

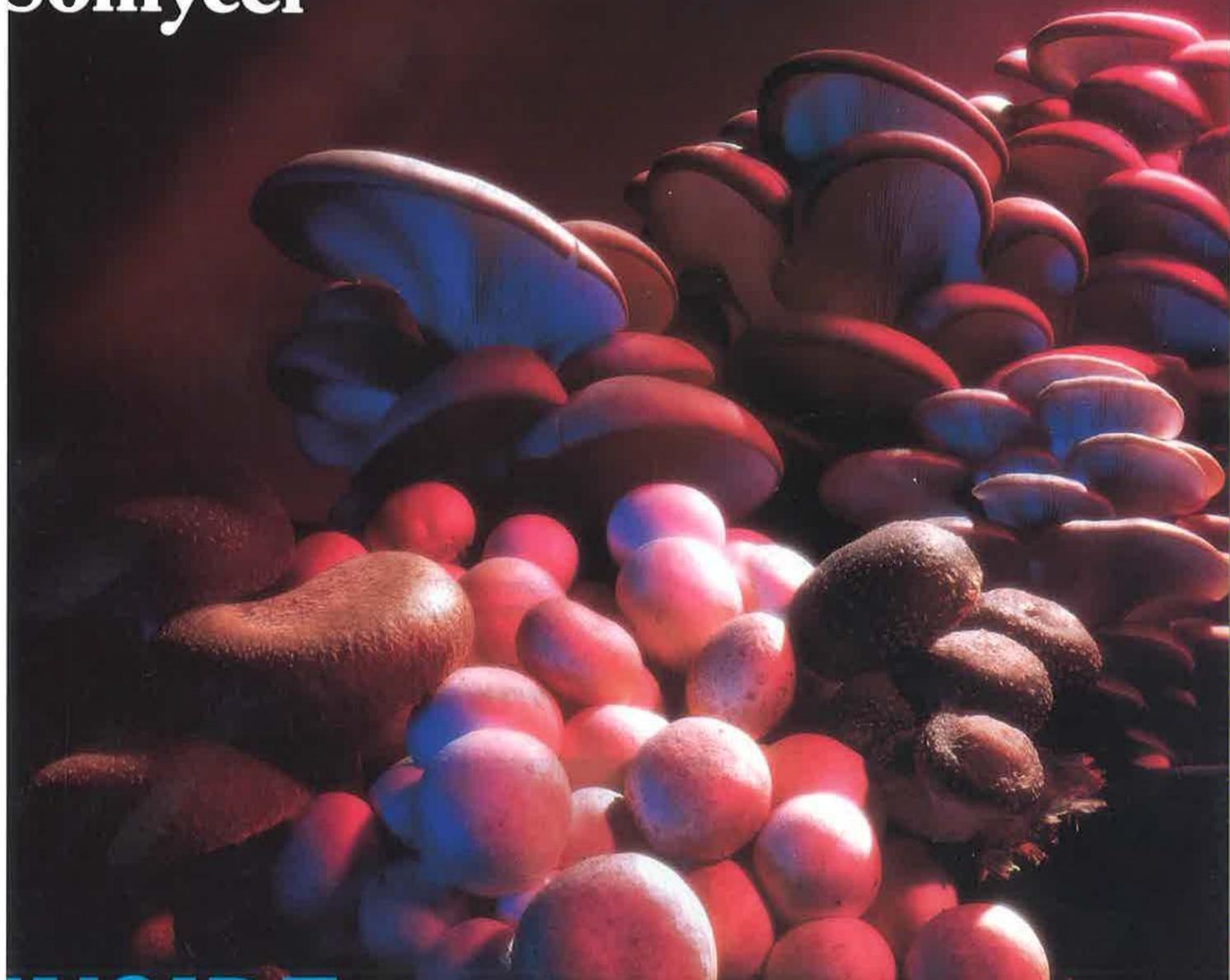
# THE *Mushroom*

OFFICIAL JOURNAL OF THE MUSHROOM GROWERS' ASSOCIATION  
JULY 1991 NUMBER 223 ISSN 0144-0551

## JOURNAL



### Somycel



# INSIDE

CASING SPECIAL FEATURE ■ NVQ  
EXPLAINED ■ THE HAYES INTERVIEW

# Somycel STRAINS

## AGARICUS

— SMOOTH WHITE

*Bitorquis*  
Hybrid  
Hybrid

MILLETT

RYE

PELLET

*Somycel* 191  
*Horst* K26\*  
*Horst* U3  
*Somycel* 112

*Somycel* 521    *Somycel* 521P\*  
*Horst* U3 SS    *Horst* U3P\*  
*Somycel* 512    *Somycel* 512P\*

— WHITE

Hybrid  
Hybrid  
Hybrid  
Hybrid

*Horst* U1  
*Somycel* 209  
*Somycel* 205  
*Somycel* 208

*Somycel* 611  
*Horst* U1 SS    *Horst* U1P\*  
*Somycel* 609    *Somycel* 609P  
*Somycel* 605    *Somycel* 605P\*  
*Somycel* 608    *Somycel* 608P\*

— CREAM

*Somycel* 344

*Somycel* 765

— BROWN

*Somycel* 856    *Somycel* 856P\*

## PLEUROTUS

*Ostreatus*  
*Ostreatus*  
*Pulmonarius*  
*Pulmonarius*  
*Colombinus*  
*Ostreatus*  
*Cornucopiae*  
*Eryngii*  
*Ostreatus*  
*Sporeless Hybrid*  
*Sporeless Hybrid*

*Inra* 3001\*  
*Somycel* 3004\*  
*Somycel* 3014  
*Somycel* 3015\*  
*Somycel* 3030  
*Somycel* 3035\*  
*Somycel* 3040  
*Somycel* 3058\*  
*Somycel* 3100\*  
*Somycel* 3200\*  
*Inra* 3300\*

## PHOLIOTA AEGERITA

*Somycel* 4021\*

## COPRINUS COMATUS

*Somycel* 4030\*

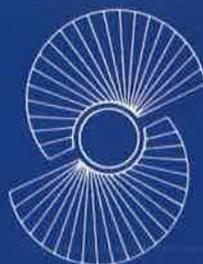
## LENTINUS EDODES (SHII-TA-KE)

*Somycel* 4055  
*Somycel* 4065\*

## LEPISTA NUDA

*Somycel* 4101\*

\*ON FIRM ORDER



# Somycel

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# THE Mushroom JOURNAL

July 1991

No 223

## EDITORIAL

### The casing dilemma

Without fear of contradiction we say that casing gives the biggest range of problems in mushroom growing. It is also an increasingly expensive process in our cultivation. Indeed one producer the other day declared that he spends £150,000 a year on casing, nearly as much as his compost. Through the years we have run the gamut of materials which can be used until now peat, which has seemed to give us some sort of stability, looks likely to come under pressure from the ever-more-powerful environmental lobby. Do we go backwards from here if it does become limited in supply. Most of us grumble in varying degrees of forcefulness about the position, reviewing what has gone and where we are at present; few of us look towards the future and where that is taking us.

We can all recall conferences at which new and near-miraculous machines or other materials were going to solve our casing problems. We all remember subjects like the waste products from paper making which, being free, was going to cut costs and prove more effective. But, being free at source, like so many other things in life, its recovery and treatment for us to use, proved more costly than ever.

With such a dilemma to be faced it is nothing short of amazing that so much work seems to have been done on the alternatives to casing with so little result.

After all, mushrooms have been produced by simply watering the compost. So why do we need a casing layer? Surely the fundamental question for a researcher to ask!

Our scientists engaged on research will surely have considered an entirely new line of investigation to answer such an important question: Why do we need a casing layer at all?

Well, will someone put up a convincing argument one way or the other?

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ISSN 0144-0551

MUSHROOM JOURNAL 3

# THE WORLD OF MUSHROOMS

**T**ony Russell is no longer a director of Traymaster Ltd where he was responsible for machinery design and production. He had been a director and shareholder for 20 years. He is now concentrating on automatic harvesting of mushrooms and associated picking aids as managing director of Priorlucky Ltd., a small design-based company.

Tony is also the current chairman of the Mushroom Allied Trades Association responsible for organising the MGA Conference Exhibition and can be contacted for information on: Tel - (0692) 582225. Fax - (0692) 581848.

**Y**ou may have heard of the Food Advisory Committee which is based at Room 504c, MAFF, Ergon House, c/o Nobel House, 17 Smith Square, London SW1P 3JR. But what does it do?

The Food Advisory Committee's terms of reference are: "To assess the risk to humans of chemicals which are used or occur in or on food and to advise Ministers on the exercise of powers in the Food Safety Act 1990 relating to the labelling, composition and chemical safety

## New managing director at Chesswood



**Myles Warnick (left) has been appointed managing director of Chesswood Produce Limited, the UK's largest mushroom grower. He was previously operations director for the company's farms in Sussex.**

**Mr Warnick succeeds Stephen Poulton (right), who has been appointed assistant operations director of British Bakeries.**

**Mr Warnick joined Rank Hovis McDougall as a graduate trainee in 1978 from Oxford, where he gained a degree in engineering. In 1988 he joined Chesswood Produce, an RHM subsidiary, as operations director of the Suffolk farms, before moving to Sussex in 1989.**

*of food. In exercising its functions the Food Advisory committee will take the advice and work of the Committee on Toxicity and other relevant advisory committees into account."*

The committee is a non-statutory body comprising a chairman and 14 members appointed for their personal

expertise and not to represent particular interests. Main task is to review and prepare reports on all matters within its terms of reference and where necessary to make recommendations for legislation. Ministers may then decide to make that advice public. Ministers pay high regard to the committee's recommendations which form the basis of much of UK legislation.

It invites written submissions from representative bodies of whom, of course, the MGA is one.

**T**he future depends largely on the willingness and ability of British growers to diversify and fully exploit all available resources, to commercially establish new technology and develop markets for new products.

All this is discussed in *Farming for Feedstocks, Fuels and Fibres* published by BABA, the Biomass and Biofuels Association.

*Farming for Feedstocks, Fuels and Fibres* is a collection of papers given by experts from some of the country's most innovative agricultural research organisations and agro-industries at a national conference held at Stoneleigh on November 13/14 1990.

Among the subjects covered at this conference were:-  
Overcapacity within the Agricultural Industry; Crops for Industrial Use; Land Restoration; Changes in Land Use; Agricultural Wastes and Residues; On-Farm Electricity Generation from Biogas; Straw and Wood as Fuels; Bioethanol Composting; Anaerobic Digestion; Fibre Crops; Pulp and Chemicals from Straw.

For further information contact The Secretary, PO Box 7, Southend, Reading RG7 6AZ.

## Training for competitive advantage...

was the title of a most interesting and well attended seminar held at Gatwick Cophtherne Hotel on Thursday 6th June to discuss the training scheme set up by Chesswood in conjunction with Sussex TEC.

Chesswoods aim to be the most profitable producer of Mushrooms. They have found that their new training scheme has resulted in: better company image, falling labour turnover, lower sickness and absentee rates, fewer accidents, higher commitment by employees, more efficient passing on of skills, and a more adaptable and responsive approach to the market place.

They feel that the initial investment in training has paid substantial dividends in both tangible and intangible ways and they intend to continue to build on this foundation by expanding the training programme to encompass a wider range of employees and to introduce a similar scheme at their other farm.

Steve Poulton, Managing Director, said:

"Our business mission is to be the highest margin UK supplier of mushrooms. We view training as a major part of this strategy and crucial investment in the future of our business."

## Sinden Award

**Mr Gerard Derks of Derinco has been selected as the recipient of the Sinden Award of this year. Mr Derks has been working on a new method of indoor composting at the Agrifung plant in Italy. A review of this development by Peter Flegg is published elsewhere in this issue. Congratulations Gerard! We look forward to seeing you at the Conference in Glasgow.**

## Young Scientist of the Year Award

This award will be presented to Doctor Parwinder Grewal who is currently working at HRI Littlehampton in the Microbiology and Crop Protection Department. Dr Grewal's special interests are nematode fungal and bacterial interactions and aspects of biological control. Dr. Grewal will be present at Glasgow to collect his award.

**News from around the mushroom world is welcome every month - closing date end of the first week in each month - send yours now!**

**NEXT MONTH  
WE PUBLISH  
A SPECIAL  
500th  
EDITION OF  
THE  
JOURNAL  
PLUS  
A conference  
supplement**

# DIRECTORS NOTES



Ken James

## Do not miss this opportunity

It is less than two months to the ISMS Congress in Dublin and our own conference in Glasgow. We do hope that many delegates in Dublin will take the opportunity to come across to Glasgow. You will be assured of a warm welcome and real commercial benefits from the conference sessions.

The programme includes a night to remember as guests of the Lord Provost of Glasgow, for a banquet in the magnificent Victorian City Hall. The Scottish flavour will be apparent in all of the events. There is a range of local accommodation to suit all pockets and the full delegate fee to cover all the social events, excepting the MGA Friday night banquet, is only £171.00 BOOK NOW – ring or fax us.

For all UK growers, the conference this year is a must. The May Executive decided to set up a working group to examine the whole of the services and financing of the MGA. By September we expect to be at the stage of needing to consult with members, home and overseas. It is your Association and we need to ensure that it meets the needs of an industry which must move positively through the 1990s.

## Do the difficult things well

The May Executive was held in the week of the second series of large scale redundancies by two of the large UK growers. These have yet again pointed up the challenges faced by this industry.

Those who meet the challenges, will be technically sound, organisationally sharp and imaginative in meeting the market of the 1990s. Steve Poulton, who was attending his last Executive before promotion from Chesswood to the bakery division of RHM, may have summed this up. He said, "Our job is to do the difficult things well." His company has set an example in technical, as well as organisational excellence; enabling them to offer a wide range of options for customers.

## Fair play for EC producers and consumers

A meeting of the European Mushroom Group with Director of Horticulture, Tilgenkamp, concentrated on looking ahead to further world development of mushroom production. We stressed that the EC industry is prepared to accept and in the case of Poland, assist in sound production development. What cannot be accepted is a situation where mushrooms are traded cheaply, in a market which is overloaded – just to boost the profits of a tiny number of entrepreneur traders.

In addition to reviewing quotas and tariffs, we put up proposals for the use of conversion factors for imports, so that border controls properly count the volume of imports, eg 100kg of canned mushrooms may equal 160kg of fresh. We also started discussion on health and hygiene standards; for none of us can afford the disastrous impact of contaminated product, such as occurred with the Chinese staphylococcal growth, causing illness in over 100 people.

## Careful handling essential

In response to a number of comments on the poor standard of mushroom presentation at retail level, Tim Cripps is chairing a group set up by the M&P Committee. This should result in a serious campaign aimed at improving handling through from picking to presentation on the retail shelf. The group hope that this serious message can be carried in a series of cartoons, to attract attention. Watch this space for better customer appreciation of the results of our hard work in growing the crop.

## Welcome...

New MGA Chairman had both to welcome and say goodbye at his first Executive in May. A welcome to Robert Brown, of Woodland Mushrooms in Essex, the new representative of small growers and to Mile Warninck, who takes over as MD of Chesswood on 1 June. George Pointing, as new chairman of the Education and Training Committee, was also welcomed to the Executive.

## ...and goodbye

Tribute was paid to the work of both Ferd Hensby, as representative of the Spawned Composters and Steve Poulton, of Chesswood, for whom this was their last meeting.

Jim Dumbreck did well to close the meeting at 5.45pm, after such a lively series of debates on virtually every committee topic.

## Sinden Award

The Executive was unanimous in confirming the recommendation of the Sinden Award Committee. This year, the prestigious industry award goes to Gerard Derks, who for 20 years has been the consultant and technical collaborator of Bruno Francescutti, in the development of bulk compost systems. In this time of environmental and economic pressure on the industry, their most recent developments are attracting interest from many parts of the World. We look forward to his Sinden Lecture at the conference.

## Outline requirements for BS 5750

As you are aware one of our Irish colleagues has met the standards of BS 5750. An outline of requirements was sent out to growers with a recent UPDATE. If anyone requires a copy of these outline requirements or the guideline notes could they please contact the MGA office. An article by Linda Boy of ADAS, a specialist on this canning subject, will appear in the September Journal. Ken James

# Maximise your breaks

In today's competitive world

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with no way to bridge the production gap.

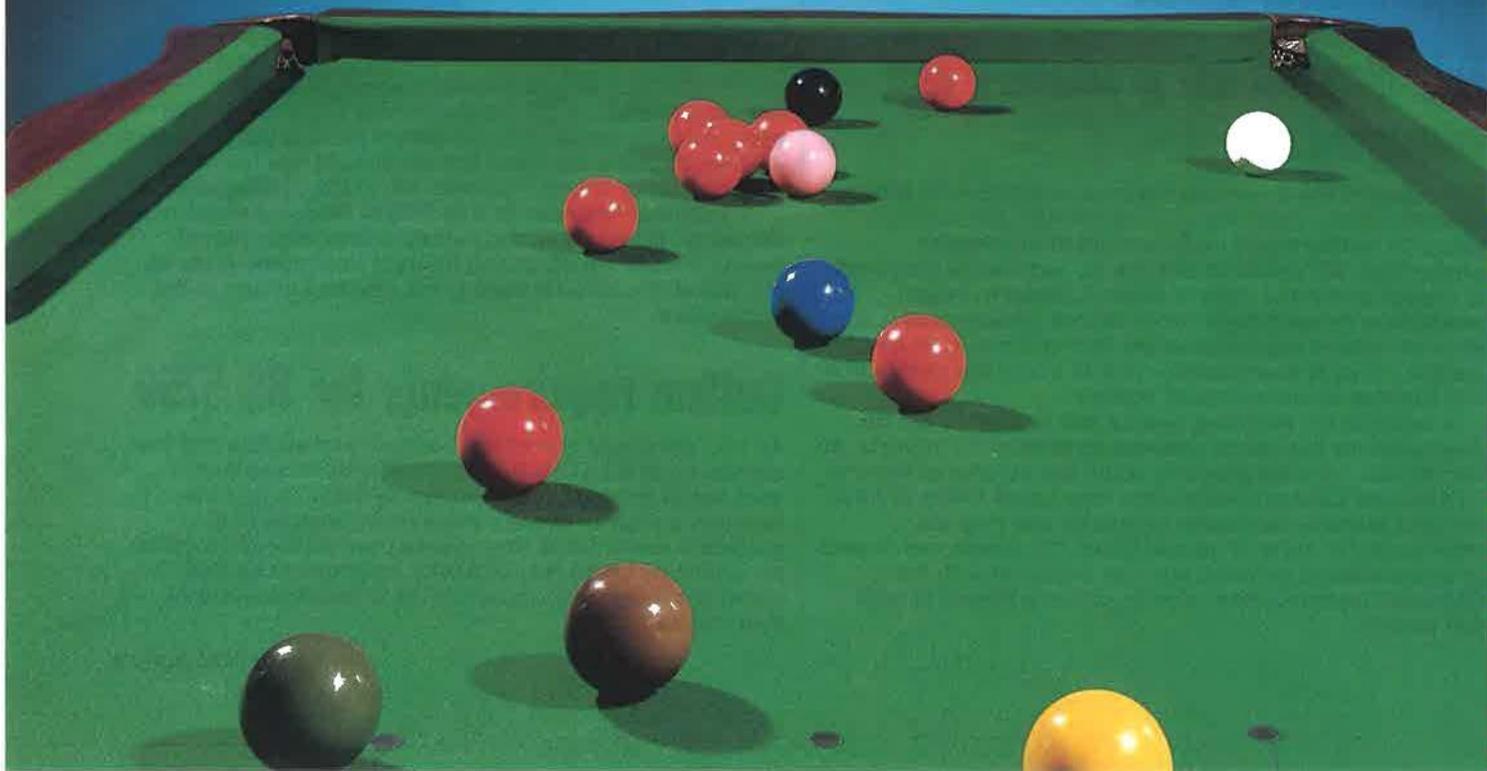
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## NVQs explained

By Jean Ellis of Brinsbury College

### NVQs? – What?

#### Levels I & II? – Why?

#### Levels III & IV? – Don't be daft!

#### Training? – We do that on our own holding.

These are typical responses given by managers/owners/supervisors engaged in horticulture, agriculture and allied rural industries. Rural industry has problems in recruiting due to:

- image
- lack of coherent career structure.
- lack of recognition of skills and technology.

To combat these, we now have the...

### National Council for Vocational Qualifications

The NCVQ was set up in 1986 to improve standards of competence required in employment and to establish a National Vocational Qualification framework to facilitate access, progression and continued learning, and also to rationalise the qualification structure.

Qualifications will be given the NVQ hallmark following research undertaken jointly between employers, farming organisations, other interested bodies such as the new Training Enterprise Councils, to ensure that awarding bodies reflect the standards of competence required by business and industry. The framework is currently based on four levels with additional levels under discussion.

**Level 1** – competence in a range of routine and predictable activities; providing a broad foundation for progression.

**Level 2** – competence in a broader, more demanding range of activities; greater individual responsibility and autonomy.

**Level 3** – competence in skilled areas over a broad range of complex, non-routine and supervisory activities.

**Level 4** – competence in complex, technical, specialised and professional activities, including planning and problem solving with a significant degree of personal accountability.

**Above Level 4** – higher level of competence than level 4.

The NCVQ has responsibility for England, Wales and Northern Ireland. In Scotland, the above responsibilities are held by SCOTVEC, the Scottish Council for Vocational Education.

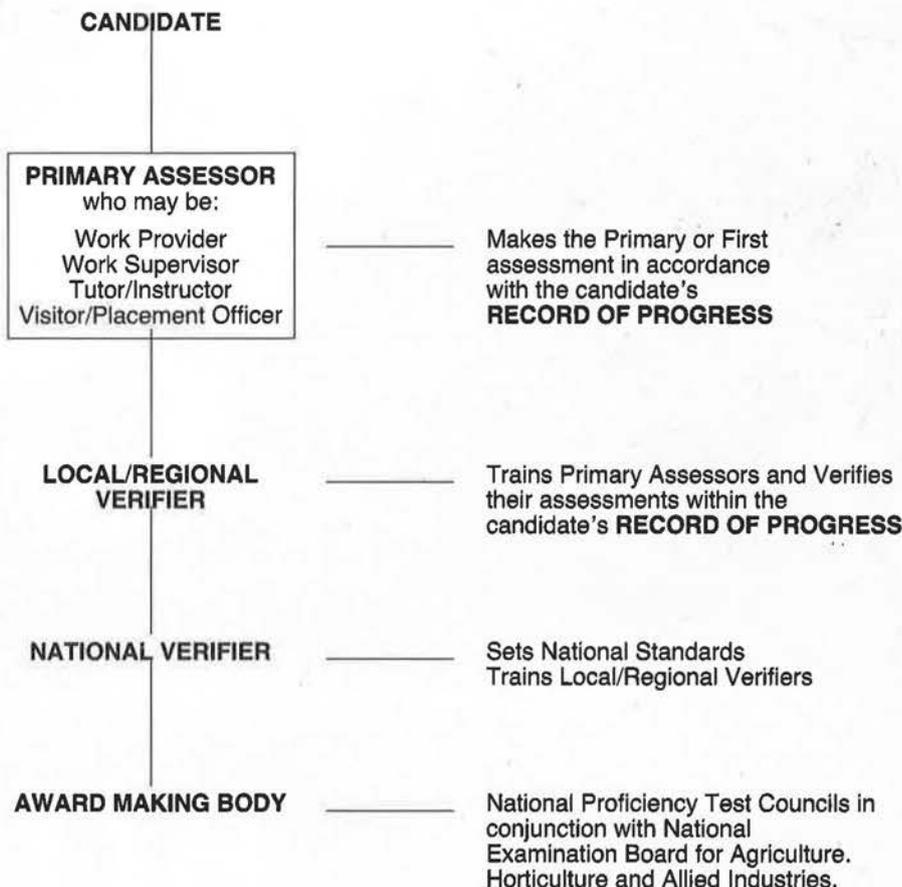
#### Q. How can NVQs be achieved?

A. By assessment and training.

- in the work place;
- at College;
- by attending short courses;
- by any other appropriate training.

Following the accreditation of NVQs in mushroom production by the National Proficiency Test Council and the National Examination board, the industry now needs primary assessors for both levels I and II. These assessors will become part of a national team.

### The Primary Assessor as part of a National Team



To be introduced to the broad aims of assessing industrial skills and underpinning knowledge, all primary assessors should attend a one-day training course. This will give an opportunity to discuss with the verifier the interpretation of the performance criteria and the importance of the role of the primary assessor.

Area training days will be organised and the mysteries of NVQs explained. In other words: all will be revealed, all over the country!!

**Please** give us your support in this long overdue qualification system for our industry. It is NOT as complicated as it

### STOP PRESS

Since this article was written two young candidates from the youth training programmes industry liaison between Chesswood and Brinsbury College have completed NVQ level 1. They will receive their awards at the open day at Brinsbury on 3rd July 1991.

sounds. Following hard on the heels of NVQ will be the new MGA Training Awards (subject to approval by the Executive Committee) using the same competencies introduced by our own lead body. Offers for venues to be used as a base for training days will be gratefully received. Further information can be obtained from:

Jean Ellis (National Verifier)  
Brinsbury College  
West Sussex  
Tel: (0798) 873832 (Daytime)  
(0273) 492560 (Evenings)

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## Mushroom Mixing Box

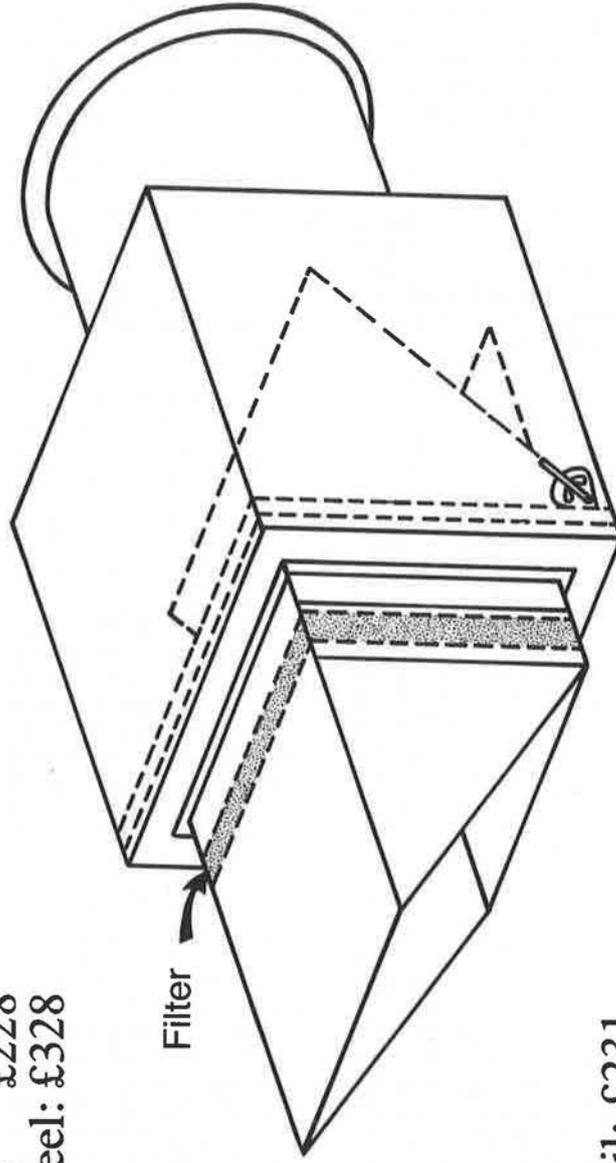
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# Geoff Ganney's

## GROWING PAINS

### May Day

Boss tell me 'A fool and his money are soon parted, yes?' My question is how did the fool get the money in the first place!

### 2nd May

Some first flush distortion caused more than some concern with regard to what had actually caused cap-cracking, stipe-stripping and hair-lip formation on pin-heads to button size mushrooms? **I had seen it before.** Then that is always the feeling one has which required digging deep into the memory box. An adjacent shed had recently been converted for spawn growing and having removed old heating pipes we still had holes through the walls. Yes we do use Dichlorvos in the spawn growing rooms!

### 3rd May

Mushroom Industry Development Officer (MIDO), a post created in conjunction with the Australian Mushroom Growers Association and the New South Wales department of Agriculture, now filled by a very bright young graduate Geoffrey Price. Certainly forward-thinking in creating a position for someone to carry new world-wide development back to the Australian Mushroom Industry. We look forward to having you spend some time with us Geoff. In fact you will probably get the job of writing these notes!!

### 5th May

Heavy casing panning quickly resolved when it came to light a new casing machine operator was underway. Did we explain what he was to do? Did we explain the quantities of materials and water? Did we check on the auto-timers and machinery condition? Well, no wonder we have dry, ground-down casing and can look forward to overpinned crops.

### 6th May

Mummy disease is not a

problem we see much of these days, maybe due to our concentration on aerobic phase I and II composting or maybe just luck. Certainly when we carried out trials with adding our own spawn-grown compost to the casing some strange excrescences appeared. Should we have expected otherwise? Using correctly prepared mycelial casing additives has given us no problems, but with such a mass of fragmented mycelium surely it could be an area of possible infection? Unlike compost, casing behaves in a different way in relation to mycelial transmitted problems. Why? Anyway we'll just stay with what we have gradually evolved over recent years. Hard enough to spot where the system has changed without introducing other factors. Then again others readily use the in-house compost technique with no apparent problems.

### 7th May

This virus of mushrooms (probably should say edible fungi?!) is a most complicated affair and I do wonder how many there are that we don't know about? But as we understand little of those we are supposed to know about, does it matter?

### 8th May

Why do we take 12 days from airing to get into our first flush? Other growers tell me their first flushes are cleared by day 21! Perhaps we are trying to save ours! Maybe it is simply we have lower bed temperatures in our lightly-filled trays because the Woodhurst bags do come on at a faster rate. There the microbase CO<sub>2</sub> levels are also higher!

### 9th May

Heavy green mould growth on newly-made timber trays is as dense and thick as I have ever seen. This is in fact on Chilean pine which is of the most excellent quality with few knots and cut most accurately.

Always cook-out prior to using new trays having in the past been hit with cecid

problems when not steaming. Subsequent colonisation by aerial spore loads seems to be quick and efficient. But then aerial contamination always is! Not using dipping chemicals has given me some concern should these green-blue moulds cause cap spotting to our mushrooms! Which of course they will most certainly do!

### 10th May

Decided to reduce press pressure on compost at spawning while at the summer fill weights. With the compost breakdown we have had in recent weeks it seems pointless to press the guts out of it. Hope it doesn't contribute to any severe heating up? But as we have taken our phase I and II to more completion we don't seem to have had as many problems in the rising of compost temperatures.

Like most things in mushroom growing you have to quickly learn to handle the situation with what equipment you have. That in the main is the ability to think a problem out, keen observation and the ability to act quickly.

Always used to say it was no good walking onto a mushroom farm half asleep. Fully asleep yes, but never half asleep. What do you mean, it's a job to notice the difference ....

### 11th May

The heavy spore loading with other edible fungi under enclosed intensive environments necessarily makes them a candidate for viral infection. That's if there is true significance in viral infections of fungi? Well, we know there is but it just seems to be such a muddled story (not for the scientist who obviously fully understands) for the grower to take in. It is 20 years this September that I gave a paper on Commercial Observations of Virus in the UK at the London International Congress. Should I have the courage to repeat that paper in Dublin with 18 years commercial experience behind me it would certainly bear little

resemblance to the published work. But then I suppose that is not so surprising as commercial mushroom production in 1991 bears no resemblance to 1971. *It is so much easier.*

### 12th May

Muggy conditions have brought about several areas of 'Bacterial Blotch' which these days has been far less of a problem on our farms. There was a time when we were never without, but more care to watering and ventilating practices appears to change its domination. But also we have modified our casing, change strain types and ambient pollution levels have fallen. So all in all who knows what has taken place to change things. Most likely to do with peat sources!!

### 13th May

Appearance of *Verticillium* on the Marigold Farm brought us all to a standstill. Having been in battle with the Department of Transport with regard to the A6 Market Harborough by-pass since 1986 we now are *fully aware* that the implications of major disease problems *was reality*.

Dust clouds across the horizon have resulted in extra disease teams, changes in working practice, vast amounts of time swilling down and many sleepless nights. Record, record, record all events but to what end. How can it be small businesses are put into jeopardy without so much as a second thought other than: "we will build this road, come what may."

Don't let your compost smell!!! Perhaps a resident QC for the MGA might be more appropriate than spending money on advertising; perhaps it could be generated from the PR fund.

### 14th May

Greatly disappointed that the Dutch course had to be cancelled due to lack of support; is that a reflection of the state of the industry; the MGA; or simply a matter of such an excellent course being taken for granted? Most certainly the executive will

need to give thought to future industry needs.

### 15th May

My first Finance and General Purposes committee really introduced me to the work involved in organising and running the MGA. The complexity of subject matter with today's legislation, European affairs and financial commitments would simply stagger much of the membership.

### 16th May

Spring Executive meeting, the first for incoming Chairman, Jim Dumbreck, took well into the early evening to cover the mountain of paper and diverse range of subjects. Must check with the Ed. to see if the journal note, 'Your Executive discusses' has any merit of re-introduction?

### 17th May

Areas of inkcaps caused some concern and on investigation it proved to be a spill over of raw lumps of deep litter chicken on to the killing piles while stacking alongside. Always difficult to find the best way of putting down the raw chicken prior to machine pick-up when turning.

### 19th May

Comment from the Grower, 16 June, well worth quoting! **DON'T BE DEFENSIVE!** Food producers should be more pro-active and less reactive in their attitude to their profession, a former senior civil servant in the Ministry has urged.

According to Eric Carter, addressing the annual dinner of Horncastle NFU members, farmers and growers are expected to produce food as cheaply as possible without creating any pollution while at the same time "conserving the countryside to look like a Constable painting.

"Don't be defensive," he said. "You are professionals with professional standing."

### 20th May

Your compost yard doesn't smell like a compost yard" so Queensland Australian

grower Pete Willemse told me. Well we only make compost with straw and chicken manure and I suppose it looks normal. "Looks pretty good to me, but no smells," replied Peter. Of course the modern vogue and panic for indoor composting (at what cost I shudder to think) is the way forward. Some thought into improving (or is it minimising) offensive odour with current systems might have been rewarding.

Perhaps that was fully explored or is it the separation of odours and chemical emission that is the key factor?

### 21st May

Aoife O'Brien arrived just ahead of me with John Kidder, General Manager from Amycel and Dr Mark Wach, research manager from Monterey Mushrooms, to visit the Woodhurst farm.

Such large mushroom producers looking at polythene sacks (bags seemed an offensive terminology) must have seemed strange. But then I suppose with all mushroom systems there is always an off-shoot that can be seen by someone that is not obvious. Certainly the concept of plastic sheds and their immense suitability to mushrooms was a good discussion point and proved of particular interest. Which of course plastic sheds are if not seen before. Mind you as I explained to Aoife the concept of plastic sheds had never been my favourite but as we have nearly 50, something must have changed. But I would still not be sure about the economics and price, but am equally sure someone will reply to these comments ...

### 22nd May

A question of hygiene. I wonder what sort of priority list would come out from a grower questionnaire. I suppose if it is like the questionnaire on Pests and Disease recently distributed and returned completed; nothing! But then like many things, it's a secret!!

### 23rd May

Communication is not simply bellowing down a tannoy system. But then a tannoy system can be used to great effect. Try putting messages from results of discussions in various groups to individuals in jocular fashion ... But get it right ...

### 24th May

Le Champignon Sauvage a restaurant in Cheltenham; despite the name and the mushrooms pictures and knick-knacks that decorate the restaurant lounge, fungi are used quite sparingly. Some cropped up with a delightful salmon mousse I ate as a starter, shaped into a round by a band of leek leaf and circled with leeks and wild mushrooms in a buttery sauce. But then for publicity matters it must be a plus!

### 26th May

Completely cleared out our spawn storage unit ready for cleaning, spraying and updating the spawn control. Great control is exercised over the storage and control of probably one of the most important (if taken for granted) commodities the mushroom grower uses.

### 27th May

Apparently in the race (I suppose there must be one?!) to implement the various legislation for the EEC 1993 open market (or whatever the hell it is!!) the UK leads the field. What a surprise ...

### 28th May

Don't like the patches of white plaster mould about the size of 10p pieces that are appearing on the compost surface 10 days after spawning. Investigation revealed not thorough enough air cleaning of the spawning line leading towards small areas of dried compost remaining from the previous week's spawning, no doubt providing a food base for unwanted invaders. Introduced new vigorous cleaning regime and thorough spraying with a phenolic

based compound. Should do the trick!

### 29th May

Fully grown compost is an obvious step towards supplying mushroom units with material ready for harvesting, which I am told is the next adjunct in the development of the industry. When I hear the words, 'Well it would be best to build a tray farm' from established European growers, I do realise that the ADAS Harrogate Conference in 1986 was very forward in its conception. Having recently sold a picking line for a few pounds complete with matching trays it leaves one confused. Having commercially operated such a line, just about restores some composure.

### 30th May

Area meeting notice of meeting in Newark for East and West Midlands intrigued me to think back to the MGA Area C meeting where we used to have standing room in the Talbot Hotel in Oundle. No one left before midnight and many much later. Discussion was fierce, conclusions limited, enthusiasm undaunted and friendship total. Subject matter was so simple; composting; spawn strains; casing; water; Pests and pathogens and occasionally something on records and management. Today we have the latest developments in Phase 2 growing. Having just returned from Europe I will be most intrigued in such new developments?

*Despite the vigilance of six pairs of eyes, we are sorry for two recent errors in Geoff's widely read diary, when he repeated some February entries.*

*Feb 11 Our "pump" should have read "pin up" (last line).*

*Feb 20 Our "short straw we have NOT had" should of course be "we have had".*

*Apologies to all concerned.*

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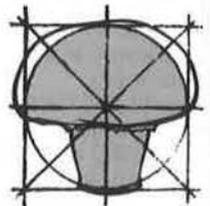
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OUR RESEARCH IS  
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## Instant compost - Italian style

Peter Flegg cuts it fine

From straw to spawned compost in 11 days, that is what is achieved at Bruno Francescutti's Agrifung compost plant in Italy!

Those attending the MGA Bournemouth Conference will remember Gerard Derks' lecture describing the plant and the composting system. Mr Derks has been consultant and technical collaborator for Bruno Francescutti for over 20 years. Members of the MGA party visiting the Tecnomico fair in Verona in May were able to see it with their own eyes. They were very impressed. This, despite a justifiable camera ban and a carefully controlled guided tour by Gerard Derks ensuring that no one came away with illicit samples!

When we arrived three-day old compost was being transferred by tractor and fore-loader into a hopper and thence by a long conveyor belt to the pasteurisation tunnels. *En route* the already quite moist compost was being heavily wetted by one fierce water jet and two sprinklers.

To reach the three-day stage, straw, a soft wheat straw as far as I could see, in large bales, is passed through a straw mill in which it is chopped and wetted. Supplements, which include chicken manure, are added via a nutrient bin and the ingredients are passed through a screw conveyor which mixes and squeezes them. The mix is then transferred to one of four open ended fermentation tunnels where it spends three days before being moved on for pasteurisation.

Three straw mills and four screw conveyors being operated for an eight hour day can produce 1500 tonnes of compost a week. Though not operating at the time of our visit, the noise emanating from the straw mills is said to be 'very loud'.

The pasteurisation stage in bulk tunnels takes six days. Our examination of the contents of an opened tunnel which had just completed that stage showed the compost two metres deep along the length of the tunnel except for the end where we were standing. The compost sloped towards us over a distance of some three metres or so reaching perhaps about half a metre in depth at our feet. Apart from being rather dry on the surface, the compost looked normal enough and was well flecked with fire-fang. Gerard pointed out to us that it was important that the floor of the bulk pasteurisation tunnels was of the 'Italian' type. It is then not necessary to fill the tunnel uniformly, even to the extent of leaving some of the floor area uncovered. He went on to point out that the fans in these tunnels are quite small, a low air flow is all that is required.

As far as the earlier stages of preparing this compost are concerned, Gerard insisted that having the right equipment, meaning the screw mixers and the straw mills, is essential. Alternative machines which appear to do the same job may not be satisfactory. Of the compost mix, he said that if chicken manure and gypsum were the only additions to the chopped straw, the pH of the resulting compost would be far too high. He did not elaborate on what the additional ingredients might be, but other workers aiming to shorten the duration of composting have often found it necessary to add materials containing soluble carbohydrates.

In early trials of this method it was found that temperatures during the three-day fermentation stage were very high. Fearing that such high temperatures may destroy the microbes needed for the pasteurisation stage, it was the practice to re-inoculate the compost with cultures of actinomycetes. However, experience soon showed this not to be necessary. The high temperatures were not developed uniformly through the compost and there was always some compost present, for example, at the edges, where lower temperatures prevailed allowing the survival of an adequate reservoir of micro-organisms. Mixing of the compost during transfer to the bulk tunnels ensured re-inoculation of the main bulk of the compost.

Our final view of the operation was the spawn run compost being compressed and heat-sealed into blocks of 18kg each. The compost in these had a very healthy smell of mushroom mycelium and had a soft, fine and friable texture.

One of the features of this process is the reduced loss of material during pasteurisation so that, per tonne of starting material, the weight of final product is much greater than with conventional composts.

As we boarded the coach ready to leave, Dr Roberto Costa, in charge of the composting operation, told us that 'this was the new road for the industry to travel'. Support for this view was ready to hand. Leaving the relatively small area in which the 'instant compost' is now produced, we were driven round the old composting yard. The vast area of now unused concrete and rows of quietly rusting compost turning machines spoke impressive volumes.

### Does it grow mushrooms?

The answer to this must be 'yes'. Before visiting the compost yard we had been taken to see a mushroom farm using the Agrifung compost. Here was saw a series of very good flushes.

The farm operated on houses containing metal shelves, six tiers high either side of a central gangway. Dr Roberto Costa was our guide, Gerard Derks our interpreter. Passing from house to house we saw crops in various stages of development. A range of spawns was being grown and a variety of cultural techniques being used. Among the spawns were some unfamiliar Italian 'King' spawns. The spawn runs were excellent.

A technique of some interest was that of casing at spawning. This was claimed to save around four days, however, it was admitted that, although giving high yields of good quality mushrooms, the method had some risks. In one house, 22 days after spawning and casing, the beds were covered in mushrooms which, however, varied from less than one to around four centimetres in diameter.

All mushrooms were harvested with roots attached. A few wooden trays full of attractive cream mushrooms packed cap upwards were ready for market, but most seemed to be destined for processing, packed in large deep plastic containers and covered in loose peat.

### Pleurotus - best left to the experts

After lunch the visit was to 'Mushroom FEM' farm of Franco Moro where there was not an *Agaricus* mushroom in sight. As we arrived we were shown some packs of *Pholiota aegerita* on their way to market. For these prices range from £6-£9 per kg with an average around £7 to £8.

The practice on this farm is, for ten months of the year, July and August being too hot, to produce substrates based on straw, mainly for shiitake and oyster mushroom production. Much of the substrate is sold to other growers.

Substrate for oyster mushrooms in plastic covered blocks is piled three-high. The water content is 70-72% at the start, but rises to 80-85% during production. Three flushes are grown and the average annual yield is around 225kg per tonne of substrate. Because of problems with the spores causing allergies staff have to wear masks with a charcoal filter when working in the cropping houses. These masks last for about 20 hours in use, say two to three days of picking and, we were told, filter out over 95% of the spores in the air.

The shiitake mushroom is grown from September to May. Production is continuous, that is, there is no flushing and yields are around 140kg per tonne.

In thanking the owner, Franco Moro, MGA Chairman said that to most of the party the visit was an eye-opener. He



went on, perhaps with a gleam of vested interest in his eye, to warn that growing *Pleurotus* and shiitake should best be left to the experts.

If anyone should think that MGA visits are just one continuous feast of mushroom visits, I should point out some of the hazards. Some or all of our 17 strong party variously paid dearly for a less than average meal just off St Mark's Square in Venice or did not fully comprehend the water transport systems of Venice and arrived back late at the coach park. By way of relief, friendships and acquaintances were made and renewed at the Tecnomico fair on the Sunday and for the whole party the visit culminated with a splendid fourteen course (fifteen for some) fish dinner on the last night; a memorable visit indeed.

## Tecnomico – Verona visit

By Martyn Dewhurst of Nazeing Farm Products

On Saturday we arrived to a drizzly, wet, grey day in Venice, and took a few hours to sample the fascinating history and delights of this city. After splitting into groups we set off to explore. Our arrangements were to meet at 8pm back at the coach, so it was with great relief that after catching the water bus back at 7.40pm and proceeding to amble off in what we thought was the wrong direction, a party including our chairman and director joined the boat at 8.20pm after having been lost. The bus surely wouldn't leave us now – or would it?

Sunday saw a trip to the Tecnomico exhibition which for anyone who has visited the Dutch exhibition could only describe this as disappointing! The exhibitors were almost exclusively Italian suppliers, of what I would describe as poorly built machinery. Two items that did catch my eye were, a straw bale chopping and breaking machine, and a corrugated plastic cover as an alternative to the standard plastic one-piece sheets currently used on poly-tunnels.

I found little else of any interest for UK growers. What was very apparent at the exhibition was the general public's passion for eating all types of fungi. They swarmed in their hoards around a stand giving out sample punnets of a combination of Oyster and *Agaricus* for people to taste, and also a stand selling hundreds of books on wild, exotic and cultivated fungi.

Monday was for most of us – the day of reckoning! The morning started badly when there was some doubt as to whether or not we were to be allowed to visit the Agrifung compost yard. Fortunately Ken James was able to resolve the situation and we left for our first stop. We made our first visit to a shelf farm where we saw some good looking compost and some potentially very heavy first flushes.

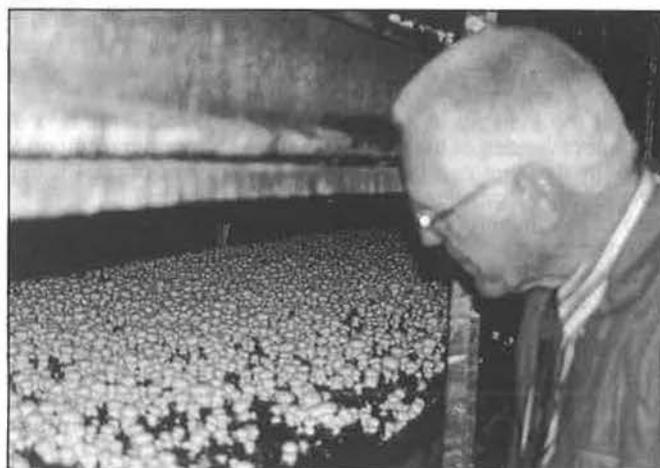
Most of the mushrooms we saw were picked and packed leaving the stalks and roots on, which could account for the high yields they were quoting. The quality of the product was variable and as Ron Jones stated: they appeared to be "tissue factories" whereby the yield was of greater importance than the quality. This also applied to their 'exotic' growing farms where the size of the fruit bodies was so large as to make them totally unacceptable to the UK market.



Chairman Jim Dumbreck enjoying the exhibition with popular visitors the Gauci family who are growers in Malta.



Martyn Dewhurst seems happy with the mycelium growth at the Francescutti farm.



John Orr, south east chairman, having a critical look at a crop on the Francescutti farm.

# THE HAYES INTERVIEW

## LIAM STAUNTON in conversation with DR W A (FRED) HAYES

13th ISMS Congress, Dublin, September 1-6th 1991

**Fred** You have the formidable responsibility of organising the 13th international Mushroom Congress which will be held in Dublin during the first week of September. It may be a surprise to many, that a small country like Eire should be prepared to undertake such a project. As Chairman of the Organising Committee you will not only have a lot of extra work to do over the next few months but also it is the culmination of what has been a dramatic and rapid evolution of the mushroom industry in Ireland. What role have you and the Kinsealy Research Centre played in this?

**Liam** I took over responsibility for mushroom research at Kinsealy from Cathal McCanna in 1979 when he left on a sabbatical to Canada. The work at Kinsealy is very much applied research, or grower-orientated. We have a small staff which in recent times has been hit by severe Government 'cut-backs' in funding. We are however at present revamping the research unit and we are hoping to improve the quality of our research when this is complete.

Kinsealy has played a major role in the development of the Irish mushroom industry. The first mushroom tunnels were built at Kinsealy in the early 1970s. At that time the Irish industry consisted of six tray farms. Over a period of time a few people got the idea that bag growing in polythene tunnels was perhaps a more cost effective system. It evolved over a period of years but the first commercial unit was Pat Walsh's composting unit at Gorey which supplied bag units to only eight bag growers at first.

Since that time we have had major expansion and the establishment of other companies like Monaghan Mushrooms, Foxfield and others. All the tray farms have now ceased operating. The success of the industry is, I believe, in the cost effectiveness of the system and the better quality that can be achieved with our system of growing. Something like 80% of the mushrooms we produce are exported to England proving that the system is cost effective and can compete on the grounds of quality.

**Fred** The interesting point is that, at about the same time, developments in Holland were moving in a different direction, seemingly to achieve the same goals, but by mechanising the shelf system which is, relatively speaking, a high capital cost system of growing.



**Liam** I would think that in Europe we see an interesting and thought-provoking divergence as reflected in the high cost and sophisticated Dutch system and low cost Irish system, both achieving the same standards of quality which are so necessary nowadays.

**Fred** This one-layer bag system does not appear to be economical on the utilisation of the total space in a polythene tunnel but the large volume of space relative to compost is surely one of the key elements in achieving the high quality standards. Even so, the economics of one-layer growing is questionable in most countries. I must therefore ask whether there is any form of Government assistance which makes it economically viable in Ireland?

**Liam** Other than some grant assistance for capital investment, there are no special circumstances. The benefits of organisation and centralised marketing are equally key elements in its success.

**Fred** This success must have been a prime motivation for you undertaking this task of organising an International Congress?

**Liam** We felt that as the Irish Mushroom Industry was expanding so dramatically it would be attractive to the rest of the mushroom world to see the various elements of the industry. A congress performs many functions in addition to merely exchanging information. You get a cross fertilization of ideas which acts as a stimulant to seeking further progress. Also, here in Ireland, the Irish Tourist Board give a lot of encouragement for or-

ganisations to attract international meetings. There is much background experience in organising conferences of this kind.

**Fred** The location of the congress, at the historic Trinity College, University of Dublin will, I am sure, give a special ambience to the occasion.

**Liam** We felt that Trinity College was the most central and convenient location, being the heart of Dublin, close to the major hotels and shopping areas. The college itself is over 400 years old and is deeply steeped in traditions of science, arts and so on. Also, the college provides a cheaper rate of student rooms which give a good price range for accommodation.

**Fred** What are the prospects for the content and participation?

**Liam** We are very happy with the response to date. We have offers of well over 100 papers, covering a wide spectrum of scientific, applied and commercial interest. We are hoping to introduce more of a grower element into the proceedings. We need the support of mushroom cultivators in this regard.

We will have concurrent sessions running through the Congress which will give the opportunity to choose between a scientific presentation and a grower orientated presentation. In addition we will have a series of seminars or symposia which will consider special topics of interest to growers on such subjects as compost making, casing technology, pest and disease control. We will have all the recognised authorities on these subjects attending and every opportunity will be given for growers to interact with the specialists.

**Fred** While we are on this theme we should mention that at the last ISMS Congress in Germany, the National Mushroom Conference was held in conjunction with the Congress and I am pleased that this is to be repeated in Dublin. Having attended the last three Irish Mushroom Conferences I have been impressed by the quality of these one day conferences and the numbers of growers attending.

**Liam** Yes, the National One-Day Conference will be held on the fourth day of the Congress and while we try to cater for Irish grower interests, all delegates to the congress will be invited to attend. The subjects covered will of course be broad ranging and practical and will include sessions on marketing.

**Fred** The trade fair will also be an attraction.

**Liam** Yes, this will be open throughout the Congress and will be adjacent to the

main lecture halls. There will be a break for one day, the Wednesday, when the technical tours will take place for delegates to have an opportunity to see Irish mushroom farms, composting sites, centralised packaging units and so forth. These tours will also give an opportunity to see the Irish countryside and an element of sightseeing has also been included.

**Fred** This is the first time for many years that we have had a Congress without simultaneous translation. Personally, I think this is a pity. There will be one language, English, but you are planning to publish the papers so that Volume Mushroom Science XIII will be available to delegates at the end of the Congress.

**Liam** One of the difficulties is to keep the costs within reasonable bounds. Simultaneous translation is costly and on this occasion it seemed sensible to do

without this facility. We will, however, offer abstracts of the papers in three languages, English, French and German and these will be available at registration.

With regard to Mushroom Science XIII. Yes, we will have this available at the end of the Congress. We are asking the contributors to exercise maximum discipline in submitting their manuscripts so that there is sufficient time for editing and printing.

**Fred** I should also mention that, for the first time, the ISMS and the Congress has been honoured with a state reception, in addition to the usual civic reception. Both events, I am sure, will be special occasions for all the participants of the Congress. It seems to me that your organisation is well in hand and that the congress will offer a complete package of information on latest scientific, technical and commercial developments. Despite the economic recession I am very much

hoping that the mushroom world will attend in great numbers. It is a major undertaking and I wish you the good luck you deserve with the organisation.

**Liam** Despite the current economic climate to which you refer, from a scientific and technical standpoint these are exciting times. We have important developments in composting, biological control of pests and breeding to name but a few of the topics. I am confident that the Dublin Congress will embrace all that is new and relevant to the future of the mushroom industries of the world. We have the active support of the Irish Mushroom Growers Association under the chairmanship of Vivian Brennan and professional conference organisers to administer the event and those who come to Dublin in September will, I am sure, gain much from the Congress and it will prove to be a memorable and worthwhile experience. Welcome.

## Golf crisis

The 17th annual golf match between the British Mushroom Growers and their associated trades took place at the Links Golf Club, Newmarket, Suffolk.

The day consisted of a 10-hole individual warm-up competition and after lunch, the annual battle between teams of 16 each side, followed by dinner and prize giving.

Final result was three matches to the growers, and five to the allied trades. This is the first time that the allied trades have had the temerity to defeat their customers for five years, and a suitable period of commiseration took place before the celebration dinner.

This is the seventeenth consecutive year that this event has taken place, the tally to date is now: Mushroom Growers 9, Allied Trades 7, with one match halved.

During the course of the day various sponsors presented special prizes as follows:-

Needham Chalks sponsored the third hole where Adrian Nunn won a golf bag;

Agrisystems Traymaster, 9th hole, dispensing golf balls



The Growers and Allied Trades Golf Match presentation. Paul Maxwell (left), Simon Alderton (centre) and Chris House.

to those that performed to their exacting limits, with Simon Fleet winning the top prize of a set of whisky tumblers;

International Mushrooms, 10th hole, where M. Dye won himself a pair of golf shoes;

Gough Packaging sponsored 17th hole with Chris House winning the decanter;

Hensby Composts provided copious quantities of champagne at the half way stage;

Darmysel Ltd provided the wines and liqueurs at dinner.

Everyone expressed their pleasure at the day's competition and friendliness and looked forward to taking part in next year's event.

Growers Team		H C P	Results	Allied Team	H C P	Margin
C. House	12	LOST	T. Claxton	14	1 down	
D. Duran	14	BEAT	T. McLoughlin	24		
R. Patrick	13	BEAT	S. Fleet	14	3/2	
S. Walter	16	BEAT	M. O'Connor	25		
G. Batchelor	10	BEAT	P. Middlebrook	9	1 up	
P. Cracknell	17	LOST	P. Glover	24		
D. Mann	26	LOST	D. Howard	18	4/3	
M. Dye	14	LOST	K. Claxton	19		
B. Mann	24	LOST	T. Russell	14	5/4	
T. Beaver	15	LOST	S. Hensby	25		
R. Stolle	13	LOST	F. Hensby	16	2/1	
D. Watkins	28	LOST	B. Annis	20		
B. Pinkerton	16	LOST	B. Woodcock	12	2/1	
C. Moore	25	LOST	D. Rowarth	24		
V. Watkins	15	BEAT	S. Alderton	18	7/6	
A. Nunn	9		S. Mills	18		
<b>Growers Team</b>	<b>3</b>		<b>Allied Team</b>	<b>5</b>		

# LETTERS

## Can anyone help?

I am 25 years old Bulgarian mushroom grower. I have worked and am well informed about the activities of the single Bulgarian spawn plant, of which my mother is manager. I am much

interested in modern ways of organising mushroom industry. I have read Modern Mushroom Growing by P.J.C. Vedder; The Biology and Technology of Cultivated Mushroom by P.B. Flegg, D.M. Spencer and D.A. Wood; The Biology and Cultivation of Edible Mushrooms by S.T. Chang and W.A. Hayes. But there aren't any suitable conditions

in Bulgaria for practising these new methods of cultivation.

I would like to work at a modern mushroom farm or spawn plant for an interval of 6 to 24 months and this is my reason to contact you and ask you if you could hire me, or advise me whom I can turn to. I am ready to do any unqualified labour as well as I can get more information and

practical knowledge about the modern methods of mushroom cultivation and (or) spawn making.

I can speak, write and read in English.

Thank you in advance.

Ilko Iliev  
53 Hr. Kabakchiev str.  
et. 2, app. 6  
Sofia 1505  
Bulgaria.

**Any offers? - Ed.**

## DIARY

**July 14 - 20** Workshop on Culture, Collection and Breeding of Edible Mushrooms, Hong Kong

**July 16** SE1 & 2 Area Meeting, Godstone, Surrey

**July 17** Manpower and Economics Committee Meeting NFU, Knightsbridge

**July 22** HDC Panel Meeting, Wellesbourne

**July 23** SW Area Meeting Farm Walk - please phone Angela for details

**July 25** Education and Training Meeting, Brinsbury College, Sussex

**July 31** Finance and General Purposes Committee Meeting, Stamford

**August 1** Executive Meeting NFU, Knightsbridge

**August 14** Editorial Board Meeting, Stamford

**September 1 - 6** ISMS Congress, Dublin

**September 11 - 14** MGA CONFERENCE, Glasgow

**October 17 - 20** Australian Conference, NSW Australia

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# CONFERENCE 1991

## Glasgow calling

Visit the superb city of Glasgow with the MGA in September. As well as being a top business and conference centre Glasgow now offers some of the finest opportunities for cultural enjoyment in Europe. We are offering an exciting and unusual social programme which will give an opportunity to sample both Scotland's famous hospitality and this fine city's culture. For those free spirits who prefer to find their own entertainment Glasgow and its environs offers a great variety of restaurants, shopping and sporting facilities, museums etc all within easy reach of the conference centre. Booklets about Glasgow and its facilities are obtainable from the MGA office or from the Scottish Tourist Board.

Here are some pictures to whet your appetite...

The Moat House International Hotel where the Conference will be held is situated on the banks of the Clyde close to the city centre.

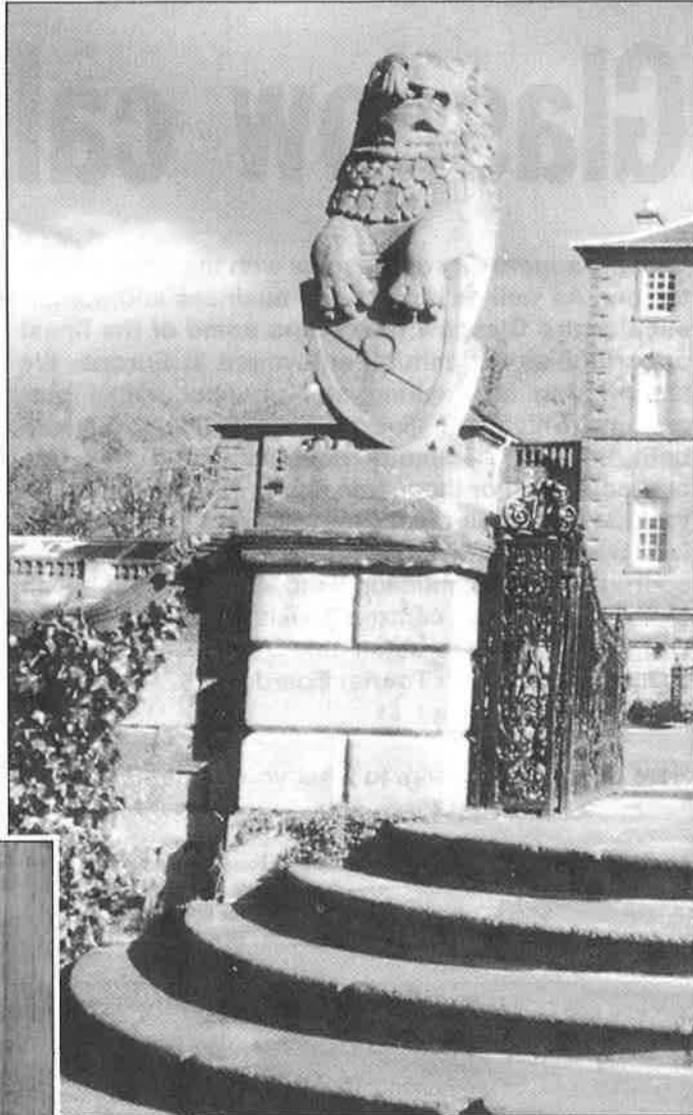


The superbly-appointed art-deco restaurant in the Hotel.

Chairman Jim Dumbreck's son Tony at Bournemouth last year showing us the shape of things to come.

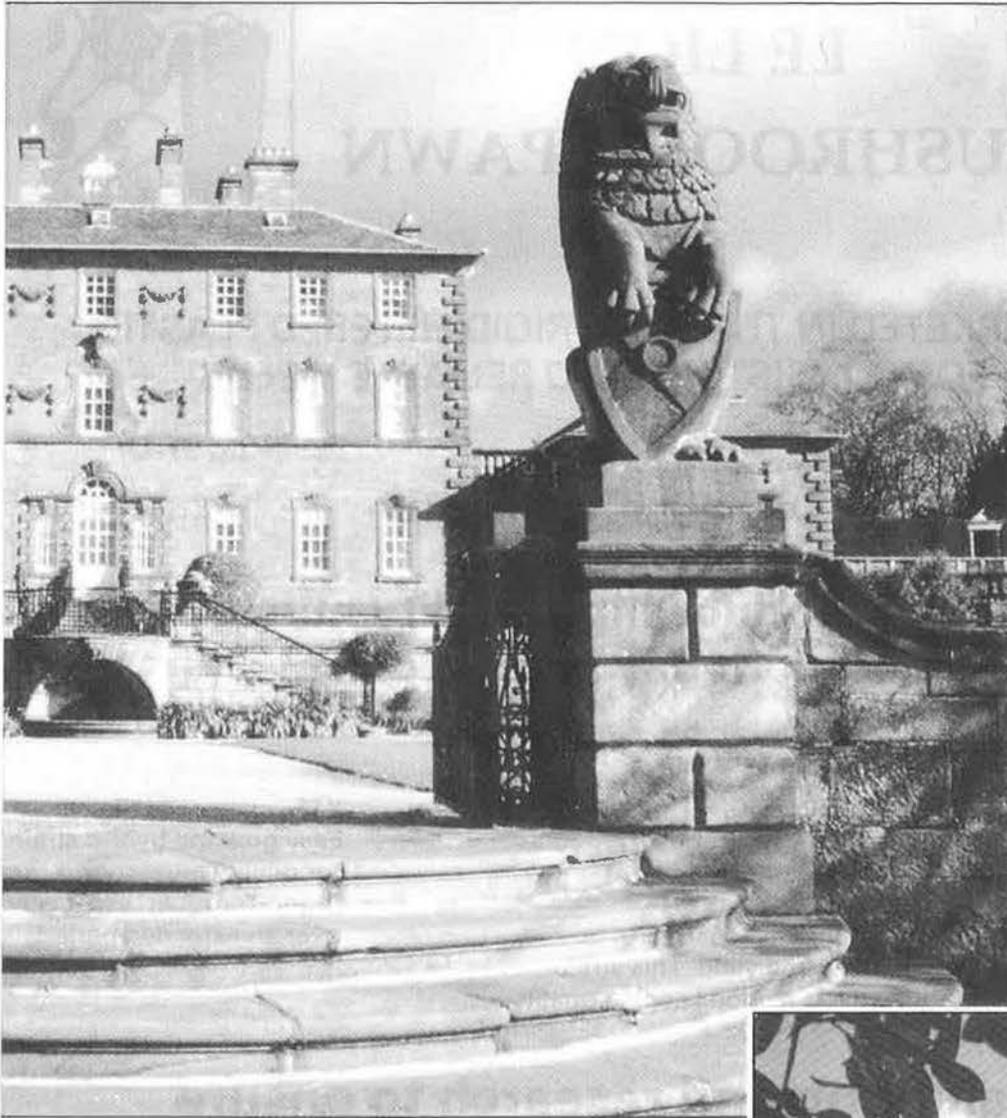


The Lord Provost of Glasgow, Mrs Susan Baird who has kindly offered the MGA civic hospitality at a reception and banquet at the City Chambers on Thursday evening.



**So! Sign up and see Scotland in September. Booking forms can be found in last month's Journal or telephone Marion on (0780) 66888. We can promise you a great time as well as a useful one. Full details of the business seminars will be published next month.**

**The exterior of Glasgow City Chambers. This fine building has become a symbol of Glasgow and its renaissance. The interior is breathtaking, with vaulted ceilings, domes, red granite columns, Venetian mosaic and magnificent three storey marble staircase - the only one of its kind in Europe.**



Pollok House. The ladies outing on Thursday will feature a tour of the Burrell collection with its unique exhibition of European paintings by Degas, Bellini and Rembrandt and display of European and oriental arts. This will be followed by lunch cooked in the Edwardian kitchen of Pollok House and eaten in a private dining room. Pollok House is described as a 'small architectural gem' and has a number of fine paintings and examples of 18th century furniture. The gardens are particularly attractive and feature a demonstration garden to inspire those who are planning changes in their own gardens at home.



The Finnieston quay crane seen from the hotel. This huge crane, monument to the heyday of the Clyde, was used to transport steam engines.





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In the following special section we examine casing, its application, challenge and future.

## The casing circle

Covered by Peter Flegg

We need a new casing medium. Or so it may seem from recent area meetings and the Bournemouth Conference.

So it seemed, also, some forty years ago when Fred Atkins, in his Chairman's Preface to the 1950 Annual Report of the Mushroom Research Association, declared that preparations had been made for an assault on the problem of 'casing soil'.

### MRA and the casing problem

Part of these preparations had been my appointment as chemist to the MRA. In those days most of the UK research on mushroom growing problems was done at the MRA laboratories, under the leadership of Director Dr Ron Edwards, on the site, or part of it, now occupied by James Gooding Ltd, Yaxley, Peterborough. The research station, at least in its early days, was paid for and run by and for mushroom growers, though the story of its short, eventful and very successful life must be left for another time.

The casing problem to be assaulted in those days was roughly this. Casing soil really was soil; soil dug from the surface, or preferably, from at least one spade's depth below the surface. This was to avoid, or at least minimise, the risks of using soil contaminated with pests and diseases. It was far from clear what the ideal casing should be and in any case most mushroom growers had to make the best of their local soil. Soils vary tremendously in type, texture, physical and chemical characteristics and are similarly varied in their suitability for mushroom growing. The cropping performance of a soil dug for casing could vary, often inexplicably, with the position in the field from which it was dug and even with the depth from which it was dug from the same hole.

Soils with a high clay content were often preferred, but clay soils could conveniently and satisfactorily be dug only in the drier seasons and had to be stored for use during the wetter months. It would often happen that the performance of an apparently satisfactory soil would disappoint, but one had to wait for several months before new supplies could be

excavated. Of course, yields were much lower in those days, up to 2lb per square foot in 10 weeks or around 200lb per ton of compost (100kg/tonne), and crop failures, for all sorts of reasons, not at all uncommon. The need seemed to be for a better understanding of the function of the casing layer and a more precise definition of the characteristic of a good casing material.

### The dramatic switch to peat

We began by studying the physical characteristics of a variety of casing soils, used commercially, in relation to their cropping potential. By 1952 we had extended our work to a study of a variety of materials alone and in mixtures so as to extend the range of physical properties of materials used for casing. The four basic materials of our mixtures were clay, sand, sphagnum peat and vermiculite with added lime as required to regulate the acidity of the peat. In addition to measuring a wide range of physical properties of these mixtures, such as water holding capacity, pore space when wet and pore space when dry, we also carried out small scale cropping trials using rows and rows of 8-inch plastic plant pots. We were looking for the particular physical properties which gave the best yields.

Because the MRA was grower-orientated, it was established practice for the first (or was it the third?) Thursday of each month to be 'open house' for any member mushroom grower to visit, see our experiments and discuss problems. On one of those Thursdays some of our trial pots were in crop and looking good. The most outstanding pots were those cased with peat and sand and peat and vermiculite mixtures. The visiting growers were very impressed.

At about the same time one very influential grower, Major C.P. Whitaker, MRA Chairman during its first formative years, was so impressed that he immediately cased 3000 square feet (a large area for those days) with a peat mixture. Fortunately, the venture was a great success and he changed over completely to peat casing. What followed was very dramat-

ic. Within a few short months nearly all mushroom growers had converted to casing with peat mixtures.

Although the widespread use of peat mixtures for casing mushroom crops undoubtedly stemmed from our systematic studies at the MRA of a range of casing mixtures, we were not the first to use peat for casing. There are reports from Pennsylvania of peat being used there in the 1930s. Dr Bewley (the first Director of GCRI) with J. Harnett reported, in 1938, that casing with peat and soil and peat alone gave good results and Dr H.C. Bels-Koning in 1950 (Mushroom Science 1) described her results using a range of materials including filter paper, cloth, brick dust and peat and vermiculite. She concluded that water holding capacity, porosity and a stable structure were important characteristics of a good casing mixture.

Also studying the casing layer at this time was Dr. B. Stoller in the USA. He, however, was using non-fibrous peat in his experiments with some success and, in fact, concluded that fibrous peat (such as sphagnum peat) was unsuitable for casing mushroom beds.

At first, peat casing mixtures were based on peat with sand or vermiculite. The change to the now familiar peat and chalk mixtures came *via* a Dr Peet (yes, really!) who was working for Geo. Monro Ltd. who then supplied spawn and sundries to the mushroom industry. He, following our work, advocated a mixture of peat and kibbled (lumpy) chalk. Chalk had to be added to the peat anyway and to use chalk as the other ingredient seemed a logical development.

### Peat mixtures and their characteristics

During the years from 1950 to its closure in 1954 we, at the MRA, carried out a very intensive study of the properties of peat mixtures and of their characteristics as casing media. Probably nothing like it on such a scale has been attempted since. It may, therefore, be worth while to recapitulate on some of our findings and the conclusions we drew so many years ago. Much of what we reported is still rel-

evant today!

We were looking for correlations between physical characteristics and the potential to produce high yields of mushrooms. In general we found that the greater the porosity of a mixture in the dry state, the more likely it was to produce good yields. A high pore space when a mixture is dry means there is plenty of room for water and for the passage of air and carbon dioxide.

Peat can be very difficult to wet and we found that the uptake of water by peat could be improved by:-

- a) increasing duration of the wetting process,
- b) the addition of wetting agents, and,
- c) the application of heat.

We spent a lot of time studying the water holding capacity of peats and peat mixtures. It became clear that simple statements on water holding properties of peat and peat mixtures (and probably of similar materials) need to be regarded with more than an average amount of scepticism. Our work showed that the water holding properties of a peat sample depended, among other things, on:-

- a) the previous treatment of the peat, how it had been dried and to what degree,
  - b) the degree of compaction of the peat when the measurements were made,
  - c) the method of measurement and amount of suction used,
  - d) the extent to which the peat is wetted before testing,
- not to mention differences between types of peat and proportion of other materials present.

### Three interacting factors

Logically and inevitably our work also covered cropping experiments on the best ways of managing peat mixtures. It was found in one trial that peat mixes were best applied 'wetter', rather than 'drier', but the most general conclusion from the work on the management of peat casing mixtures was that the subject was complicated.

The influence of management on the cropping performance of casing media is

perhaps well demonstrated by the following true episode dating from the days of 'casing soil'. In an attempt to learn more about the casing problem as perceived in the early 1950s, two well known and highly respected mushroom growers agreed to swap casing soils. The two growers were Stanley Middlebrook and Fred Atkins. Each grew quite satisfactorily with their own local soils, yet using one another's soil, in a whole-house trial, the results were less than good. For successful cropping it is essential that the casing medium and its management should complement one another. The situation, as the MRA work showed, is obviously 'complicated' and not helped because spawn strains may react differently.

At a recent Area Meeting the idea was put forward of conducting a series of cropping trials to compare the various casing media currently available. A commendably logical suggestion, but one which brings us full circle to the point reached by the work at the MRA around forty years ago. How do we reconcile three important factors, the casing medium, the cropping environment and the cultural management? The difference this time round is that the demands on the grower in terms of yield, crop quality and timing are much greater. On the other hand, our technology is much more advanced. A solution is not impossible, but it will take a lot more effort than is being made at present.

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# Some thoughts on peat and the quest for an alternative

By Dr W A (Fred) Hayes

It is interesting to reflect on the series of seminars held at Aston University during the 1970s on topics which, at that time, were assessed to be those which would be important for the future of the mushroom industry in the UK.

The first, held in 1974, was on 'The Casing Layer', the second on 'Compost', followed by the third on 'Mushroom Quality'. Events have shown that these assessments were well founded, since both composting methods and mushroom quality are key issues today. The first, and chosen priority topic, has not achieved the same prominence as an issue but is now a subject area which has relevance to ecology and the environmental movement and, of course, to the production of quality mushrooms.

Although these three subject areas are interrelated, the main conclusion of the 'Casing Layer' seminar was the urgent need to eliminate the variable in peat to achieve a more standard product. If today the seminar were to be re-convened I am convinced the same conclusion would be made. Why then the lack

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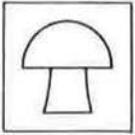
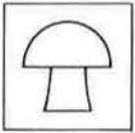
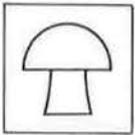
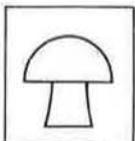
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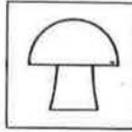
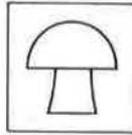
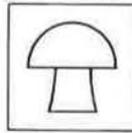
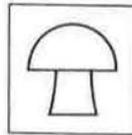
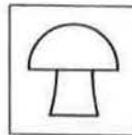
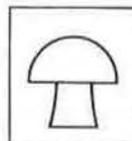
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of progress over these years in securing a more standard product?

## What happened to PMB (paper mill by-product)?

Guided by the seminar, we at Aston embarked on what turned out to be quite a costly programme to find a 'more or less' standard product which would provide an alternative to peat as a main ingredient for UK conditions. Thanks to some sterling work by Drs Steene, Cresswell and Yeo over a ten-year period and with the collaboration of W. Darlington and Sons and the Bowater Paper Company, the waste product from the paper making process at the Sittingbourne Mill seemed to provide the answer. A mixture of wood fibres and clay was a material which could be standardised and provided all the physical, chemical and biological requirements. This was thoroughly tested and proven in trials on UK commercial farms and proved to be equal and in some respects superior to peat-based substrates, particularly in terms of mushroom quality, meeting the high standards set by today's market place.

What went wrong? Answer – in one word – cost. It is a strange fact, that a 'no value' waste, which is expensive to dump in an unsightly landfill, assumes a value when a good use is found for it – in this case a prohibitive value.

## Prospects for an alternative

Mushroom growers who use peat on a continuous basis may find it difficult to accept that, for the function it performs in mushroom growing, it is relatively cheap and certainly good value. However, not many growers would contemplate an increase in cost of such an extensively used raw material.

It is evident therefore, that an alternative for the UK must be cost-effective and competitive with existing peats. This immediately rules out most, if not all, of the possible synthetic or manufactured materials, such as foam plastic, perlite and ermiculite, on the grounds of cost alone.

In other countries, where peat is not available or where it is too costly to import, alternatives are used but in most cases give a less satisfactory casing layer. In India, for example, a decomposed cow manure was found to have many of the characteristics of peat and its use had a considerable impact in the development of mushroom cultivation in the rural areas of the Western Himalayas. In Kenya, a cocktail of decomposed plant products, soil and Wattle

bark after the extraction of tannin, performs exceptionally well. In some tropical countries pulverised coconut fibre is a viable alternative but for best results requires addition of other decomposed plant products. Spent compost is also used in some countries but its general performance and reliability is variable.

## Casing soil pasteurisation

A major disadvantage of all alternatives to peat is the need to pasteurise before use as a casing medium. Virtually all the viable alternatives are known to carry some pest or disease, nematodes and the fungus pathogens of mushrooms being the most common. This pasteurisation requirement adds to the cost and because of the complexity of the biological and chemical factors involved in the formation of mushroom fruits in the casing layer, a very precise temperature treatment is required for optimum results.

With the judicious use of an ever-decreasing number of permissible chemical control agents, the pest and pathogen risk from peat is masked. How long this reliance on chemical control agents will be permitted is open to question. The few UK growers who pasteurise peat-based casing soils would testify to its value in minimising disease outbreaks and it is a surprise to me that it is not more widely used in UK mushroom growing. Any future cost effective alternative will almost inevitably involve the inconvenience of pasteurisation.

## Texture and structure

The unique property of peat to absorb and release water is the main advantage over other possible alternatives, but the tendency of many peats to 'pan' on water application and thus prevent the required gaseous exchange between the compost layer and the atmosphere is a major disadvantage.

These characteristics relate primarily to the texture (the relative proportion of particles of different size) and structure (the shape and size of the aggregates when crumbled). A good casing soil requires a range of particle size, from the very small colloidal particles, which are generally deficient in most peats, through to macro-sized particles which are abundant in peat. Generally the alternative, paper mill by-product, mentioned earlier, contained a proportion of clay and silt (micro-sized particles) which we associated with the better quality fruits from PMB than from peat. The current trend to blend peats from different sources can be seen as a measure to achieve a more

suitable mix of particle size and usually improves the general structure of a casing soil.

The mushroom industry is an important sector of the UK peat market. There was ample evidence of this at the BGLA Exhibition held at the NEC in January, no fewer than nine companies projecting brands of peat which were targeted at the mushroom market. Despite the current ecological concerns and the environmental lobby for the conservation of peat bogs, I feel certain that peat will continue to be used as the primary component of a casing soil for many more years, or even decades. The prospects for a viable alternative are bleak.

I am reminded of a statement that was made by Mr. Pat Walsh at the Aston Seminar in 1974. Thanks to the published proceedings I can quote his words verbatim: 'I would like to draw the attention of peat suppliers to the problem of quality (of peat). With the use of machinery to mix peat and chalk it is difficult to obtain the right structure in order to retain the moisture. The Irish peat is sometimes too fine for the purposes of mushroom growing.'

One and a half decades later we can say that this statement still applies, but nowadays not only to Irish peat, but also to other sources which have since come on the market.

Both texture and structure are key characteristics of a peat for use in mushroom growing. I fail to understand why peat companies are unable to grade peat to suit the requirements of mushroom growing – the extent of the market and its use, over many years, surely justifies some special consideration. There is perhaps a glimmer of hope on the horizon, one company is to market graded peats with a given particle size range – in the near future. This will be a first step in achieving a greater degree of standardisation so that the approach to the preparation and subsequent management of a casing soil can be done more objectively.

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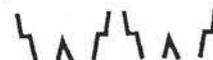
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# A peat producer's point of view

By Jim Smith - UK Horticultural Adviser, Bord na Mona

Tremendous advances in environment control within the mushroom house, house construction, compost making, and disease control have surprisingly been accompanied by very little experimental work on improved casing materials.

The most comprehensive work was reported in 'The casing layer' published after the first seminar in the mushroom seminar held at the University of Aston in Birmingham in 1973.

In evaluating the importance and development of various casing materials one must appreciate the very complex structure which is required to enable mushroom fruiting to occur. In the early days of commercial mushroom production, either sterilized top soil or sub soil was used as a casing material. Limitations in terms of availability, high cost, and variability necessitated the use of alternative materials. In the UK and most of Europe peat has become the standard casing material mixed with either lime, chalk, or sugar beet lime waste to correct the pH to above 7.

As horticultural adviser with Bord na Mona, I have been closely involved in researching growers' requirements and how these can best be met, through developing a range of casing materials based on a wide range of black and white peats.

This year I have been visiting many mushroom growers, attending talks, and holding small seminars with groups of growers. The aim has been to obtain a clear idea of mushroom growers requirements for casing materials.

Prior to this research I went along with the commonly held belief that there is a wide diversity of casing requirements amongst growers. This has proved to be a misconception, with strong similarities in terms of the qualities required from casing materials, being expressed by all of the growers contacted.

These similarities can be summarised as follows:-

- 1 casing materials must have excellent water holding capacity;
- 2 structure and texture are very important;
- 3 casing must be easily rewetted between flushes;
- 4 the casing must be consistent for each delivery.

Despite the consistency of expressed requirements, trials conducted by Bord na Mona have proved that no single peat type can provide these qualities for all growing methods. The solution lies in the



Good structured casing mix, milled black peat with chalk on a shelf system.

selection of the most appropriate peat type for the growing system and management routine adopted. So let's examine the growing methods.

The traditional and possibly most popular system is trays. Water is one of the most important ingredients and essential for high yields and good quality. It is, however, potentially one of the most destructive ingredients of the peat in the casing. The peat must absorb the water very quickly without turning into structureless pudding. This is a formidable but not impossible task providing the optimum structure and texture of peat is selected.

The tray system of growing is generally labour intensive and can only handle small quantities of casing at a time. Most growers mix their own casing from baled peat which offers convenience and freedom from the possibility of disease contamination. Two to three bales are broken up into a mixer, chalk/lime is added to correct pH, and a considerable volume of water is applied and expected to be absorbed immediately.

Selection of the most appropriate baled peat type, makes the lighter moss peats such as Shamrock medium Irish moss peat as the most suitable. Alternatively Shamrock superabsorbent peat has been specially developed for those growers requiring easier rewettability between flushes. This product contains a wetting agent which serves to break

down the surface tension between the water and peat allowing much faster uptake of water by the peat. The advantage for growers is that the water is absorbed in a matter of a few minutes instead of taking several hours to reach optimum absorption.

Trials have shown that water uptake occurs so quickly that growers must ensure they are not tempted to add more water than usual during the initial wetting up process. The danger of over wetting is that the structure will be destroyed. An additional aid to management is that the wetting agent makes watering between flushes much easier with the water going directly into the peat instead of running off or puddling, which may result in panning.

It is essential to harvest the right type of peat at the right moisture content and screen to give a consistent particle blend required for casing materials. Harvesting and screening techniques of peat have changed in order to cope with increased demand at competitive prices. Going back 20 years, peat was all harvested as sods which were dried and milled before baling. Now most peat is harvested using a hook miller. The major determinant of particle size of the end user product is not related to the harvesting method, but rather to the peat source, screening techniques and moisture content.

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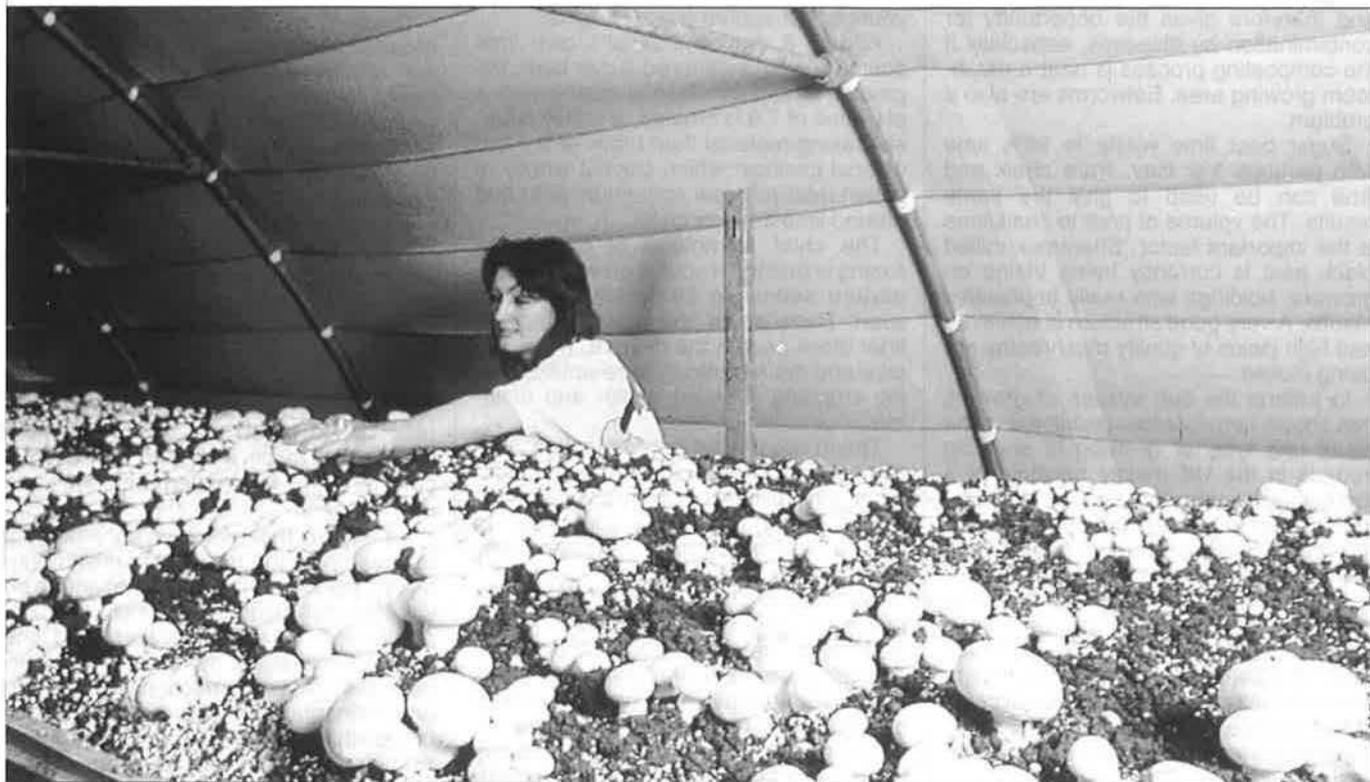
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most appropriate peats from sources in Ireland which vary from light young fibrous and spongy peats to very decomposed black gritty fuel peats. The selection of Shamrock medium grade Irish moss peat was not specifically created for the mushroom industry but has proved to be the standard. With the installation of modern star wheel screening techniques enabling the peat to be

split into fractions of set particle sizes and reblended to provide a wide range of absorption, density and structure, Bord na Mona will be introducing new baled peat products specific to mushroom growers.

Shelf system growers require a peat structure with quite different characteristics. The shelf system is highly mechanised and demands bulk deliveries of

casing usually of a much denser peat than used by the tray grower. This heavy more decomposed black peat tends to start off with less structure than the white peats. This is not a problem because the structure is made in the mixing. Instead of just correcting the pH vast quantities of chalk/lime/sugar beet lime waste are added. This gives the peat a sticky adhesive feel and when put in the mixer tends

## Guaranteeing quality

By Graham Panter, Managing Director, CC Imports

to ball and these form the casing structure on the bed. If the mix is correct then water will be freely absorbed without destroying the structure.

On the continent sugar beet lime waste is widely used to correct pH and provide the structure. The advantage of this material is that in being a waste material it is cheap and creates a very good structured casing when combined with peat. The disadvantage of this material is the fact that it must be composted for several months to remove any sugar which encourages bacteria and moulds. The composting is generally done outside and therefore gives the opportunity for contamination by diseases, especially if the composting process is near a mushroom growing area. Eelworms are also a problem.

Sugar beet lime waste is 99% lime with perhaps 1% clay. Pure chalk and lime can be used to give the same results. The volume of peat to chalk/lime is the important factor. Shamrock milled black peat is currently being trialed on growers' holdings with really impressive results. A very good structure is achieved and high yields of quality mushrooms are being picked.

In Ireland the bag system of growing has shown considerable promise and the small unit type of growing is showing inroads in the UK mainly because of a low capital investment to set up. The casing used on bags can either be the baled moss peat or the denser black peat. Both are used in Ireland successfully.

The way forward lies in the development of new blends of peat and advanced screening technology, which match the demands of the modern mushroom industry. Bord na Mona accepts this challenge and will respond by working with growers to develop the optimum casing material.



Continuation of quality can, to a certain extent be guaranteed with the increasingly popular continental casing. Like any blended material, the subtle differences that occur in natural raw materials can be anticipated and the blending process used to provide a product of consistent quality.

Even from the primary stages of extraction, the intensive process of blending this prestigious German blend of black humified sphagnum peat – which is dug from deeper and older levels, with the brown (often referred to on the continent as white) less humified and younger sphagnum peat – begins.

Add to it the continental's own lime source – well-weathered sugar beet, by-product – and continental casing with a pH value of 7.6 is created, a totally different casing material than many of the traditional casings, which consist wholly of brown relatively-raw sphagnum peat and ground limestone or chalk.

The chief advantage of continental casing is that the mycelial growth into this mixture seems to be faster and more even. Because of the incorporation of finer black peat in the mixture, water uptake and more particularly re-uptake during cropping is much easier and faster too.

These two factors in combination, lead to a greatly enhanced casing management with mycelial growth and moisture levels being precisely controlled to ensure optimal pinning conditions and subsequent flush development.

Many users of continental casing have observed improved mushroom quality from these materials with an abundance of cleaner and heavier mushrooms which undoubtedly meet the high demands of quality control by supermarket chains.

The density of mushrooms is probably attributable to the ability to maintain optimum moisture levels throughout the casing due to its ability to accept and take up water so well.

The cleanliness of these closed cup mushrooms is partially due to the ease of pinning management, but the physical characteristics of continental casing must play a considerable part in this too. The developing mushrooms do not appear to collect unwanted peat in the way that can so frequently happen with traditional casings.

Application of continental casing could not be more simple. It can be used successfully whether the growing system is shelves, trays or bags. The casing can be bought for delivery either in bulk or "dump bags" and in a range of moisture levels from grade 0 (68-69%) to grade 6 (74-75%).

Grades 1 and 2 are usually recommended as the casing is sufficiently moist for it to be applied without adding further water at this stage. Gentle watering after application easily achieves full water-holding capacity of the casing without destroying its in-built structure.

Grade 0 can also be used, but this requires additional water before application which can be done either by using spray lines or a sprinkler system. If the casing's unique structure is lost during application on to the beds then ruffling is an option, but with suitable management it should not be necessary.

Although ruffling is a legitimate technique in its own right, as an alternative to spawning the casing and ensuring an even spawn throughout the casing layer, it is not necessary if appropriate care is taken not to lose the structure in the first place.

It is perhaps important to note, and only fair to point out, that if optimum results are to be expected, continental casings must be treated with the care they deserve.

As far as the rapid advancement of technology in the mushroom growing industry, continental casing is proving to be ideal for pelletised spawn incorporation. Application is straightforward and the growth once again more even, but perhaps the greatest attraction of spawning on continental casing is that the rapidity of growth from casing to airing is reduced considerably from 8/9 days down to a staggering 4/5 days.

Today, apart from being consistent in quality, continental casing produces a higher quality, denser and cleaner closed cup mushroom, and at the same time because of its unique structure aids watering and pinning management, and by no means less importantly, can be used in conjunction with casing spawn.

If you haven't already, why not try continental casing yourself. You are unlikely to be disappointed.

# WHICH TRAY DOES THE MARKET DEMAND TODAY?

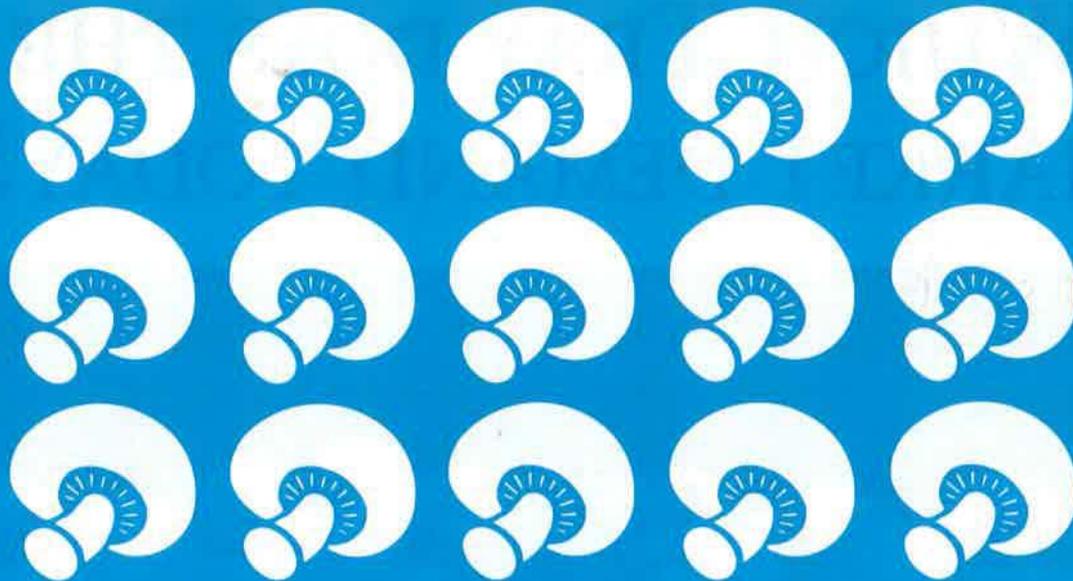


**Would you believe these two trays were picked at the same farm on the same day?**

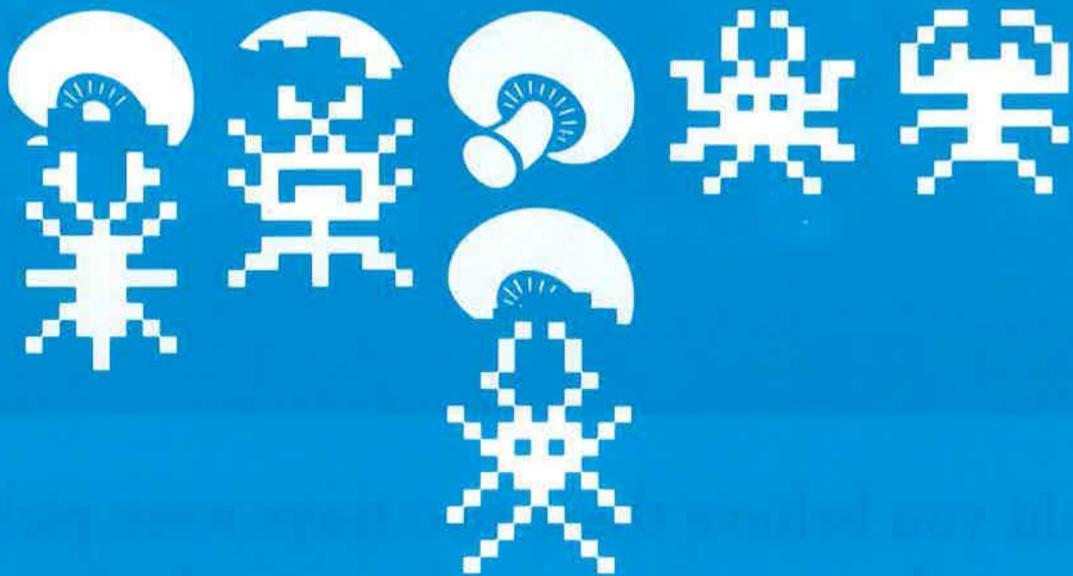
The only difference being, the one on the right was grown using Euroveen casing, against a commonly used Grower's own mix.

The not so obvious advantages from the photograph are a uniformly delivered casing ready to use, good crumb structure, speedier mycelium growth and an acceptability of water between flushes which together add up to increased profitability.

For more information write or telephone today to Graham Panter, CC IMPORTS, 8 Byron Crescent, Higham Ferrers, Northants. NN9 8DG. Telephone: 0933 315057



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Sodium-o-benzyl-p-chlorophenate	.....	9.3%
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ENVIRON IS A TRADE MARK

## Environmental computer control for mushroom farms

### An Agrisystem contribution

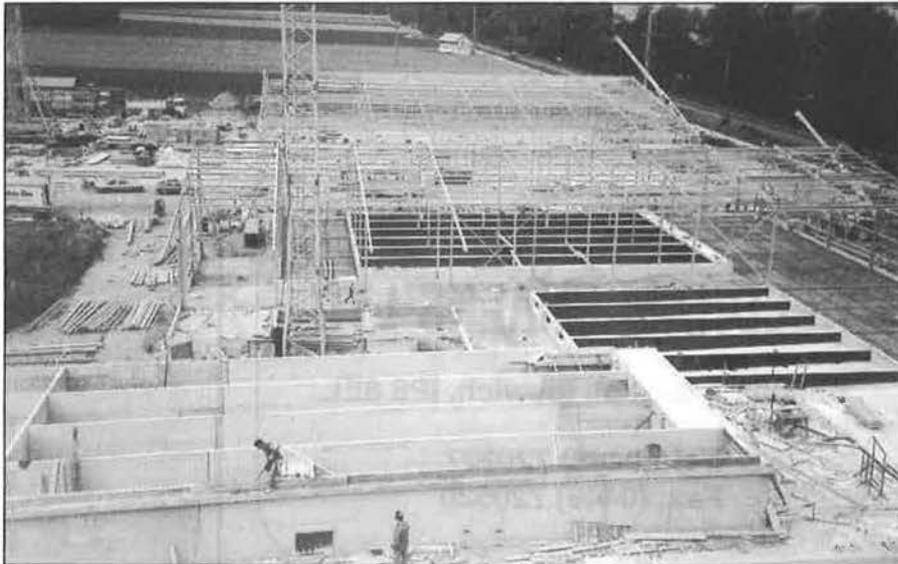
During the second half of the early eighties, Agrisystems B.V. set their sights on developing a computerised environment controller which would set the world standard for this type of device.

Some suppliers and purveyors of mushroom farm computers were still very much using "home" computers for data storage and for the very simplest temperature control. Alternatively, there were other companies, producing computer controllers still fairly unsophisticated and designed for other environmental control applications.

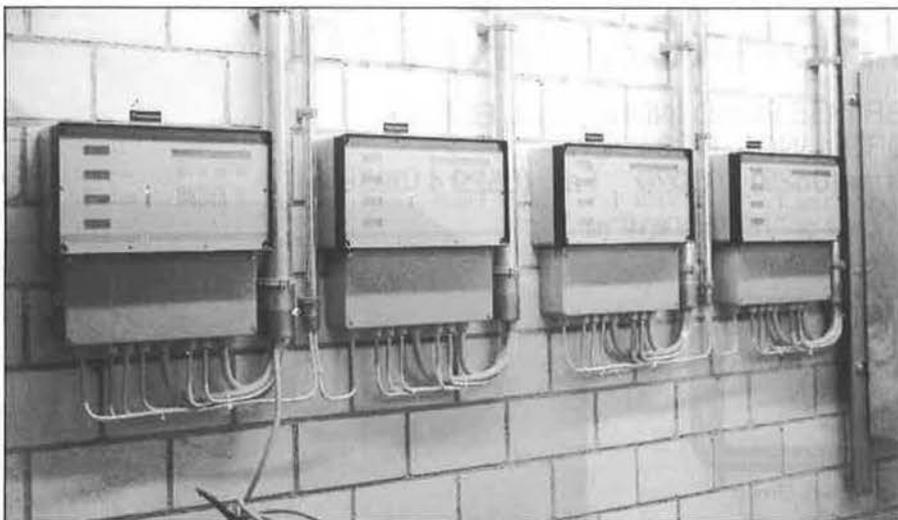
In this period of 1984/85, none of the companies existing, at that time, and in the opinion of the Agrisystems' engineers, could adequately fulfil the guide specifications which had been accumulated.

These were generally as follows:

- compost temperature sensitive control;
- air temperature and humidity control simultaneously controlling pre-heater coil cooling coil after-heating coil cooling coil with re-heat for de-humidification humidifier;
- carbon dioxide control operating the fresh air/recirculating air dampers;
- automatic fan speed regulation – on demand;
- room over/under pressure functions;
- to respond to climate conditions and use energy conservation choices;
- out-going signals to control analogue and digital devices (valve motors etc.);
- in-coming analogue and digital sensor signals;
- de-centralised control device;
- data transfer system to communicate with central computer and/or other controllers;
- fully programmable with the possibility to completely automate the growing cycle from phase II compost preparation to sterilisation of the growing rooms;
- applicable to all growing systems, i.e. Dutch shelf system, tray farms, bag growing, etc., etc.;
- to be insensitive to external natural and/or man-made electrical disturbances;
- provide immediate visual display of the important controlled parameters and cultivation status.



The farm at Kuhn farm under construction.



Agriconrollers at the Kuhn farm.

Agrisystems B.V. were fortunate enough to be given the opportunity they were seeking when they were able to engineer the most modern "Dutch" mushroom farm ever to be built, in Switzerland, which is now well known as the Kuhn Farm.

Subsequent to, and during, the design and construction of this farm, engineers were learning first-hand how to grow mushrooms and the implications of the cause and effect of the variations which were trying to be incorporated into the control device.

From all these efforts, the AGRICONTROLLER was developed, which had to perform as a multi-purpose control de-

vice from the very outset. The hardware was relatively easy to establish – use the very latest components, with a view to the future, and allow it to at least correspond to the specification guidelines.

The AGRICONTROLLER was produced with the following attributes:

- heavy duty enclosure, virtually impervious to external electrical influences;
- a fascia which is fully protected against full accidental water shower;
- average compost temperature, air temperature, humidity and CO<sub>2</sub> or oxygen level display window;
- programme location/setting display window;
- a series of LED displays showing important functions;

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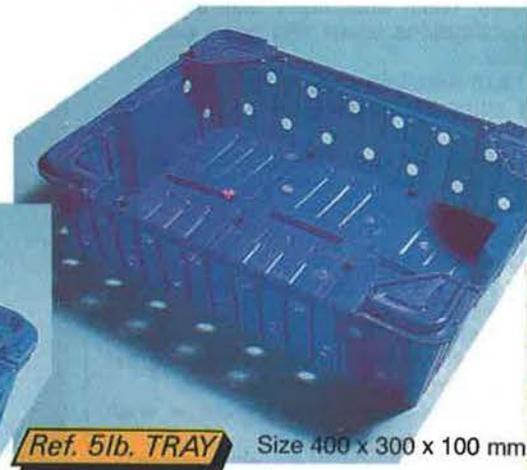


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7. Improved cooling time

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● in and out-going connections as follows:

- 16 analogue inputs from temperature sensors etc.
- 8 - analogue outputs for -
  - Pre-heater
  - Cooling coil
  - After heater
  - Humidifier
  - Fan speed regulation
  - Fresh air damper adjustment
  - Exhaust air fan regulation
  - Spare ...
- 12 - digital inputs from sensors
- 12 - digital outputs for control and alarm functions.

## Cultivation software

The cultivation software was more difficult to establish directly.

Agrisystems were fortunate to have some of the most knowledgeable and imaginative growers and engineers available during this very important period and the result was that a software package has been developed comprising: six main programmes which may each be composed of sixteen sub-programmes.

This gives an almost limitless opportunity to programme any function or cultivation parameter which any grower/farm may require.

The AGRICONTROLLER is not limited by this software. All parameters are adjustable, from temperature limits which may involve high and low alarm settings and "trigger" functions, for over-riding fan speed settings, to varying P (proportional) and I (integral) settings of the control devices. These values can be permanently "set" into each and all AGRICONTROLLERS but without, in any way, limiting, minute by minute, adjustment of the function of the air-conditioning system.

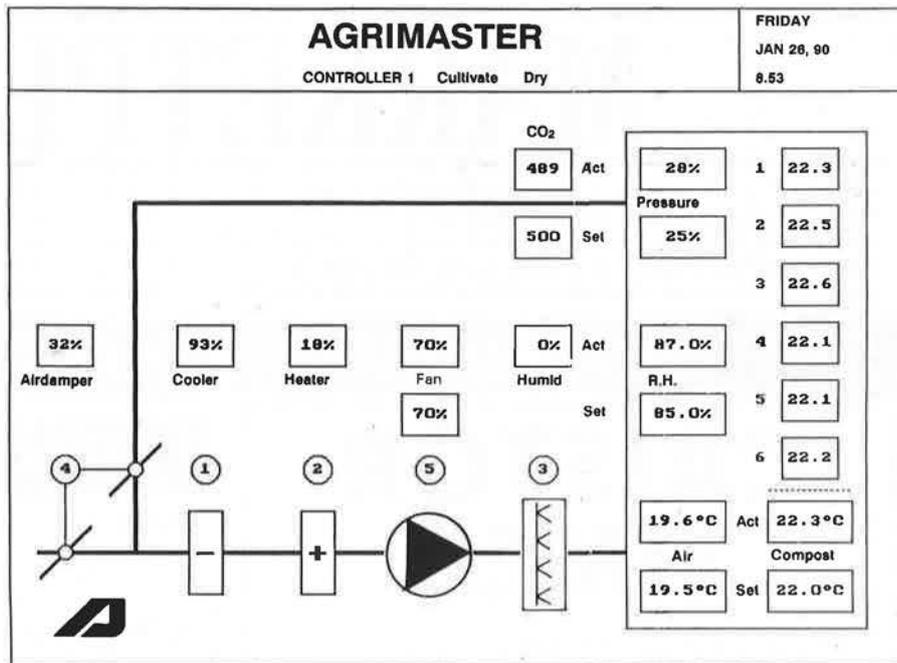
## Continuous improvement

Despite these attributes of the AGRICONTROLLER, development has never ceased on both the hardware and the software of the system. Agrisystems are continuously reviewing the sub-programme modules and writing new versions and/or additions which are added to the standard programme library.

In one major respect the hardware has been improved by the use of "active" temperature sensors, as opposed to "passive" sensors which are generally applied to control systems, to increase sensitivity and to avoid degeneration of the signal.

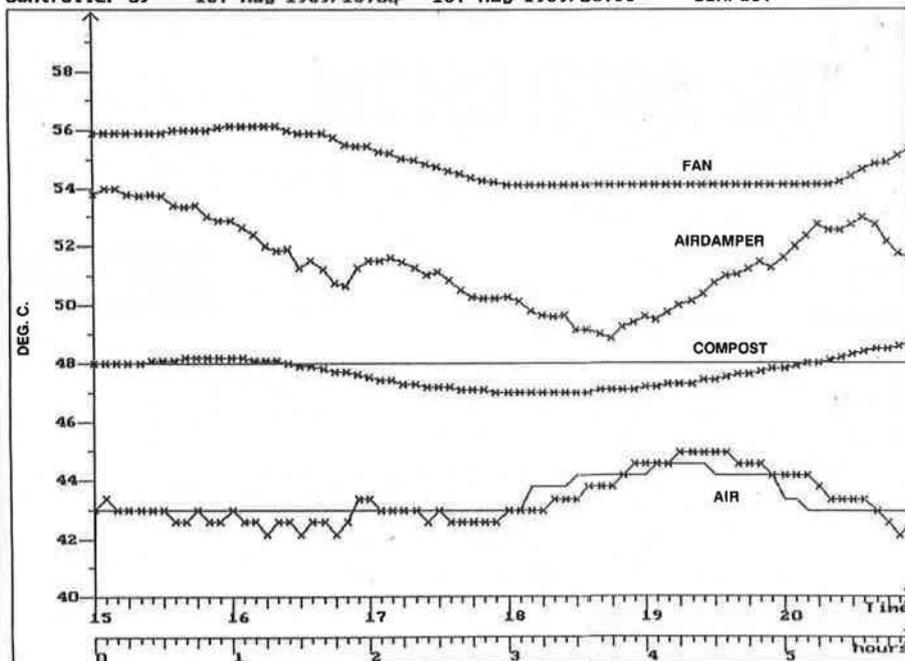
## Additional management and communications

Since some of the required attributes of the AGRICONTROLLER were to involve data accumulation etc., Agrisystems were instrumental in writing and developing the AGRIMASTER monitoring pro-



Continuous progress can be followed in tabular form...

Controller 09 18. May 1989/15:00 - 18. May 1989/20:55 COMPOST



...or by means of individual dynamic system representation.

gramme.

The AGRIMASTER programme can be applied to any computer of sufficient capacity which is IBM compatible. The AGRIMASTER programme will then allow direct communication with each individual AGRICONTROLLER.

The AGRIMASTER programme is an invaluable aid to the grower. Environmental and control function data can be accumulated for reviewing later, both as a "paper" copy or as a screen display.

Meanwhile continuous progress of each individual growing room or compost preparation tunnel can be followed, both in a tabular form or by means of individual dynamic system representations.

A subsequent addition to the AGRICONTROLLER/AGRIMASTER package is the introduction of world-wide communication modem. This unit which is now fully available will allow communication not only with secondary management computers, located at the farm manager's home, but also with the office of Agrisystems BV, allowing viewing of data and potential trouble-shooting.

Since the introduction of the AGRICONTROLLER more than 400 units have been sold and incorporated on many prestigious projects. Without doubt the AGRICONTROLLER has set a standard which other companies still try to emulate.

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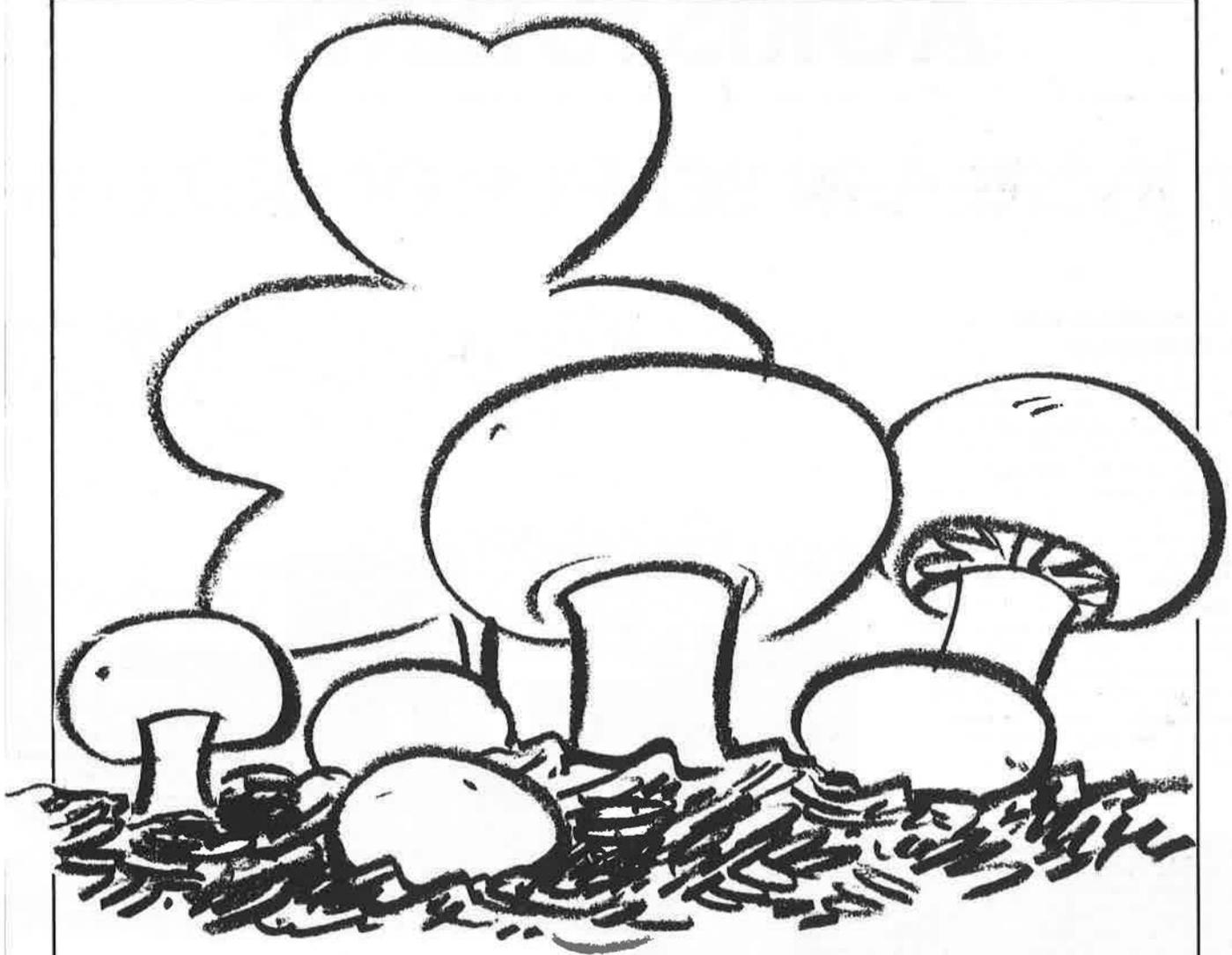
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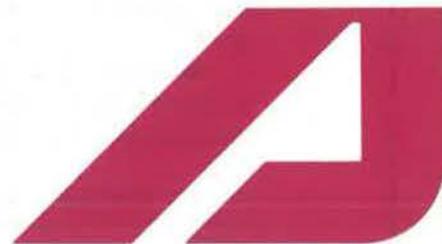
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