2013 스카이72 동계 세미나

Jan. 23, 2013

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- 약제(작물보호제)의 안전한 사용(Safe use of pesticide)

생장 조정제

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ILLUSTRATION BY ROGER SCHILLSTROM

And the survey says. . .

Plant growth regulators lead innovations in modern greenkeeping

By definition, innovation is the introduction of something new; an idea, method or device. Hardly a week goes by that we aren't exposed to "something new" in our daily lives as technology races forward, spawning products that promise convenience, a sense of security, efficiency or entertainment. The cell phone comes to mind.

In September, *Golfweek's SuperNEWS* asked readers to nominate their choices for the top innovations of modern greenkeeping. Our intention was to compile from the suggestions we received a top 18 list that truly reflected the greenkeeping industry's attitude on what's most important to it. But as is the case with just about every list of rankings, our top 18, derived from submissions and ranked by a panel of superintendents and an industry expert, probably will receive as much agreement as do polls of the greatest rock bands of all time or the best college football players ever.

In the end, lists seldom answer the question of who or what is No. 1 and so on but merely invite scrutiny of the rankings and ignite break room debate on the order of importance and omissions. As *SuperNEWS* contributing editor Frank S. Rossi, Ph.D., quipped when he was told of the final order of the top 18: "Who came up with this list?"

Frankly, plant growth regulators never were mentioned in our conversations as we discussed possible innovations that superintendents would most likely cite as most important to them. But as the nominations came in via TurfNet.com, our online affiliate, and by e-mail, voice mail and the ancient art of letter writing, we quickly saw how important PGRs are to superintendents.

Some superintendents, like John R. Clark of Rochester Country Club in Dover, N.H., were brief in their submissions for the top 18 list.

Clark's only nomination was "the newest plant growth regulators," which he supported with this testimony: "The consistency of the course conditioning with less labor input is great!"

A few others, like Walter C. Montross, MG, CGCS, at Westwood Country Club in Vienna, Va., went to the extra effort to rank their top 18. In many instances, his list was very similar to the top 18 at left.

Regardless of the nominations mentioned by each participant, all lists reflected the impact particular innovations had on the profession. Some superintendents were passionate in their feelings about a product or practice.

"Live radar being available to us is huge," wrote Brian Bossert, CGCS, at Bryn Mawr Country Club in Lincolnwood, Ill. "I can remember mulling over spraying decisions with our arms folded and looking toward the heavens as if we could read the clouds or something."

Real-time weather forecasting came in at No. 4 on the final tally.

Brad Fox, superintendent of New Jersey National Golf Club in Basking Ridge, was equally emphatic about one of his selections, though he was the only one to include the sod cutter. "(It) saves more labor than any other invention. PERIOD," he wrote.

Of course, there were some surprises (at least to us) about what wasn't mentioned at all or so infrequently it couldn't be considered as a finalist. The GCSAA and certification made only a couple of lists submitted by superintendents. Roundup, which since its introduction in the early 1970s has found a home in nearly every golf maintenance facility, did not garner one nomination.

For brief accounts of the origins of each of the top 18 innovations, see pages 18-28.

— Michael A. Boslet

The list

1. **Plant growth regulators**
2. **Deep tine aerification**
3. **Softspikes**
4. **Weather data stations**
5. **Wetting agents**
6. **Contour mowers**
7. **Hydraulics**
8. **Fungicides**
9. **Automated irrigation**
10. **Bunker fabrics**
11. **Turfgrass breeding**
12. **Toro Hydroject**
13. **Fertigation**
14. **Topdressers**
15. **Lightweight fairway mowers**
16. **Education**
17. **Stimpmeter**
18. **USGA Green Section**

1 PGRs

Plant growth regulators – or PGRs, as they are popularly known – can be broadly defined as any compound that alters the growth and development of a plant. Since the application of PGRs on turf is most often accompanied by varying degrees of phytotoxicity, early PGRs were restricted to low maintenance areas and usually applied in conjunction with some type of herbicide.

The introduction of Embark (mefluidide) by the 3M Co. in 1974 – and Cutless (flurprimidol, by Elanco) and Trimmit/Turf Enhancer (paclobutrazol, by Zeneca) in the 1980s – brought PGRs out of the weeds and onto golf course fairways, tees and even greens. Before these products came on the market, superintendents could only "macromanage" the growth characteristics of their particular cultivars by altering fertility regimens and adjusting mowing schedules.

PGRs provided turf managers with a practical tool to micromanage the metabolic processes within the turfgrass plants. Reduced seedhead development, improved color and slower overall growth for reduced mowing frequency were benefits to be enjoyed. Superintendents had to proceed with caution, however, to balance these benefits with the potential phytotoxicity and the often unpredictable response of the turf.

A significant step forward in reduced injury and predictability of response came with the introduction of Primo (trinexapac-ethyl) by Ciba-Geigy (now Syngenta) in 1988. Foliar-absorbed Primo worked differently inside the plant than either Cutless or Trimmit/Turf Enhancer. Both root absorbed, they stopped gibberellic acid (GA) production – and consequently, cell elongation – early in the metabolic pathway. Primo affected GA synthesis later in the pathway, interrupting the conversion of one form to another, so that GA was still formed but not active. Cell elongation within the turfgrass plant was slowed as a result but not stopped. Mefluidide worked differently, by inhibiting cell division rather than elongation.

As the first PGR to be safely and predictably used on all fine turf areas, Primo was nominated above all other advancements in modern greenkeeping as the No. 1 innovation for the purposes of this survey. A newer formulation, Primo MAXX, has succeeded the original brand.

Since PGRs are applied in minute amounts compared with traditional pesticide and fertility products, fine-tuning of application systems is critical. Timing of application also is critical for both seedhead inhibition and reduced top growth, keeping one eye on the turf maintenance schedule to avoid aerating or major turf disturbance when the turf is under maximum regulation. Properly used, however, plant growth regulators have proven an invaluable tool for superintendents to save mowing labor, control seedheads and maximize turf color and density.

COURTESY OF SYNGENTA

Primo MAXX, successor to Primo

– Peter L. McCormick

2 Aerification

Invention and innovation often come in the form of adaptation of products or technology from other industries, and the deep-tine aerator is no exception. The first Verti-Drain models introduced by Redexim in the late 1970s for relief of compacted soccer fields in Holland had their roots in articulating spading machines manufactured in Italy for deep cultivation of agricultural fields. The spades on these early machines worked like hand shovels on a crankshaft, with each spade taking a turn entering the soil.


COURTESY OF REDEXIM CHARTERHOUSE

Verti-Drain deep tine aerator

A visionary at Redexim thought to replace each spade with a block of tines, fine-tune the timing and the deep-tine aerator was born.

The first Verti-Drain unit imported to North America in 1983 was the big Model 305-200, a behemoth by comparison to today's popular models. Smaller units like the Model 005-145 were introduced a bit later, with Johnny Burns at Charlotte (N.C.) Country Club buying the first for use on greens, according to Paul Hollis of Redexim Charterhouse Inc.

Deep-tine aerators like the Verti-Drain allowed superintendents finally to penetrate the hardpan created by years of 4-inch coring of greens and fairways. Originally with large solid tines but later with coring tines as well, deep-tine units penetrated the soil as deep as 16 inches, shattering the soil profile as the tines entered, lifted and exited the soil. The channels created enhanced water percolation, gas exchange and overall root growth.

One of Redexim's distributors, K.V. Estess of Southern Green in Zachary, La., decided he could build a better mousetrap and introduced the Soil Reliever in 1994. Since the early Verti-Drains worked slowly and required a large tractor with a creeper gear, Estess focused on engineering the Soil Reliever so it could be used on any tractor, without a creeper gear. He also utilized the hydraulic top linkage on the tractor 3-point hitch to adjust the operating depth of the aerator from the tractor seat without altering the tine angle.

Redexim merged with English manufacturer Charterhouse in 1997, established a branch in the United States and bolstered its product line. It now offers eight models between 48 inches and 104 inches in width, and will introduce two new models in 2004. Southern Green also has expanded its product line to six units, from 48 inches to 80 inches working width. Both manufacturers have introduced a wide variety of tine options, slicer heads and multitines to extend the versatility of these machines beyond deep cultivation.

– Peter L. McCormick

3 Softspikes

When Ernie Deacon took over as general manager at Warm Springs Golf Course in October 1989, one of the first things that caught his attention was a sign at the Boise, Idaho, facility that said: "No spikes allowed until March."

"It just didn't make sense," Deacon recalls. "You'd buy these waterproof DryJoys, but you couldn't use them in the wintertime." Deacon, who wasn't aware of the damage metal spikes did to frozen greens, began to think about golfers playing in sneakers, with their feet unprotected from the wet ground, slipping as they swung.

So Deacon set out to design a "wintertime golf spike" for local golfers. It would be interchangeable with the traditional golf shoe, yet be less damaging to greens.

Deacon took his idea to local inventor and materials expert Faris McMullin, a man who knew a little about golf, having designed clubs for Adams Golf and shafts for Callaway Golf, Cleveland Golf and Ping.

Three years later, after input from Warm Springs superintendent Lee Monroe and others, the co-inventors settled on a polyurethane disk with crescent-shaped spikes that fanned out from the center.

"I knew from the beginning what the potential was," says Deacon, who now sells golf accessories. "We tested it with some of our older members and some would come out with tears in their eyes because their feet didn't hurt anymore. I really felt the comfort was the key. We recognized about 80 percent of our players were seniors and we almost called it Senior Spike."

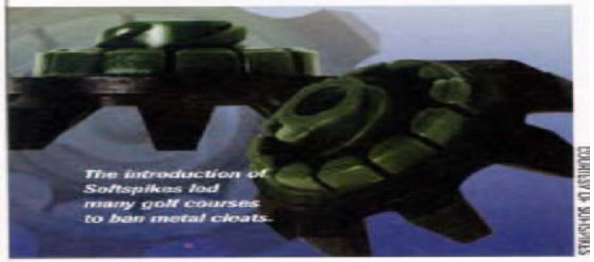
As it turned out, the new cleat would have a much broader market than just Boise seniors with bad feet.

Entrepreneurs Bill Ward and Myron Gerber bought the patent and design rights from Deacon and McMullin for a reported $2.6 million in October 1993. Soon after, Ward and Gerber formed Softspikes, a company that became synonymous with the alternative cleat.

In many ways, the plastic cleat would revolutionize the sport, just as metal woods did in the 1980s. In fact, with more than half of the nation's 16,000 golf facilities banning metal spikes and 60 percent of pro golfers wearing alternative cleats, metal spikes have gone the way of Sans-A-Belt slacks.

In many ways, the creation of Softspikes spawned a true grass-roots revolution.

– Scott Kauffman


The introduction of Softspikes led many golf courses to ban metal cleats.

COURTESY OF SOFTSPIKES

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생장 조정제란 무엇인가?

- 생장조절제란 식물의 생리적반응을 일으키는 혼합물
- 생장조절제는 종종 생장억제제로 불리기도 함(왜냐하면 두 가지 모두 PGR이란 준말을 사용하기 때문)
- 잔디에 사용하는 대부분의 생장조절제는 생장억제제

잔디 생장 조정제의 장점
The Ideal Turf Growth Regulator

- 웃자람을 억제시킴
- 꽃대의 성장을 억제
- 잔디의 회복능력을 향상
- 잔디의 품질 향상
- 예지횟수를 줄여 경제적인 이익창출
- 균일한 성능
- 모든 주요 잔디 초종에 작용

잔디에 사용되는 생장 조정제의 종류

- **Class A:** 후기 지베렐린 합성 차단제

  Primo Maxx(trinexapac-ethyl)

- **Class B:** 초기 지베렐린 합성 차단제

  Trimmit (paclobutrazol), Cutless (flurprimidol)

- **Class C: Mitotic Inhibitors(**유사분열 억제물질**)**

  Slo-Gro (Maleic hydrazide), Embark (Mefluidide), Limit (amidochlor)

- **Class D: Herbicidal Mode(**제초제 적용**)**

  Touchdown Pro/Roundup(glyphosate)

  SU's (Metsulfuron methyl)

  Prograss (ethofumesate)

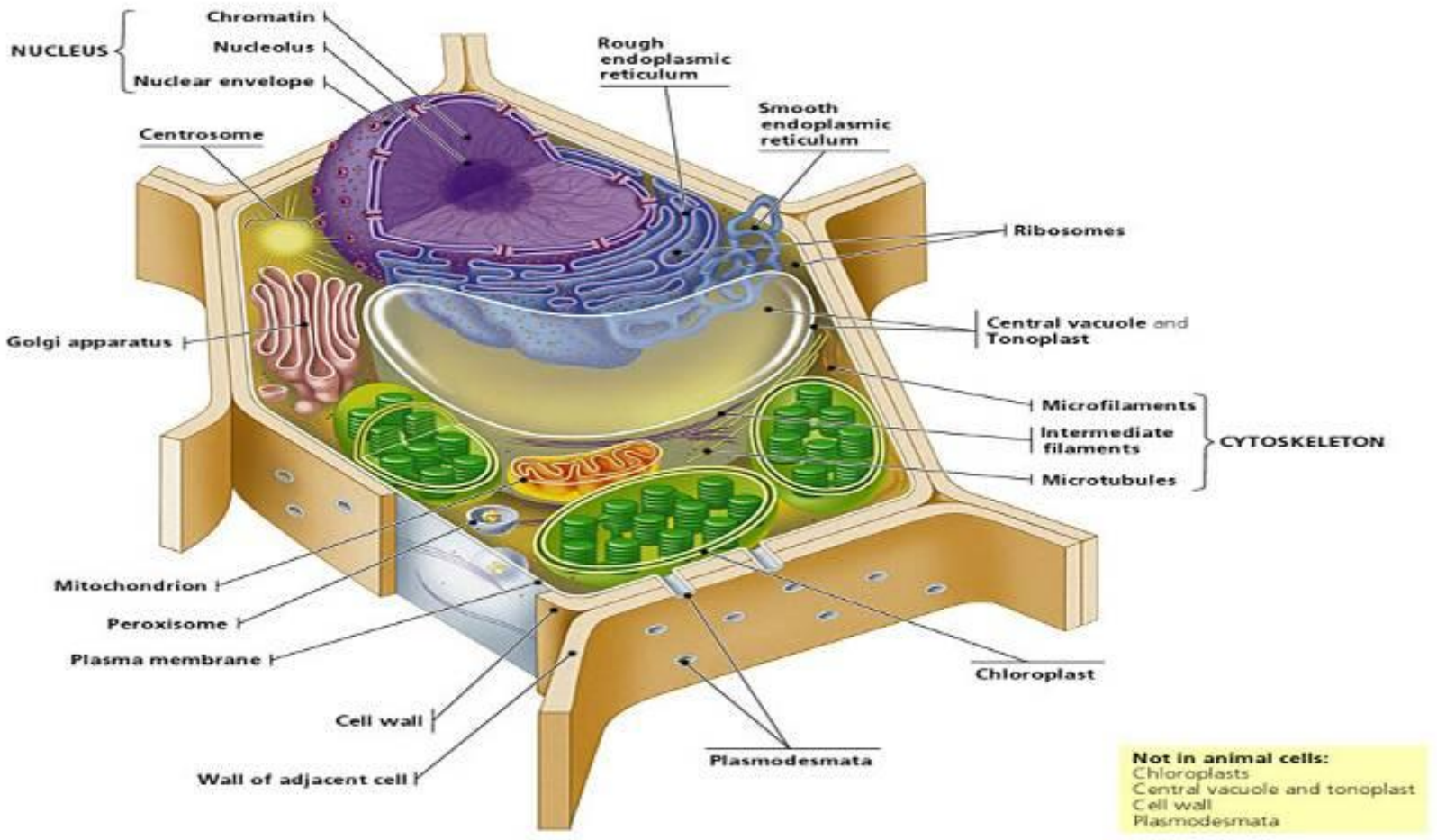
- **Class E: Ethylene Production Enhancement(**에틸렌 생산 촉진**)**

  Proxy (ethephon)

생장조정제가 호르몬에 미치는 영향
PGR's Impact Natural Hormone Levels

- Abscisic Acid: 기공은 닫으며 발아, 지베렐린산, 싸이토키닌의 생산을 억제 시킨다.
- Cytokinens: 세포의 분열, 생장, 꽃대의 생김 을 도와주는 역할을 한다. 옥신의 생산을 억제한다.
- Gibberellins: 세포의 생장, 광주기의 반응, 추위에 강하게 만든다. 100개 이상의 형태가 있다.
- Ethylene: 스트레스로 인해 자극이 되며 뿌리의 생장을 도와주고 꽃대의 생산을 억제시켜 준다.

생장조정제 는 세포의 분열을 억제시켜 잔디의 생장을 억제함



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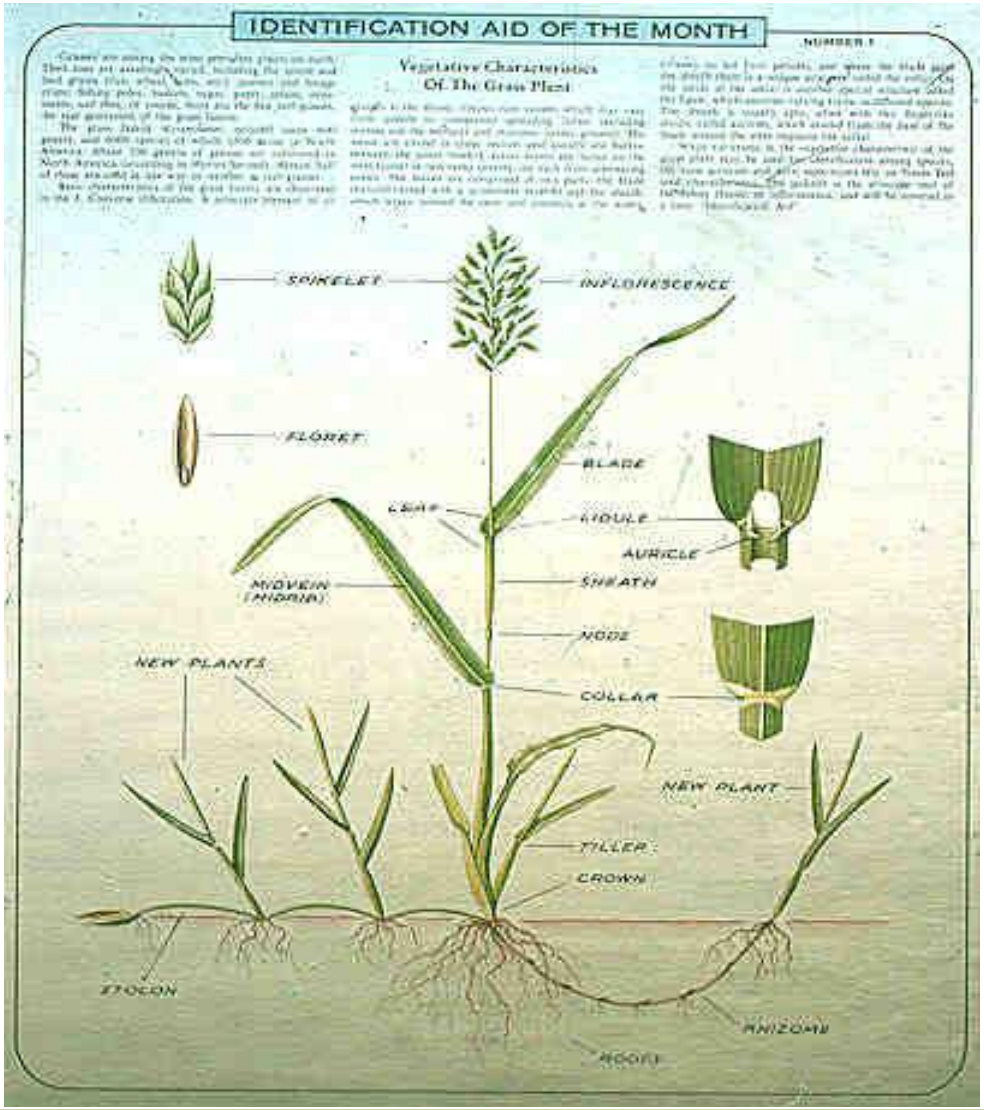
생장조정제: 잔디 형태에 미치는 효과



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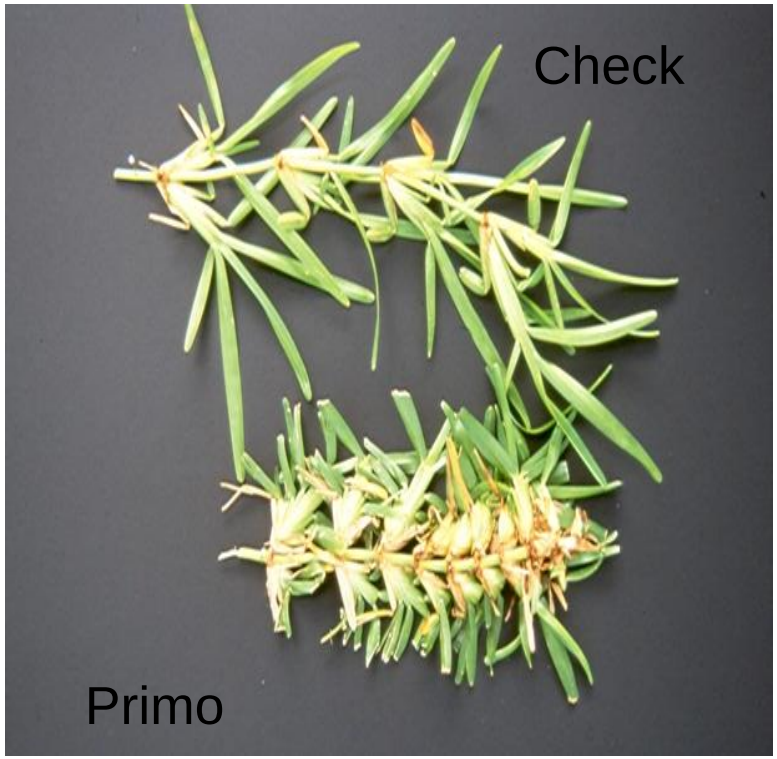
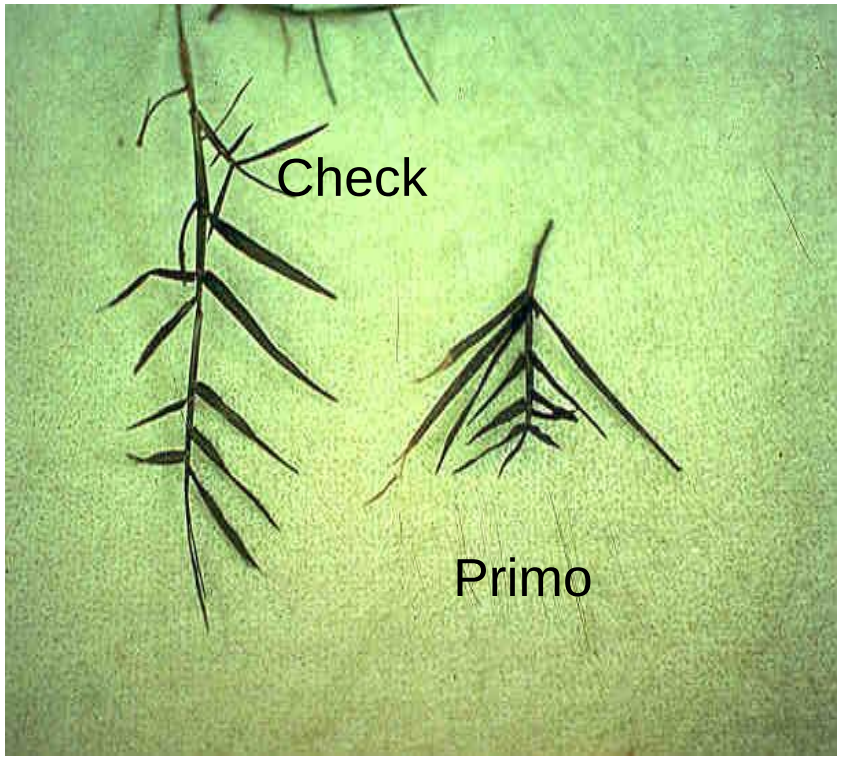
잔디 형태에 대한 프리모의 영향
Primo Effect on Turf Morphology



St. Augustinegrass



Hybrid Bermudagrass

켄터키블루그라스에 대한 프리모의 영향 – 약제처리 3주 후
Primo MAXX Effect on KBG – 3 WAT

Primo MAXX **Control**

분얼 증가 **vs.** 수직 성장

Photo from Dr. Bruce Branham – Univ. of Illinois

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생장조정제 : 뿌리에 미치는 효과

- 생장조정제를 사용하더라도 잔디는 생물이 생존하기 위해 필요한 모든 절차를 실행하고 있다. (광합성 작용 & 호흡작용)
- 수직 성장이 억제가 되면서 에너지는 러너 및 뿌리로 이동을 하게 된다.
- 지속적인 사용은 뿌리의 밀도를 높여주며 잔디의 밀도도 함께 높여준다.
- 사진은 뿌리를 땅에서 부터 때어내기 위해 필요한 힘을 측정 하는 장비다.

Primo MAXX – 1990's

- 유효 성분 – 트리낵사팍-에틸
- 사이클로헥사디온 방식의 최초 생장조절제 – ㅡMEC 형태
- 1시간 안에 엽면 으로 흡수가 되며 후 비가와도 상관 없음
- 주요 사용 : 모든 잔디에 수직 성장 억제, 스트레스 감소, 품질 향상.

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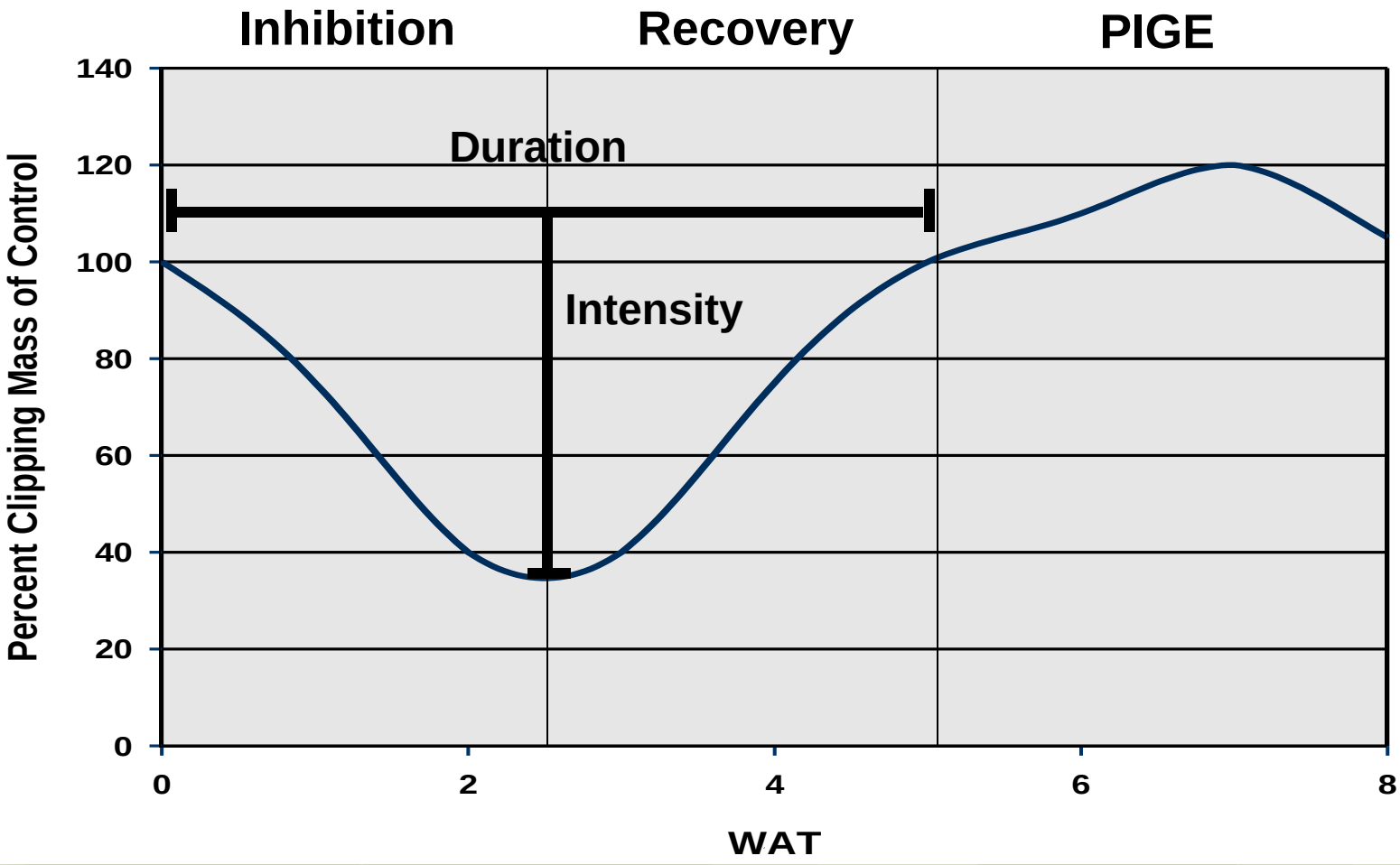
Primo의 성공 이유

- 많은 대학에서 광범위한 프리모의 연구를 통해 기작과 사용방법에 따른 이점이 홍보되었다.
- 프리모의 반복처리로 수직성장을 줄이고 밀도를 높일 수 있음.
- 권장사용량은 약 3~4주에 한번 또는 약량을 줄여 적은량을 자주처리하는 두가지 방법
- 반복처리로 답압, 그늘, 가뭄 등 스트레스에 대한 내성이 생김
- 골프장 건설 붐과 더불어 인터넷을 통한 빠른 소문, 연료 절감
- 프리모가 인기를 모으자 다른 생장조정제도 같이 상승함

프리모맥스에 대한 잔디의 반응
Turfgrass Response to Primo MAXX



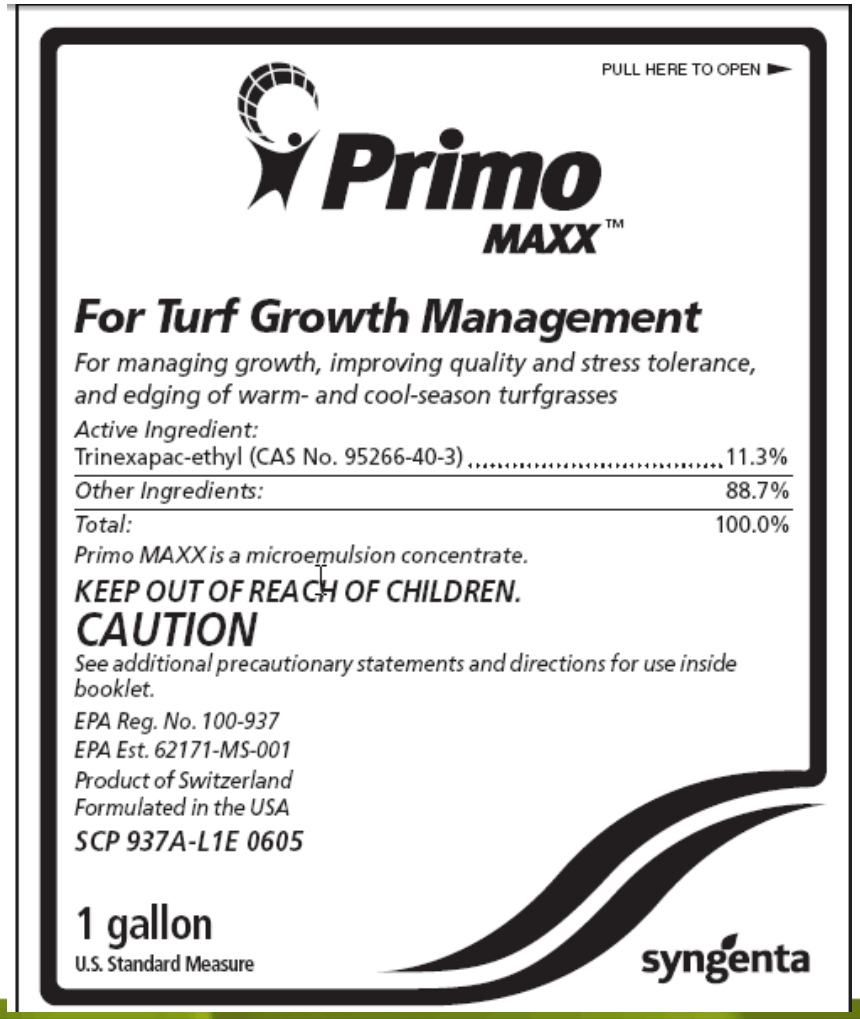
Slide Credit: Dr. Bruce Branham

골프장에 사용하는 생장 조정제

- Trinexapac-ethyl (Primo MAXX, Generic Brands)
- Paclobutrazol (Trimmit, Turf Enhancer, Generic Brands)
- Flurprimodol (Cutless 50W)
- Mefluidide (Embark, Embark Lite)
- Ethephon (Proxy)
- Trinexapac-ethyl + Flurprimidol (Legacy)

Primo MAXX™

- Labeled in 1993
- 잔디의 생장을 50% 억제시켜 주며 약효는 4주까지 간다.
- 지속적으로 사용 시 잔디의 밀도와 품질을 높여줄 수 있다.
- 모든 잔디에 사용 가능하다.
- 그린,티,페어웨이,러프에 사용 가능하다.
- 엽면으로 1시간 이내로 흡수된다.



Trimmit®

- Labeled in mid-1980's
- 벤트그라스 코스에 세포아풀을 억제시켜 준다.
- 한지형 잔디에 대부분 사용한다.
- Turf Enhancer label is similar to the Trimmit label
- 뿌리로 흡수가 된다.
- 년간 1ml/m2 이하의 사용을 권한다.

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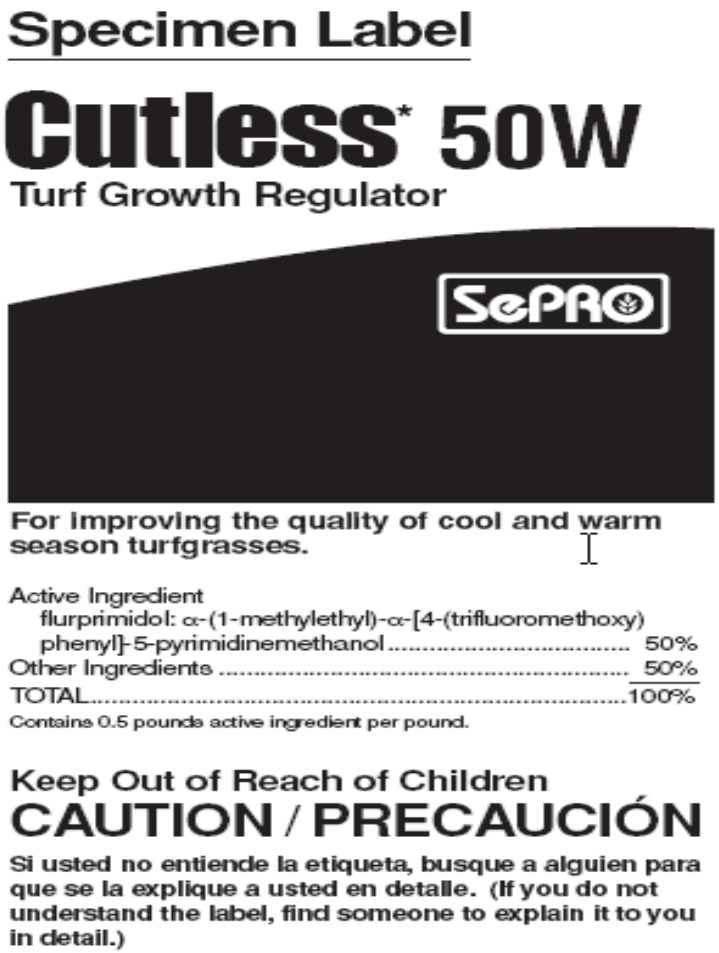
Cutless*

- Labeled in mid-1980's
- Growth suppression of warm- and cool-season turfgrasses
- *Poa annua* reduction on bentgrass greens and fairways
- Water-in for root uptake



Specimen Label

Cutless* 50W

Turf Growth Regulator

SePRO

For improving the quality of cool and warm season turfgrasses.

Active Ingredient	
flurprimidol: α-(1-methylethyl)-α-[4-(trifluoromethoxy) phenyl]-5-pyrimidinemethanol	50%
Other Ingredients	50%
TOTAL	100%

Contains 0.5 pounds active ingredient per pound.

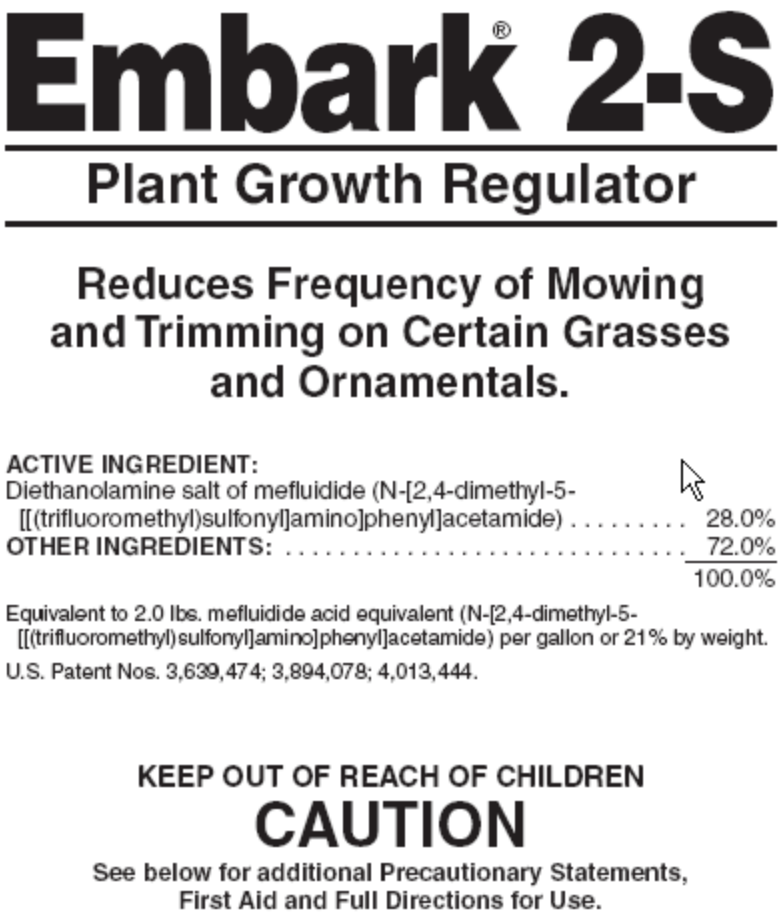
Keep Out of Reach of Children

CAUTION / PRECAUCIÓN

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Embark® 2-S

- Labeled in mid-1970's
- *Poa annua* seedhead suppression
- Growth suppression of cool-season turfgrasses
- Do not apply to golf greens
- Do not apply within four months of seeding
- Wait at least three days after seeding for application
- Foliar uptake



Embark® 2-S

Plant Growth Regulator

Reduces Frequency of Mowing and Trimming on Certain Grasses and Ornamentals.

ACTIVE INGREDIENT:
Diethanolamine salt of mefluidide (N-[2,4-dimethyl-5-[[(trifluoromethyl)sulfonyl]amino]phenyl]acetamide) 28.0%
OTHER INGREDIENTS: 72.0%
100.0%

Equivalent to 2.0 lbs. mefluidide acid equivalent (N-[2,4-dimethyl-5-[[(trifluoromethyl)sulfonyl]amino]phenyl]acetamide) per gallon or 21% by weight.

U.S. Patent Nos. 3,639,474; 3,894,078; 4,013,444.

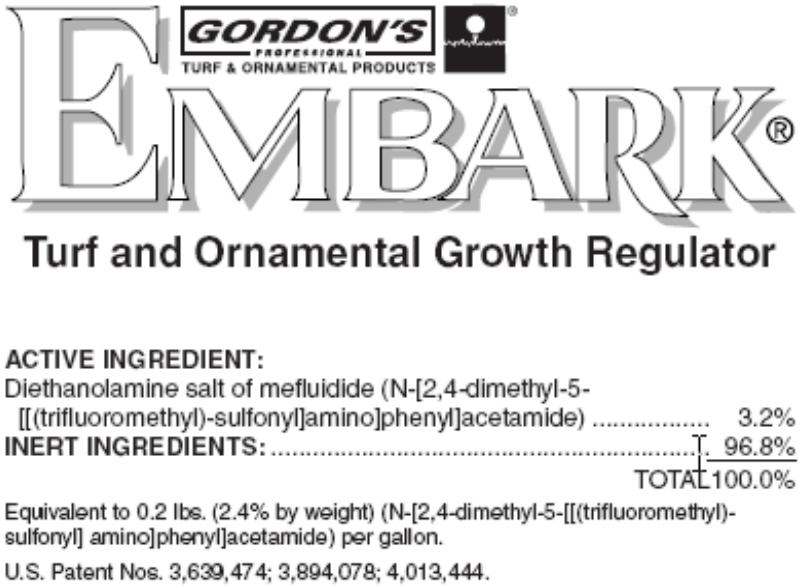
KEEP OUT OF REACH OF CHILDREN

CAUTION

See below for additional Precautionary Statements, First Aid and Full Directions for Use.

Embark® T&O

- *Poa annua* seedhead suppression
- Has 10% of the active ingredient as Embark 2-S
- Growth suppression of cool-season turfgrasses
- Foliar uptake



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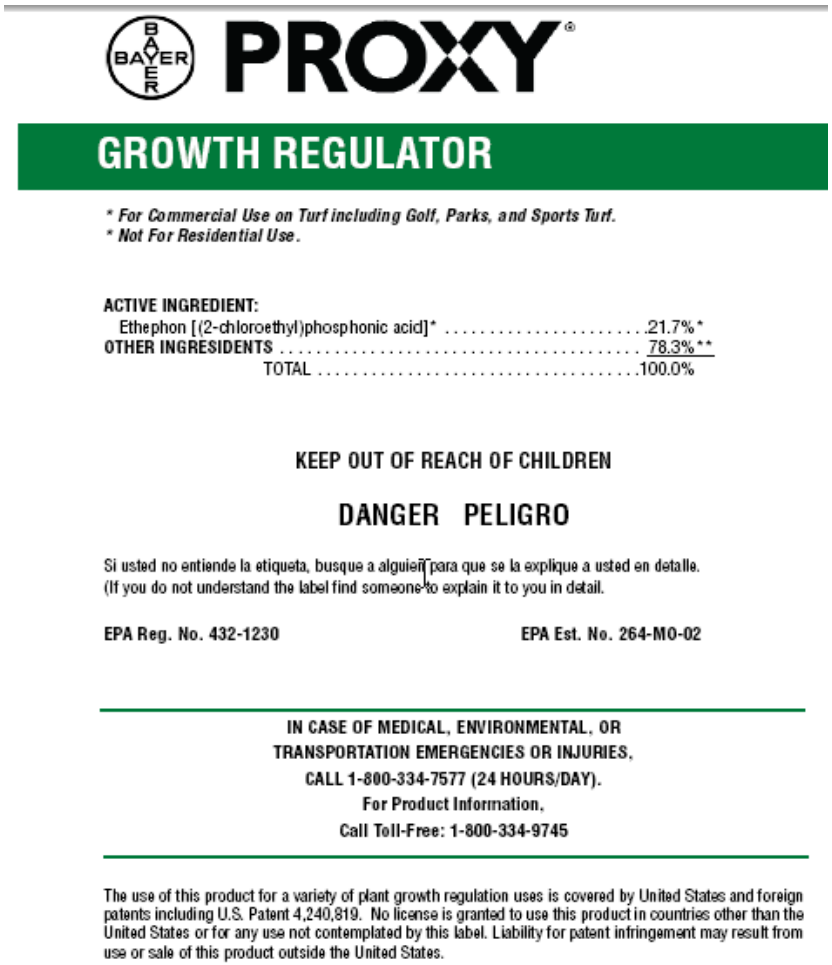
Proxy®

- Labeled in late 1990's
- Tank-mixed with Primo MAXX for suppression of *Poa annua* seedheads
- Suppresses white clover seedheads
- Foliar uptake



BAYER **PROXY®**

GROWTH REGULATOR

** For Commercial Use on Turf including Golf, Parks, and Sports Turf.*
** Not For Residential Use.*

ACTIVE INGREDIENT:
Ethephon [(2-chloroethyl)phosphonic acid]* 21.7%*
OTHER INGREDIENTS 78.3%**
TOTAL 100.0%

KEEP OUT OF REACH OF CHILDREN

DANGER PELIGRO

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle.
(If you do not understand the label find someone to explain it to you in detail.

EPA Reg. No. 432-1230 **EPA Est. No. 264-MO-02**

IN CASE OF MEDICAL, ENVIRONMENTAL, OR TRANSPORTATION EMERGENCIES OR INJURIES, CALL 1-800-334-7577 (24 HOURS/DAY).
For Product Information, Call Toll-Free: 1-800-334-9745

The use of this product for a variety of plant growth regulation uses is covered by United States and foreign patents including U.S. Patent 4,240,819. No license is granted to use this product in countries other than the United States or for any use not contemplated by this label. Liability for patent infringement may result from use or sale of this product outside the United States.

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Legacy*

- Labeled in 2008
- Growth suppression of warm- and cool-season turfgrasses
- *Poa annua* reduction in bentgrass greens, tees, and fairways
- Root and foliar uptake

Specimen Label

Legacy*

Turf Growth Regulator

SePRO

For Growth Management and Quality Improvement of Perennial Cool- and Warm-Season Turfgrasses on Golf Courses.

Active Ingredient

flurprimidol: α-(1-methylethyl)-α-[4-(trifluoromethoxy) phenyl]-5-pyrimidinemethanol	13.26%
trinexapac-ethyl: 4-(cyclopropyl-alpha-hydroxymethylene)-3,5-dioxo-cyclohexanecarboxylic acid ethyl ester	5.00%
Other Ingredients	81.74%
TOTAL	100.00%

Contains 1.10 pounds of flurprimidol per gallon of product.
Contains 0.41 pounds of trinexapac-ethyl per gallon of product.

Keep Out of Reach of Children

WARNING / AVISO

생장조정제 프로그램은 어떻게 시작하는가?
How to Start a PGR Program

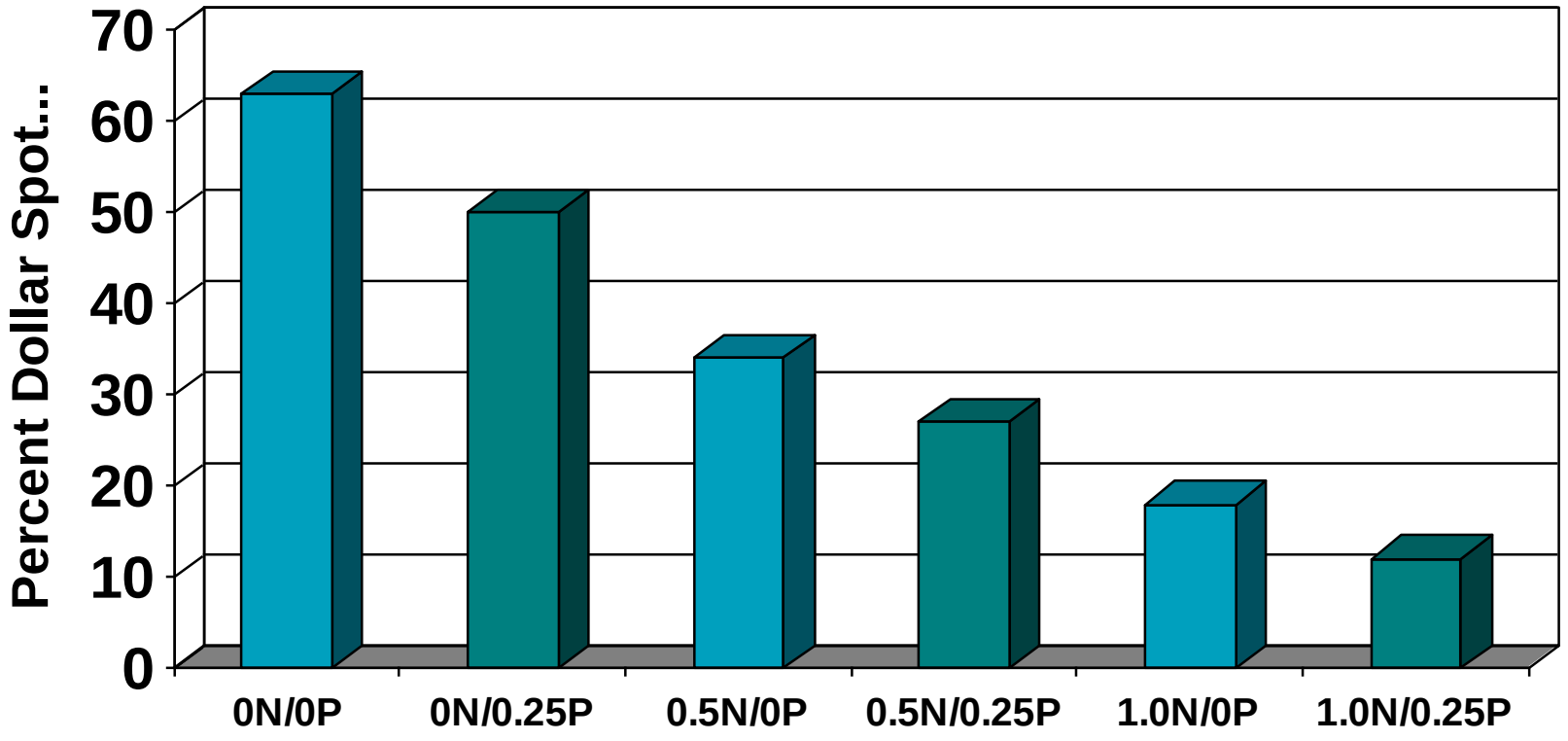
1. PGR 프로그램으로 부터 원하는 이점을 결정.
2. 잔디 품종을 파악.
3. PGR 제품 라벨을 검토.
4. 생산자에게 문의.
5. 다른 관리자에게 문의.
6. 전문 연구원들에게 문의.
7. 현재 관리 계획 검토 후 생장조정제 결정, 처리 시기 및 원하는 결과를 위한 처리 약량 결정.
8. 다른 제품과 혼합해 사용시 우선 소규모 시험 후 사용.
9. Keep records and take pictures of application information and turf response
10. 기록을 보관하고 처리 정보 및 잔디 반응에 대한 사진을 확보.

다른 성분과 혼합해 사용

- 엽면으로 흡수되는 제품을 함께 혼합해서 사용할 수 있다.
- 살균제화 함께 사용하면 더욱 효과적인 결과를 볼 수 있다.
- 엽면으로 흡수되는 경엽처리 제초제와 같이 사용할 수 있다.
- 발아전 처리제는 대부분 뿌리로 흡수가 되므로, 혼합해서 사용하면 안된다.
- 액체로 생산된 철분을 같이 혼합해 사용하면 제품의 효과를 증가 시킬 수 있다.

프리모와 질소 혼용처리가 동전마름병에 미치는 영향

PrimoMAXX and Nitrogen Influence on Dollar Spot



Fairway height Creeping bentgrass

From: Golembiewski and Danneberger, Ohio St. Univ., 1996

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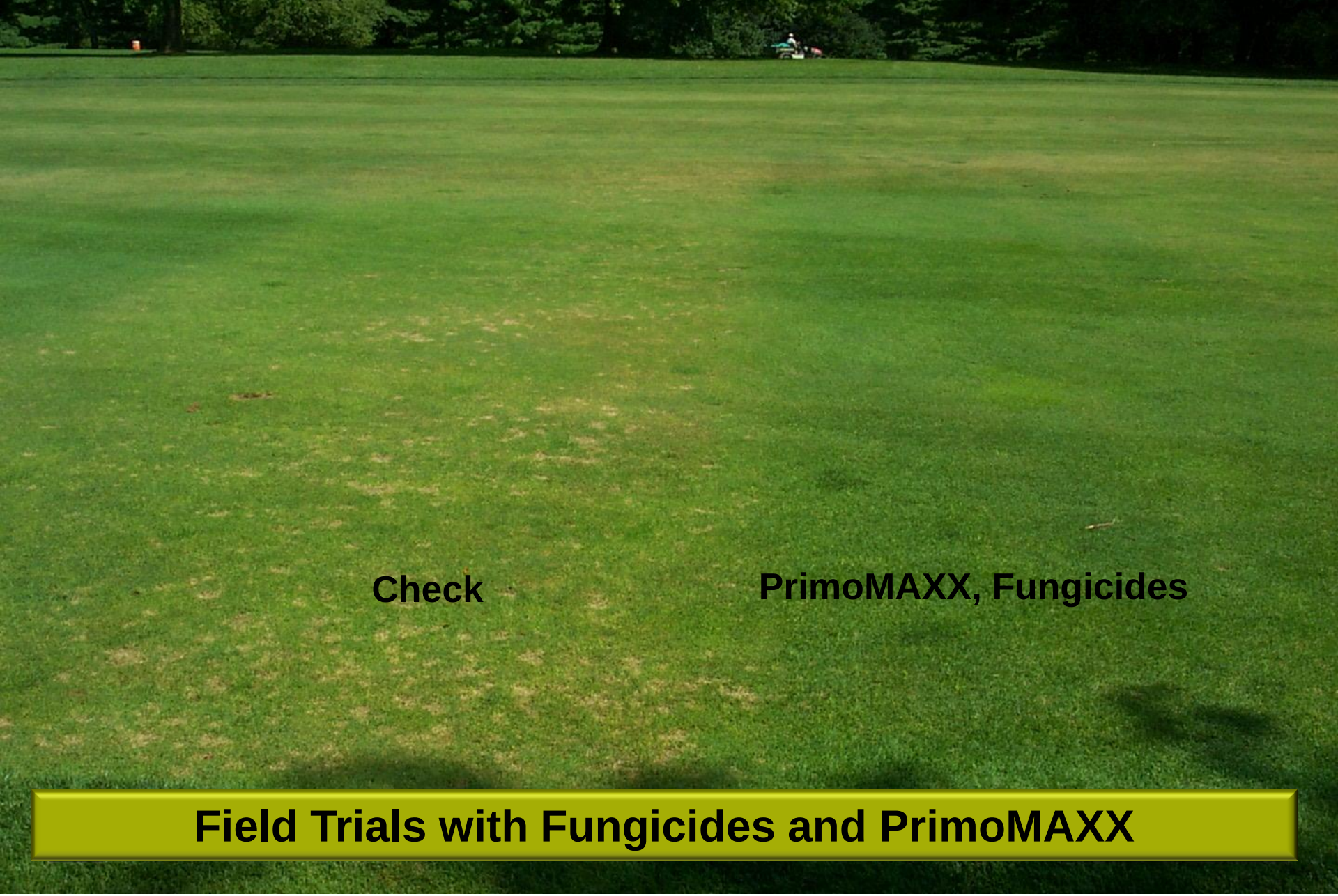

Field Trials with Fungicides and PrimoMAXX

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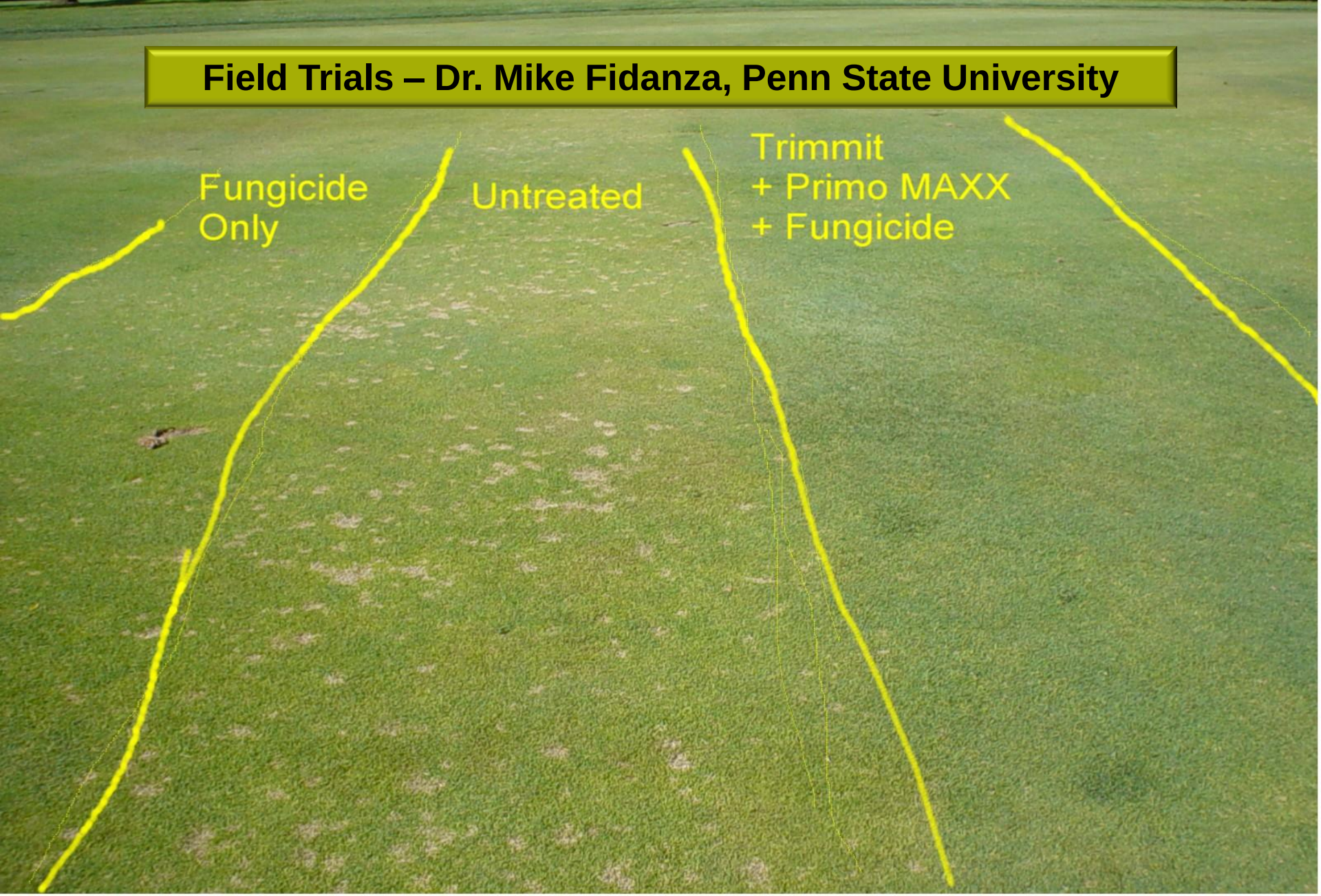
Field Trials – Dr. Mike Fidanza, Penn State University



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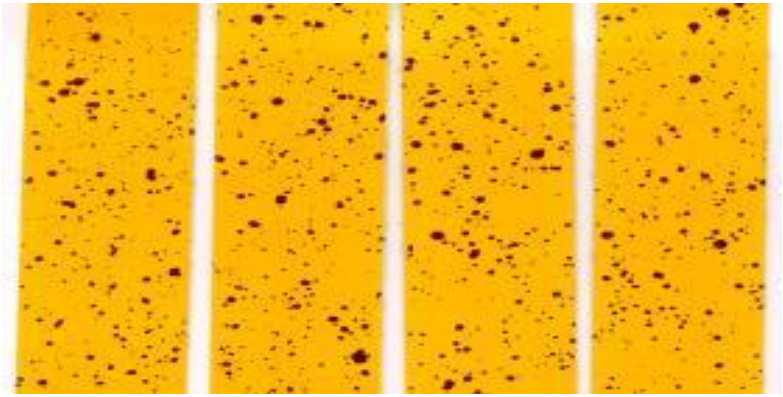
물량과 노즐 선택

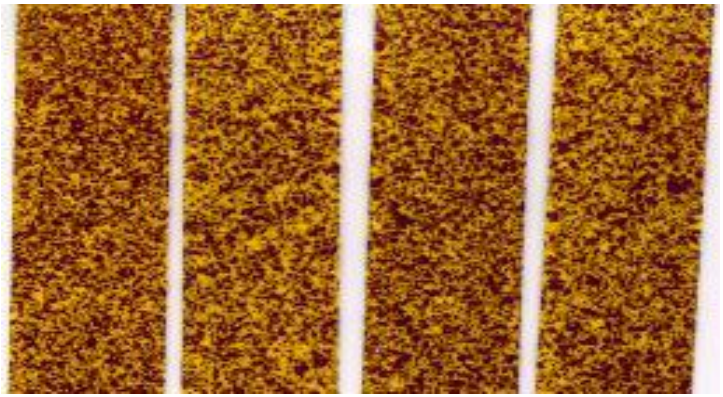
물량과 노즐 선택

- 균일한 살포를 위해 flat fan spray 방식 노즐을 선택
- 분무입자의 크기는 중간에서 약간 큰 것이 좋음
- 분무 압력은 30~60psi로 유지(2~4 bar)
- 과도하게 큰 분무입자 금지.
- 빗 물과 같은 형태의 노즐 금지.
- 물량은 50-100 ml/㎡(500~1,000L/ha)로 사용

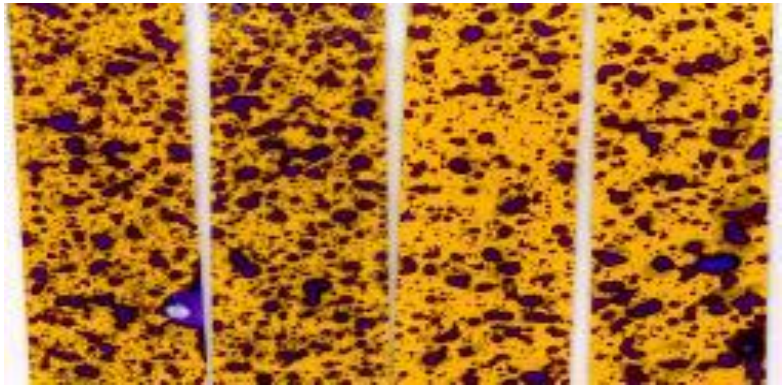
살포물량, 분무압력, 속도
Carrier volume, operating pressure and speed or sprayer



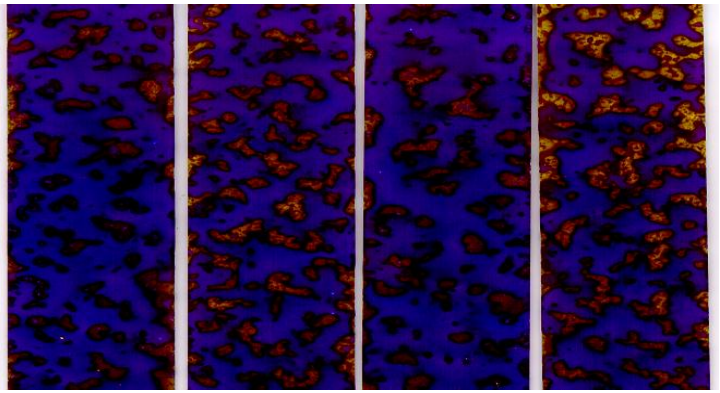
42 L/ha; 1 bar, 6,6 km/h



220 L/ha; , 4 bar, 2.5 km/h

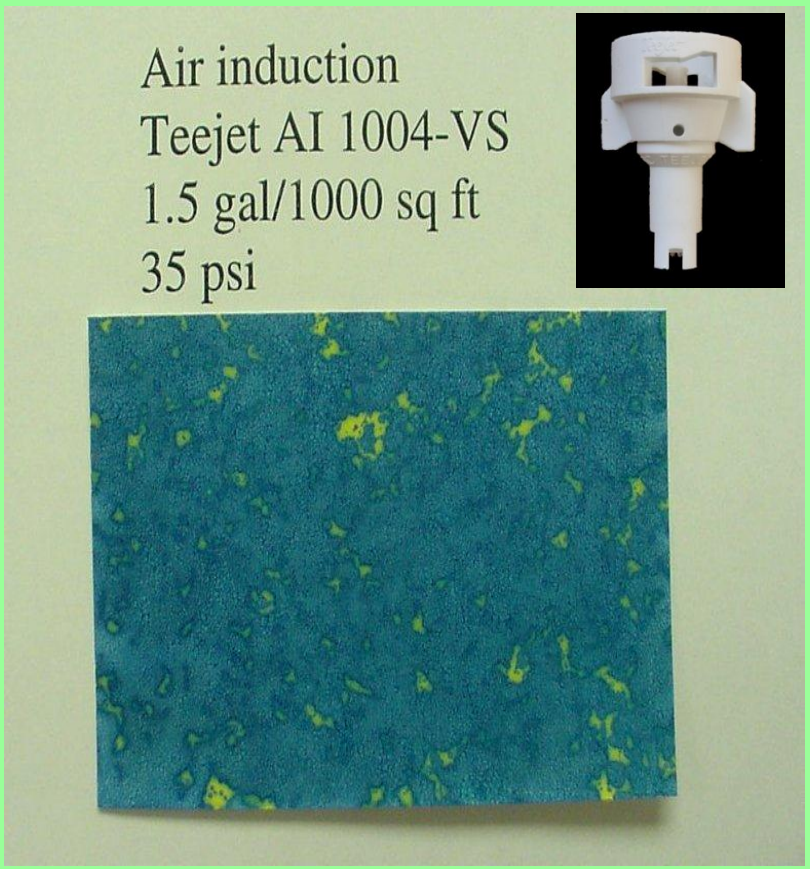


230 L/ha; 1 bar, 5.8 km/h



1000 L/ha; 3.5 bar, 2.5 km/h

추천 노즐- 접촉형

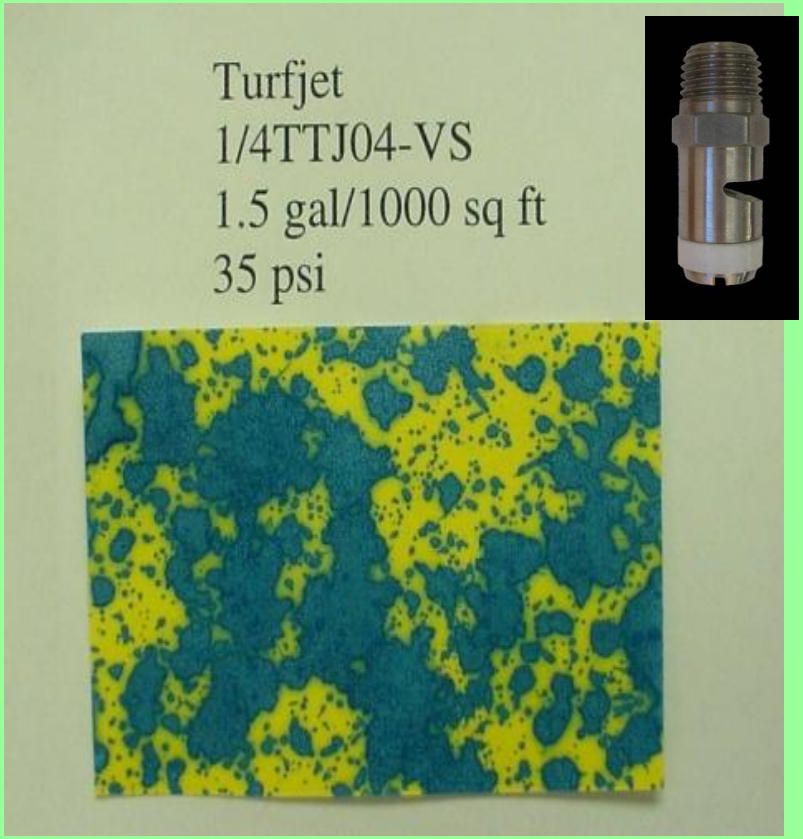


Dr. Vincelli – Univ. of Kentucky

Dr. Vincelli – Univ. of Kentucky

비 추천- 접촉형

Dr. Vincelli – Univ. of Kentucky



Dr. Vincelli – Univ. of Kentucky

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XR/XRC TeeJet® Flat Fan Nozzles

Driftable Fine % at 40 psi (0.4 Mpa or 4 bars): XR8004 = 5% (<150 Microns)
XR11004 = 14%

	HERBICIDES		INSECTICIDES		FUNGICIDES		DRIFT
	Contact	Systemic	Contact	Systemic	Contact	Systemic	Control
XR , XRC TeeJet	EXCELLENT	GOOD	EXCELLENT	GOOD	EXCELLENT	GOOD	GOOD
XR, XRC TeeJet at pressures below 30 psi (2.0 bar)	GOOD	VERY GOOD	GOOD	VERY GOOD	GOOD	VERY GOOD	VERY GOOD

TurfJet Wide Angle Flat Spray Nozzles

Driftable Fine % at 40 psi: 1/4TTJ04-VS = < 1% (<150 Microns)

HERBICIDES		INSECTICIDES		FUNGICIDES		LIQUID FERTILIZER		DRIFT
Contact	Systemic	Contact	Systemic	Contact	Systemic	Broadcast	Directed	Control
	EXCELLENT		EXCELLENT		EXCELLENT	EXCELLENT		EXCELLENT

Not recommended for products with contact activity.

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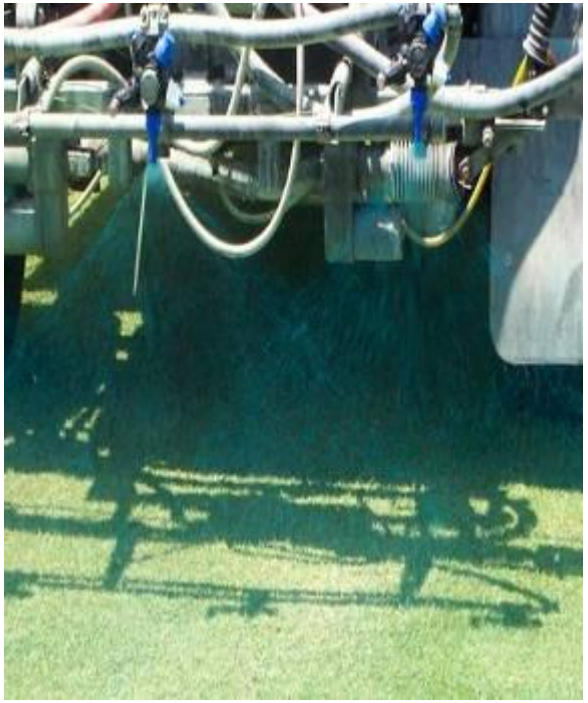
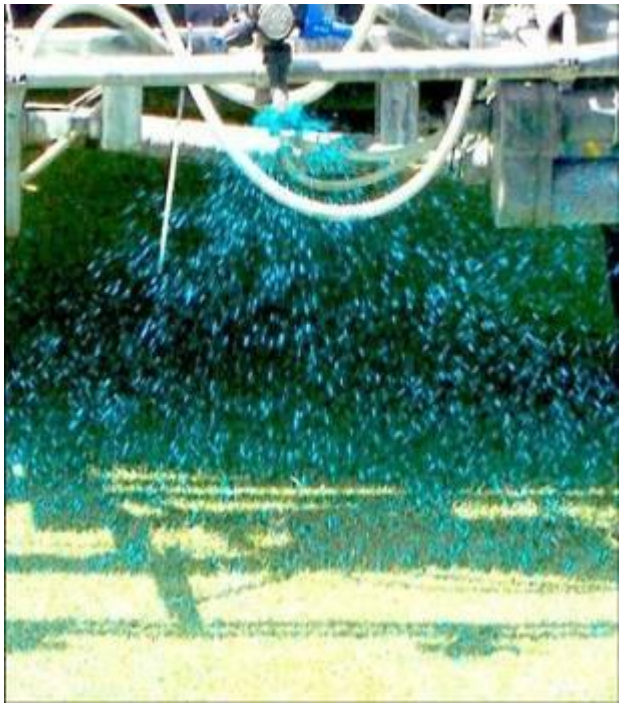
분무입자 크기 비교
Comparison of Droplet Size

XR Flat-fan

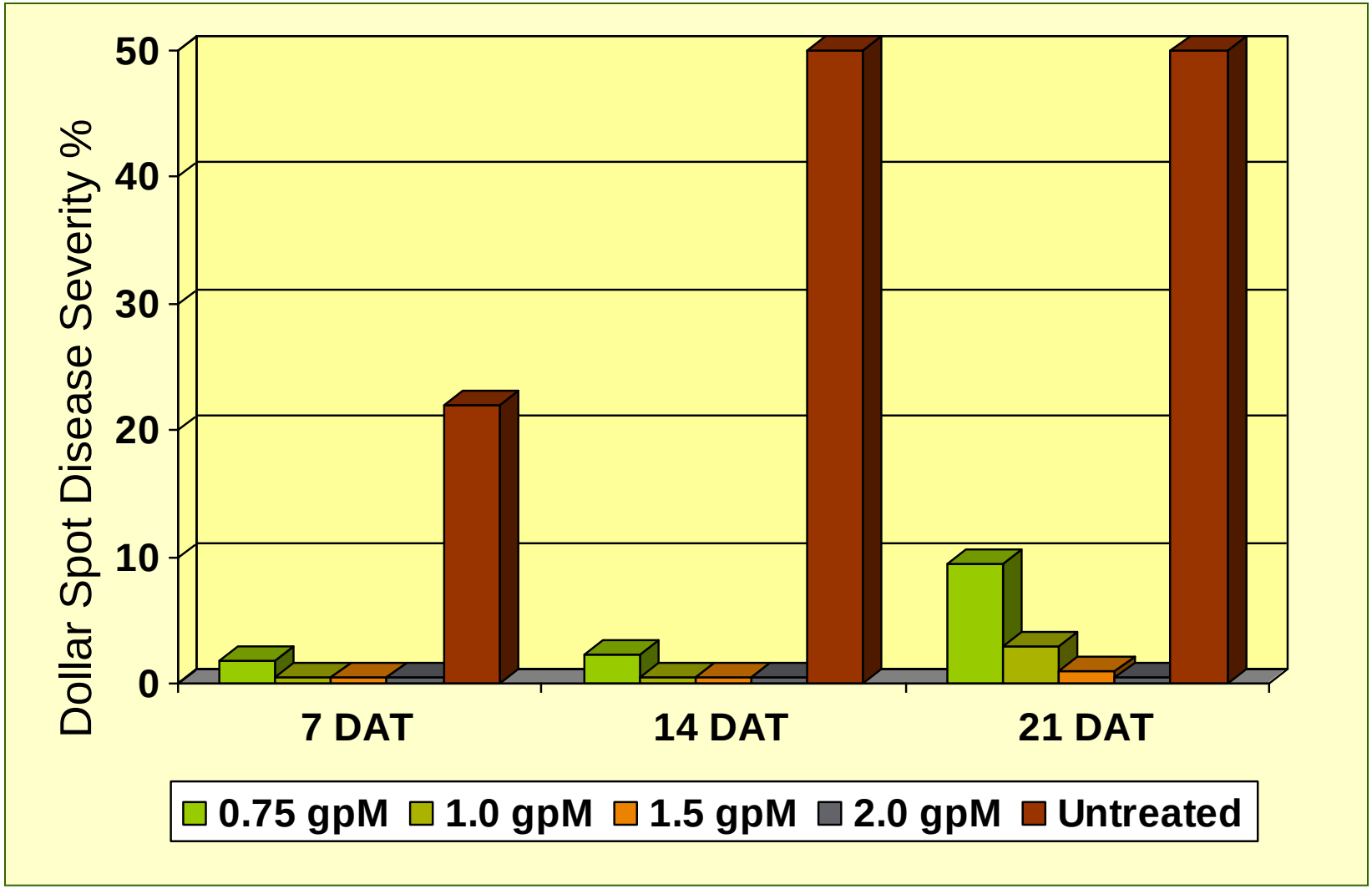


Air-induction



TurfJet

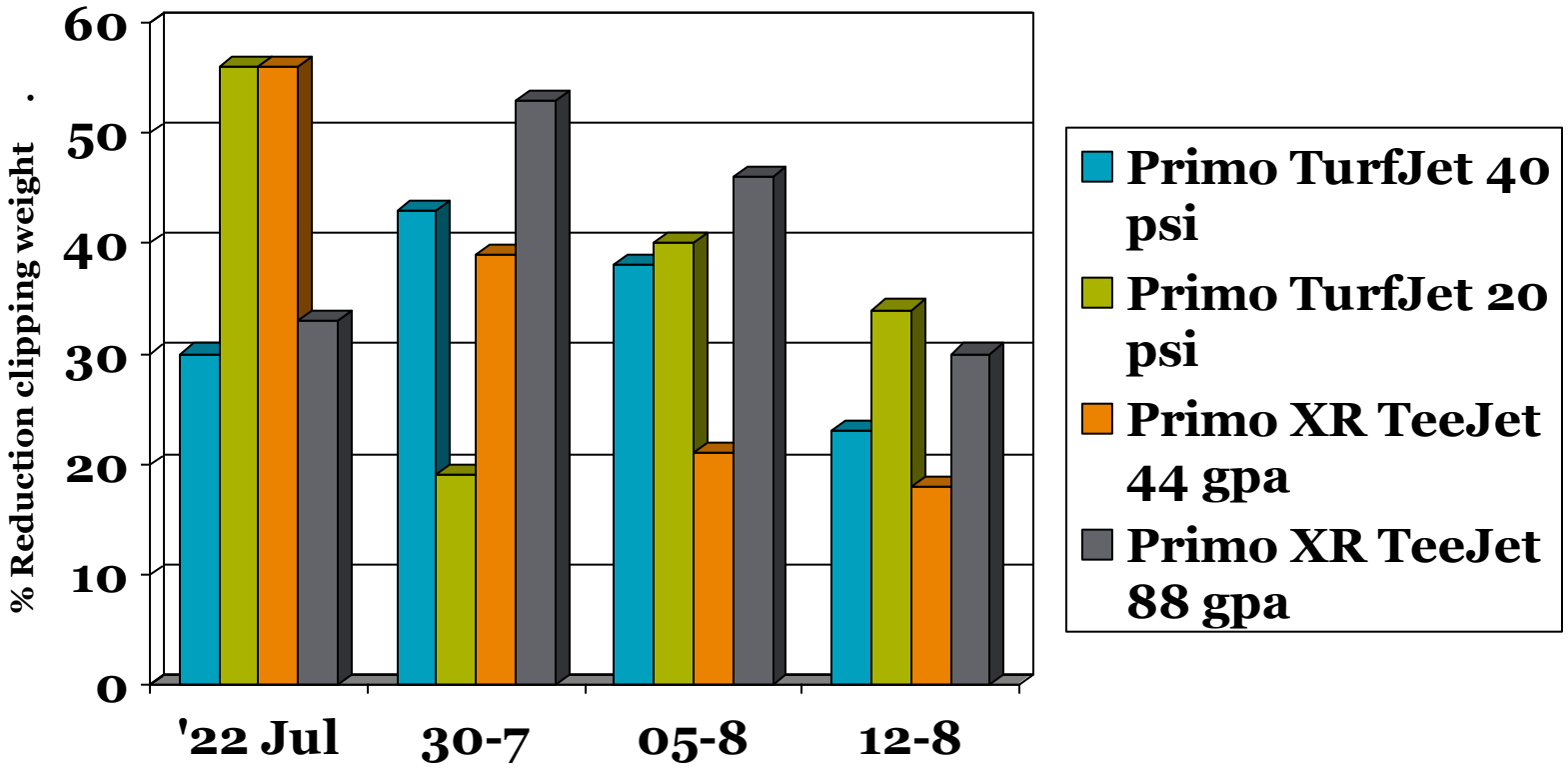
Water Volume – Banner MAXX



Dr. Rick Latin: Purdue University – 2005

노즐과 살포물량이 예지물량에 미치는 영향

Effects of Spray Nozzles & Water Volume on Clipping Weights.
Dr. Fidanza - Wyncote GC, PA 2004



Primo MAXX applied once at 0.25 oz/1000 sq ft (0.8 L/ha) on July 13. Application volume was 44 gpa (40 ml/ sq. m or 400 L/ha) unless noted otherwise.

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