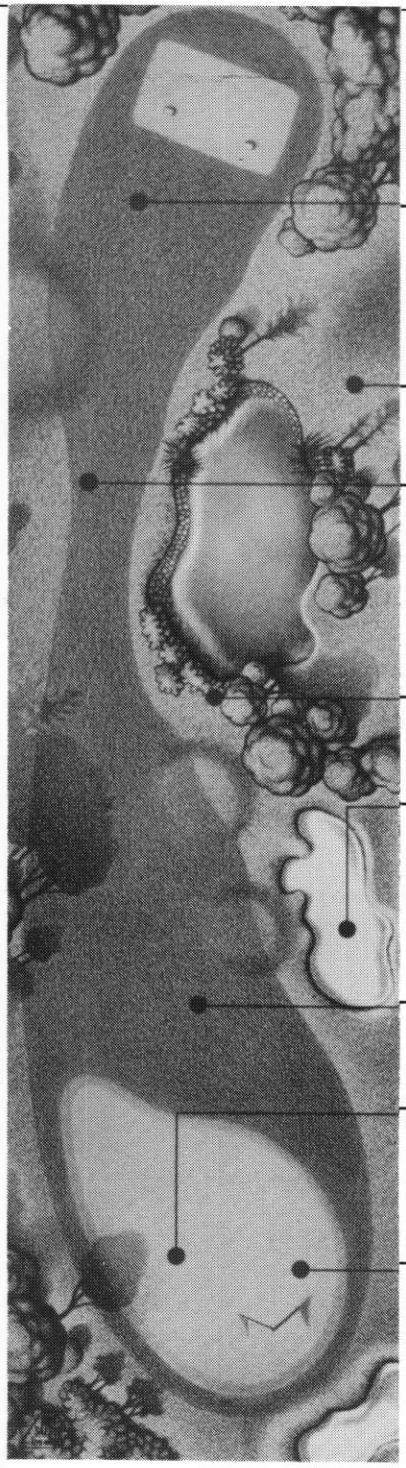

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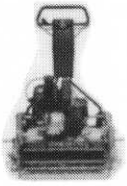

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Turfgrass Nitrogen Sources

By Donald V. Waddington
Department of Agronomy
The Pennsylvania State University

(Editor's Note: The following article was downloaded and adapted from PENpages Internet file at Penn State University — College of Agricultural Sciences. Those of you who can access this database would find many useful turf and horticultural articles available. Thanks go to Bob Mugaas at the Minnesota Extension Service for collecting this information. Because of the length of this article, Hole Notes will present it in two parts.)

Nitrogen (N) sources used for turfgrass fertilization encompass a wide variety of properties and release characteristics. Physical forms range from granules for dry applications to powders, suspensions, and true solutions for liquid application. Release of N is rapid with some sources and slow with others, and there are different release mechanisms among the slow-release N sources. Slow-release N sources have lower salt indexes and thus less potential for fertilizer burn than quick-release, or soluble, N sources; and salt indexes differ among the quick-release sources. Nitrogen sources can be used alone or in mixed fertilizers with phosphorus and/or potassium sources, and various combinations of slow- and quick-release N sources may be used. Knowledge of the properties and characteristics of N sources is of great importance when one is making decisions of N fertilization programs. Examples of N sources are listed in Table 1.

Quick-Release N Sources

Quick-release sources are also called quickly-available, fast-acting, soluble, readily-available, and other terms that indicate rapid availability of N after application. This group includes urea (a synthetic organic), inorganic salts containing ammonium (NH4+) or nitrate (NO3–), and a group of urea-formaldehyde reaction products. Some Urea-formaldehyde reaction products contain enough water-soluble nitrogen so that they give a response closer to that obtained with urea and other solubles than with the slow-release sources such as activated sewage sludge, IBDU and ureaform. The quick-release sources are divided into two groups for discussion.

Inorganic salts and urea: These materials are soluble, have N contents ranging from 15 to 46%, and are less expensive than slow-release sources. Being water soluble, they may be applied in solution as well as in dry form. These sources have high salt indexes and thus have high potentials for fertilizer burn. They give a rapid response and frequent applications at low rates are recommended to minimize over-stimulation of growth and fertilizer burn.

These salts readily dissolve in water and dissociate into their cation and anion components: e.g., ammonium nitrate (NH4NO3) dissociates into ammonium ions (NH4+) to NO3– in an oxidation process called nitrification. Plants may utilize nitrogren in either the NH4+ or NO3– form, but most is taken up as NO3–. Nirtrates are readily leached, but ammonium is less susceptible to leaching because it can be adsorbed by soil colloids (clay and humus).

Urea is water soluble, and is quickly hydrolyzed (reacts with water) in the presence of adequate moisture and the enzyme ureas to form ammonium–N. More than 60% of the applied urea can be expected to hydrolyze in one day, and hydrolysis should be complete in about 7 to 10 days. Under alkaline conditions gaseous loss of N as ammonia may occur from urea and ammonium compounds. This process, called volatilization, is also favored by low soil cation exchange capacity, drying of moist soil and high temperature. Losses are usually greatest with urea, and on grass areas, losses as high as 30% of the applied N have been reported. Watering-in fertilizer will minimize such losses.

Urea-formaldehyde Reactions Products: A well-known urea-formaldehyde fertilizer is ureaform, which is a slow-release source of N with about 70% of the total N being water insoluble. By altering the ratio of urea to formaldehyde, reaction products with considerably less water-insoluble N (WIN) can be produced. The water soluble nitrogren of these products contains compounds such as unreacted urea, methylol urea and methylene ureas. The amount of each is largely dependent on the urea/formaldehyde ratio and the conditions under which the reaction takes place. these N sources are more expensive than the conventional solubles, but they are safer from the standpoint of fertilizer burn.

Methylol urea is the first compound formed when urea and formaledehyde are chemically combined. As the reaction continues, short-chain and, later, long-chain methylene urea polymers are formed.

The short-chain molecules are water soluble and the longer chain molecules are water insoluble. RESI-GROW 4340 and 4341 are clear aqueous solutions containing methylol urea and unreacted, or free, urea, which supplies abou t 50% of the N. Other water-soluble urea-formaldehyde reaction products are Formolene Plus, CORON, and Nitro-26 CRN. They are solutions that contain water soluble methylene ureas and some unreacted urea. About 25 to 30% of the N is from unreacted urea. N-SURE is a solution that differs from the previously mentioned solu-

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tions in that it contains N primarily in the forms of triazones and urea. Triazones are cyclic N compounds that form when the fertilizer is manufactured by reacting urea, formaldehyde and ammonia. Each of these solutions has a lower burn potential than urea, and can be used more safely at higher rates or on heat or water stressed turf. However, turfgrass response to these N sources has been very similar to that obtained with urea.

FLUF, homogesol-27 and RESI-GROW 4318 are flowable urea-formaldehyde reaction products that contain water-insoluble as well as water-soluble methylene ureas. Quick response is obtained with these materials, but the intensity of response is not as great as with urea and the previously discussed solution fertilizers.

Methylene ureas can be made with varying amounts of WIN. We have used a granular material supplied by O. M. Scott & Sons that had 36% of the total N as WIN, and a sprayable material having 30% of the N as WIN. Such materials can be expected to give a good initial response, but also have a greater residual effect than the soluble materials. The granular product gave turfgrass response similar to that obtained with fertilizers containing 50 and 60% ureaform-N, with the remainder from soluble N sources. Such response more closely followed that from soluble N sources than that from ureaform. Other methylene ureas used by Scotts contain considerably less WIN, but safety is preserved by the presence of soluble, short-chain methylene ureas. Homestead's Homogenite 40 is a granular methylene urea product containing 41% N, with about 27% of the N as WIN. Nutralene is NOR-AM's product in this category. It contains 40% N and 14.5% WIN.

Slow-Release Nitrogen Sources

Slow-release nitrogen sources, which are also called controlled-release, slowly-available, slow-acting, and insoluble, can be classified according to the method by which the nitrogen is released:

(1) microbial activity is required for decomposition and release of N from natural organics and urea-formaldehyde reaction products (ureaform, methylene ureas), (2) low water solubility and a very slow rate of dissolution gives the slow-release characteristic of IBDU, and (3) coatings on soluble N sources act as physical barriers that delay the dissolution of N from sources such as sulfur-coated urea and plastic-coated fertilizers.

Slow-release sources provide a longer duration of N release than the soluble, quick-release sources. They are safe from the standpoint of fertilizer burn (lower salt index), and may be applied at higher rates and with less frequency than soluble sources. The efficiency of some slow-release sources is often low in the first year or two of use. The low efficiency (often expressed as the percentage of the applied N utilized by the plant) and higher cost for N associated with the slow-release sources are reasons that combination of slow and fast-release N sources are used in many turf fertilizers. A discussion of individual slow-release sources follows:

Natural ogranics: For the most part, these materials are by-products from the plant and animal processing industries or waste products. Considerable variation exists in the properties of different materials, and even within a given material. The natural organics can be characterized by relatively low N content, the presence of WIN, and N release intermediate between that of soluble N sources and ureaform. Examples include hoof and horn meal, fish scrap and meal, seed meals (cottonseed, linseed, castor pomace), dried manures, activated sewage sludge and process tankage. Release of N is dependent on microbial activity. Environmental conditions affecting breakdown of natural organics include temperature, soil moisture and oxygen, soil pH and available minerals. Milorganite is an activated sewage sludge and is the most popular natural organic N source used on turf. Milorganite has been more efficient than several other natural organics in our tests. Terrene is a relatively new product with characteristics similar to Milorganite. A number of other natural organics, such as poultry manure and seed meal, are used in products sold under the names of Harmony, Plant Right, Ringer and Sustane as well as others.

Ureaform: Ureaform is made by reacting urea with formaldehyde. Ureaform is not a single compound, but is composed primarily of a mixture of straight-chain polymers. Ureaform contains 38% N and about 70% of this N is water insoluble. Ureaform can be divided into three, almost equal fractions based on solubility. Fraction I is soluble in cold water, and contains unreacted urea and the short-chain methylene ureas: methylene diurea and dimethylene triurea. Availability of N in this fraction is similar to that of soluble sources, but is not as quickly available. Fraction II is made up of slow-release, intermediate length polymers (trimethylene tetraurea and tetramethylene pentaurea). It is insoluble in both hot and cold water and is made up of pentamethylene hexaurea and longer chain polymers. It is the most resistant fraction. In a study by Kaempffe and Lunt (from California) the breakdown of these fractions was studied over a period of 26 weeks. After this time period, 4% of fraction I, 25% of fraction II and 84% of fraction III remained in the soil. The slow decomposition of fractions II and III accounts for the low efficiency of ureaform in the initial years of use. With continued use and build-up or ureaform, recovery of applied N improves.

According to the Association of American Plant Food Control Officials, ureaform should contain at least 35% N, with at least 60% of the total N being water insoluble N (WIN), and the WIN should have an activity index (AI) of at least 40%. The AI represents the amount of cold water insoluble N that is soluble in hot water (commercially avail-

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able material has an AI of about 55%). Nitroform Blue Chip and Powder Blue meet these criteria. Urea-formaldehyde reaction products not falling within these guidelines are referred to by other terms such as methylene urea, methylol urea and flowable ureaform. By using urea-formaldehyde solutions, ureaform (or methylene ureas) can be made during the manufacture of mixed fertilizers.

Release of N from ureaform is dependent on microbial activity and the same environemtnal factors that affect release from natural organics also affect release from ureaform (or methylene urease) can be made during the manufacture of mixed fertilizers.

Release of N from ureaform is dependent on microbial activity and the same environmental factors that affect release from natural organics also affect release from ureaform. Because of low N recovery (efficiency) in the first years of use, it is usually necessary to use higher rates or supplement ureaform with soluble sources in these years. This low recovery and slow response during cool periods support the concept of fertilization with combinations of ureaform and solubles.

Organiform: Organiform is a N source made by reacting urea and formaldehyde in the presence of a natural organic N source. Organiform contains about 24 to 25% N, of which about 70% is WIN. Organiform LT is a copolymer of leather tankage and methylene ureas, and Organiform SS is a copolymer of sewage sludge and methylene ureas. Release of N is dependent on microbial activity. We have found these materials to be slower in release and less efficient than Milorganite and Nitroform. Response has improved with continued use. A combination of 50% Organiform N and 50% soluble N greatly exceeded the performance obtained with straight Organiform.

Other urea-formaldehyde reaction products: Although we often think of slow-release N when we hear the term urea-formaldehyde, there are some urea-formaldehyde reaction products that tend to be more quick-release than slow-release. The ratio of urea to formaldehyde used during manufacture affects the amount of WIN in the fertilizer. Ureaform is made using a ratio of about 1:3:1. Other N sources are made using wider ratios (more urea), and the result is lower amounts of WIN. I am not aware of any formal or informal rules that dictate when the term 'slow-release' is justified for a N source with a given amount of WIN. Certainly, confusion can arise when 'slow-release' is used with a material that has less of the total N as WIN than mixed fertilizers containing combinations of slow-release and soluble N such as 50% IBDU or Ureaform N and 50% soluble source N. Even more confusion occurs when water soluble methylene ureas are described as being sources of slowly available N. The characteristics of three urea-formaldehyde reaction products (methylene ureas, methylol urea and flowable ureaform) were given under the 'Quick-Release N Sources' heading. Of these three, the slowest-release of N would occur with methylene ureas having the higher amounts of WIN.

Table 1. Typical properties of nitrogen sources used for turfgrass fertilization.

Physical Form	Common or Trade Name	Manufacturer	Fertilizer Grade	Total N	Water-Insoluble
				%	%
SOLUBLE SOLIDS					
	Monoammonium phosphate	-	10-50-0	10	0
	Diammonium phosphate	-	18-46-0	18	0
	Ammonium nitrate	-	33.5-0-0	33.5	0
	Ammonium sulfate	-	20-0-0	20	0
	Calcium nitrate	-	15-0-0	15	0
	Sodium nitrate	-	16-0-0	16	0
	Potassium nitrate	-	13-0-44	13	0
	Urea	-	46-0-0	46	0
SLOW-RELEASE SOLIDS	Milorganite	1	6-2-0	6	5.5
	Terrene	15	6-2-0	6	5.5
	Nitroform Blue Chip	2	38-0-0	38	27.0
	IBDU (coarse)	3	31-0-0	31	27.9
	IBDU (fine)	3	31-0-0	31	26.3
	Nutralene (Methylene ureas)	2	40-0-0	40	14.5
	Other Methylene ureas	4,13	--	38-41	10-14
	Sulfur-coated urea	4,5,6,8	--	32-38	--
	Plastic-coated fertilizer	3,7,8	Variable (see text)		
	Melamine, "Super 60"	8	Variable (see text)		
SOLUTIONS	RESI-GROW 4340	9	30-0-0	30	0
	RESI-GROW 4341	9	30-0-2	30	0
	CORON	10	28-0-0	28	0
	N-SURE	11	28-0-0	28	0
	Nitro-26 CRN	12	26-0-0	26	0
	Formolene Plus	11	30-0-0	30	0
SUSPENSIONS	Homogesol-27	13	27-0-0	27	2.7
	FLUF	14	18-0-0	18	4.5
	RESI-GROW 4318	9	18-0-0	18	4.5
SPRAYABLE POWDERS	Methylene Urea	4	41-0-0	41	12
	Nitroform Powder Blue	2	38-0-0	38	25
	IBDU	3	31-0-0	31	23

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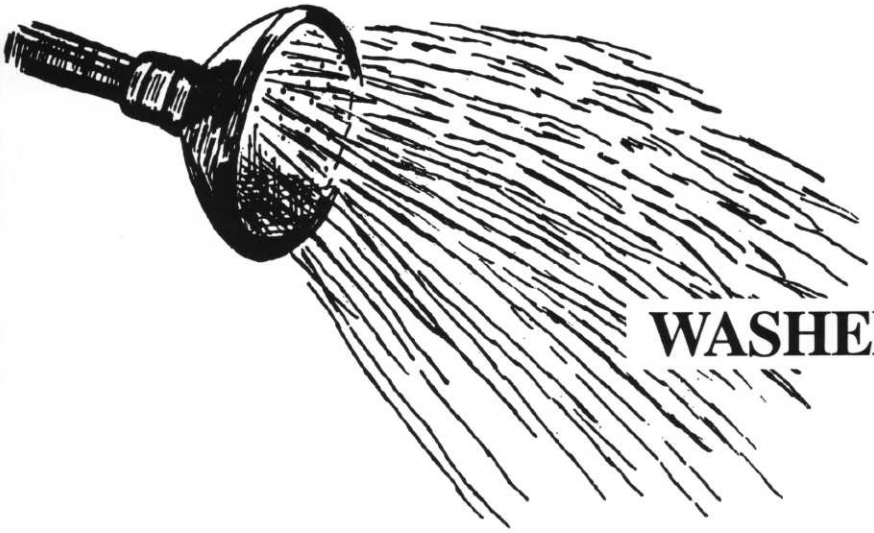

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University of Minnesota UPDATE

By Phil Larsen
University of Minnesota

TURF DISEASE COURSE TO BE OFFERED AT THE UNIVERSITY OF MINNESOTA, WINTER, 1996

A course on diseases of turfgrasses will be offered Winter Quarter, 1996, by the Department of Plant Pathology at the University of Minnesota through Continuing Education and also through regular day school classes. The course, entitled *Diseases of Turfgrasses*, PIPa 1004, will be offered for 2 credits and will emphasize identification and management of turfgrass diseases with special attention to diseases common to the north central United States.

Dr. Phil Larsen, Professor in the Department of Plant Pathology, will serve as instructor. The course will consist of nine sessions on Monday evenings, 6:30–9:30 p.m., starting January 8, and will meet in 365 Borlaug Hall on the St. Paul Campus. Representatives from the turf industry and the Minnesota Extension Service will also participate as guest lecturers in the course. Enrollment is limited to 20 students. Professional turfgrass managers are invited to enroll. For registration information, contact Continuing Education at the University of Minnesota, phone 612-625-2500, or you may call Phil Larsen at 612-625-1999.

After serving as Head of the Department of Plant Pathology at the University of Minnesota for over nine years, Phil Larsen will return to teaching and research in the area of plant disease management in the urban setting. His primary focus will be on diseases of turfgrass. Larsen will also have supervisory responsibility for the Plant Disease Clinic in the Department of Plant Pathology.

Larsen is presently engaged in surveying golf course superintendents and other turf professionals to assess their research and educational needs. Results of the informal survey will be used to set teaching and research priorities on turfgrass disease research and education programs for the future.

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If It Isn't Green!

By Dick Morey
Southern Golf

A good many years ago we would hear the old lament form the turf side of the landscape contracting business that the golf course people were a very 'nomadic' group.

The old saying was, "Don't unpack for you may not be there very long!" After 25 years that situation hasn't changed very much.

Insecure About Keeping It Green

The other day we were visiting with a local superintendent about some renovation taking place at his course, and a comment he made then brought back to mind this whole situation about the insecurity felt and experienced by just about every superintendent in this business of "keeping it green!"

This very affable superintendent made the following comment, which really brought home this precarious plight of almost every superintendent in this business. He said, "This is the first time in my 10-year career that I have ever felt I might buy a home where I've been!"

What a sad commentary on this business!

Don't Unpack

Another note in a a recent issue of the Green Sheet Bulletin from the Florida Golf Course Superintendents Association announcing the names of a couple of 'supers' and congratulating them on their just receiving their 'certified' status struck me because it was in this van of 'don't unpack!'

One of the recently certified superintendents was congratulated on how long he had held his present job. He had been there 10 whole years. The comment sounded, "How many other Florida superintendents can say that?"

Enough examples of this problem.

What's The Answer

Well, there probably isn't any one answer to this situation. Too often it's because the "grass isn't green." That in itself is such a big subject that there is no answer.

Somehow the superintendent is expected to perform miracles in spite of weather conditions and all the related problems turf can be subjected to. Unfortunately, he is dealing with and reporting to green committee chairmen and club managers who know practically nothing at all about turf and landscaping. We will not be able to change much in that respect. One either lives with it, puts up with it or moves on!

'Supers' Defend & Educate

Oh, there are defenses and maneuvers which might help. One of the biggest openings is to educate and convince the 'management' group that greens were never intended to be cut down to the so-called tournament 1/8" and a stimpmeter rating of 10 to 12. Ask any 'super' who has had a USGA event and suffered these requirements and how long it took to get his course back in decent shape for regular day-to-day play.

Greens are where it's at. Sure fairways and roughs are important, but it's the greens they complain about. Perhaps that's as it should be since *aficionados,* such as Dave Peltz, have pointed out that 80% of the game is played around the green.

Take your committee or manager around to talk with some other same-region course superintendents and let them experience a broader viewpoint.

In Florida this year, you can inspect most any layout and find lots of general problems. After 10 to 15 years of the wonder turfs, Tifway and Tifdwarf, segregation and winter damage are on a rampage. Moving superintendent and playing 'musical chairs' isn't going to answer the problem!

Camouflage!

There are some ways to "keep the members happy." Do a great job on the rest of the layout. Beautify the course with stunning floral displays. Police the grounds with diligence. Keep the crews well-groomed and busy. Sloppy, inactive maintenance people can cause a lot of bad relations. Explain in memos posted to the membership what the problems may be.

Get to know members and management on a business-like basis. At 'daily fees' treat the players as if they were regular members. Above all, keep the equipment and the operational center in top, spic-and-span shape. Friendliness and reasonable contact in the proper way can help keep you content with your position and your players pleased.

Yes, you may even be able to unpack and perhaps buy a home!

Can We Talk?

Is Productive Communication Possible at Your Club?

I was touring a golf course recently with a fellow superintendent and was overwhelmed by how perfect his grounds were.

The fairways were tight and weed-free, greens were uniform—even the rough was consistent. Then a funny thing happened. A group of members stopped to give him their comments on the conditioning: "Hey, did you f— up the 12th hole yet?" "What the hell are you doing on number seven?" "These fairways are horrible; I can't hit my three-wood off them."

These are actual quotes from respectable members of a prestigious club. Four or five more groups approached us on our tour, and not one had a positive comment. There wasn't a single, "Hello! Good afternoon." It may not be this bad at all clubs, but a pervasively negative tone seems to be prevalent at many clubs today. What's going on?

In the last few years, it appears that the playing surfaces at our clubs have gotten better and the appreciation of a job well done has diminished. Has this raised the stress level for you and your turf? Has the recent rash of job openings in the region made you more—or less—secure in your job position? I'm getting a stress headache just thinking about it. The stress on the average golf course superintendent is greater now than ever, and it's not going to subside in the near future.

Why is this? Have we promised our members more every year so that it's difficult to live up to expectations? Has TV golf conditioned our members to expect indoor arena conditions every day regardless of weather, amount of play or budgets? How about our members' personal lives? Have they become negative from all the downsizing in business and the uncertainty of their immediate future?

I think the answer is yes to all three questions. I think one problem many of us have is promising the moon, even when we know our booster rocket is short on fuel. During the good years, Mother Nature may help us reach our destination safely, but during the bad years, even with 14-hour work days and the miracle cures for diseases, the finished product just doesn't meet expectations.

Often the amount of play is too much, the window of opportunity to do "meaningful" work is small, and the cultural practices, so needed to maintain fine turf, are frowned upon by committee members. And beyond all that, the cost of producing a hundred acres of immaculate turf is usually more than our clubs' budgets can handle. Then our members go home and watch a perfect golf course host the best players in the world. What do they think during commercials—"Time for a cold one?" Well, maybe, but more likely it's "I hit a putt just like that today and my ball didn't come close to the hole! Our greens are horrible."

Television, which during the sixties was responsible for the upgrading and increased popularity of the game, has gone beyond that and dissects every aspect of the playing surface and the player's golf swing. It is no longer a game played on unique and different golf courses, which offer a multitude of diverse conditions. There are now written and unwritten uniformity standards which the announcers live by in the commentary of the action. On TV, golf greens all must putt the same. It doesn't matter if one green is surrounded by trees and built of clay, and the next green is open and built of sand. Uniformity rules and "knowing the greens" doesn't enter the commentary. Funny thing is that the turf management professionals have gotten so good that uniformity is usually achieved.

Television has increased our paychecks and decreased our job security. The average member, even at wealthier clubs, has seen his or her standard of living remain stagnant, or even decrease, in the last ten years. The profit margins are squeezed ever tighter. Downsizing has been the operative word since the mid-eighties in most larger corporations. Most people's personal budgets aren't so large that they can spend lavishly on non-essential items. Golf and club life may be essential to one's mental health, but it usually falls after the house, car and schooling for the children.

How about the chaotic world around us? Just turn on the six o'clock news. Many of us have become desensitized to

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