CLIPPING DISPOSAL INVESTIGATIONS WITH ROTARY LAWN MOWERS

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Traditionally the homeowner has removed clippings when mowing lawns. The removal of clippings is a time-consuming process. In the 1960's a number of professional turfmen questioned this practice, although very little research existed to substantiate this position. Clipping return has been reported to increase the infiltration rate of water into the soils (3). Noer (4) measured the amount of nutrients removed in the clippings from a creeping bentgrass (Agrostis palustris Huds.) green in Milwaukee, Wisconsin. He reported 4.8 pounds of nitrogen, 0.7 pound of phosphorus, and 2.6 pounds of potassium removed annually per 1,000 square feet. Such data indicate the beneficial effects of clipping return, particularly the value of nutrient recycling.

One objection some homeowners have to clipping return is the residue of brown dead clippings that is sometimes left on the surface of the lawn which creates an objectionable appearance. Under infrequent mowing the resulting layer of clippings can be so thick that light is excluded causing yellowing and weakening of the turf. Unsupported statements can also be found in the literature indicating that clipping return contributes to thatch accumulation. The objective of this investigation was to study the disposition and potential problems associated with clipping return as it relates to non-mulching versus mulching type rotary mowers.

MATERIALS AND METHODS

These studies were conducted during the 1972, 1973, and 1974 growing seasons at two sites. The primary experimental site was located at East Lansing, Michigan. The cool season turfgrass, Merion Kentucky bluegrass (Poa pratensis L.), was used for both the clipping disposition and mower comparison studies. The turf was a typical, mature northern cool season lawn maintained at a cutting height of 1.2 inches; mowed twice weekly with clippings returned; irrigated as needed to prevent visual wilt; received 5 pounds nitrogen per 1,000 square feet per year; and had received no pesticides for two years prior to initiation of the study. The soil on the site was a Conover sandy loam having adequate phosphorus and potassium levels.

The second experimental site involved the warm season species, Floratine St. Augustinegrass (Stenotaphrum secundatum Kuntze), located at Fort Lauderdale, Florida. The turf was a typical lawn maintained at a cutting height of 2 inches; mowed twice weekly with clippings returned; received 6 pounds nitrogen per 1,000 square feet per year; was irrigated as needed to prevent wilt; and had received no fungicides or herbicides for one year prior to initiation of the studies. Carbaryl had been applied for chinch bug control. The soil on the site was a sand of high infiltration rate and low nutrient holding capacity. The phosphorus and potassium levels were adequate. Similar experiments conducted at the same site on Ormond bermudagrass (Cynodon dactylon (L.) Pers.) mowed at 0.5 inch gave results comparable to that for St. Augustinegrass and thus will not be reported.

Clippings Removal vs. Return Studies. A nitrogen recycling study was initiated on a mature Merion Kentucky bluegrass turf at East Lansing, Michigan. Clippings had been removed for a one year period prior to initiation of the treatments. Seven levels of nitrogen fertilization, 0, 2, 4, 6, 8, 10, and 12 pounds of nitrogen per 1,000 square feet per year, were applied in four split applications. Two methods of clippings disposal, clipping removal versus clipping return, were superimposed on a split plot basis across the seven nitrogen rates. Plot size for the nitrogen treatments was 3 by 8 feet in a randomized split plot design of four replications. Visual ratings were made regularly to evaluate the rate of initial nitrogen release as well as long-term effects of clipping removal on visual turfgrass quality, particularly color. On an adjacent area maintained at 5 pounds of nitrogen per 1,000 square feet per year, all clippings were collected from the Merion Kentucky bluegrass turf for a three year period and analyses of total nutrient removal conducted.

Clipping-Thatch Studies. Thatched turfs from Kentucky bluegrass and red fescue (*Festuca rubra* L.) lawns where clippings had been returned for an extended period of time were collected and detailed physical examinations conducted. Plugs of the thatch were carefully separated into half inch vertical layers. Plant parts composing each of these layers were isolated and examined under a microscope to determine which plant tissues and structures contribute to thatch accumulation.

Mulching Versus Non-Mulching Mower Comparisons. A mulching mower* and four non-mulching mowers widely used by the homeowner were utilized to assess the validity of the mulching concept. The non-mulching mowers were 21 inch, self-propelled units. All five mowers were new models recently purchased specifically for use in this study. The rpm levels were checked and found to be in the operating range specified by each manufacturer.

Initial attempts during 1972 to assess the clipping length distribution involved collection, measurement, and counting the lengths of a clipping subsample from each mower. This method proved extremely time consuming and difficult to accomplish with the desired degree of accuracy and repeatability. After trying a number of other systems of physical separation the following procedure was found to give accurate, repeatable results.

Clipping collection with the mulching mower involved using a specially built plug cutter which removed a sod plug 5 inches in diameter and 3 inches deep. Cups were then placed in these openings with the upper lip slightly above the soil surface so that the mower could readily pass over the sampling cups. The number of cups required to collect an adequate sample varied with the turfgrass density and cutting height. Six cups were required in most situations and as many as 15 cups in turfs which were thin or closely mowed. Clipping collection from the non-mulching mowers was accomplished with the standard grass catcher attachment supplied by the manufacturer. A random sample of clippings was immediately removed from the grass catcher or cans and placed in a plastic bag to minimize moisture loss.

The plot size was 20 feet long by 24 inches wide. Each plot had a width greater than that of the mowers so that a full swath of grass was cut at each pass. The mowers were operated at full throttle across the entire 20 foot distance. One clipping sample was collected per plot, thus five separate plots were required for each mower in order to obtain five replicated samples. The physical separation into clipping length classes was conducted on one replication of each mower at one time in order to minimize drying.

Clipping samples contained in the sealed plastic bags were immediately taken to the laboratory for physical classification according to the following procedure. Twenty-gram fresh weight samples were weighed and immediately placed on a rack of sieves stacked with the larger sieves at the top and smaller at the bottom. The rack

* Bolens Model No. 8444-01, 22 inch, self-propelled mulching mower.

of sieves was mounted on a mechanical shaker which was operated for 2 minutes duration in a horizontal back and forth motion. This duration was sufficiently long to achieve repeatable fractionation. Clippings retained on each individual sieve were then collected, immediately weighed, and the weights recorded. Originally six sieve sizes were used resulting in the following classes: Class 1 - clippings less than or equal to 0.5 mm; Class 2 - 0.5 to 1.5 mm; Class 3 - 1.5 to 2.5 mm; Class 4 - 2.5 to 4 mm; Class 5 - 4 to 8 mm; and Class 6 - 8 to 12 mm and larger. In this report the data for Classes 1 through 4 were grouped as they did not prove significantly different in terms of visual clipping accumulation in the turf. In the case of the St. Augustinegrass, Classes 1 through 4 consisted of clippings less than 15 mm; Class 5 - 15 to 28 mm; and Class 6 - 28 mm or larger. The larger class size was necessary because of the wider leaf characteristics of St. Augustinegrass.

RESULTS

Clipping Removal vs Return Studies. Daily visual observation of a Kentucky bluegrass turf maintained at seven nitrogen fertility levels indicated that a nitrogen response to clipping return appeared within 14 days after the clipping removal versus return treatment differential was initiated. That is, the nitrogen contained in the clippings was leached and/or released from the clippings; returned to the soil; absorbed by the root system; and translocated to the leaves for utilization in chlorophyll synthesis within a 14-day period.

On an annual basis where 2 pound increments of nitrogen fertilization were compared with clippings both returned and removed, an 8 pound per 1,000 square feet nitrogen rate was required where clippings were removed to achieve a comparable visual color, appearance, and shoot density to a turf receiving 6 pounds of nitrogen with clippings being returned. This quality differential persisted throughout the three-year duration of the study. An allied three-year study conducted by Rieke and Beard (5) showed that 5.7 pounds nitrogen, 0.6 pound phosphorus, and 3.4 pounds potassium were removed annually per 1,000 square feet from an adjacent comparably maintained Kentucky bluegrass turf which was fertilized at 4 pounds nitrogen, 1 pound phosphorus, and 2 pounds potassium per 1,000 square feet per year.

Clipping-Thatch Studies. Detailed physical examinations of thatched Kentucky bluegrass and red fescue turfs where the clippings had been returned for a period of 8 years revealed no whole or partial fragments of clippings existing in the dense, central body of accumulated thatch. Depth of the thatch examined ranged from 3 to 4.5 cm. The thatch was composed primarily of crown and stem tissue plus some root fragments. Stem fragments were composed of leaf sheaths and nodes which tend to be more sclerified and thus persist for a longer period of time. These observations were supported by earlier reports conducted on more intensively maintained bentgrass (*Agrostis* spp.) turfs (2).

These observations indicate that leaves are readily decomposed and are of minimal importance in thatch formation. There were some leaf clippings observed in the pseudo-thatch layer just at the top or somewhat elevated above the thatch layer. The pseudo-thatch layer is composed largely of the longer leaf clippings which bridge across living stems and leaves. This bridging prevents intimate contact with the soil and/or thatch layer where moisture and microbiological conditions are more favorable for rapid clipping decomposition. A pseudo-thatch of bridged clippings has no long-term detrimental effects similar to those associated with thatch.

It was concluded that the return of clippings is not a significant factor in the accumulation of a problem thatch layer. It was also evident that methods of mowing which fractionate the clippings into shorter lengths will enable them to fall through the turf into more intimate contact with the soil. This will enhance the rates of clipping decomposition and nutrient recycling.

Mulching Versus Non-Mulching Mower Comparisons. Mulching versus non-mulching rotary mower comparisons were made at intervals during the 1972, 1973 and 1974 growing seasons at East Lansing, Michigan, on Kentucky bluegrass. At least five and as many as seven replications were utilized in each test. Representative data from mid-July of 1974 are presented in Table 1. In all tests the mulching mower ranked superior to the non-mulching mower in terms of shorter fractionation of leaf clippings. From 3.6 to 4.3 cm of Kentucky bluegrass clippings were removed at each mowing.

Since earlier studies reported in this paper show that clippings decompose rather rapidly and are not significant in thatch accumulation, the main concern where clippings are returned is the presence of a brown appearance on the lawn surface. Thus, a shorter clipping length is important in facilitating clipping penetration to greater depths in the turf. With Kentucky bluegrass, the bridging and/or suspending of clippings at higher heights in the turf occurs above 8 to 12 mm in length. It can be seen from Table 1 that the mulching mower produced 15 to 20% more clippings in the narrower size range which will more readily fall through the turf canopy.

Similar results were observed with St. Augustinegrass in both 1972 and 1974 at Fort Lauderdale, Florida (Table 2). In the St. Augustinegrass tests approximately 3.8 to 5.0 cm of clippings were removed at each mowing.

DISCUSSION

Results of these investigations indicate that leaf clippings decompose quite rapidly compared to stem and crown tissues. This leaf decomposition can occur quite rapidly, with recycling of nitrogen occurring in as short a time as 14 days. A significant recycling of other nutrients can also occur as a result of clipping return. A second potential problem with clipping return involves an objectionable brownish appearance which may be left on the lawn. Results from the mulching versus non-mulching rotary mower comparison study indicate that it is possible to design and construct mowers with the capability of fractionating clippings into smaller lengths. This will enable the clippings to fall farther into the turfgrass canopy and, thus, into a microenvironment that is more favorable for rapid decomposition and recycling. It should be mentioned that there are certain situations where the return of clippings may increase the potential for disease development. This potentially negative effect was not investigated in this study. However, the benefits from clipping removal in terms of reduced disease development will only occur with certain diseases and usually on more intensively maintained sports and golf course turfs rather than on medium or low maintenance lawn turfs.

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Table 1. Clipping size differences resulting from one mulching and four non-mulching rotary mowers conducted on a Kentucky bluegrass lawn.

Mower Type	Percentage clipping length distribution by class			
	Class 1, 2, 3 & 4 (<4 mm)	Class 5 (4 to 12 mm)	Class 6 (>12 mm)	Class 5 & 6 (>4 mm)
Mulching rotary	41.2 a	33.1 c	25.7 a	58.8
Rotary A	14.6 d	27.0 a	58.4 e	85.4
Rotary B	17.2 c	28.9 a	53.9 d	82.9
Rotary C	28.4 b	37.4 d	34.3 b	71.6
Rotary D	27.8 b	30.1 b	42.0 c	72.2

Table 2. Clipping size differences resulting from one mulching and two non-mulching rotary mowers conducted on St. Augustinegrass.

Mower Type	Percentage clipping length distribution by class			
	Class 1, 2, 3 & 4 (<15 mm)	Class 5 (15 to 28 mm)	Class 6 (>28 mm)	Class 5 & 6 (>15 mm)
Mulching rotary	69.1 a	22.3 b	8.6 a	30.9
Rotary D*	63.8 b	20.3 a	15.9 c	36.2
Rotary A*	52.3 c	24.2 c	23.5 d	47.7

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