FERTILIZER & CHEMICAL INPUTS FOR HEALTHY TURF

ASIANGOLF INDUSTRY FEDERATION

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WE HAVE A SERIOUS "COST" PROBLEM IN GOLF !!!

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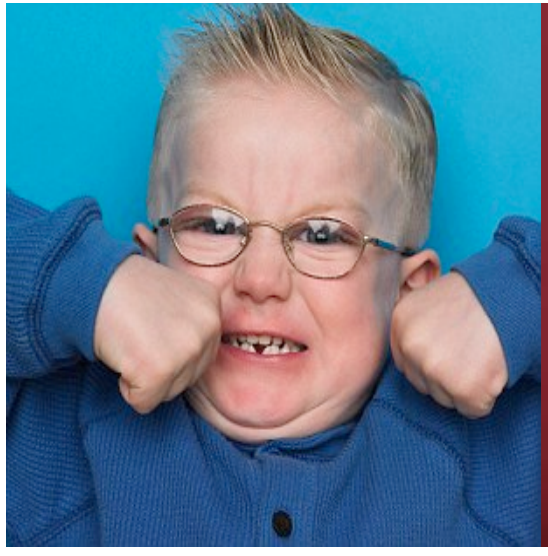
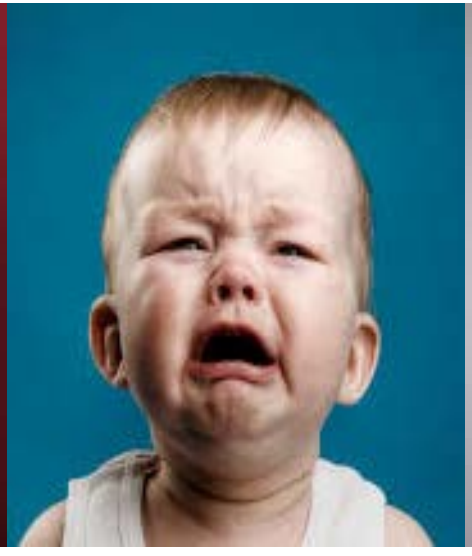
1. *Golf is too expensive and superintendents are much to blame! WHY?*

2. *From my experience and observations I have found that 75 – 80% of Golf Course Superintendents world-wide are weak to extremely weak in skill levels to calculate their comparative fertilizer / chemical use accurately.*






WE HAVE A SERIOUS "COST" PROBLEM IN GOLF !!!

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1. *Golf is too expensive and superintendents are much to blame! WHY?*

2. *From my experience and observations I have found that 75 – 80% of Golf Course Superintendents world-wide are weak to extremely weak in skill levels to calculate their comparative fertilizer / chemical use accurately.*

3. *LET's GET REAL! If you can't calculate your actual use accurately in a standard format, you will be completely lost when it comes to:*

    A. *COMPARATIVE Cost Use Analysis*
    B. *COMPARATIVE Material Efficacy*

4. *What skills do YOU need to have or to gain intelligent competence ?*

SKILLS YOU NEED TO HAVE OR NEED TO GAIN

1. ***You must be able to do elementary mathematic calculations with understanding of some simple Algebra / Geometry.***

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SKILLS YOU NEED TO HAVE OR NEED TO GAIN

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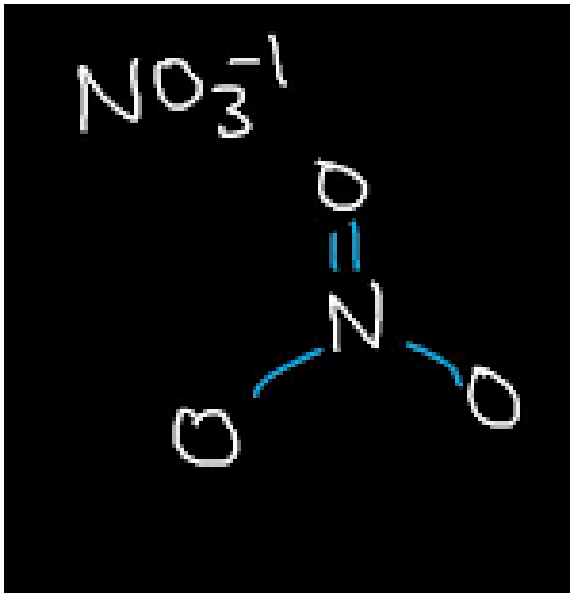
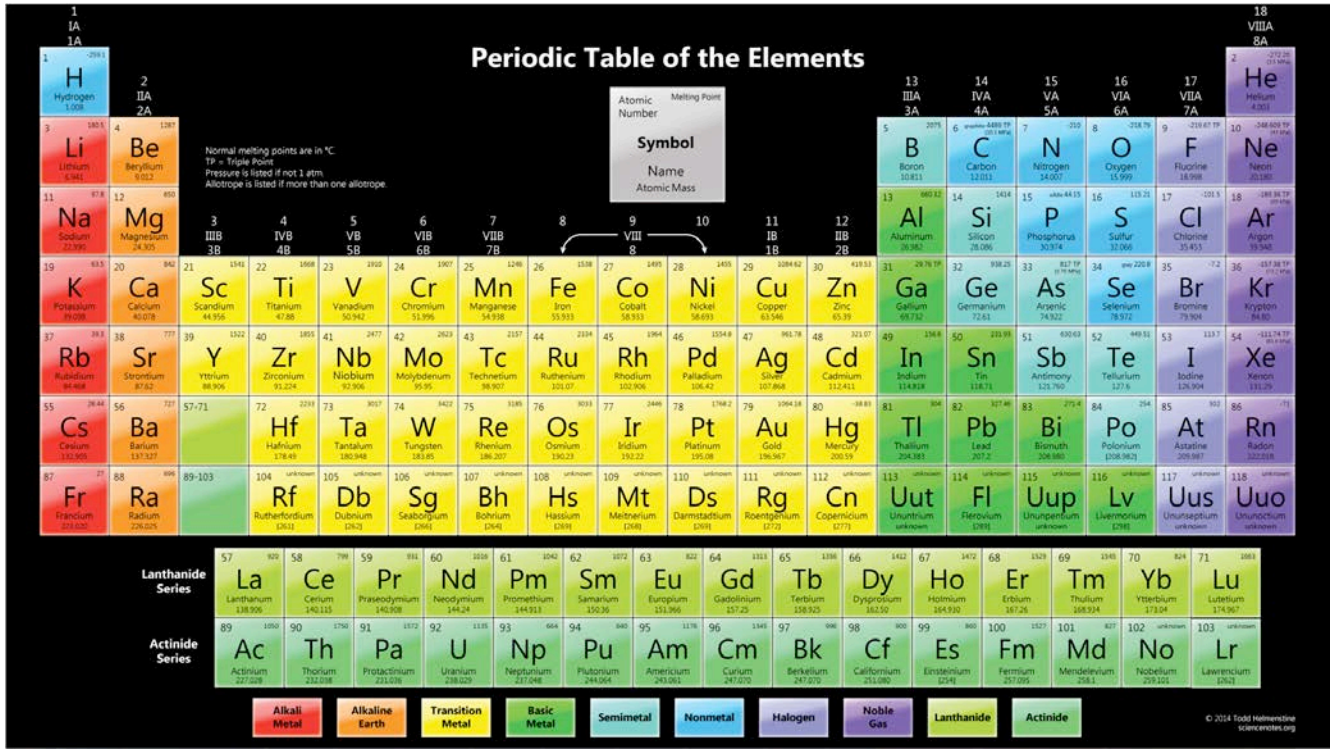
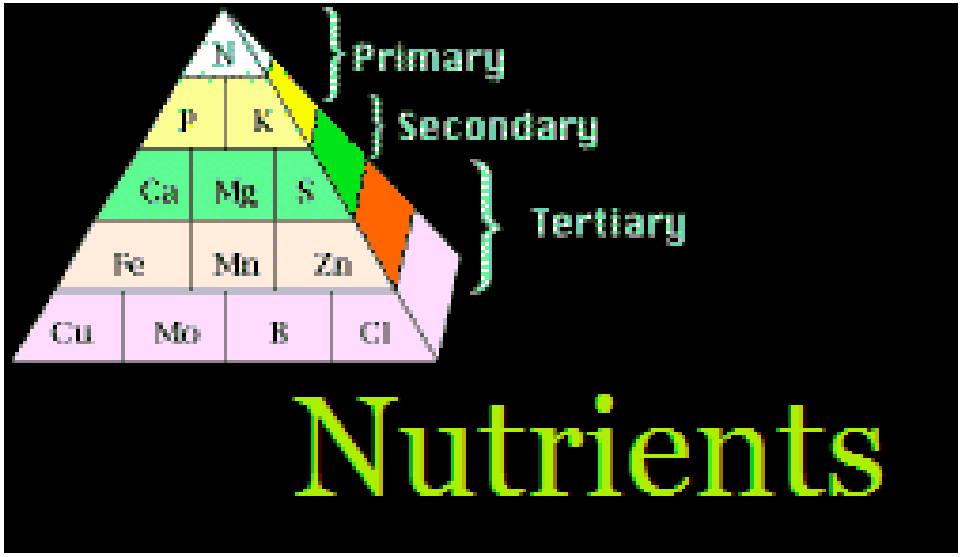
1. *You must be able to do elementary mathematic calculations with understanding of some simple Algebra / Geometry.*
2. *You need at least a high school level understanding of simple Chemistry.*

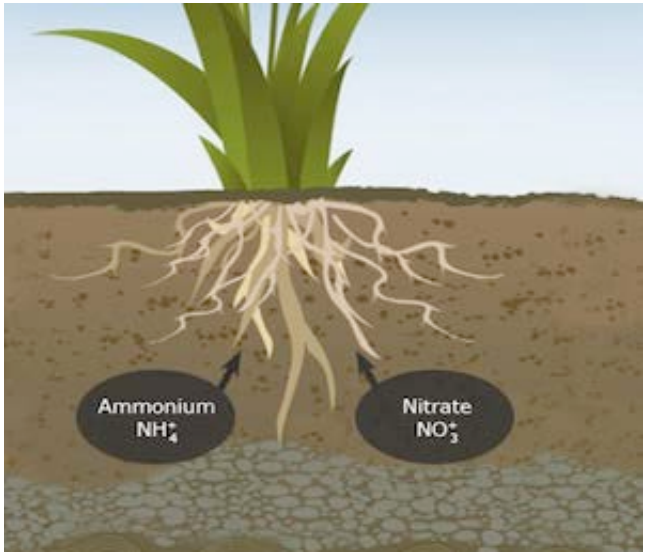




SKILLS YOU NEED TO HAVE OR NEED TO GAIN

1. *You must be able to do elementary mathematic calculations with understanding of some simple Algebra / Geometry.*
2. *You need at least a high school level understanding of simple Chemistry.*
3. *You need a must have, basic understanding of <u>plant</u> nutrient requirements – MORE THAN 'SIMPLISTIC.'*





SKILLS YOU NEED TO HAVE OR NEED TO GAIN

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1. *You must be able to do elementary mathematic calculations with understanding of some simple Algebra / Geometry.*
2. *You need at least a high school level understanding of simple Chemistry.*
3. *You need a must have, basic understanding of plant nutrient requirements – MORE THAN 'SIMPLISTIC.'*
4. *You need some basic Accounting and record keeping / clerical skills – and be subject to auditing.*
5. *You need to be able to layout 'must do' test / demonstration plots on your golf course to show golfers, boss, staff & YOURSELF!*
6. *You need to know as much or more than sales people!*
7. *You need to be able to explain and PROVE your use.*

STANDARDS & FUNDAMENTALS

1. **To do meaningful cost comparisons as in Agriculture we use *TURFGRASS INDUSTRY STANDARDS* for measuring.**

2. **Throughout Asia our standard measurement of fertilizer and chemical applications are recorded as: *grams (or milliliters) per square meter* (*i.e.* 1.0g / m^2)**

3. **In North America the standard measurement is recorded as: *pounds per 1,000 square feet* (*i.e.* 0.25 lbs. / 1000 ft^2)**

In Asia you must know how to CONVERT back and forth to compare PESTICIDE LABELS and FERTILIZER APPLICATION RATES:

STANDARDS & FUNDAMENTALS

Make a simple conversion calculator in an Excel spreadsheet:

Pounds per Kft^2 to Metric			
:			
0.25			

Metric to Pounds per Kft^2			
1.00			

Excel FILE LINK

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STANDARDS & FUNDAMENTALS

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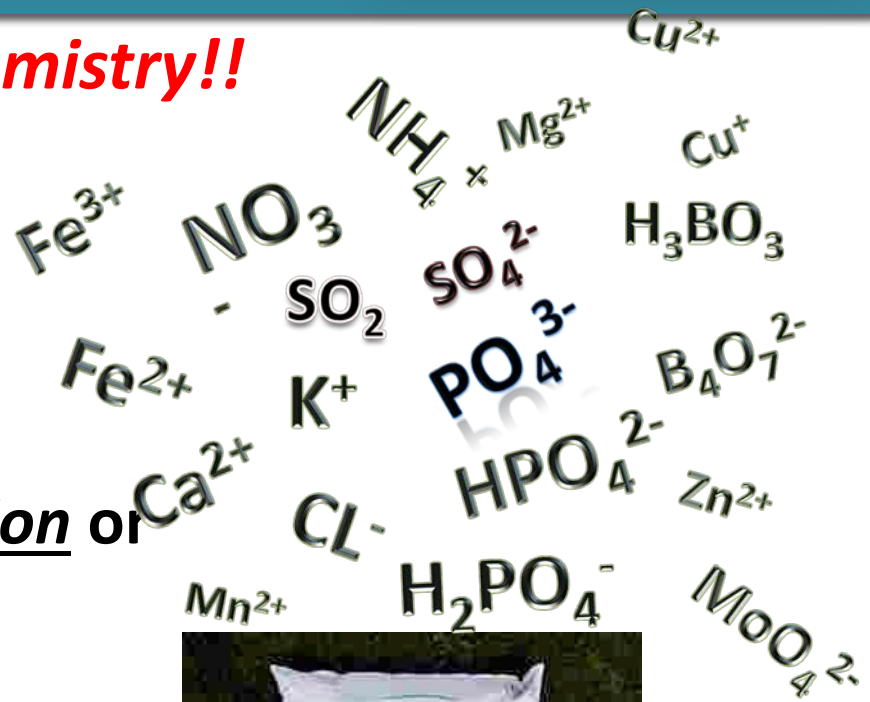
Oh, that Basic Chemistry!!



1. You must know FERTILIZER FUNDAMENTALS and the chemical structure of the 'ACTUAL' NUTRIENT MOLECULE that the turfgrass PLANT uptakes each AVAILABLE nutrient ***cation*** or ***anion***.

2. These are defined LEGALLY in FERTILIZER STANDARDS CODES to determine both our application rates and financial calculations.

% by Weight

MATERIAL and SUPPLY Costs - Testing

KNOWING "*ACTIVE INGREDIENTS*"

₩ 10,000

2.0 L

10%

≠

₩ 15,000

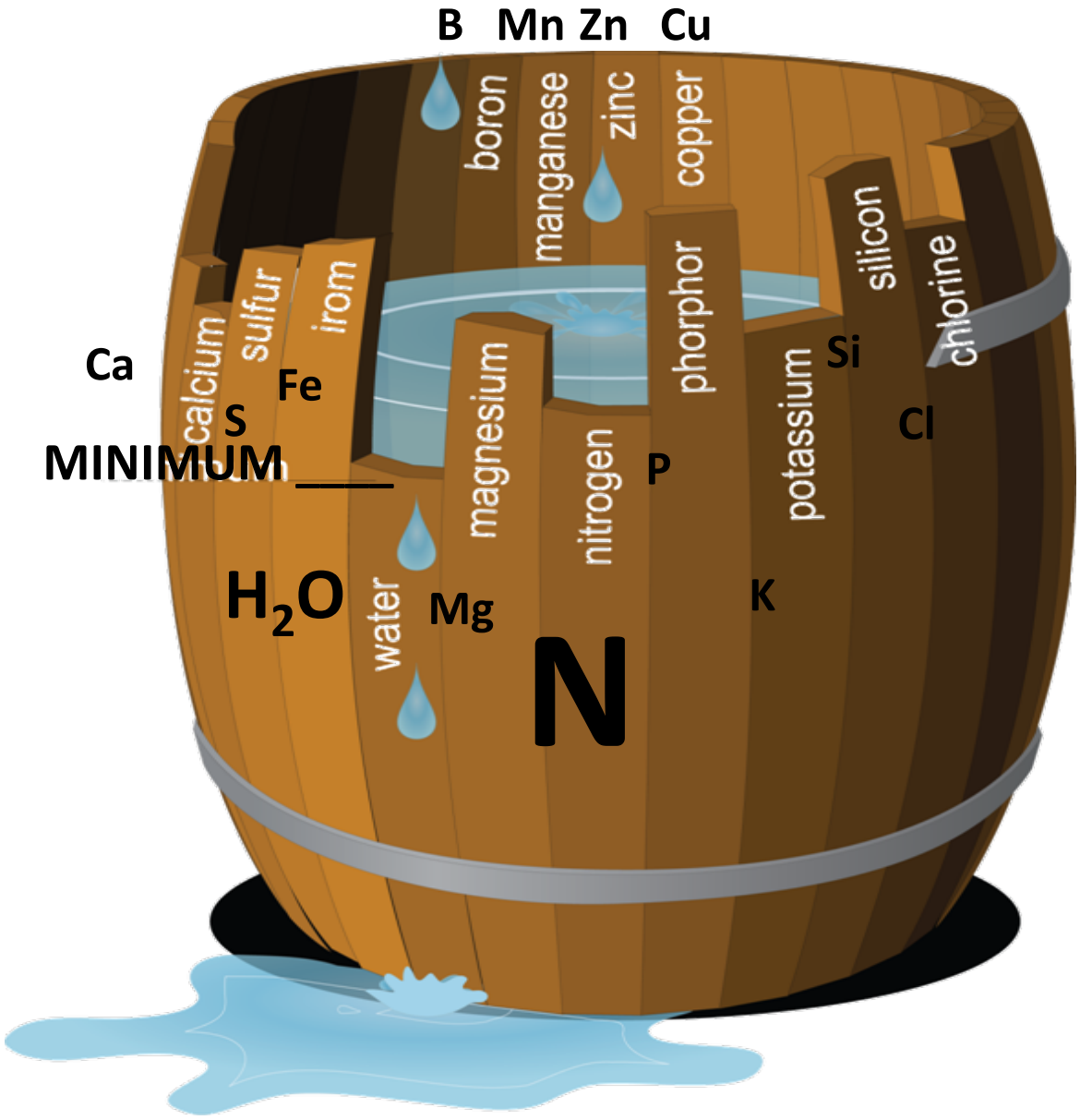
2.0 L

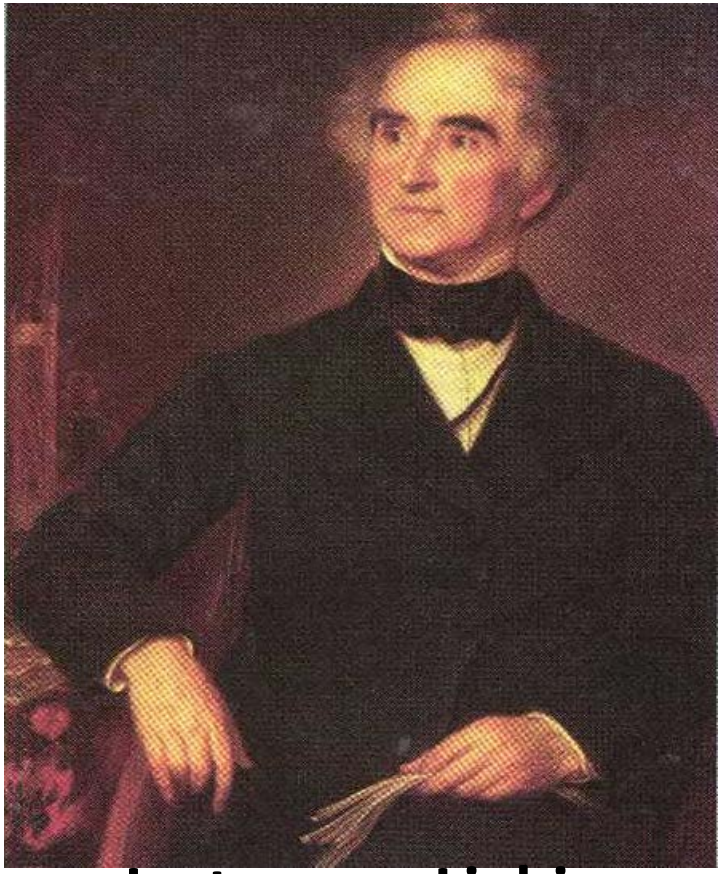
90%

LEAST EXPENSIVE

CALCULATE COST '*ACTIVE INGREDIENT*' / ml

Law of Minimum





Justus von Liebig

1803 -1873

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MATERIAL and SUPPLY Costs - Testing

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KNOWING "*POUR COST*" and "*APPLICATION COST*" – SIMILAR

?

?

?

?

?

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MATERIAL and SUPPLY Costs - Testing

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SKY72 – Zoysia Material Evaluation Plot Plan

1.01.1 Varieties to be included in the Material Evaluation Agreement will include:

1.01.1.1	-	Zeon* need 20 sq feet using 12" x12" format
1.01.1.2	-	L1F
1.01.1.3	-	M-66
1.01.1.4	-	M-24
1.01.1.5	-	29-2-B7
1.01.1.6	-	662
1.01.1.7	-	M-45
1.01.1.8	-	DR-39
1.01.1.9	-	29-2-B23
1.01.1.10	-	29-2-B9
1.01.1.11	-	M-85
1.01.1.12	-	Y-2
1.01.1.13	-	TDI2013 (this will ship from Oregon)
1.01.1.14	-	M-60

18 individual material plots replicated X 3 = 54 total study plots.

- Each plot shall be 1 meter by 1 meter (square). All plots will be separated by 30 cm of bare ground areas on all sides.
- This plot plan will be installed in three Ocean Course locations: (1) OC Greenhouse; (2) OC #1 PG – south face; (3) OC LPGA Range – north face.

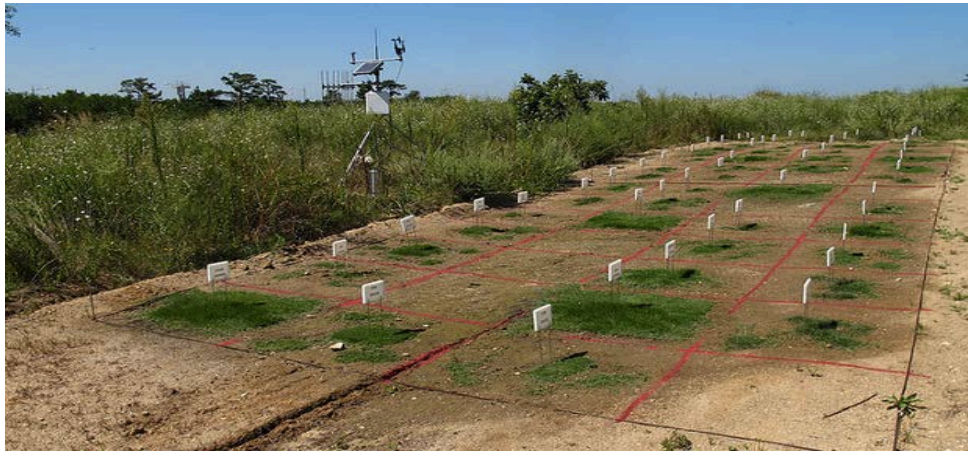
1. Zeon (sodded)	2. L1F	3. M-66	4. M-24	5. 29-2-B7	6. 662	7. M-45	8. DR-39	9. 29-2-B23	10. 29-2-B9	11. M-85	12. Zeon (plugged)	13. Y-2	14. TDI 2013
15. M-60	16. BLANK	17. BLANK	18. BLANK	19. Zeon (sprigged)	20. DR-39	21. 29-2-B9	22. Y-2	23. M-24	24. Zeon (sodded)	25. M-66	26. 662	27. L1F	28. 29-2-B23
29. M-85	30. Zeon (sodded)	31. TDI 2013	32. M-45	33. 29-2-B7	34. BLANK	35. Zeon (sprigged)	36. BLANK	37. M-60	38. M-66	39. 29-2-B7	40. Zeon (sodded)	41. BLANK	42. DR-39
43. BLANK	44. 662	45. Y-2	46. M-85	47. Zeon (sprigged)	48. L1F	49. BLANK	50. 29-2-B9	51. M-45	52. TDI 2013	53. 29-2-B23	54. M-24	55. M-60	56. Zeon (plugged)

We have added Myers as an index due to its known cold tolerance trait. Bent grass and Kentucky Bluegrass (K.B.) are added for exacting green-up comparison and evaluation of any encroachments. Plots are all to be well maintained at all times. After spring green-up in 2015 all plots will be mowed with two (2) heights of cut (HOC).

- **FIRST Step in costing things is to know what you really need:**

  T – E – S – T

- **EVERY Greenkeeper should establish TRIAL TEST EVALUATION plots for fertilizer and grasses.**
- **When developing a golf course first plant grass test plots for grasses you are considering. Test varieties perpetually!**



MATERIAL and SUPPLY Costs - Testing

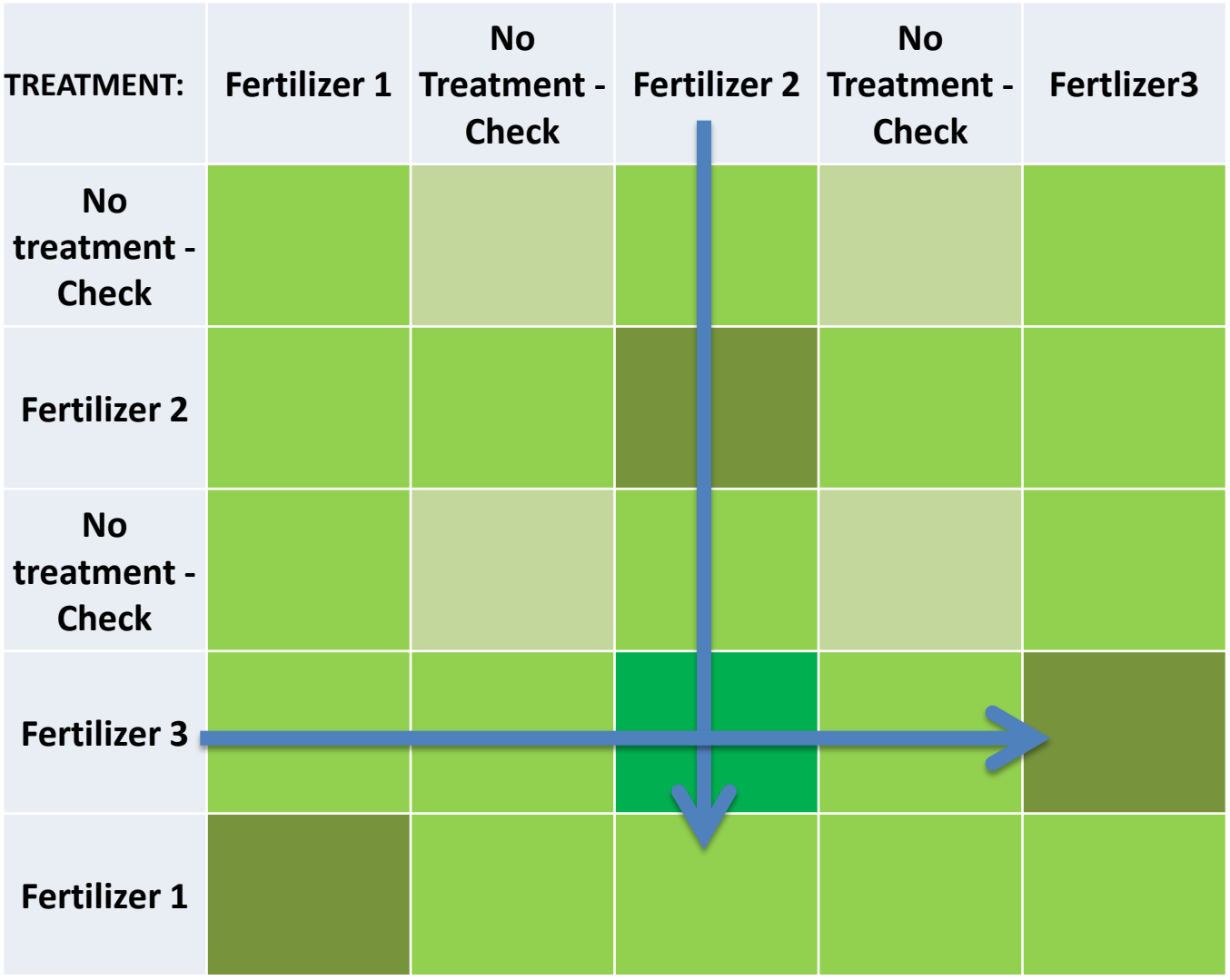
Do you really need what is in all those bags? ***Likely not*** **!**

- **EVALUATE fertilizer perpetually!**
- **In conjunction with laboratory soil and water testing, confirms best fertilizers for your specific site!**

REQUIRED NUTRIENT ELEMENT	PERCENTAGE BY DRY WEIGHT
Carbon (C)	44%
Oxygen (O_2)	44%
Hydrogen (H)	5.5%
Nitrogen (N)	3 - 6.5%
Potassium (K)	2 - 4%
Phosphorus (K)	0.4 - 0.8%
Sulfur (S)	0.3 - 0.7%
Calcium (Ca)	0.3 - 0.6%
Iron (Fe)	0.1 - 0.3%
Magnesium (Mg)	0.1 - 0.2%
Manganese (Mn); Zinc (Zn) Copper (Cu); Molybdenum (Mo) Boron (B); Chlorine (Cl)	TRACE AMOUNTS FOUND

Fig. 2: Nutrient Composition of Turfgrass by Elemental Dry Weight Percentage

SETTING UP YOUR TEST PLOTS



Doing your own quick application test plots is also a good, old-fashioned soil test.
It also cuts to the quick on how any particular fertilizer formulation will work in the complexity of your own golf course location!
(I.E. Harding Park GC)

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Plot	Application	Notes	Plot	Application	Notes	Plot	Application	Notes	Plot	Application	Notes

ation crossover application.)

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Classic Course #1 Practice Green Fertilizer Trial Plots

(All nitrogen fertilizers applied at 0.75 grams N / M²)

NORTH to Cart Path

All plots are 1 meter by 1 meter square
300 separate plot combinations

WEST to Classic #1 tee

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	APPLICATIONS	Ammonium Sulfate	Ammonium Molybdate (Mo) 0.25g / M2	Potassium Nitrate	Calcium Nitrate	CLASSIC COURSE Nutri-Tech 11-10-30 +2 MgOSO4	CHECK	Boric Acid 0.57g / M2	Urea plus Fe Sulfate 1g Mg Sulfate 1g	Urea	Ammonium Sulfate + Fe Sulfate 1 g Mg Sulfate 1g	Iron Sulfate 1 gram	Iron Sulfate 2 grams	Mono Ammonium Phosphate (MAP) (P)	Magnesium Sulfate 2 grams	Magnesium Sulfate 1 grams	PROSTIM (Ocean Course)	OCEAN COURSE Nutri-Amino	Balance (Ocean Course)	NO TREATMENT ASSIGNED	NO TREATMENT ASSIGNED
1	Urea	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2	Urea + Fe Sulfate 1 grams Mg Sulfate 1	21	22	23	24	25	16	27	28	29	30	31	32	33	34	35	36	37	38	39	40
3	Iron Sulfate 1 gram	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
4	Iron Sulfate 2 grams	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
5	Magnesium Sulfate 2 grams	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
6	Magnesium Sulfate 1 gram	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
7	Ammonium Sulfate + Fe Sulfate 1g Mg Sulfate 1g	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
8	CLASSIC COURSE Nutri-Tech 11-10-30 +2 MgOSO4	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
9	Boric Acid 0.57g / M²	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
10	Calcium Nitrate	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
11	Mono Ammonium Phosphate (MAP) (P)	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220
12	Ammonium Molybdate (Mo) 0.25g / M2	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
13	Ammonium Sulfate	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260
14	OCEAN COURSE Nutri-Amino 10-3-9	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280
15	Potassium Nitrate	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300

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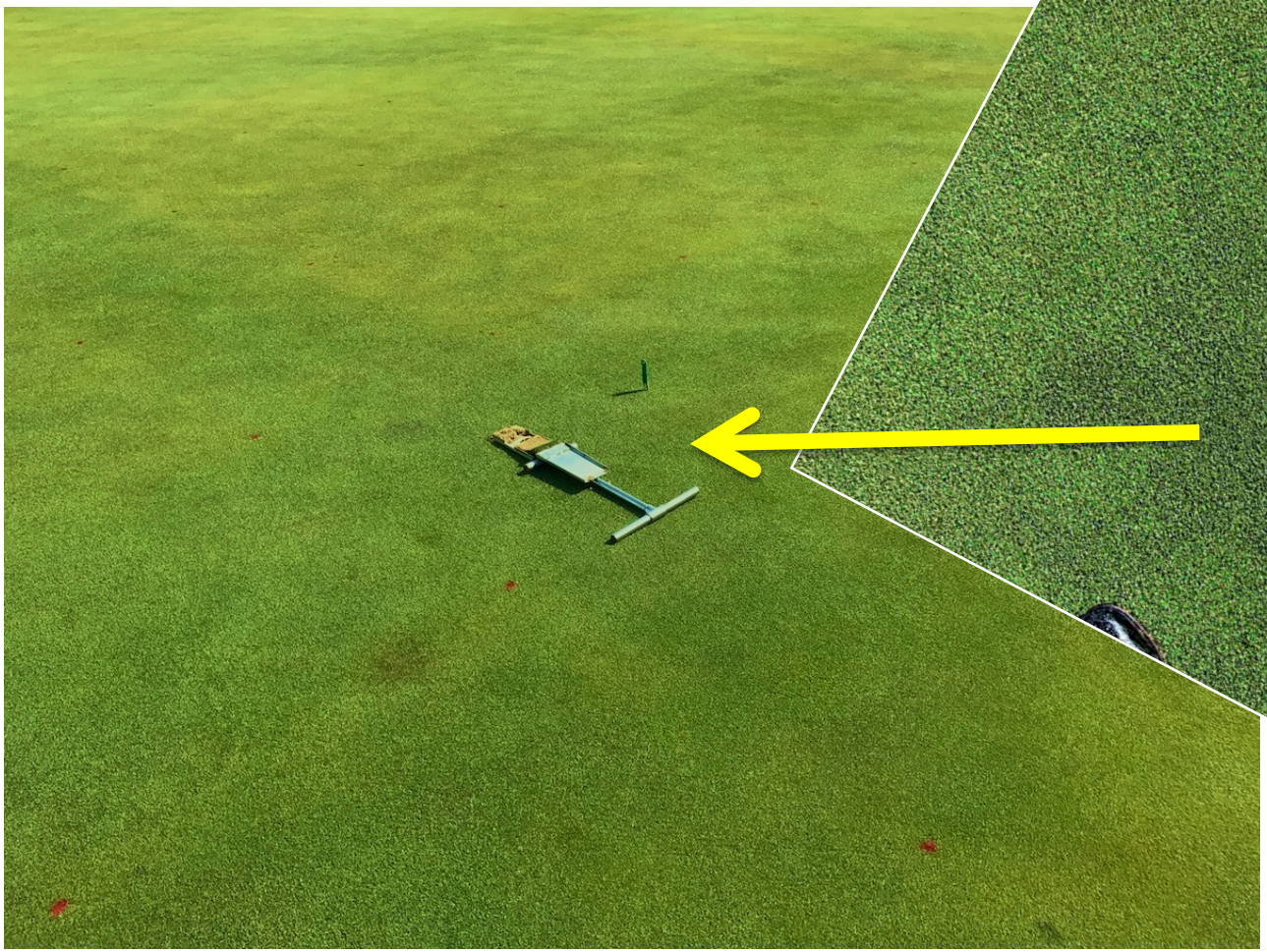

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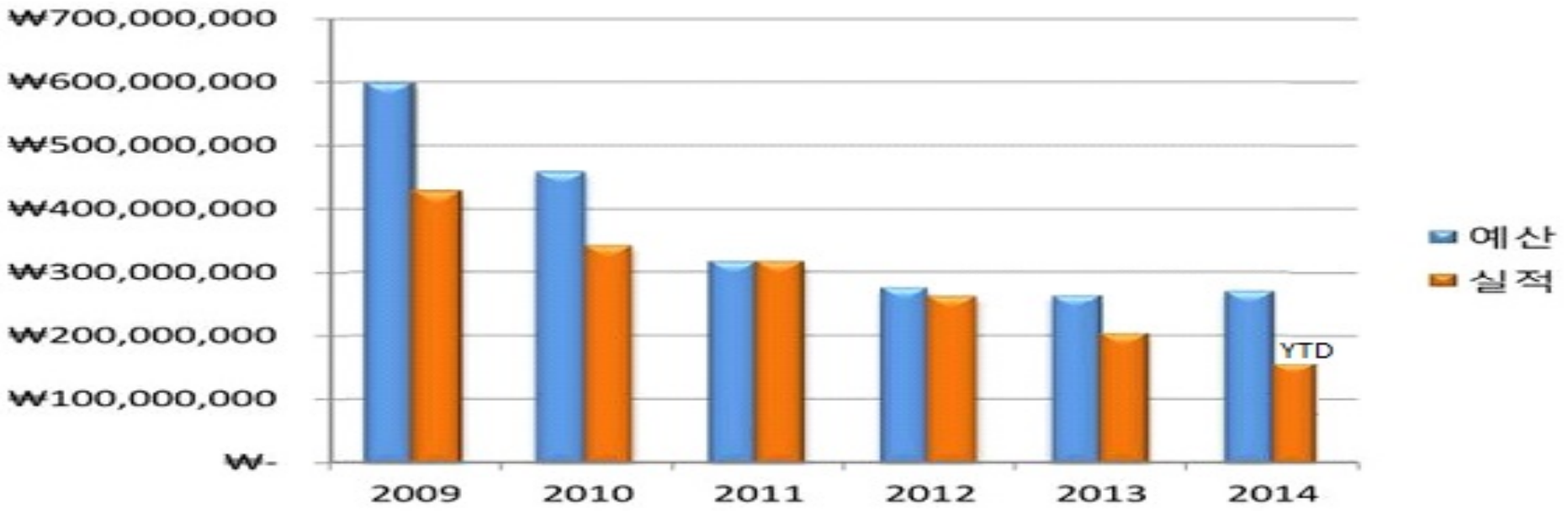
I've learned and taught that the secret of exceptional golf courses is BELOW the surface.

구분	2009	2010	2011	2012	2013	2014
예산	600,000,000	459,760,105	318,162,150	278,452,110	265,887,200	272,529,000
실적	428,658,000	343,186,360	317,623,500	264,049,500	204,329,500	YTD 161,463,600



6. 첨부파일

1) 2014 년 비료 입찰 결과 자료
2) 2014 년 납품 계약서 8부(업체별)
3) 기타 참고 자료(업체별 입찰 취합본)

Knowing Your True Cost Efficacy in Chemical, Fertilizer and Fertigation Use

James Graham Prusa

ROYAL GEMS GOLF RESORT

Nakhon Pathom, THAILAND

ASIAN GOLF COURSE SUPERINTENDENTS SUMMIT

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HOW TO CALCULATE YOUR FERTILIZER COSTS

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Pricing Strategies:
Travel
Weddings
Fertilizers!

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Single Element Fertilizer Cost Comparison

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- **Doing single element product comparisons for an element such as Nitrogen (N) is simple.**
- **An example:**

UREA 46-0-0 **(20KG bag = ₩ 16,000)**

1000 kilograms or 1 metric ton (mt) costs ₩ 800,000

1000 X 0.460 = 460 kg of N costs ₩ 800,000

TRUE COST = ₩ 800,000 / 460 = ₩ 1740 / 1 kg of actual N

LEAST EXPENSIVE

AMMONIUM SULFATE 21.5-0-0 **(20KG bag = ₩ 12,000)**

1000 kilograms OR 1 metric ton (mt) costs ₩ 600,000

1000 X 0.215 kg of N costs ₩ 600,000

TRUE COST = ₩ 600,000 / 215 = ₩ 2790 / 1 kg of actual N

Complete or Complex Fertilizer Cost Comparison

Requires Very Simple Algebra

$$A + B + C = X$$

X is the total cost of the fertilizer per a given amount of weight such as a metric ton.

A, B and C represent the different essential plant nutrients ***by weight*** in the fertilizer and there could be more than only three nutrients (variables).

Since we know the total cost that X represents, we can simply assign a known or defined cost for B and for C variables in order to derive the cost of A.

$$X - B - C = A$$

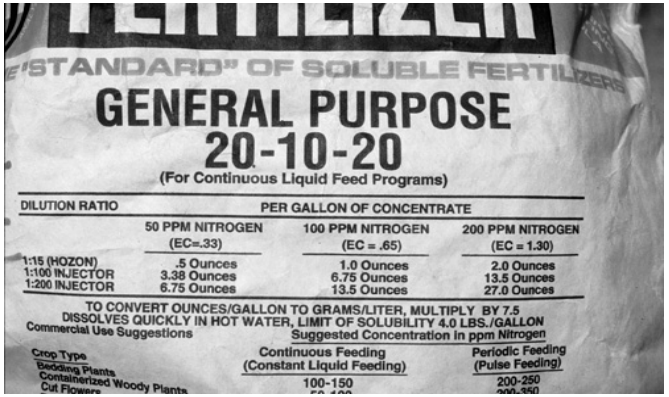


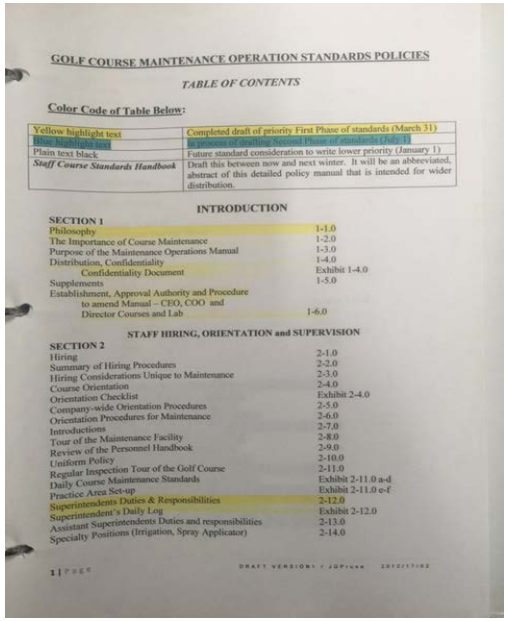
CHART OF COSTS FOR ESSENTIAL SINGLE ELEMENTS COMMON IN TURFGRASS FERTILIZERS

FIXED PRICES FOR USE IN WORKSHEET, MULTIPLE VARIABLE FORMULAS. Current Korean market price for commercial fertilizer grade:	Estimate current price per metric tonne (mt) in Won of this commerical grade product ₩:	Calculated Cost of single essential element:	Plant Uptake Molecule	Estmated percentage of this element (can vary):	Price Per Gram / Kilogram of single fertilizer essential element in ₩ Won :	
Urea 45-0-0 $CO(NH_2)_2$	**525,000**	N	NO_3^-; NH_4^+	**46.0%**	1.141	1,141
Monammonium Phosphate (MAP) 11-61-0 $(NH_4)H_2PO_4$ **[99% pure N=11.8%; P_2O_5 = 61%]**	**315,000**	P_2O_5	$H_2PO_4^-$; HPO_4^{-2}; PO_4^{-3}	**61.0%**	0.315	315
Potassium Chloride 0-0-61 (KCl) **[K = 61%, Cl = 46.5%]**	**150,000**	K_2O	K^+	**61.0%**	0.246	246
Soil Sulfur (Brimstone) S	**925,000**	S	SO_4^{-2}	99.0%	0.934	934
Sulfuric Acid H_2SO_4 **[98% purity; Solution Density = 1.55; 31% Sulfur]**	**250,000**	S	SO_4^{-2}	31.0%	0.078	78
Gypsum ($CaSO_4 \blacklozenge 2H_2O$) **[Pure: Ca = 23.2%, S = 18.6%]**	**100,000**	Ca	Ca^{+2}	**23.2%**	0.023	23
Ferrous Sulfate $FeSO_4 \blacklozenge 7H_2O$ **[98% purity: Fe = 19%, S = 10%]**	**360,000**	Fe	Fe^{-2} [ferric ion Fe^{-3}]	**19.0%**	1.403	1,403
Magnesium Sulfate (Epsom Salt) $MgSO_4$ **[Mg = 10%, S = 13%]**	**375,000**	Mg	Mg^{+2}	10.0%	2.535	2,535
Manganese Sulfate (Manganous) $MnSO_4 \blacklozenge H_2O$ **[Mn = 32.3%, S = 17%]**	**925,000**	Mn	Mn^{+2}	32.3%	2.372	2,372
Copper Sulfate $CuSO_4 \blacklozenge 5H_2O$ **[Cu = 25.4%, S = 12.9%]**	**2,200,000**	Cu	Cu^+; Cu^{+2}	25.4%	8.187	8,187
Zinc Sulfate $CuSO_4 \blacklozenge 7H_2O$ **[Zn = 21%, S = 10%]**	**3,000,000**	Zn	Zn^{-2}	21.0%	13.841	13,841
Sodium Molybate $Na_2MoO_4 \blacklozenge 2H_2O$ **[Mo = 39.3%]**	**2,000,000**	Mo	Mo_4^{-2}	39.3%	5.089	5,089
Sodium Borate (Borax) $Na2B_4O_7 \blacklozenge 10H2O$ **[B = 11.3%]**	**100,000**	B	BO_3^{-3}	11.3%	0.885	885
Potassium Chloride KCl **[K = 61%, Cl = 46.5%]**	**150,000**	Cl	Cl^-	46.5%	0.323	323
Calcium Silicate Ca_2SiO_4 **[Ca = 46.5 %, Si = 16.5%]**	**350,000**	Si	Cl^-	16.5%	2.121	2,121
	ENTER MARKET PRICE ABOVE			ENTER CORRECT % ABOVE IF CHANGED	*PRICES REVISED:*	*2010년 4월 21일*

* In order to establish known values for the three N-P-K cost values, it is necessary to firmly estimate two of three variables (example, P_2O_5 and K_2O) for an algebraic calculation of the price of the predominant element such as the nitrogen (N) variable. The same can be done for non-NPK fertilizers. Thus, objective cost analysis and comparison can be done for complete fertilizers. Absolute cost accuracy of P and K is not necessary for N cost comparison as long as consistant values are used for P and K. Periodically update the price of these two products.

Setting Clear WRITTEN STANDARDS

- **Protects the management, GREENKEEPER & MEMBERSHIP from arbitrary & capricious committees in private clubs**
- **Assures ACCOUNTABILITY**
- **Training tool and informative**
- **Quality Assurance – assures consistency**
- **Takes time and effort to develop; *annual review***



GOLF COURSE MAINTENANCE OPERATION STANDARDS POLICIES

TABLE OF CONTENTS

Color Code of Table Below:

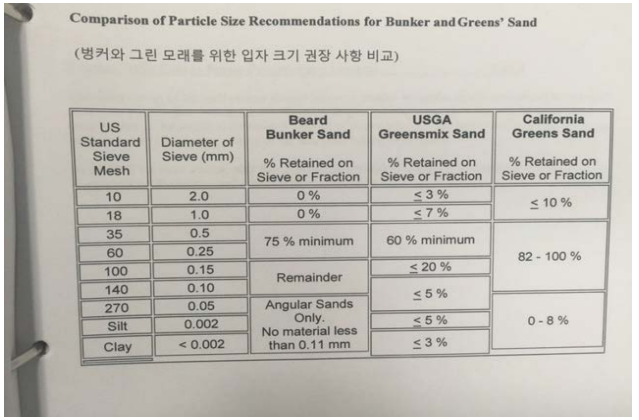
Yellow highlight text	Completed draft of priority First Phase of standards (March 31)
Blue highlighted	In process of drafting Second Phase of standards (July 1)
Plain text black	Future standard consideration to write lower priority (January 1)
Staff Course Standards Handbook	Draft this between now and next winter. It will be an abbreviated, abstract of this detailed policy manual that is intended for wider distribution.

INTRODUCTION

SKY72 sets standards for every aspect of operation.

300 pages of Maintenance Standards!

Over the years I have written these for F&B; lodging, HR, maintenance, security, budgeting, accounting.



Comparison of Particle Size Recommendations for Bunker and Greens' Sand

(벙커와 그린 모래를 위한 입자 크기 권장 사항 비교)

US Standard Sieve Mesh	Diameter of Sieve (mm)	Beard Bunker Sand % Retained on Sieve or Fraction	USGA Greensmix Sand % Retained on Sieve or Fraction	California Greens Sand % Retained on Sieve or Fraction
10	2.0	0 %	≤ 3 %	≤ 10 %
18	1.0	0 %	≤ 7 %	
35	0.5	75 % minimum	60 % minimum	82 - 100 %
60	0.25			
100	0.15	Remainder	≤ 20 %	
140	0.10		≤ 5 %	
270	0.05	Angular Sands Only. No material less than 0.11 mm		0 - 8 %
Silt	0.002		≤ 5 %	
Clay	< 0.002		≤ 3 %	

FERTILIZER & CHEMICAL INPUTS FOR HEALTHY TURF

ASIANGOLF INDUSTRY FEDERATION

JAMES GRAHAM PRUSA

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