that lawns become much more susceptible to fungal diseases in the summer season. At the same, even weeds have been observed to grow faster when the temperatures are high. Thus, it is advisable to take proper care of garden, keeping them free of fungi as well as weeds.
- Mowing: In the summer season, we should always increase the height of the grass, mowing it to a height of 7.5-8.5 cm. This will help cool down the crowns of the grass and also discourage various diseases.care should be taken while mowing in the summer season that more than one-third of the total leaf area is not removed at any one time.

General lawn care in winters

- Fertilizer application: In the winter months, lawn will not grow much, remaining more or less dormant. Therefore, it is advisable not to use fertilizers therein. Rather, wait for later-winters, when the temperature is a bit higher, for adding fertilizers to lawn. Still, for fertilizing purposes, the best time would comprise of late fall or early summer.
- Irrigation: It is true that in winter season, lawn does not lose too much moisture. However, this does not mean that stop watering it altogether. Rather, water it at a gap of somewhere around 3-4 weeks. As and when the grass growing more rapidly, it is advisable to increase the frequency of watering.
- Mowing: With the approach of the winter season, start lowering the height of mower i.e. mowing down the grass to a shorter length; say around 5.0-7.5 cm. Otherwise, lawn might become prey to winter diseases. However, make sure to be gradual in the process. Otherwise, might end up removing all the green leaf tissue and damaging the turf.
- Weed management: Winter season present adverse condition for the growth of grass, but not weeds. In fact, weeds are known to grow faster in cold conditions. So, make sure to keep looking out for weeds and removing them before they get a chance to do any damage or else, grass will be in the danger of getting killed by the time spring comes.

General tips for lawn care under shade

- ➢ Shady lawns require less fertilizer compared to lawns exposed to the sunlight. 450 to 900 g of actual nitrogen per 1,000 square feet per growing season at two intervals. The ideal time for fertilization is the first week of September.
- ➢ Shady lawns don't require ample watering but when watered does it thoroughly.
- ➢ Lawns in shade are not meant for rough use. As they are quite weak compared to sunny lawns so it is better not to walk or let the children play on it.
- ➢ Though moss and creepers like ivy grow largely on the shady lawns but it is not harmful. It only grows on the empty soil because the grass grows slowly.

4. Insect Pest Management in Lawn

Several of insects and mites are found to be associated with lawn, but not all of them cause considerable economic or aesthetic damage. Insects like white grubs, sod web worm, chink bug, armyworm, cutworms, greenbugs and ants cause considerable damage and require immediate control measures. These insects are not uniformly distributed throughout the land cover, but they occur sporadically in concentric spots. Diagnosis of insect damage, correct identification of insect and regular monitoring of insect population and need based application of correct control measures are the key factors in effective management of lawn pests.

The insects causing economic damage to the lawn can be grouped based on their habit into

i. Subsurface feeding insects, which feed on roots, thatch. Eg.: root grubs, mole cricket, termites.

ii. Surface feeding insects, which feed on foliage. Eg.: armyworm, cutworm, chinch bug and greenbug.

I Subsurface feeding insects

1. **Root grub:** The beetles are polyphagous pests. These beetles are problem in light sandy and sandy loom soils. They lay eggs in soil. The grubs feed on rootlets due to which it dries up in patches. Grubs feeding on roots cause yellowing and wilting appearance which could be misdiagnosed as a nutrient deficiency, which ultimately leads to gradual thinning and death of the lawn. When turf is easily pulled from the soil and roots are damaged, it is likely that the grubs are responsible for damage. When lawn is cut about 2 inches deep at the edge of discolored area and rolled back, if the roots are chewed off and grubs are present in the soil confirms the root grub infestation.

   Control measures: The root grubs are difficult to control by means of insecticide application as they are protected by thatch.

i. Bioagents like *Heterorhabditis* spp., *Steinernema* spp., *Bacillus subtilis* can be applied at monthly intervals for augmentation of these bioagents. Proper moisture content has to be maintained for development of these bioagents. Once they are well established, will check the root grub population buildup.

ii. Apply insecticides like quinalphos (0.05%) or carbofuran (0.05%) or phorate 10 G @ 10 kg/ha followed by proper irrigation to allow the percolation of insecticides to grub feeding zone will also check the root grub problem.

2. **Mole cricket:** These insects feeds on grass. The female lays about 100 eggs in chambers in soil. The nymphs grow slowly by undergoing 8 moults at monthly intervals. The insects damage the lawn grass by burrowing and feeding on roots.

Control measures: Adults of mole cricket are active for few hours during dawn and dusk hours and are attracted to light. A light trap can be used for the monitoring of adult activity.

i. Dust the lawn with Malathion 5 per cent @ of 10 kg/acre or phorate 10 G @ 10 kg/ha followed by proper irrigation.

3. **Termite:** Termites are polyphagous pest which attack roots of lawn grass. The lawn look like wilt and dry in patches at the site of attack.

Control measures:

i. Soil drenching with chlorpyriphos (0.05%) or malathion (0.1%) before planning the lawn.

ii. Application of Imidacloprid 30.5SC (0.075%) on affected area.

II Surface feeding insects

1. **Armyworm:** Young larvae feed on tender leaves by skeletonizing the foliage. Grownup larvae feed on whole plant leaving circular bare area in the turf. Larvae are distributed uniformly over a large area. These insects will be active during early morning or late evening hours.

2. **Cutworm:** The larva dig a burrow in the ground or thatch, emerge at night and cut the grass blades off close to the ground level in a circular pattern around the burrow. Feeding produces brown spots of 1 – 2 inches in diameter and appears as circular spots of dead grass or depressed spots that look like ball marks.

Control measures for armyworm and cutworm : Adults of mole cricket are active for few hours during dawn and dusk hours and are attracted to light. A light trap can be used for the monitoring of adult activity.

i. Application of acephate (0.05%) or carbaryl(0.1%) or indoxacarb(0.1%) or spinosad(0.05%)

3. **Chinch bugs:** These insects feed by sucking the sap from grass stem and foliage. Damage starts as small, yellow or brown discolored areas. Injured plants look stunted, yellowed, wilted or dead. Yellowish to brown patches are often noticed along sidewalks. The young ones found in patches throughout the lawn and prefer dry area. Young ones will be abundant in thatch and adults will come to the surface between the plants.

   Floatation method can be used for monitoring the chinch bug population, in which, a cylinder with two sides open may be inserted into the lawn till the soil surface and filled with water, in 10 minutes the chinch bugs will float to the surface.

   Control measures:

   i. Soil drenching with quinalphos (0.05%) or malathion (0.1%) in the infested area.

4. **Green bugs:** Tiny insects present in dozen on plant especially on tender foliage. These insects suck the sap continuously. The infested plants look sick appearance, discoloration and wilting of affected parts.

   Control measures:

   i. Spot application of monocrotophos (0.05%) or oxydemeton methyl (0.05%).

   ii. Soil drenching with chlorpyriphos (0.1%) or malathion (0.1%) in the infested area.

5. Lawn Management Calendar

Activities \ Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Seed/Seedling Planting												
Gap Filling												
Seeding												
Fertilizer Application												
Liming												
Dethatching												
Aeration												
Weed Management												
Insect Pest Management												
Root grub												
Chinch bug												
Sodwebb worm												

Notes

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