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The Newsletter of the International Turfgrass Society

May 2019

Peter McMaugh recently awarded The Order of Australia at the level of Member of the Order

by Gary Beehag and John Odell

Sydney, Australia

Peter E. McMaugh AM. B.Sc. Agr. FAIAST who resides in Sydney has recently been awarded The Order of Australia at the level of Member of the Order (AM) for his services to the Australian turfgrass industry. The Order of Australia celebrates and recognises Australian citizens who have made outstanding and significant contributions to the Australian way of life. Peter has had an unequalled and dedicated career in the Australian amenity horticulture and turfgrass industry spanning over five decades and continues to do so.

Peter graduated with a Bachelor of Science in Agriculture (B.Sc.Agr) in 1964 from the University of Sydney. His passion for botany and plant science enabled Peter to have the distinction of being the first person in Australia with an agricultural degree to be appointed on a permanent full-time basis as a consultant/researcher in the turfgrass industry. In 1964 Peter was employed by the now-defunct Grass Research Bureau/Australian Turfgrass Research Institute and was its director from 1975-1978.

Picture from the 2017 13th International Turfgrass Research Conference in New Jersey. From left to right: the late Dr. Jim Beard, Drs. Paul Rieke, Dick Schmidt, Joe Vargas and Peter McMaugh AM.

Peter's unrelenting quest for knowledge for all things turfgrass and his acute understanding and practical application of plant science and physiology of grasses became unequalled in Australia and later recognised

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In July, most members of the ITS Board members will be meeting in Copenhagen to continue planning and preparation for the 14th ITRC. Shortly there after in early 2020 a call for papers will be announced so it will not be long before the conference is here. However in the meantime, have you renewed your ITS 2017 to 2021 membership? Remember to submit a paper for publication in one of the several journal options, at least one author must be a member of the society.

Also, if you have any newsworthy stories or information for readers of International Turfgrass, I hope you will consider submitting an article for the next newsletter in September 2019.

I hope you enjoy the very good articles in this edition.

Sincerely,
Nathan R. Walker

In this Edition

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Memberships and awards

Peter has amassed a multitude of professional memberships and awards.

1970	Member of the Weed Society of NSW
1973	Joined International Turfgrass Society (ITS), served on Board of Directors (1985-2000) and nominated President (1993-1997) for 8th ITS Conference (University of Sydney).
1981-83	Board member of Musser Foundation (USA)
1983	Co-organised the Turf Growers Association of New South Wales and elected president in 1985
2000	Recipient of the Australian Sports Medal, Recipient of Distinguished Service Award from Australian Golf Course Superintendents Association (AGCSA)
2002-2005	Foundation Board Member of Turf Producers Australia (TPA)
2003	Recipient of Life Member of Turf Growers Association of New South Wales
2004	Recipient of Honorary Member of Turf Producers International (TPI)
2005	Recipient of Life Member of New South Wales Golf Course Superintendents Association (NSWGCSA) Fellow of the Australian Institute of Agricultural Sciences and Technology Recipient of Greening China Award (Honoured at a state lunch in Western provinces in China for contributions for assistance during the 1990's to set up turf farms in Tianjin (China)
2009	Recipient of Graham Gregory Award for excellence in horticulture (Horticulture Australia Limited). First person in Australian turfgrass industry to be given this prestigious award.
2010	Initiated the Peter McMaugh Scholarship with New South Wales Golf Course Superintendents Association (NSWGCSA)to cover tuition and expenses during the first year for successful candidates enrolled in the Master of Agriculture (Turf Management) at the University of Sydney, Sydney.
2013	Recipient of Medal Of Excellence. Weed Society of NSW
2014	Member of scientific panel – 3rd International Conference on Turfgrass Management & Science for Sports Fields. Brisbane, Qld. 17-24th August
2017	Awarded Turf Australia Hall of Fame membership

overseas. In 1979, Peter established his consulting company Turfgrass Scientific Services Pty Limited.

Peter is widely known throughout Australia and overseas as a turfgrass consultant, educator, researcher and turfgrass breeder. However, very few people are aware of his involvement in turfgrass technologies. Unquestionably recognised as Australia's foremost authority on turfgrass, Peter's life-long devotion of turfgrasses and their management has benefited so many people and organisations in the wider Australian turfgrass industry, not just cricket wicket curators, golf course superintendents and racecourse managers. For over forty years, Peter has been a notable often keynote speaker at numerous regional, state, national and international seminars and conferences

Turfgrass educator and motivator

One of Peter's single, greatest legacies as a turfgrass educator was the exposure of the Australian turfgrass industry to notable, overseas turfgrass researchers and scientists by interacting and inviting them to speak at the national conferences in Australia. The results were two-way. Australian turfgrass managers benefited from a wider knowledge base and overseas persons engaged in the turfgrass industry recognised the worth of the Australian industry. The first person was the late Dr. James B Beard in 1973. Other eminent persons are Drs. Richard Smiley, Jim Watson, Jeff Krans, Joe Vargas, Henry Indyk, Arden Baltensperger (USA) and John Escritt (UK). Numerous other overseas persons continue the legacy to this day.

Of Peter's depth and breadth of the turfgrass literature, Dr. Jim Beard in 1988 at Perth made the comment "in Peter McMaugh you have here in Australia the only man I know who knows the turf literature as well as I do". Understanding the importance of turfgrass education, Peter over many years has devoted time as a member of the Advisory Committee of the then Hawkesbury Agricultural College now University of Western Sydney

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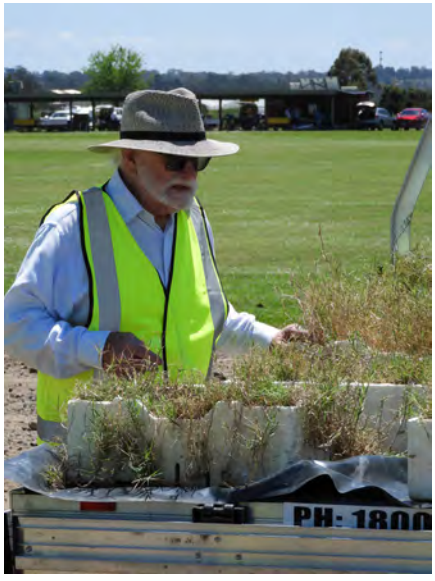

Peter examining *Cynodon* spp. germplasm.

(Richmond) and member of the Advisory Committee of the Ryde School of Horticulture now Ryde TAFE (Sydney). He made a significant contribution with Mike Clune to reconstruction of the Greenkeeping syllabus. Peter was also involved in the post-graduate diploma/masters course taught by Professor Peter Martin of the University of Sydney for which he was the external examiner 1994-2008. He has also been a guest speaker at the University of Queensland (Gatton).

In wanting to further empower Australians, Peter initiated the Peter McMaugh Scholarship in 2010 with New South Wales Golf Course Superintendents Association (NSWGCSA) to cover tuition and expenses during the first year for successful candidates enrolled in the Master of Agriculture (Turf Management) at the University of Sydney.

Turfgrass agronomist and consultant

As the consummate turfgrass consultant, Peter has been commissioned to consult on existing and new golf course, sports ground and racecourse projects throughout Australia and South East Asia. Over the years, Peter has been commissioned on numerous golf construction projects particularly during the boom decades of the 1980's and 1990's. Peter consulted directly to notable golf course architects such as Graham Marsh, Jack Nicklaus, Robert Trent Jones Jr, Pete Dye, Reece Jones, Peter Thomson and Michael Wolveridge Watson International and Michael Coate on golf course projects in Australia and throughout South East Asia. Among some of his golf projects included Shah Alam (Malaysia 1990) for the Sultan of Selangor and Tuanku Jaafar Country Club (Malaysia 1990) for the King of Malaysia.

Outside golf, Peter has further been involved in numerous elite sports and cricket grounds, polo fields and racecourses around Australia and in Singapore. He consulted to Consolidated press (the late Kerry Packer) on cricket wickets for the introduction of World Series Cricket at the then Sydney Showground (Sydney) in 1978. He originated the concept of drop-in wickets used everywhere today. Peter has also consulted to the Melbourne Cricket Ground (MCG) in 1981/82, North Sydney No. One Oval (Sydney) in 1984 (the first sand-based oval construction in Australia), Western Australian Cricket Association (WACA) cricket wicket re-construction and Homebush Stadium now branded ANZ Stadium (Sydney) in 1989 and the new Royal Agricultural Society Showground Arena. Peter was also involved in the construction of Allianz and Parramatta Stadiums which are currently being rebuilt. Peter also grassed 7 polo fields for the late Kerry Packer at Ellerston. During recent years, Peter, has been consulting on turf matters at the National Stadium, Singapore.

Turfgrass author

Peter wrote two booklets. The first "Bowling Green Construction" (33p 1968) and the second co-authored with the late Vince Church "Golf Green Construction" (36p 1970). Peter as an author is listed in Jim Beard's mammoth publication "Turfgrass History and Literature" (2014). Over the decades, Peter has written a multitude of extension articles and scientific-based papers in Australian and overseas conference proceedings and journals including the International Turfgrass Society Research Journal. Others far too many to list.

Turfgrass developer and breeder

One of Peter's greatest passions is improved turfgrass varieties in recognising the potential benefits of Australian ecotypes of buffalo grass and couchgrass. Among the notable examples of Peter's involvement in the selection and subsequent commercialisation of turfgrasses are Greenlees Park (early 1970's), Wintergreen (1981), WindsorGreen (1993) and Sir Walter soft-leaf buffalo (1996). Collectively, these four varieties represent the most widely grown and successful turfgrasses on turf farms throughout Australia. WindsorGreen couchgrass was the first couchgrass cultivar in Australia to be developed

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and commercialised through Plant Breeders Rights (PBR). Peter has also been involved in assisting others in their development of other buffalo, couch and seashore paspalum varieties. Peter has been engaged since 1996 as a "Qualified Person" for PBR applications and continues to develop improved couchgrass varieties. During the 1980's and 1900's large quantities of his turfgrasses were exported to South East Asia and the Middle East.

Turfgrass technologist

Over the years Peter has been intimately involved in the design and development of several turfgrass industry technologies. It was during the early 1970's that Peter provided technical assistance to Frank Forrest of Melbourne then owner of the Ron Kaye-designed, ride-on motorised bowling green rollers. Today, the Australian multiple-roller technology of bowling and golf green rollers is exported worldwide. He also introduced the "Verti-Drain" technology to the turf industry in Australia. Peter co-developed with the late Charles JP Smith the tractor-mounted "Level Lawn".

Peter during the 1980's independently developed a mechanical, row-planting unit and a horizontally-oriented, pressurised water-washing unit to produce washed sod. Today, numerous turfgrowers around Australia continue to benefit from further improvements of such technology. Peter was also involved in the development of a *Eucalyptus*/*Leptospermum* oil-based insecticide mixture. This mixture was subsequently registered as the first organic-based insecticide for turfgrass application in Australia.

Turfgrass producer and contractor

From 1974 to 2005 Peter owned and developed the 40 ha Qualturf farm at Richmond (NSW) which grew his own turfgrass varieties. He served as honorary secretary for the NSW Turfgrowers Association for over 15 years and was primarily responsible from 1998 to 2001 in making submissions to NSW Water on behalf of the Association which ultimately saved the turf farmers water extraction rights on the Hawkesbury River. The race course industry has also benefited from his expertise in building and supervising horse racing tracks in Sydney, country NSW and Perth.

Turfgrass researcher

Peter's involvement in turfgrass research began way back in the late 1960's supervising research into plant-feeding nematodes in the Newcastle (NSW) region. In more recent years, Peter has been Team Leader in the investigation of the occurrence and taxonomy of turfgrass mites in warm-season turfgrasses funded by Horticulture Australia Limited (HAL). This project was the first of its kind ever conducted on turfgrass in Australia. Peter's contributions to weed control saw him conduct efficacy trials for the introduction of the then new herbicides Endothal for winter grass control and Siduron for the control of couchgrass invasion into bentgrass putting greens. The ground breaking work on nut grass control earned him the NSW Weeds Society Medal of Excellence in 2013. Peter is currently engaged in developing new herbicide and insecticide mixtures to meet current industry needs.

14th International Turfgrass Research Conference in Copenhagen July 11 - 16, 2021 – Save the date!

By Maria Strandberg, ITS president, Sweden

The next International Turfgrass Research Conference will be arranged by STERF (Scandinavian Turfgrass and Environment Research Foundation) in Copenhagen 2021.

Development and Sustainability is the theme of the conference. The challenges for the future of the turfgrass sector are many and diverse. Climate change impacts are exceeding the worst expectations. Strong restrictions on the use of chemicals and fertilizers, and increasing pressure on natural resources (notably water, energy and land) are expected. There is an accelerating loss of ecosystem services and biodiversity in the urban landscapes. All this calls for more research and innovation for a sustainable future.

The United Nations´ Sustainable Development Goals (SDGs) set out in Agenda 2030 will constitute the conference programme framework. We have identified seven SDGs related to the turfgrass industry: SDG 3 (Good health and well-being), SDG 11 (Sustainable cities and communities), SDG 12

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(Responsible consumption and production), SDG 13 (Climate action), SDG 14 (Life below water), SDG 15 (Life on land) and SDG 17 (Partnership for the goals).

The ITRC 2021 programme will include keynote speakers, oral and poster presentations, industry networking opportunities, technical tours, social events and much more. The programme will focus on increased sustainability by a multidisciplinary approach; science in action by ready-to-use research; and mobilising forces from academia to industry.

The One-Day Practitioner Seminar is new for this conference. This seminar is a meeting arena for practitioners and turfgrass researchers, which will strengthen the ambition to take a lead in making research results and new knowledge easy accessible to end-users and to provide support to implement changes.

Scientific topics of interest may include: Establishment and maintenance; Soil physics, soil chemistry and soil biology; Integrated pest management - Weed biology and control, diseases, insect pests and nematodes; Genetics and breeding; Physiology / stress physiology; Environmental impacts; Biodiversity and ecosystem services; Precision management - New technologies and measurements.

Technical tours will introduce you to Nordic turfgrass research and development which is focusing on internationally important key areas.

Copenhagen is the congress capital of Scandinavia and its vibrant cultural heart. Copenhagen is also truly a green city surrounded by water and parks, with climate-friendly citizens to match. The ambitious green profile of the city has a clear goal: The City of Copenhagen aims to become the world's first CO_2-neutral capital by 2025. Experience it for yourself. Swim in the clean waters of the city's harbour baths, stay in a sustainable hotel, eat organic, and ride the electric city bikes around the old maritime city.

The conference will bring together researchers, planning authorities, technical experts, consultants, high level turfgrass managers and top industry delegates. This will give us the best opportunities to improve and extend important international interdisciplinary collaboration.

Please join us in 2021 for the latest cutting-edge research in the turfgrass industry and stay to enjoy all that the Copenhagen area has to offer!

The most recent information about ITRC 2021 can be found on www.itrc2021.org.

For more information about STERF please visit www.sterf.org.

Turfgrass has No National Boundaries in Asia
- Participating the Conference of The Turfgrass Society of Korea -

by Masakazu J. Ushilo
Director of Japanese Society of Turfgrass Science
Visiting Professor, Advanced Science Research Laboratory, Saitama Institute of Technology, Japan

The conference of the Turfgrass Society of Korea (TSK) was held on January 24, 2019 at Ananti Namhae Resort at the southern coastal region of Korea where the citrus "Yuzu" grows well due to its warm climate. Three keynote addresses, five oral, and 16 poster presentations were given there. Dr. Ikemura and I participated the conference of TSK by the aid of Japanese Society of Turfgrass Science to give oral presentations and build friendship between Korea and Japan. Dr. Ikemura presented his recent research "Change in soil temperature due to day time irrigation and mine was "Microstructure of turfgrass leaf epidermis: A review". Dr. Tanaka et al. presented poster "Zoysia turfgrass genetic resources in Japan: Speciation and diversification based on genome sequence".

Fig. 1: Conference room and participants listening enthusiastically to a presenter.

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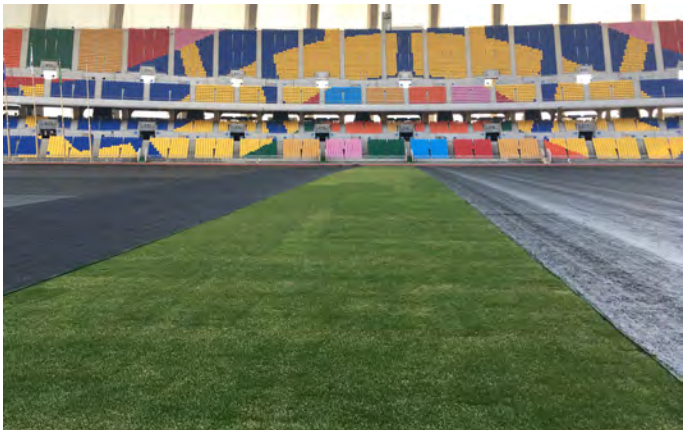

Fig. 2: Busan Asiad Main Stadium using Kentucky bluegrass covered with 90% light shield against frost.

Before the conference Dr. Ki Sun Kim, professor of Seoul National Univ. and previous president of TSK, and Dr. Joon Soo Choi, professor of Dankook Univ. and previous president of TSK, organized a great tour to us for visiting many turfgrass facilities in Korea. Dr. Kim drove around long distance for us. We visited at first Busan Asiad Main Stadium and next Dongrae Benest Golf Club in Busan. Then we went to Hanul Sports Turf company to see Kentucky bluegrass field. Finally we visited Namuhae Sport Park having many sport facilities.

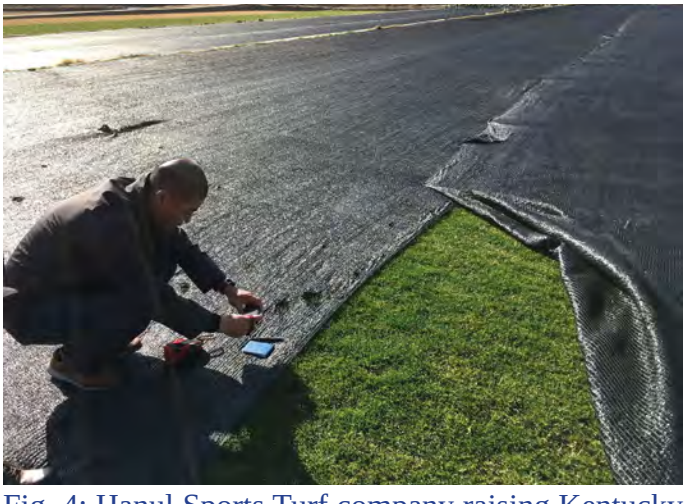

Fig. 4: Hanul Sports Turf company raising Kentucky bluegrass at the field covered with 70% light shield sheet and Zoysiagrass at the other field all in 20 ha field.

Dr. Choi once had talked to me at the tour by Japanese Society of Turfgrass Science about the interesting fact that *Zoysia japonica* distributed in Korea more than in Japan, on the other hand, *Z. matrella*, Korean turfgrass (Kourai-shiba common name in Japanese), grows in Japan more than in

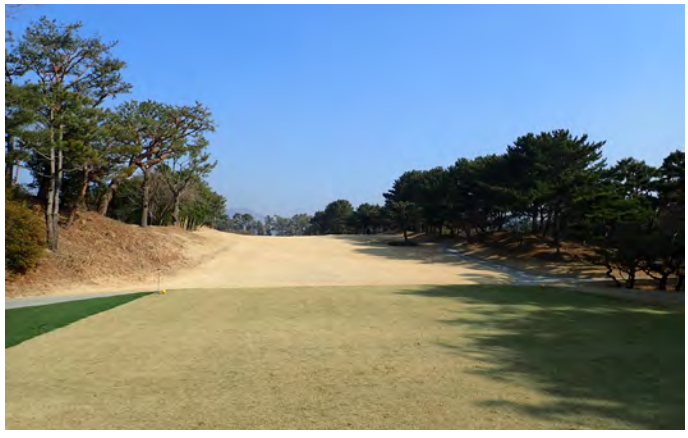

Fig. 3: Dongrae Benest Golf Club which had 18 holes with creeping bentgrass for green, *Zoysia matrella* appearing *Z. japonica* due to its wide leaf for fairway, and *Z. matrella* or Kentucky bluegrass for tee.

Korea. It is interesting that we use turfgrass species named by each other's country name.

I talked at the final party after the conference as follows:

"We are greatly thankful for the hospitality of Dr. Kim, Dr. Choi, and other members of Turfgrass Society of Korea. We also would like to foster friendship and fraternity between Korea-Japan and

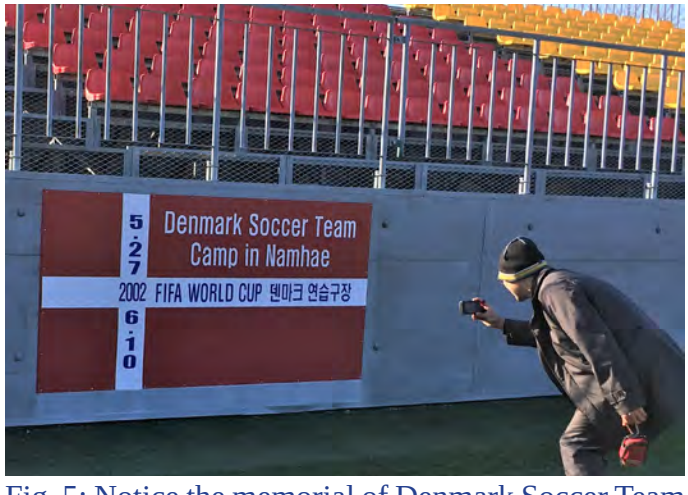

Fig. 5: Notice the memorial of Denmark Soccer Team Camp during May 27 – Jun. 10, 2002 FIFA World Cup in a soccer stadium of Namuhae Sport Park, which has 11 natural turfgrass soccer fields, baseball fields, and futsal fields in 33 ha area.

Japan-Korea beyond the historical hardness and suffering through our science, research, and industries. Finally, turfgrass has no national boundaries!"

STERF Yearbook 2018

by Maria Strandberg, STERF,
ITS president, Sweden

The Scandinavian Turfgrass and Environment Research Foundation (STERF) has released its 'Research and Development Yearbook 2018'. This reports on the research being undertaken across Scandinavia into global issues such as water and fertilizer management and multifunctional use of golf facilities, and pesticide use and winter stress which have more regional relevance.

Seven of the 17 UN Sustainable Development Goals (SDGs) set out in in Agenda 2030 are closely related to the turfgrass industry´s everyday challenges and to STERF's programmes, projects and dissemination efforts. These are:

1. Sustainable use of natural resources and chemicals (SDGs 12, 14, 15).
2. Ecosystem services and enhanced biodiversity (SDGs 14,15).
3. Adapting to a changing climate and minimising factors affecting climate change (13).
4. Sustainable cities and communities (SDG 11).
5. Healthy lives and well-being for people of all ages (SDG 3).
6. Partnership for sustainable development and for new regulations (SDG 17).

During 2018 STERF had 15 ongoing projects contributing to the fulfilment of the seven SDGs in Agenda 2030.

Key to STERF's work is the dissemination of research findings. 2018 saw STERF host workshops on efficient irrigation practices on golf courses and seminars on winter stress management of turfgrass and on sustainable use of pesticides on golf courses. In addition to this, a new step-by-step workbook for mapping values, functions and activities on and beyond golf facilities, and also for finding key partners and engaging them in multifunctional projects was added to the library on the STERF website www.sterf.org During 2018, the very important fact sheets on turfgrass winter stress management' was translated into all Nordic languages and launched at several seminars. Two new videos about the projects **From dense sward to biodiverse roughs** and *The golf course as an outdoor classroom* were launched. The two videos can be found at www.sterf.org.

Please let us know if you have any questions or comments related to the yearbook. Your feedback on STERF's ongoing projects and activities would be very valuable for us. Ideas of potential new programmes and projects would also be interesting and inspiring.

The 2018 yearbook and more information about STERF´s programmes, projects and activities can be found on www.sterf.org.

Biostimulants for Turfgrass Use in Spain

by Gómez de Barreda Ferraz, D. and De Luca Fabra, V.
Universitat Politècnica de València
Valencia, Spain

Spain is a medium size country (505,000 km^2 and 46,000,000 inhabitants), a tenth of the USA. That difference in size dramatically increases when speaking about maintained turfgrass surface: around 25,000,000 ha in the USA (Chawla et al 2018) vs 35,000 ha (estimated) in Spain, a thousand times less. Even so, turfgrass in Spain is an attractive market for chemical companies trying to introduce its pesticides, fertilizers and biostimulants, especially in the golf sector, where they can obtain more benefits. However, the future of pesticides for turfgrass in Europe is uncertain, tending towards the "pesticide-free" scenario. In this context, nutritional status of turfgrass species become more important, the healthier we maintain the plant the less pesticide use will be required, and biostimulants could play an important role supporting this hypothesis.

According to the European Union Council (2018), "plant biostimulant" means a product stimulating plant nutrition processes, independently of the product's nutrient content with the sole aim of improving one or more of the following characteristics of the plant or the plant rhizosphere: nutrient use efficiency, tolerance to abiotic stress, crop quality traits or availability of confined nutrients in the soil and rhizosphere. Right now, there is a proposal for

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the regulation of product function categories (PFC) of EU fertilizing products, which includes "plant biostimulants" as one of the proposed categories. Biostimulant products can be composed of amino acids, humic acids, seaweed extracts, plant extracts or microorganisms. Those ingredients are collected in the Spanish legislation under the name "other fertilizers and special products" in the Royal Decree RD 506/2013, of June 28, whose last modification (RD 999/2017, of November 24) includes a specific law to the use of products based on microorganisms. The future of the regulations (under discussion) includes an optional Community Harmonization where European Regulations will coexist with national legislations and they will still depend on mutual agreement between the Member States.

Du Jardin, 2015, reported an extensive review on biostimulants for general agriculture in which he structured these products into the following categories: a) Humic and fulvic acids; b) Protein hydrolysates and other N-containing compounds; c) Seaweed extracts and botanicals; d) Chitosan and other biopolymers; e) Inorganic compounds; f) Beneficial fungi; and g) Beneficial bacteria.

In Spain, biostimulants are nowadays organized in a vade mecum called "Eco Vad" (De Liñán, 2019) together with all inputs for organic agriculture. Within this book, 426 products belonging to circa 50 chemical companies are considered biostimulants, however only 18 of them are specifically authorized for turfgrass use and they are as follows.

Humic and fulvic acids: Within this category there are 50 authorized products in Spain, only 5 of them for turfgrass use (Table 1).

Protein hydrolysates: There are in Spain 249 different products based on amino acids, with very diverse amino acid content (2 to 80%) and more or less reinforced with fertilizers (Table 2). However, there are just 2 of them authorized for turfgrass use:

- **Product 1:** Amino acids (8%); total nitrogen 6% (organic nitrogen 3%) + Fe (0,4%) + Zn (0,4%) + polysaccharides (4%).
- **Product 2:** Amino acids (12%) + total nitrogen 8%.

Table 2: Types of amino acid-based biostimulants in Spain.

Number	Nutrients
94	No additional nutrients
41	Nitrogen
2	Potassium
23	Nitrogen + potassium
27	Nitrogen + phosphorous + potassium
11	Calcium
5	Magnesium
46	Micronutrients (B, Cu, Fe, Mn, Mo & Zn)

Microorganisms: Many types of beneficial microorganisms are regularly included in biostimulants (soil bacteria, mycorrhizal fungi, and yeasts). There are in Spain 40 different commercial products containing living microorganisms. The most common is *Glomus intraradices*, alone or in mixture with some of the following species: other fungi (*Funneliformis mosseae*, *Glomus aggregatum*, *Oidiodendron* sp., *Rhizoglomus irregularis*, *Rhizophagus irregularis*, *Rhizoscyphus ericae* and *Trichoderma* sp.), bacteria (*Azospirillum brasilense*, *Azotobacter* sp., *Bacillus* sp., *Bradyrhizobium japonicum*, *Lactobacillus* sp., *Paenibacillus* sp., *Pantoea dispersa* and *Pseudomonas* sp.) and yeast (*Sacharomyces* sp.).

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Table 1: Characteristics of the humic and fulvic acid biostimulants for turfgrass use in Spain.

	Organic matter (%)	Humic extract (%)	Humic acid (%)	Fulvic acid (%)	Other constitutes (%)	Origin	Management recommendations
1		65	53	12	K_2O (17)	American leonardite	3-5 kg/ha diluted in the irrigation water
2		15	7	8	K_2O (5)	Vegetal	200 l/ha & year
3		16	9	7	K_2O (4)	-	10 l/ha & application
4	30	-	-	22	S (3) Fe (0.3)	Hydrolysates of vegetal extracts	25-150 l/ha
5	42	-	-	28	S (3) Fe (0.3)	Hydrolysates of vegetal extracts	80-150 l/ha

Only 5 products out of 40 containing living microorganisms are authorized in Spain for turfgrass use:

- **Product 1:** Rhizobacteria (5 x 10^9 cfu/g): *Bacillus megaterium*, *B. subtilis* and *B. methylotrophicus* + humic acid + algae extract (*Ascophyllum nodosum*) + *Yucca schidigera* extract + dextrose. Application dose: 5 kg/ha and month.
- **Product 2:** Rhizobacteria (1 x 10^8 cfu/g): *Bacillus* sp. and *Paenibacillus* sp. + Mycorrhizal fungi (1%), 5 species of the genus *Glomus*. Application dose: 5 kg/ha and month.
- **Product 3:** Rhizobacteria (2.5 x 10^7 cfu/g): *Bacillus* sp. + Mycorrhizal fungi (22%), 5 species of the genus *Glomus*. Application dose: 3 kg/ha.
- **Product 4:** Rhizobacteria (1 x 10^9 cfu/g): *Azospirillum brasilense* and *Pantoea dispera*. Application dose: 3 g/m^2.
- **Product 5:** Mycorrhizal fungi: *Glomus intraradices* (4.000 active spores/g). Application dose: 400 g/ha just after sowing or 200 g/ha and year during 3 years on established turf.

Algae extracts and botanicals: There are three types of algae extracts in the Spanish regulatory market: solid, liquid and fertilizers with algae extracts. In total there are 66 commercial products, 49 of them are not reinforced with fertilizers and they are extracts of the algae *Ascophyllum nodossum* in a very different percentage range (normally from 1 to 24%) delivering alginic acid (0.3 to 21%) and mannitol (0.1 to 5%). The remaining 17 products also have fertilizers, 7 of them with potassium (2-18%), 4 of them with both nitrogen (1-6%) and potassium (1-19%) and 6 of them with nitrogen (1-3%), phosphorous (0.5-10%) and potassium (4-18%).

Only 4 products out of 66 containing algae extracts are available in Spain for turfgrass use:

- **Product 1:** *Ascophyllum nodossum* extract (15%), alginic acid (1.5%) and mannitol (0.5%). Application dose: 4-6 l/ha in winter and after every mowing event.
- **Product 2:** *Ascophyllum nodossum* extract, alginic acid (19.5%), mannitol (6%) and potassium (18%). Foliar application at 0.05-0.06% and soil application at 500-750 g/ha.
- **Product 3:** *Ascophyllum nodossum* extract + organic matter (3-4%) + phosphorous (0.3-0.5%) + potassium (18-20%) + calcium (1-1.5%) + magnesium (0.5-1%) + traces of B, Cu, Fe, Mn, Mo and Zn. Application dose: 20-25 l/ha and year distributed in all irrigation events.
- **Product 4:** *Ascophyllum nodossum* extract (20%) + alginic acid (3.32%), mannitol (1,41%) + nitrogen (1-2%) + phosphorous (2-4%) + potassium (7%) + sulphur (1-2%) + calcium (0,1-0.2%) + traces of, Cu, Fe, Mg, Mn, Mo and Zn. Application dose: 20-25 l/ha and year distributed in all irrigation events. Foliar application at 3-4 l/ha for sport turfgrass and 1-2 l/ha for lawns.

In addition to the algae extracts there are other plant extracts used as biostimulants called botanicals. They are extracts of the following species: *Allium sativum*, *Arnica montana*, *Azadirachta indica*, *Betula* sp., *Capsicum frutescens*, *Citrus* sp., *Hypericum perforatum*, *Mimosa tenuiflora*, *Pongamia pinnata*, *Quassia amara*, *Quillaja saponaria*, *Thimus zigis*, *Vitis vinifera* and *Yuca schidigera*. There are in Spain 20 botanicals for general agriculture, 2 of them registered for turfgrass use:

- **Product 1:** Vegetal extracts of *Arnica montana*, *Hypericum perforatum* and *Betula* sp. + algae extract (21%). Application dose: 10-20 l/ha (diluted in 1.000 l of water); Apply 2-3 days after mowing and repeat applications every 4-6 weeks.
- **Product 2:** Vegetal extracts of *Quillaja saponaria* and *Yuca schidigera*. Application dose: 40 a 60 l/ha or several applications at 20-25 l/ha just after sowing. Once the turf is established the product can be applied through the irrigation system at 10-15 l/ha.

In conclusion, it is important to emphasize that the prohibition of the use of pesticides for turfgrass management is likely to occur. In this scenario biostimulants will become very important. However, lack of knowledge on the use of biostimulants on turfgrass is critical. Note that none of the 18 biostimulants described for turfgrass use in Spain have a turfgrass species name in it (*Cynodon dactylon*, *Festuca arundinacea*, *Lolium perenne*, *Poa pratensis*, …). It seems biostimulant companies' do not matter about differences among turfgrass species on physiology, stress adaptation and management practices; they just matter about application rates. Research on biostimulant use for turfgrass is necessary.

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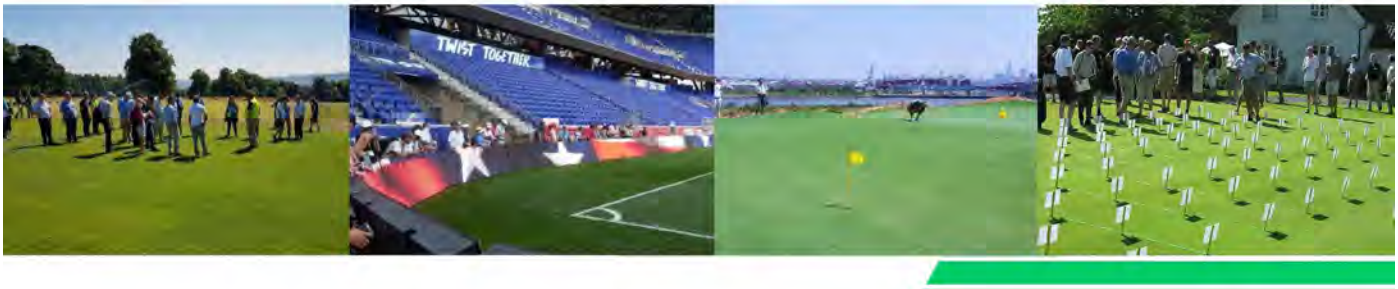

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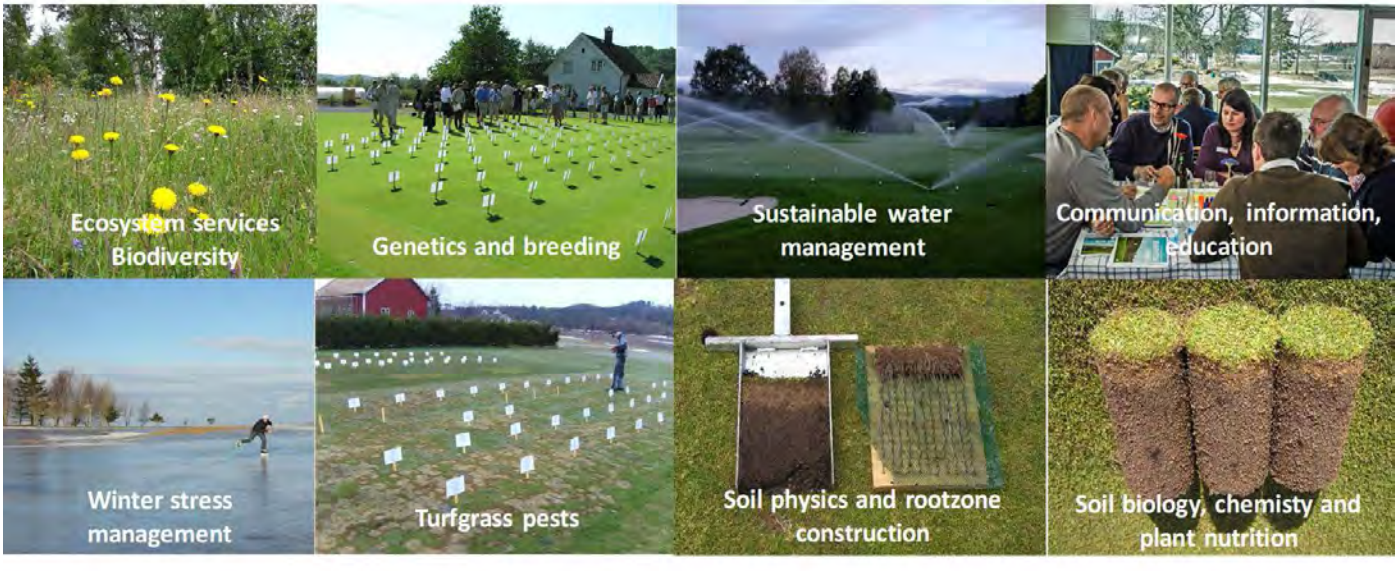

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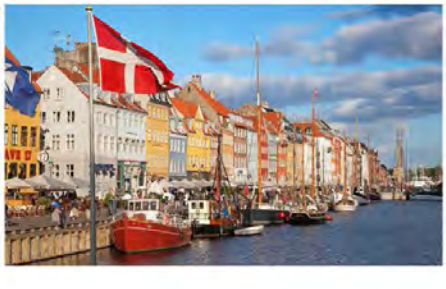

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