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Grasscycling in California

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Mowing is the primary cultural practice in sound turfgrass management. It is also the most stressful of all maintenance activities; even under ideal conditions, l/3 of the turfgrass plant's aboveground portion is removed once a week for the life of the turf stand. Historically, much basic and applied research has focused on how to mow so that turfgrass will recover quickly and healthy from this drastic removal of photosynthetically active tissue.

In the past, the practice of clipping removal from the site after mowing has been standard. Among the reasons for this practice have been: aesthetically a more pleasing (manicured) lawn, and minimizing thatch buildup, disease carryover and weed invasion. Recently, however, turf and landscape professionals, as well as homeowners in California and many other states face mounting pressure to reduce the volume of landscape waste sent to municipal landfills.

Each year Californians generate in excess of 40 million tons of municipal solid waste. As our population grows and landfills become scarce, the solid waste problem becomes more critical. Although voluntary waste recycling has been in place in many California communities for years, waste reduction became mandatory for California municipalities with the passage of AB 939, California's Integrated Waste Management Act. This statute mandates that each city and county in the state reduce the amount of waste it sends to the landfills by 25% by 1995 and 50% by the year 2000, with 1990 as the base year. Concurrent with the passage of AB 939, the newly created California Integrated Waste Management Board (CIWMB), began implementing a comprehensive set of guidelines addressing California's solid waste reduction mandates.

It is estimated that 20% of waste going to landfills is yard (green) waste. Composting is one successful method of dealing with such waste; other ways to reduce green waste generation must also be explored and grasscycling, the contemporary term for the old practice of returning lawn clippings to the lawn after mowing, could be the most sensible method in many cases. If widely adopted, grasscycling has the potential to reduce California's current urban solid waste production by 5- 10%.

Grasscycling is Environmentallv Sound

Grasscycling can be practical on most stands of grass, the few exceptions being close-cut sports fields such as golf putting greens, bowling, tennis and croquet courts, or where an exceptionally uniform turf is required, such as a major league sports field or sod farms. Grasscycling is simple, easy and environmentally sound. Also:

- Saves time by eliminating bagging and removing of clippings.
- Saves energy by conserving the energy required to haul clippings, often many miles, away.

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- Saves valuable landfill space.

- Encourages a healthier stand of grass. In addition to releasing nutrients to the soil, grass clippings decomposition may substantially enhance soil microbial activity.

- Saves money. Research indicates that significant amounts of nutrients (mainly nitrogen) could be returned to the soil by grasscycling. Fertilizer costs are thus reduced.

Grasscvcling and Maintenance Activities

Grasscycling can be practiced on any healthy turfgrass stand as long as proper turf management guidelines are followed. Many people, both novice and professional, treat their lawns like a "crop", encouraging (unnecessary) extra growth by overwatering and over-fertilizing. The "crop" (grass clippings) is bagged and transported to a landfill. Proper mowing, watering, and fertilizing moderates turf growth while still producing a healthy, green lawn.

Mowing

Frequent mowing is required for successful grasscycling. Turfgrass should be mowed when dry with a sharp bladed mower. The " l/3 rule" should be followed: turfgrasses should be mowed often enough so that no more than l/3 of the length of the grass blade is cut in any one mowing. When grass is mowed frequently, short clippings will fall through the canopy and will not cover the lawn surface. In most cases once-a-week mowing is frequent enough for successful grasscycling. However, in colder months of the year when turf grows slowly, the period between mowing can be extended. Turfgrasses mowing height requirements differ among species. The following table lists California turfgrasses and their respective proper mowing heights.

GRASS TYPE	MOWER SETTING (inches)	MOW WHEN GRASS REACHES THIS HEIGHT (inches)
Bentgrass	1/2- 1	3/4- 1½
Bermudagrass (common)	1-1 1/2	1½ – 2¼
Bermudagrass (hybrid)	l/2- 1	3/4- 11/2
Kentucky Bluegrass	1 1/2-2 1/2	21/2-33/4
Kikuyugrass	1 – 1½	1½ – 2¼
Perennial Ryegrass	1½ – 2½	2¼ - 3 %
Tall Fescue	1½ – 3	2¼ – 4½
St. Augustine	l - 2	1½ – 3
Zoysia	l/2- 1%	3/4-- 2¼

Grasscycling is possible with any type of mower, although the most effective type of mowers for grasscycling are known as mulching mowers or recycling mowers. These mowers cut grass blades into very small pieces and force them into the turf canopy to mulch the soil. Within the past few years, nearly all lawn mower manufacturers have introduced new lines of recycling mowers to the market, satisfying any lawn maintenance needed. Grasscycling is also possible with "bag" mowers, if the collection bag is removed to allow clippings to drop on the lawn. If a bag mower does not have a safety flap when the collection bag is removed, a local dealer may be able to provide a retrofit kit.

Irrigation

Turfgrasses vary in their need for water. Although, each site's evapotranspirational (ET) rate determines a given turfgrass's water needs, most turfgrasses need about 1 inch of water every 5-7 days during the growing season and much less during the colder winter months. Deep, infrequent watering produces a deep extensive root system which enables turfgrasses to resist disease and use stresses. Lawns watered too frequently tend to develop shallow root systems which may make them more susceptible to disease, and environmental and use stresses. Turfgrass stands which are irrigated with more water than necessary (over-watering), in addition to being wasteful, also grows faster and require more frequent mowing for proper grasscycling.

As a general rule, lawns should not be mowed when grass blades are wet; i.e., shortly after irrigation, or early morning when dew is still present on turf blades. It is difficult to mow effectively under these conditions.

Fertilization

Proper fertilization is essential in maintaining a healthy turfgrass stand. Over-fertilization weakens turfgrass plants by causing excessive and succulent top growth. Excessive shoot (stems and leaves) growth requires more frequent mowing for successful grasscycling, and thus should be avoided. For moderate, even growth, use a combination of fast acting fertilizers (ammonium nitrate, ammonium sulfate, or urea) and slow release nitrogen, such as sulfur-coated urea, urea formaldehyde, IBDU, or organic fertilizers. Avoid applying large quantities of fast acting fertilizers; these fertilizers produce very fast growth for short periods. Regardless of grass type and specific fertility needs, generally it is better for the lawn and for grasscycling, to apply smaller quantities of fertilizer more frequently rather than larger amounts less frequently. Grasscycling can reduce the amount of fertilizer needed by 15-25% since grass clippings return nitrogen to the soil.

Thatch management

Thatch is composed primarily of roots, stems, rhizomes, crowns and stolons; plant parts that contain large amounts of lignin (wood) and decompose slowly. Grass clippings, on the other hand, are largely leaves composed of SO-85% water with only small amounts of lignin, and they therefore decompose rapidly. Research projects in different areas of the United States have shown non or very small additional thatch development from grasscycling. Although to date research in California has shown some thatch buildup due to grasscycling, the benefits received from grasscycling appears to far outweigh the potential disadvantages of a slightly higher rate of thatch development.

Some turfgrasses, such as bermudagrass, Kentucky bluegrass and kikuyugrass, are naturally more thatch-prone than others, and should be regularly dethatched even if grasscycling is not employed.

A small amount of thatch (approximately l/2 inch) is actually beneficial to a lawn, providing insulation to roots and serving as a mulch to prevent excess water evaporation and soil compaction. It may also create a cushioning effect for lawn play.

Disease Management

Most turfgrass diseases occur in improperly irrigated and fertilized stands or under poor soil conditions. Much research has been conducted on grasscycling throughout the country but no relationship, positive or negative, between grasscycling and the spread of turfgrass disease, has been established. It appears that if a desirable environment for turfgrass disease exists, infestation will occur with or without grass clippings.

Weed Management

Concern over an increase in weed populations due to grasscycling is common. However, the limited data available on this issue do not support the popular belief that grasscycling encourages weed invasion. Although further research is needed to establish more precise guidelines in this regard, it can be argued that weed invasion is a problem on lawns regardless of whether grasscycling is practiced: i.e., weeds are opportunists and will invade any turfgrass stand unable to out-compete them. Therefore, if a lawn is healthier due to the more desirable environment created by proper grasscycling, it may overcome weeds, even if additional weed seeds remain on the lawn.

Conclusions

If a turfgrass stand is properly irrigated, fertilized and mowed, grasscycling can actually produce a healthier lawn. It is important to mow a grasscycled lawn frequently to produce small clippings that will decompose quickly. If a turf stand is not mowed frequently and clippings are left on the lawn, the result is a "hay-like" look some consider unsightly.

Fortunately, most golf courses and parks have successfully practiced grasscycling for years, providing encouragement for hesitant homeowners and managers of small sites. On the other hand, grasscycling is not appropriate in every situation. Prolonged wet weather, mechanical breakdown of mowers, or the necessity of infrequent mowings are situations where grass clippings should probably be bagged, since an excessive volume of clippings will be generated.

If clippings are removed from a lawn, it may not always be necessary to discard them in landfills. Grass clippings contain large amounts of both nitrogen and water and are excellent additions to both large-scale, commercial and small, backyard composting programs. Unless herbicides have been applied recently to a stand of grass, its clippings can also be used as mulch to provide weed control and prevent moisture loss around flower beds, trees, and shrubs.

Turfgrasses 1) protect our soils from erosion and our surface waters from sediment deposition; 2) cool our environment through transpiration; 3) protect our surface water and ground water by absorbing chemicals in their thatch layer and root system; 4) increase infiltration of water movement into the soil and out of the storm system; and 5) enhance property values and recreational surfaces. Grasscycling is an environmentally sound approach to maintaining this great resource.

The Use of Recycling Mowers in Grasscycling

M. Ali Harivandi[1], W. Bill Hagan[1], and Clyde L. Elmore[2]

Public interest in recycling (mulching) mowers has increased considerably in the past few years. Conventional rotary mowers typically are used with a bag attachment to catch turfgrass clippings. Clippings are often removed, despite the fact that their removal is time consuming and results in nutrient loss, because they can be unsightly and are feared to contribute to disease and thatch buildup. Nevertheless, the passage of AB 939 in California and increased yard waste and grass clippings dumping fees in many other states have prompted several mowing equipment manufacturers to renew recycling mower production. These mowers have an enclosed housing wherein clippings are chopped to fine debris before discharge beneath the mower. By reducing the size of clippings left behind, a recycling mower facilitates their disappearance into the turf canopy and their speedy decomposition, thereby addressing concerns about both appearance and thatch.

Grasscycling saves time, labor, and fertilizer. The following study focused on the effect of recycled clippings on weed invasion, turf quality and thatch accumulation. It also measured biomass and nitrogen removed using a non-recycling (bag) mower.

To compare the effects of recycling and non-recycling mowing, a two-year study was initiated in May, 1992, at the University of California Bay Area Research and Extension Center, Santa Clara, CA, on a 2- year-old turf mixture of Kentucky bluegrass *(Poa pratensis)*, and perennial ryegrass *(Lolium perenne)*. Treatments were arranged in a randomized complete block design with split-plots and 4 replications. Half of each replication was overseeded with three "weeds": rough bluegrass *(Poa trivialis)*, in November, 1992; hairy crabgrass *(Digitaria sanguinalis)*, in February and April, 1993; and dandelion *(Taraxacum officinale)*, in June, 1992. Plots were mowed weekly at 2 inches with either a recycling or bag mower. The plots were evaluated in May, 1993 and April, 1994 for type, number, and percentage weed cover. Mowers used were Toro 21 inch SF Recycler, Model No. 20 107 and Toro 2 1 inch SF 4-in- 1 Rear Bagger, Model No. 26622. Sample size for clipping measurements was 26.25 ft^2 within each plot. Total clipping weight (fresh and oven dried) removed with the bag mower was recorded biweekly and doubled for monthly totals. Total nitrogen removed through the clippings was measured by laboratory analysis. Average overall turf quality ratings which include density, texture and color, were made quarterly using a scale of l-9, with 9 being best. Thatch accumulation was measured yearly from 3 non-compressed core samples

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taken from each plot with a golf green cup cutter. Ammonium sulfate (2 l-0-0) was applied quarterly at the rate of 1 lb N/l,000 ft^2. Plots were irrigated as needed to prevent stress.

Results and Discussion

Biomass (clippings) production for 1992-94 remained relatively constant from April to July, increased during August and September and dropped during October and November. Small quantities of biomass were produced from December through February. Average biomass produced was 12,995 lbs/acre/year fresh and 4,206 lbs/acre/year oven-dried (Table 1). Nitrogen removal with the clippings followed the pattern of biomass production and was highest during high biomass production. Average total nitrogen removed with the clippings was 139 lbs/acre/year (Table 1). Although a clear benefit of grasscycling is nitrogen return to the turf stand, not all the nitrogen returned from grasscycling becomes available to plants. Based on research information from throughout the country, it appears that turf stands on which grasscycling is practiced require 20-30% less nitrogen then where clippings are removed. Extrapolating from this information, a recycling mower should be able to reduce nitrogen application approximately 25% from levels required when a bag mower is used.

Rough bluegrass and dandelion took hold when overseeded on the established stand of Kentucky bluegrass and perennial rye (Table 2). Although hairy crabgrass was overseeded twice, in February and April of 1993, this weed did not become established in the plots during the term of this study. Tables 2 and 3 summarize data related to rough bluegrass and dandelion overseeding. Weed presence increased as the study progressed (Table 2). Turf quality did not differ for weed overseeded plots (6.6) compared to non overseeded plots (6.9) in 1993. However, in 1994 turf quality was inferior (5.9) in weed overseeded plots compared to weed free (7.6) plots (Table 2). Mower type had no effect on weed establishment in 1993 or 1994 (Table 3). Turf quality was superior (7.5) when a recycling mower was used in 1993, but this superiority was lost by 1994 (Table 3). This may suggest that the extra nitrogen from clippings enhanced turf quality in 1993, before weeds were established, but enhanced weed growth once they took hold.

Effect of weed overseeding and mower type on overall turf quality and thatch development is presented in Table 4. Each treatment (weed overseed and mower type) significantly affected quality (Table 4). Quality was best for all treatments in 1993 compared to the same treatments in 1994 (6.1), best when no weed overseeding was compared with an overseeded plot with the same mowing treatment (6.2), and best for the recycling mower in all treatments (5.9). Density was better in 1994 (7.0) than in 1993 (6.8) for all treatments. Texture was not affected by any of the treatments. Turf color was superior where weeds were not overseeded (6.7) and when a recycling mower was used (6.4) but on overseeded plots the recycling mower produced better color than the bag mower. Thatch was thicker in 1994 (0.2 inches) than in 1993 (0.024 inches) for all treatments and was thicker where a recycling mower was used (0.18 inch) than were a non-recycling mower was used (0.004 inch). Even though these differences in thatch depth were statistically significant (Table 4), their magnitude was too small to concern a turf manager.

As anticipated, significant biomass (12,995 lbs/acre/year) and nitrogen (139 lbs/acre/year) were removed with a non-recycling (bag) mower. A recycling mower enhanced turf quality and color; however, texture and density were not affected by mower type.

It appears from these studies that the advantages (additional nitrogen, higher turf quality, and reduction of green waste) of mowing a turf stand of mixed bluegrass-ryegrass with a recycling mower far outweigh the few disadvantages (i.e., slightly higher thatch development). This study did not indicate a significant interaction between grasscycling and weed invasion. However, further studies, with more invasive and prolific seed producing weeds (e.g. annual bluegrass) would be useful.

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Table 1. Average removed fresh and dry turfgrass clipping weight and nitrogen content when mowed with a non-recycling mower (1992-l 994).

Treatment	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
	lb./acre												
Fresh Clippings	72.1	105.0	977.7	1288.5	1415.8	1359.7	1130.0	1662.5	2162.9	1477.2	1174.5	170.9	12,995.5
Oven Dry Clippings	36.5	48.0	308.9	424.7	455.9	479.0	445.2	571.6	643.8	420.3	307.2	62.3	4,206.5
Total Nitrogen Within Clippings	0.9	1.7	9.8	13.3	13.3	13.3	13.3	17.8	25.8	16.0	11.5	1.7	138.9

Table 2. Kentucky bluegrass-perennial ryegrass turf qualtiy and weed invasion when overseeded with rough bluegrass and dandelion (1992-1994)^{Z}.

Treatment	Rough bluegrass (% cover)	Dandelion (number plants/plot)	Turf^{X} Quality
May 1993			
Weed Overseed	5.0 a^{Y}	21.4a	6.6 a
No Overseed	1.4b	2.3 b	6.9a
April 1994			
Weed Overseed	45.6 a	31.3 a	5.9 a
No Overseed	4.3 b	5.0b	7.6 b

‘Established Kentucky bluegrass-perennial ryegrass plots were overseeded with rough bluegrass in November 1992, and dandelion in June 1992.
‘Mean values followed by similar letters are not statistically significantly different.
‘Turf quality visual ratings based on a scale of l-9, with 9 being best.

Table 3. Effects of mower type (recycling and non-recycling) on turfgrass quality and weed establishment (1992-1994).

Treatment	Rough bluegrass (% cover)	Dandelion (number plants/plot)	Turf” Quality
May 1993			
Non-recycling Mower	3.3 a^{Z}	15.0a	6.0 a
Recycling Mower	3.1 a	8.6 a	7.5 b
April 1994			
Non-recycling Mower	28.4 a	21.4a	6.6 a
Recycling Mower	21.6 a	14.9 b	6.9 b

^{Z} Mean values followed by similar letters are not statistically significantly different.
^{Y} Turf quality visual ratings based on a scale of 1-9, with 9 being best.

Table 4. Effects of year, weed overseeding and mower type on turf quality and thatch development.

Treatment	Overall Turf Quality^{Z}: Turf Quality	Density	Texture	Color	Thatch (inch)
1993	6.1 a^{Y}	6.8 a	6.5 a	6.3 a	0.024 a
1994	5.5 b	7.0 b	6.5 a	6.2 a	0.200 b
Weed Overseed	5.5 a	6.9 a	6.5 a	5.7 a	0.136 a
No Overseed	6.2 b	6.9 a	6.6 a	6.7 b	0.088 a
Non-recycling Mower	5.7 a	6.9 a	6.6 a	6.1 a	0.040 a
Recycling Mower	5.9 b	6.9 a	6.5 a	6.4 b	0.184 b

^{Z} Average visual ratings for 1992-94. Ratings are based on a scale of l-9, with 9 being best quality, most dense, finest texture and darkest color.
^{Y} Mean values followed by similar letters are not statistically significantly different.

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UC Turf Corner contains summaries of recently reported research results, abstracts of certain conference presentations and announcements of new turf management publications.

Tall Fescue Growth Characteristics and Water-Use Rates

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There are substantial differences in evapotranspiration (ET) rates (often referred to as water-use rates) among turfgrass species, and even cultivars within a species. Correlating various growth characteristics of turfgrasses with their water-use rates may be a useful tool in the development, selection, and use of species and cultivars that require less water.

Due to the proliferation of dozens of new tall fescue *(Festuca arundinacea)* cultivars released over the last ten years that exhibit finer leaf texture, darker green color and increased density than earlier tall fescues, the authors were interested in assessing growth characteristics and evapotranspiration (ET) rates of some of these new introductions.

Tall fescue is native to Europe, and was introduced into the United States by early settlers for pasture use and soil stabilization purposes. Tall fescue is very useful in turfgrass transitional climatic zones, located between temperate and subtropical climate zones across the United States because of its high tolerance to warm temperatures and ability to grow in cool winter temperatures without going dormant. It is well adapted to the environmental conditions of Southern California.

In this study, ET rates, clipping yields, leaf density, vertical leaf-extension rates, leaf length, and leaf width of seven cultivars of tall fescue grown under field conditions at UC Riverside were recorded over a five-week period in July and August 1994, and again in June to August 1995. The above-ground morphological diversity within this group was fairly representative of the morphological diversity observed among turf-type tall fescue cultivars. Turfs were established from seed in plastic pots (9-inch diameter x 12-inch deep) filled with fritted clay for 7.5 months prior to 1994 measurements.

In 1994, correlation coefficients between clipping yield vs. leaf density, vertical leaf-extension rate, leaf length, and leafwidth were -0.56**, 0.87***, 0.60***, and 0.39*, respectively. Note that there were positive (+) and negative (-) correlation coefficients. A (+) correlation means as one variable increases, so does the second variable, while a (-) correlation means as one variable increases, the second variable decreases. Whether a correlation is (+) or (-) should not be confused with its level of significance: NS, *, **, ***, are: not significant, significant at the 0.05 level, significant at the 0.01 level, and significant at the 0.001 level, respectively. The 0.001 level is the most significant level.

In 1994, correlation coefficients between ET rate and all morphological traits measured were not significant. This means that there is no association between the ET rate and all morphological traits, including clipping yield.

These preliminary data suggest that cultivars with a high leaf density and slow leaf extension rate produce the lowest amount of clippings. Dwarf-type tall fescue cultivars offer these characteristics. These data also suggest that morphological traits do not influence water-use rates of tall fescue when assessed under well-watered conditions.

In addition to the results reported above, another interesting finding in this study relates to the 46% range in clipping yield produced among the seven cultivars.

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Cultivar selection could be an important method for facilitating grasscycling and reducing the amount of grass clippings being deposited in California landfills.

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WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in their original labeled containers in a locked cabinet or shed, away from food or feeds and out of the reach of children, unauthorized persons, pets, and livestock.

Recommendations are based on the best information currently available, and treatments based on them should not leave residues exceeding the tolerance established for any particular chemical. Confine chemicals to the area being treated. THE GROWER IS LEGALLY RESPONSIBLE for residues on his crops as well as for problems caused by drift from his property to other properties or crops.

Consult your County Agricultural Commissioner for correct methods of disposing of leftover spray material and empty containers. **Never burn pesticide containers.**

PHYTOTOXICITY: Certain Chemicals may cause plant injury if used at the wrong stage of plant development or when temperatures are too high. Injury may also result from excessive amounts of the wrong formulation or from mixing incompatible materials. Inert ingredients, such as wetters, spreaders, emulsifiers, diluents and solvents, can cause plant injury. Since formulations are often changed by manufacturers, it is possible that plant injury may occur, even though no injury was noted in previous seasons.

NOTE: Progress reports give experimental data that should not be considered as recommendations for use. Until the products and the uses given appear on a registered pesticide label or other legal, supplementary direction for use, it is illegal to use the chemicals as described.

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