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# ***The Mushroom Journal***

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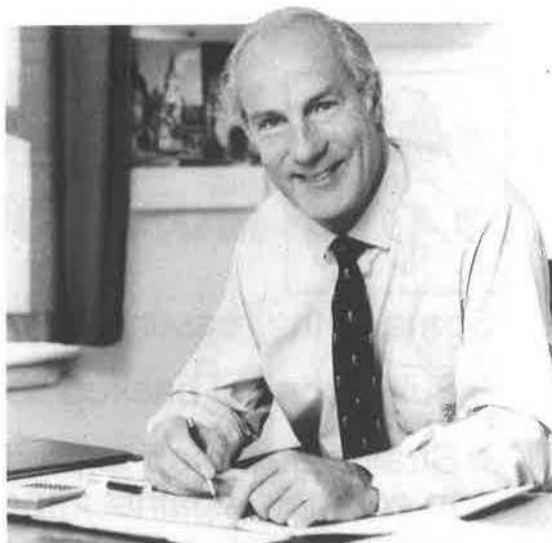
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*The Mushroom Journal No. 170*  
*February 1987*

# Mushroom Growers' Association

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*Telephone: 01-235 5077.*



## *Director's Notes*

The last four weeks have been significantly affected, first by Christmas and the New Year and then by the prolonged spell of arctic weather conditions. Whilst the holiday period is always a difficult time for growers, the cold weather has provided a mixture of problems and advantages. Snow and ice have, in many parts of the country, severely hampered production and distribution. On the other hand, once mushrooms have got into the shops there have been good opportunities for increased and profitable sales.

To capitalise on this, we sent out a press release pointing out that, unlike outdoor vegetables frozen into the ground, mushrooms can be harvested under all conditions. Being readily available they therefore make an excellent ingredient for

nutritious and warming winter meals.

UK grower members will have received this month the first issue of *Update*. It is intended to keep those members in touch with current legislation and items of general interest affecting growing in this country. It provides another link in our improving chain of communication.

A further aspect of communication receiving attention is our area structure.

Although current travel conditions have delayed things, we are in the midst of visiting Area Chairmen and planning events for the year. The aim is to provide interesting opportunities for members and prospective members around the country, to participate within the MGA.

### ***ANNUAL GENERAL MEETING***

The Annual General Meeting of the MGA is being held at the Moat House International Hotel, Stratford on Avon, Warwickshire, on Tuesday, 14th April, 1987, at 10.30am.

We would draw to your attention rule 61 which states:

**"A member may bring any subject before a General Meeting providing notice thereof in writing is in possession of the Director not later than the twenty-first day previous to the Meeting".**

Therefore, if you have any subject you wish to be discussed at the AGM, would you please let the Director have this in writing by Monday, 16th March, 1987?



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Articles submitted for inclusion in the Journal are always welcome. Whilst the Editor cannot undertake to publish all the copy received, submissions will be acknowledged. Originals, wherever possible, will be returned to the contributor, who will also be notified as to if and when the article will appear.

No responsibility can be accepted by the Editor, the Editorial Board, or the Mushroom Growers' Association for statements made or views expressed in this Journal, or for any advertisements included.

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# MGA AFFAIRS

## Is this an all-time first?

During the recent blizzards that swept Great Britain, Donald Bradfield of Broadlands Mushrooms, Norfolk was completely snowed in. However, Darmydel decided that they would not let a little thing like a snow drift put them off getting spawn to a valued customer, so they airlifted it in by helicopter. This shows what determination will do for you. I am sure Donald Bradfield was extremely grateful — all he had to do then was get his mushrooms out!

## Recipe

Margaret Harbottle's recipe in the Cook of the Realm competition was Deeside Mushroom Delight.

### Ingredients

4 × 6oz (175g) fillet of sole\*

or

4 × 6oz (175g) darne of salmon

2oz (50g) finely chopped shallots

½ lemon

Light seasoning salt and pepper

6floz double cream

Liquor measure of Drambuie

Chopped chives to garnish

4oz very finely chopped mushrooms\*

4 × 4" approximately large mushrooms

### Side Salad:

12oz (350g) Kenya beans

Parsley

3oz (75g) chopped hazelnuts

Lettuce

### Lemon dressing:

4oz olive oil

1oz wine vinegar

½-1 lemon (to taste)

Seasoning

Freshly buttered oatmeal bread

### Method

Prepare all ingredients. If using sole\* stuff each fillet with very finely chopped mushrooms and roll.

Poach sole or salmon darne in fish stock for 8-10 minutes.

Drain fish and keep warm.

Reduce cooking liquor and add finely chopped shallots, lemon juice and lightly season. Poach large mushrooms in boiling, salted lemon water. Drain. When cooking liquor is reduced remove from heat and add Drambuie and double cream. Return to heat and simmer until sauce coats back of spoon.

Place poached mushrooms on to heated serving plate.

Place poached sole or darne of salmon on to each mushroom.

Coat each fish piece with sauce.

Sprinkle with chopped chives.

Serve with side salad and freshly buttered oatmeal bread.

### To make side salad:

Top and tail Kenya beans. Boil for a few minutes in salted, boiling water. Plunge into cold water. (Do not overcook — they are delicious when still crunchy.)

Toss beans in lemon dressing (mix olive oil, lemon to taste, wine vinegar and seasoning). Serve on a bed of finely shredded lettuce topped with chopped hazelnuts and garnished with parsley.

*This recipe concludes our series of recipe ideas from the Cook of the Realm Competition winners.*

### DIARY DATES

1987

September 20-27. 12th International Congress, Braunschweig, West Germany.

February 1-4. Spawnmate Conference, Scotsdale, Arizona.

April 14. MGA AGM.

May 21. Allied Trades Golf Match. Links Golf Club, Newmarket.

May 22-25. Tecno Mico 87. Verona, Italy.

June 1-5. Dutch Course, Horst, Holland.

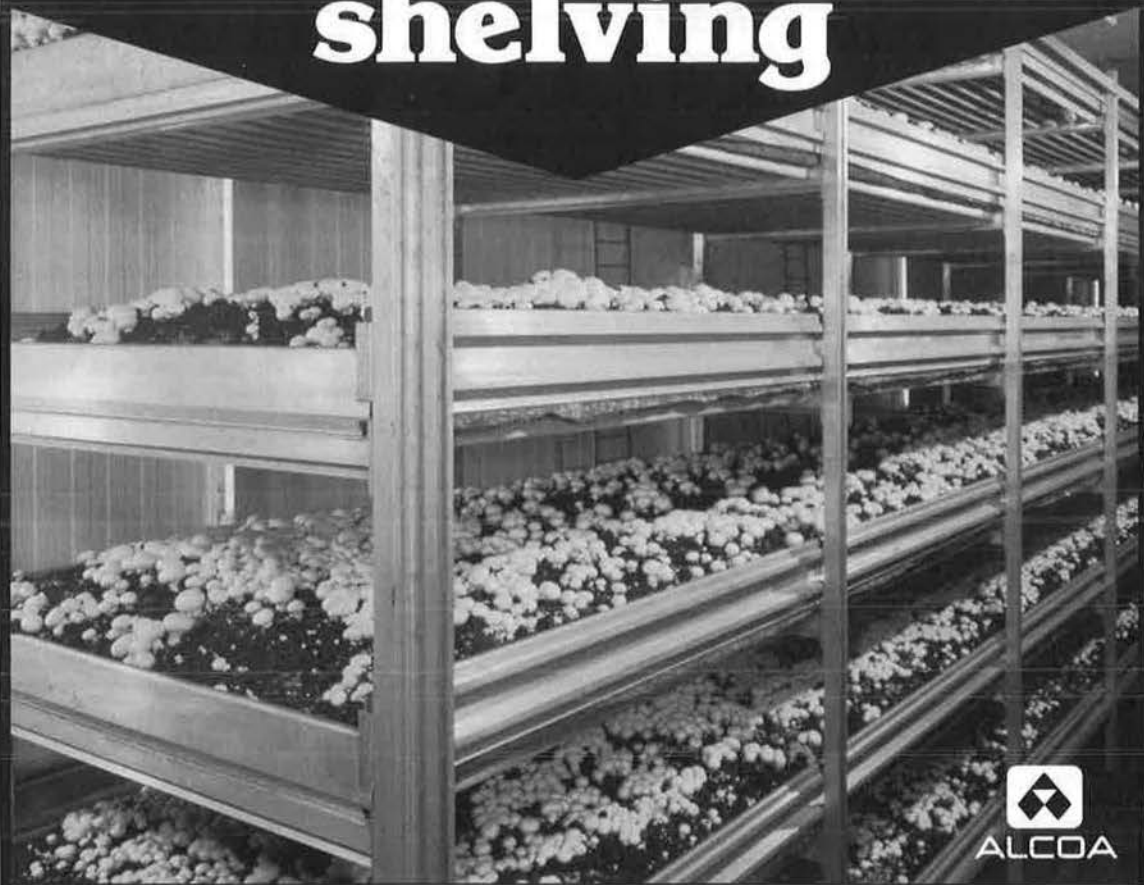
October 7-9. MGA Annual Conference, Thistle Hotel, Cheltenham.

1988

March 6. North American Mushroom Conference, New Orleans, Louisiana.



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## MGA AREA MEETING REPORTS

### *Impact of mushroom imports*

by Aoife O'Brien

The December meeting of the South East I MGA/ADAS area held in Godstone was extremely well supported. Charles Spencer had the onerous task of giving a paper on the "Impact of Mushroom Imports". A difficult subject at the best of times but one that at the moment can become quite emotive.

The statistics he presented were known by most growers but many may not have been aware of their magnitude. For example, the annual growth rate of fresh mushrooms was five per cent up to 1981, but between 1981-1985 this figure had increased to 12 per cent. Within this expanding market the proportion taken by imports had increased from eight per cent in 1976 to 14 per cent in 1985. Imports of frozen mushrooms had increased by 285 per cent in the last two years and the level of canned mushrooms had increased 160 per cent over the same period — indicating increased catering interest.

Mr. Spencer offered some explanation for the overall increase in the mushroom market (both home and imported). One reason was the major changes that have occurred in eating habits, particularly over the last 10 years. Consumers are now more travelled, adventuresome, and health conscious. They are also more mushroom conscious. This of course has been helped by the generic advertising and marketing campaign.

The multiples too have played their part. With their expansion has come expansion in mushroom sales. Certainly the multiples are buying more mushrooms but alongside this they have had to look further afield to maintain their continuity of top quality mushrooms.

At present, of mushrooms sold through multiples, approximately:

- 66 per cent are home produced
- 26 per cent are Dutch
- 4 per cent are Scottish
- 2 per cent are Irish (Northern)
- 2 per cent are Irish (Southern)

Whether the 66 per cent figure for home produced will increase or decrease is very much up to the home producers. Importing countries can only afford to export their best quality. To compete one needs top quality produce.

One other sector that Mr. Spencer mentioned was the rapid expansion in prepared foods. 26 per cent of all Marks & Spencer prepared foods contain mushrooms and this figure is set to increase. Some other interesting statistics were that:

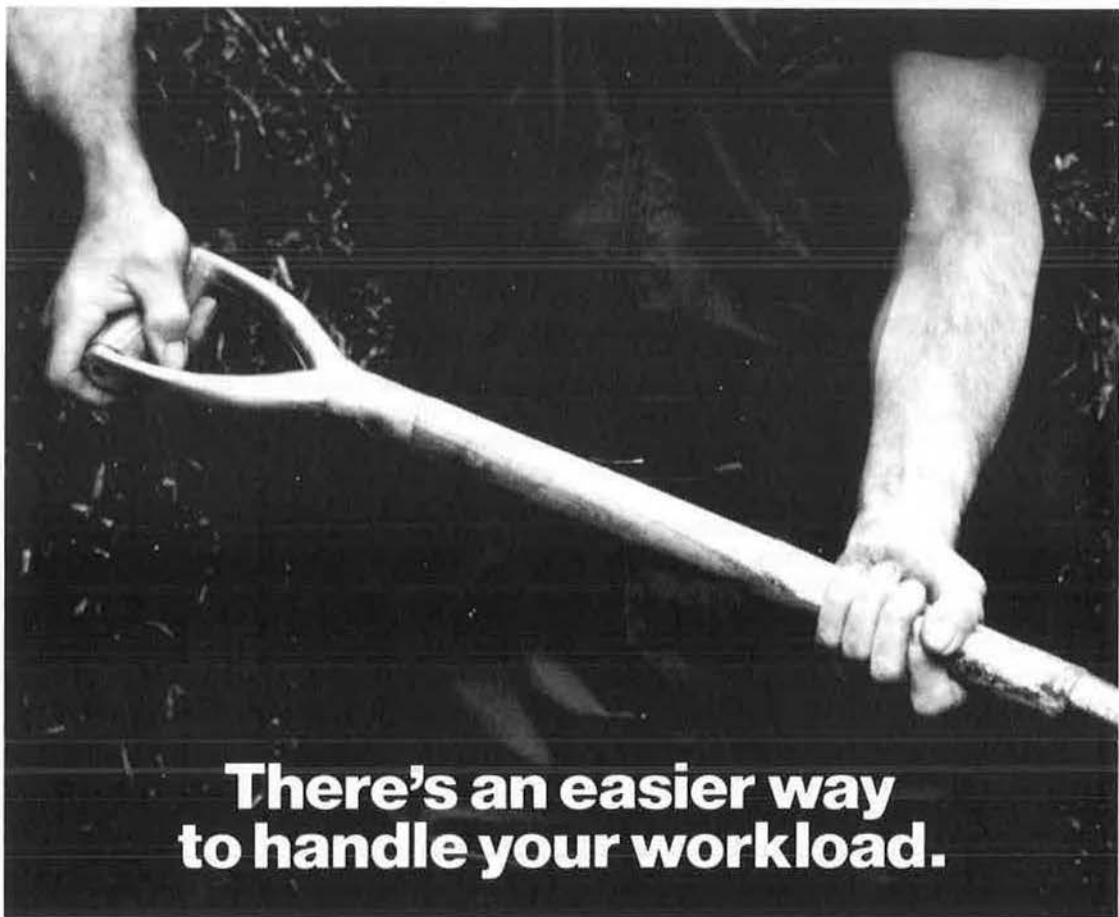
5 per cent of the population is vegetarian

10 per cent of women between 16-24 are vegetarian and

75 per cent of women prepare two to three non-meat meals/week.

These figures only emphasised the tremendous potential that mushrooms have in the fresh market sector. He felt that growers in the UK had grossly underestimated the rate of expansion of the mushroom market but he hoped that growers could now meet the challenge that faced them. In this connection, he pointed out that the Dutch — whose imports into the UK had doubled in the last twelve months — competed not amongst themselves, but with French, German, British and other growers internationally. There was a lesson in this related to the UK's marketing attitude.

There was considerable discussion from the floor with many growers quite anxious about the overall market situation. The benefits of standardised packaging, refrigerated transport and storage and centralised selling were all mentioned, but few felt that there would be major changes in the selling and marketing strategy. Most did agree however that quality, be it English, Irish, Dutch or from elsewhere, does sell.



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# ***E & W Midlands areas visit Birmingham Wholesale Market***

by Jane Bland

On 3rd December, 1986, Stan Hughes, with his specialist knowledge of mushrooms, welcomed the East and West Midlands members to his market unit. He then showed the party round the Smithfield Wholesale Fruit and Vegetable Market. This was first opened in 1883. In October 1976, HRH Princess Anne opened the new Wholesale Markets Precinct, which was rebuilt on the old market site. Last October, Birmingham Market had its 10th Anniversary celebrations.

Today, the market occupies 8.5 hectares within the largest section, the Horticultural Market, accounts for over 2.5 hectares. It is arranged in a "Y" shape with the three arms housing a total of 100 separate units, each of which has a frontage

of either 5.5m or 7.5m.

Members attending the early morning meeting, accompanied by Jane Bland, were able to see mushrooms being bought and sold and to discuss at length with Stan and other mushroom wholesalers, the current market situation prior to Christmas.

After an interesting and unusual three hours the meeting ended at 9.00am with a hearty breakfast provided by Stan. A similar meeting was held recently by the South East group at London's New Covent Garden Market and clearly these breakfast meetings, which enable members to attend without interrupting their pattern of work, are very useful innovations.



*Early morning in the market.*

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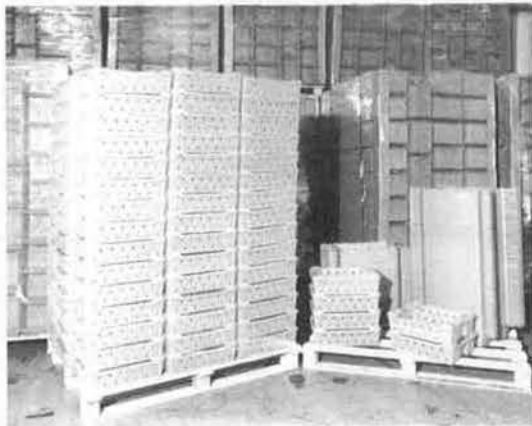
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# Commercial Cultivation of Shiitake in Taiwan and Japan

by Dr. A. C. Campbell and Dr. R. W. Slee, Seale-Hayne Agricultural College

The Japanese wood mushroom *Lentinus edodes* (Berk.), commonly referred to as shiitake in Japanese, is the most important cultivated mushroom in Japan. The mushroom may be found growing naturally in Japan, China, Taiwan, the Himalayan mountains, Borneo and Papua New Guinea. Because of the wide distribution of the naturally growing fungus many related strains of *L. edodes* have been identified having specific characteristics adapted to the region in which they grow.

In nature *L. edodes* grows as a saprophyte on broad-leaved wood, namely Fagaceae, with *Quercus* spp. being the most commonly colonised substrate. Shiitake cultivation began in a primitive form in China about 800 years ago and was further developed in Japan about 300 years ago. This early semi-cultivation was heavily dependent on luck, the basic method being to cut small notches in the trunks of felled trees and hope for the natural wind borne species of the correct *L. edodes* strain to colonise the wood. This was obviously a very crude technique, relying on prevailing weather conditions and other natural elements and therefore met with only limited success. It was not until about 60 years ago that the late Dr. Mori of Kiryu in Japan decided that a more scientific approach to cultivation was necessary if a steady, reliable crop of shiitake was to be obtained. To this end Dr. Mori developed the techniques which are used today by growing the fungal mycelium on a wood substrate as spawn and inoculating it directly into the felled logs. This spawn method has now been adopted in all areas of Japan and there are now about 160,000 farmers growing this mushroom.

Cultivation on hardwood logs is the traditional method of production but an alternative, more intensive cultivation technique has been developed which uses hardwood sawdust in polypropylene bags as a substrate for fungal growth.

Initially shiitake was grown on a small scale as an alternative enterprise to supplement farmers' income. Today, some Taiwanese and Japanese

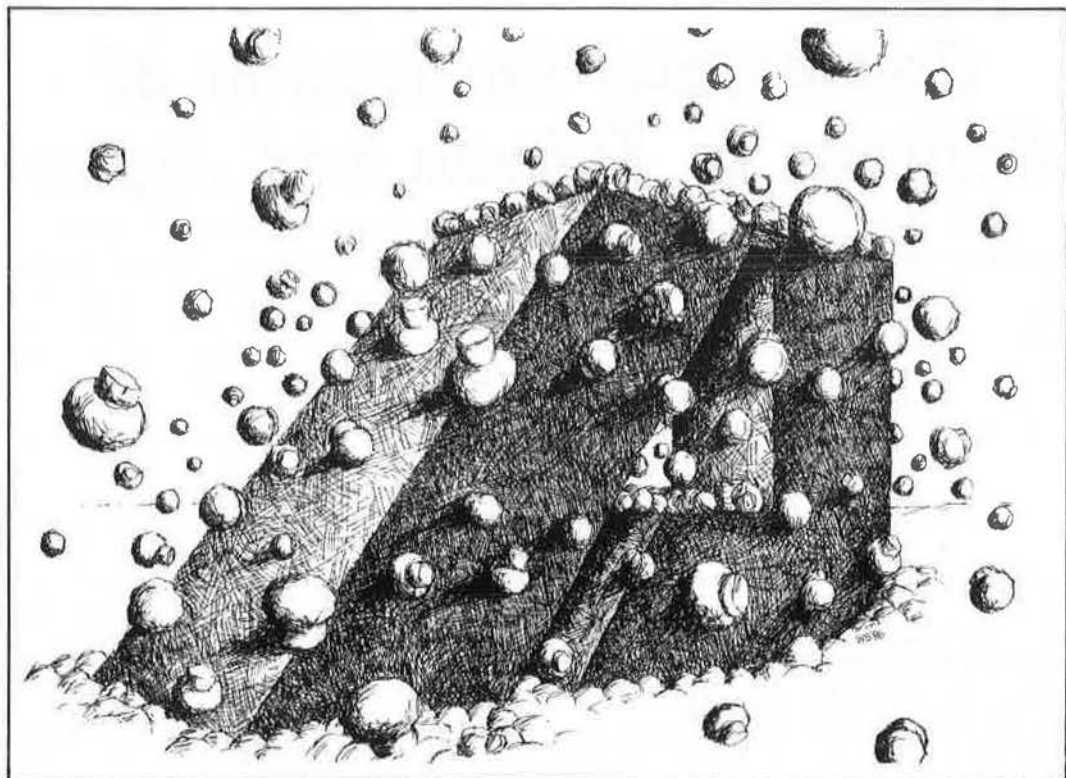
farmers still use shiitake as a second crop. Others grow shiitake exclusively on very large, profitable farms. The methods of cultivation have developed to such an extent that successful cultivation is more or less guaranteed and hardwood, particularly *Quercus* is now in short supply in some growing areas of Japan, so wood must be transported some distance to supply farms.

In Britain the need to manage broad-leaved woodland has diminished through the demise of the charcoal industry and tannin from trees is no longer widely used in the leather industry. Also, many farms in Britain have areas of woodland which serve no purpose and no income is made from them.

In the present economic climate in Britain where farmers are faced with restrictions such as milk quotas it is becoming increasingly difficult to run a profitable business. British farmers are therefore searching for alternative enterprises to supplement their income and it appears that cultivation of shiitake may provide an enterprise which is profitable and at the same time encourages management of British broad-leaved woodland, with associated conservation benefits.

At present shiitake is imported into Britain in a dried form and there is a market for the product, particularly among the oriental community living here. It is an expensive foodstuff and therefore sells as a luxury commodity. However, more "exotic" types of food are gradually gaining acceptance by the general public in Britain. At present the white mushroom *Agaricus bisporus* is the dominant commercially cultivated mushroom in the UK. This situation is likely to change as the public become aware of the alternatives available.

There is also an increase in popularity of health food among the general public in Britain. Shiitake has been found to have many attributes as a healthy, natural commodity and can currently be found for sale in specialised health food shops. It is said to endow people with vigour and energy



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and is effective against hypertension and high blood pressure. Recent medical experiments have shown shiitake stimulates the immune system which acts against cancer cells. As well as this anti-tumour activity shiitake has also been found to have anti-viral activity.

Interest in the cultivation of shiitake has recently been taken up by researchers in America, Germany, the Phillipines and many European countries. Reports from Poland indicate that shiitake has been successfully grown in Polish climatic conditions.

The aim of this study therefore was to visit Taiwan and Japan to investigate the methods used in Shiitake cultivation with a view to establishing cultivation of this mushroom in the UK.

### **Laboratory studies**

Approximately 100 different strains of *Lentinus edodes* are known and microbiologists in various countries including Japan and Taiwan are actively searching for new mutations of the fungus to suit a wide range of environmental conditions and produce better quality and quantity of fruit through the year. Such studies must involve detailed laboratory work.

Strains of *Lentinus* are commonly grown in the laboratory on synthetic media, the most common being potato dextrose agar and malt extract agar. It is recommended however that stock cultures should be grown on media which are low in nutrients, such as water agar, to maintain optimum viability of strains.

Vegetative growth can be achieved with ease by growing the organisms on yeast extract agar at a temperature of 22°C but, under such conditions, fruiting bodies are rarely formed. To achieve fruiting on synthetic media a relatively high incubation temperature of 25-30° is employed initially until mycelium growth is fully established and fruiting can then be induced by lowering the temperature to 17-20°C. Under these conditions fruiting bodies will appear after two to three weeks.

The most vital factor governing successful cultivation of *Lentinus* under field conditions is correct strain selection. To ensure correct strain selection extensive laboratory trials should be carried out using wood as a substrate. Sawdust obtained from oak (*Quercus spp.*) with or without the addition of rice bran is a suitable substrate for laboratory trials. Correct moisture conditions

must be maintained during mycelium development in the sawdust substrate. Laboratory trials may be conveniently carried out using autoclavable plastic bags filled with substrate and sterilised by heat. A suitable fruiting body growing in artificial culture provides the most useful material for inoculation. The fruiting body should be selected for stalk and cap characteristics, homogenised and the homogenate used as an inoculum. By preparing the inoculum in this way the complete genetic complement may be maintained throughout subsequent trials. When sawdust is used as a substrate fruiting bodies may take two to three months to develop.

It is essential that laboratory studies are followed up by extensive field trials.

### **Sawdust spawn production**

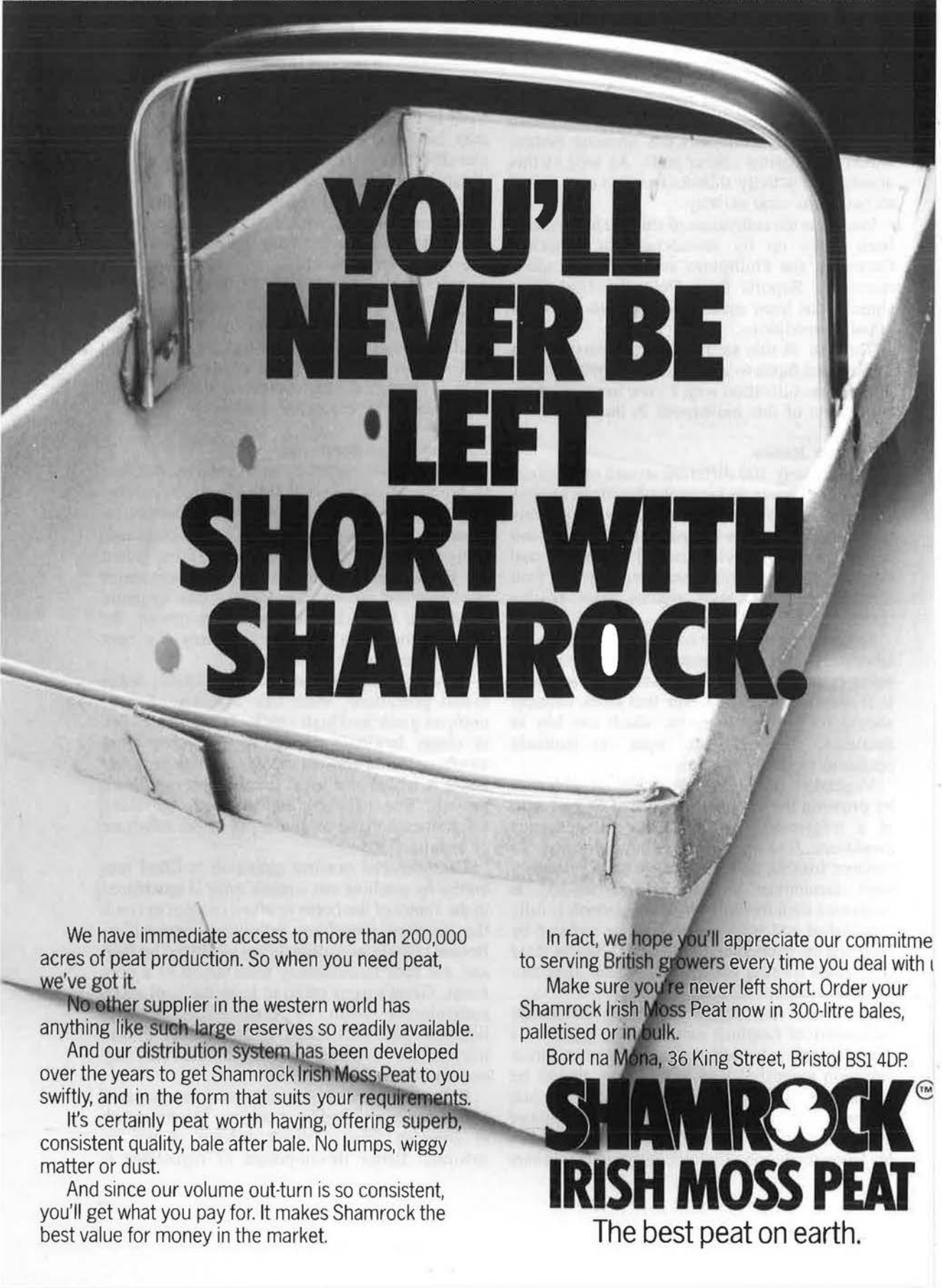
Sawdust spawn used for commercial inoculation is produced by a few independent companies, especially in Taiwan, and supplied to commercial growers. Spawn manufacturers have a responsibility to growers to provide pure culture spawn of various strains of *Lentinus* in optimum condition for growth. To achieve this hygienic conditions must be observed throughout the spawn production process and only the best quality materials are used.

Spawn production has become a highly automated procedure. Pure oak sawdust of fine, uniform grade and high quality is stored indoors in clean, hygienic conditions protected from weather. The sawdust is mixed with rice bran and water is added to a level suitable for mycelium growth. The pH may be adjusted, by using calcium carbonate, to give a pH of the substrate of around 7.0.

The prepared sawdust substrate is filled into bottles by machine and a metal spike is introduced in the centre of the bottle to allow oxygen to reach the growing mycelium following inoculation. Bottles containing substrate are sterilised by heat and are then immediately transferred to a cool room. Great care is taken to keep the cool room scrupulously clean by disinfection between batches. The cool room is completely closed during the cooling period to prevent any contamination entering.

Following sterilisation and cooling the prepared bottles are inoculated by machine. The inoculum is obtained from a stock culture grown on sawdust. Better development of mycelium is





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achieved if a sawdust culture is used rather than one growing on synthetic laboratory media.

During the winter months in Taiwan the inoculated bottles are held outdoors for one month at ambient temperature to allow the mycelium to develop. In summer incubation rooms having a temperature of 15-25°C are employed. After the mycelium has fully developed the spawn may be held at 4°C ready for use. Each bottle contains 550g of spawn which is sufficient to inoculate 50 polypropylene (PP) bags for commercial cultivation. The scale of spawn production varies with the largest Taiwan spawn producing company producing two million bottles of spawn per season at a retail cost to growers of 30NT\$ (£0.6) per bottle.

Sawdust spawn may also be used to inoculate logs with 550g being sufficient to inoculate 20kg of wood.

### **Commercial bag cultivation**

Commercial cultivation of shiitake may be carried out in polypropylene bags. Hardwood sawdust including oak (*Quercus spp.*) and maple (*Acer spp.*) is delivered to the farms from sawmills, which may be situated some distance away, and is sorted by sieving. A very fine grade of sawdust is generally used for cultivation. Various additives may be included in the sawdust to encourage growth of the mycelium, the most common being rice bran and corn meal. The pH should be adjusted to 5.5-7.0 using calcium or sodium carbonate. The correct water content of the mixture is of paramount importance but is often only determined by squeezing the mixture in the hand, after which the sawdust should hold together.

Packing bags with sawdust substrate is carried out by machine and a spike is introduced into the centre of the packed substrate. Each bag contains 1.2kg of sawdust for ease of handling. Sterilisation of the bags is achieved either by steaming or by autoclaving.

The quality of material used in the manufacture of the bag is said to be important as some may produce inhibitory substances which may prevent mycelium growth, especially during autoclaving. Also, the quality and purity of the sawdust must be ensured as chemicals used as preservatives on wood and wood impregnated with salt water will inhibit mycelium development. Following sterilisation and cooling the bags are inoculated



*Typical mushroom growing in houses in Taiwan.*

by machine with approximately 10g of sawdust spawn. It is during this inoculation stage that contamination with competitive fungi is most likely and so conditions must be scrupulously clean. For this reason it is recommended that inoculation be carried out within a laminar flow cabinet or a room with filtered air.

The inoculated bags are stacked on their side in growing houses for approximately two months to allow vegetative mycelium to develop. After one month of growth a small amount of mycelium can be seen covering the surface of the sawdust. Complete mycelium development takes approximately two months. To combat contamination by competing species the floor of the growing houses may be sprinkled liberally with calcium carbonate to provide unfavourable conditions for competitors. Any bags showing evidence of contamination are immediately removed and discarded. Losses due to contamination vary enormously with loss of one per cent of bags being normal.

During mycelium development bags should be kept in conditions of low light intensity and high humidity with little ventilation. This is achieved by constructing growing houses with straw lattice or plastic netting which can be removed to increase light and ventilation if necessary. No watering is carried out during mycelium growth.

When mycelium development is complete the bags are transferred to a single layer arranged



Fully colonised sawdust bags at the end of vegetative growth cycle.

upright on the floor of the growing house where they remain for a further month. The tops of the bags are then removed and vigorous watering is applied by fine mist overhead sprays to induce fruiting. Immediately after watering the bags are inverted and water is taken up from the floor by capillary action. The bags are left inverted overnight then turned upright again. This procedure may be repeated up to three times. Coincidental with watering, light intensity and ventilation should be increased.

Fruiting is stimulated by water, a decrease in temperature and an increase in light intensity and ventilation. If high temperature conditions are prevalent at the fruiting stage poor quality fruits are obtained. Water should be carefully controlled and polythene sheet screens are used in the roof of the growing house to prevent rain water reaching the bags.

Harvesting of fruit is done by hand and, provided a good strain of *Lentinus* is used fruit may be collected up to seven times per year. If a poor strain is used only two harvests may be possible. Under optimum conditions 200-250g Shiitake may be obtained per kg sawdust.

The scale of mushroom production by this method varies in Taiwan with most production centred around the Nantou area in central Taiwan. Many farmers grow *Lentinus* as well as a range of other normal crops in the area on a fairly low scale. However, the largest producer of *Lentinus* by the PP bag method uses 700,000 bags and produces high quality mushrooms obtaining a yield of 250g/1.2kg substrate at a retail price, in the dried form, of 1,000NT\$ (£20) per kg.



Shiitake growing on sawdust substrate.

### Log cultivation

#### (a) Spawn production

Spawn used for initial inoculation for log cultivation of shiitake may be produced in the form of sawdust spawn of the type used in PP bag cultivation or, more conveniently, may take the form of a small wedge-shaped or rod-shaped piece of wood impregnated with active mycelium. For log cultivation plugs are considered superior to sawdust, due to the fact that they are easier to use. Log growers in Taiwan seem to favour sawdust inocula for logs whilst Japanese growers favour plugs.

There are about 150 spawn manufacturers in Japan producing various types of spawn including sawdust, wedge-shaped and rod-shaped wood spawn. Initially, wedge-shaped pieces of wood impregnated with mycelium were inserted into axe cuts in logs but recent spawn types take the form of a wood cylindrical plug.

Although various forms of spawn for log inoculation exist the method of production is similar for all types. Plugs are generally made from oak inoculated with mycelium. Storage of spawn should be at 4-10°C for a maximum of six months in order that the mycelium has sufficient nutrients to be able to transfer from the spawn material to the wood substrate following inoculation.

Strains of *Lentinus* available for log cultivation fall into three categories: (i) those which will fruit at 20°C; (ii) those which fruit between 10-15°C; and (iii) those fruiting around 10°C. No single strain will allow year-round production of fruit

and so, to achieve this, a combination of different strains should be used. The low temperature strains should fruit during spring, while those fruiting between 10° and 15°C may be expected to fruit during spring and autumn.

#### **(b) Log substrate**

Trees used for cultivation should be felled between late autumn and early spring. During this period the sugar content and moisture content of the wood provide easily available nutrients and correct moisture conditions for the development of mycelia. When trees are felled they should be left intact for one month during which any inhibitory characteristics of new wood is lost and water levels within the wood will fall to an acceptable level.

The period of one month is important as wood which has been felled for much longer than this period will be useless for shiitake cultivation. After one month the branches are cropped and cut into logs of 1m in length and 3-15cm diameter.

Some farmers consider that better yields are obtained on logs of small diameter (3-4cm) than on larger logs but the average diameter is usually about 10cm. Larger logs which have been split can also be used but the quality and yield of Shiitake produced using split logs is usually poor.

#### **(c) Inoculation**

Holes are drilled into the wood at intervals of between 5 and 35cm depending on the species of *Lentinus* used and other environmental factors. Plugs of inoculum are then inserted into the holes to a point where they are flush with the surface of the log. If sawdust is used drilled holes are packed with spawn and the inoculation points are then sealed with wax.

#### **(d) Vegetative growth**

After inoculation logs are placed in a position which is favourable for the development of mycelium. The main requirement for rapid and vigorous growth is correct water levels within logs. No watering should be carried out during vegetative growth and therefore logs should be arranged so as to prevent excessive water loss by evaporation. Water loss can be prevented either by arranging logs in flat piles or by situating the logs in a sheltered position within woodland. In either case light intensity should be low and ventilation should be good. In extreme cases, when logs have dried, water may be applied but



*Logs arranged below the forest canopy during vegetative development.*

this is inadvisable. In any case water levels should be carefully controlled and no rainfall should be allowed to reach the logs. Piles of logs may be covered with straw matting or vinyl netting, to keep out dry air and protect from rainfall. It is important that the strain of *Lentinus* is compatible with the wood species used. With a good strain the degree of decay is very low but cover of the log is very fast. This produces good mycelia, a good yield and continued production. An incompatible strain uses too many nutrients in the vegetative phase rather than in the fruiting phase and only one or two fruitings may be obtained from the log.

Various methods may be used to assess the extent of mycelium development in logs. The simplest and most convenient method is to examine the cut end of the log and if mycelium development is advanced it will be evident.

#### **Fruiting**

Full mycelium development within logs may take between one and two years to complete depending on the type of strain used, the quality of the substrate and the environmental conditions prevalent during vegetative growth. It is possible to achieve faster development under optimum conditions.

Fruiting depends on environmental conditions and may be induced in two ways. The fruiting of Shiitake requires a drop in temperature, increased humidity, considerably more moisture within the substrate and an increase in light. Vegetative growth may take place within the woodland and logs may then be transferred to



another location, offering different environmental conditions, for fruiting. In one method logs may be arranged in an upright position, leaning in rows supported by fencing. There is usually some protection offered at this stage in the form of black vinyl netting to control light intensity and ventilation and polythene sheeting to protect from rainfall. Logs are sprayed with water from fine overhead sprays. Vegetative growth requires a temperature of 24-28°C and a temperature of 12-20°C is employed to induce fruiting. The primordia of the fruiting bodies would take approximately 24 hours to develop following watering with fruit being of a size suitable for harvesting after about seven days.

An alternative to spraying with water is to immerse the logs in a tank of water at about 16°C for anything between one and three nights. This shock treatment will induce fruiting. This method has the advantage that fruiting can be carried out in batches and may be delayed, within limits, to suit market conditions and the convenience of the farmer. Following dipping the logs may be arranged indoors to fruit and may or may not be covered to maintain humidity. In any case higher light intensity is required for fruit formation and therefore any covers should not provide too much shade.

Fruit is normally harvested up to three times from a batch of logs after which the logs are rested before being dipped again. This can be repeated up to four times per year with a good harvest being obtained following the first dipping and subsequent harvests producing significantly lower yields.

It is possible to obtain fruit from logs for up to six years but the yield by the fifth year is generally poor. It is more normal to use logs over a three year period and a good yield would be 200g shiitake per kg wood substrate over that three year period. It is estimated that, in Japan, a farmer can make a profit at levels of 150g shiitake per kg wood.

Harvesting is carried out by hand.

### **Drying**

Drying of shiitake is carried out in ovens fired with wood, oil or gas. Picked fruits are arranged in single layers on shelves within the drying oven and relatively low temperatures are applied for the first three hours followed by 40-60°C for 18 hours. Drying, as well as preserving the product,



*Shiitake growing on logs.*

is said to enhance the flavour and appearance of the product.

### **Modern approach to shiitake production**

Although conventional methods of shiitake production are well established in Japan at least one company is developing alternative methods of cultivation. This involves more of a biochemical approach at the enzymic level to provide optimum growing conditions. By using this approach shiitake cultivation can take place indoors in a controlled environment using PP bag culturing techniques. The basic theory behind such techniques is that, to provide fruit, a succession of enzymes is involved and the methods used are designed to manipulate the environment, particular temperature, to provide the optimum conditions for each successive enzymic activity. One area of active investigation is concerned with additions of various materials to the basic sawdust substrate to produce better growth. Also alternative substrates to sawdust have been investigated, including wheat straw and



bagasse, with promising results.

### **Current research**

A stock of forty strains of *Lentinus edodes* has been obtained from various countries throughout the world and all strains are being maintained in the laboratory on synthetic media and also on oak sawdust. Preliminary trials are in progress using both PP bag and log cultivation methods.

#### **(a) PP bag method**

Eleven strains of *Lentinus edodes* were selected from stock on the basis of their vigour on a sawdust medium, their history obtained from the suppliers if available and their fruit formation if present in initial cultures.

Pure oak sawdust substrate was prepared by adding wheat bran at a level of 10% w/w and the moisture content was adjusted to 65% w/w. 1.2 kg of substrate was filled into polypropylene bags and packed by hand. Bags were sealed with cotton wool and sterilised by autoclaving at 121°C for one hour. Cultures of each strain were inoculated into a central hole in each bag and incubated at 20°C for approximately two months. Six replicates of each strain were prepared in this way.

Following two months incubation the mycelium had developed through the sawdust substrate producing a tightly packed column. Three replicates of each strain were then used to investigate fruiting under the PP bag cultivation regime while the other three replicates were used as spawn to inoculate oak cordwood in a subsequent trial.

The bags of the three replicates of each strain used to investigate fruiting were removed and each culture was sprayed with chilled water and left under ambient indoor conditions. No attempt was made at this stage to decrease temperature but the trial did coincide with a cold spell during which ambient temperature fell from 20°C to 15°C, although wide fluctuations did occur. By holding the cultures in this way excessive surface drying occurred which seemed to have the effect of inhibiting fruit formation. To overcome this each culture was enclosed within a plastic container in which levels of humidity were maintained. Under these conditions fruit bodies formed from three of the eleven strains and a yield of approximately 150 g fruit/kg sawdust was

obtained.

This trial was designed as a preliminary investigation primarily to demonstrate that fruit could be obtained. In view of the uncontrolled nature of the experiment very few firm conclusions can be drawn except that the strains selected were suitable for bag cultivation.

Additional trials are now in progress where more control will be exerted on environmental conditions and results will be quantified.

#### **(b) Log trials**

Twenty five lengths of oak cordwood of approximately 1 m and averaging 15 cm in diameter were inoculated with each of nine cultures of *Lentinus edodes* and stacked in a polythene tunnel. Nineteen of the 25 lengths of cordwood were felled in November 1985 while the rest were felled in February 1986. Inoculation was carried out as described previously. Each stack of logs was covered with 65 per cent shade plastic netting. This trial is long-term and it is expected that fruit will be produced approximately 18 months to two years after inoculation. Temperature and humidity within the wood stacks are being constantly monitored. Initial investigation shows that strong mycelium development is occurring within the wood but it is too early to draw any firm conclusions from this trial.

### **Conclusion**

It is evident that the production of shiitake is a well organised and profitable industry in Japan. Although Japanese climatic conditions are very different to those of the UK low temperature strains are available which may suit UK conditions. The most vital factor governing successful production is therefore correct strain selection.

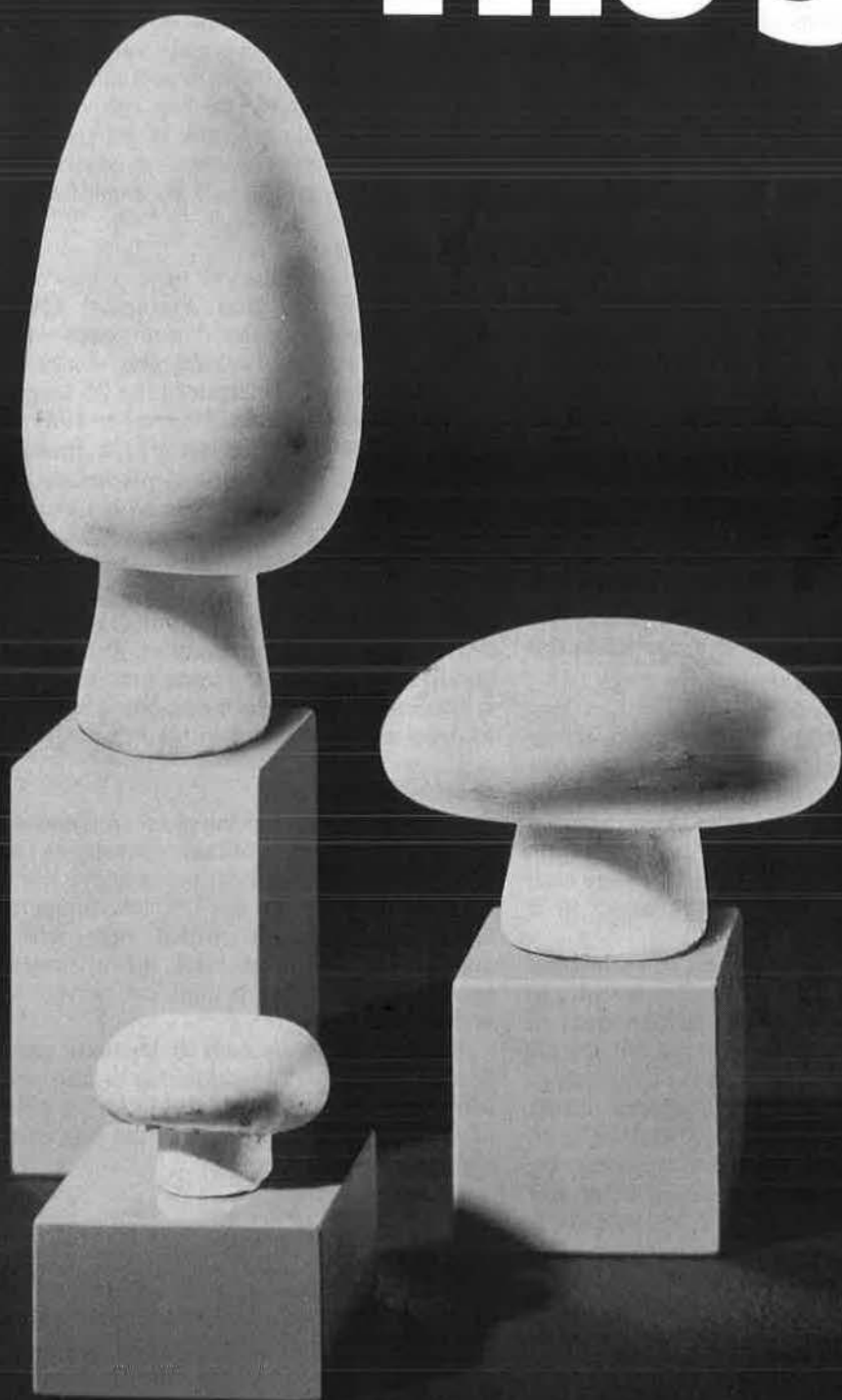
The unanimous opinion of Japanese growers is that shiitake production in Britain should certainly be possible and may, in fact, yield fruit of superior quality because of the less extreme climatic conditions.

### **Acknowledgements**

The authors wish to thank the Farmers' Club of Great Britain for the financial support which made this study possible. We would also like to express our thanks to Dr. W. A. Hayes of the University of Aston for his help and encouragement in preparation for this work.

We are deeply indebted to all the growers, spawn producers and researchers who gave so freely of their time to assist us in our study.

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# Geoff Ganney's

## Growing Pains



### 1st January

A "New Year" begins. Will it be an improvement on 1986? The call of it "**can't be worse!**" is heard clearly from the office next door!!

### 2nd January

Over pinning of first flushes last week, followed by far too heavy second flushes has pushed picking out of control. Me thinks that the time required in environmental changes to cause such problems is very short! CO<sub>2</sub> levels in relation to the strain conditions is important in relation to flush size.

### 3rd January

What effect has compost formation on the quality of the mushroom? Does a totally horse manure compost produce a better quality product than a straw based compost? If nitrogen level is high are mushrooms smaller and softer? Maybe it is related to the ash content? What a subject to discuss . . .

### 4th January

After crop cook-out temperatures have been rising unnecessarily high and a good saving can be made by reducing by 10°-15°F. Also by allowing the time factor to increase by stewing in a well insulated building then penetration of heat will be achieved.

### 5th January

Discussing MGA membership with Keith Willoughby gave renewed optimism with regard to the hard work being put into recruiting all categories of membership. Remember we can all help to prod those growers local to us or encourage with *subtle digs*, trade persons to join and our overseas friends to help in their way to push up MGA membership. Don't leave it all to the office!

### 6th January

Casing too lumpy this week with criteria not met to the required standards. **What is Quality Control?**

### 7th January

Debating with John Peaker the best time to put the "kill" on the Phase II and how long to hold it for? There seems to be variation as wide as mushroom growing itself with some growers killing early, others towards the end of the process! Some growers hold the kill from nil to over four hours and I suppose it **boils** down to the system, situation, compost conditions and individual preferences. Apparently in some instances it is accomplished without steam? The uniformity of temperature in the air, compost and of the structure is all important. Exceeding 140°F in the compost receives a poor review these days, when once on deep layers of compost it could be commonplace! That's what makes mushroom growing such a fascinating subject!!

### 8th January

Pleased to receive a copy of a letter from John Fletcher on chlorine. I am sure this will help many growers. Pleased also to know that I have another reader!! My mother also enjoys the notes . . .

### 9th January

Received MGA new notes "Up-date" which is extremely well presented and contains much condensed data. Have opened a file to keep these for record purposes. Irradiation of imported mushrooms is a very immotive subject and one that required early resolution! Another subject not mentioned, but could have been under the use of additives, is that concerning the use of certain sulphites for washing mushrooms?

### 10th January

Trying to push too much compost in some trays at spawning with a resulting extremely poor finish to the compost surface. How can you expect even flushing without even casing?



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### 12th January

Discussing progress on the mushroom open learning projects some of which are apparently progressing to the publication stage. Obviously a larger input of time was required than had been envisaged, which with the complexity of the subject this is not a surprise. Must check to see how the MGA/ATB selection board is to function?

### 13th January

Severe weather caught farms in the East of England, and Catfield is under a snowdrift!! When the grower has to go home on a tractor it must be quite bad! When the next day the tractor is buried then you know it is bad!!

### 14th January

"Blotch" re-appearing which with extreme cold outside could be considered surprising! Yet by opening a door the cold air entering the shed will change the mushrooms' temperature in a very short time. There is nothing like environmental variations to cause "Blotch" as Jim Sinden pointed out many years ago. A clear pattern could be seen along the bottom trays where the cold air passed rapidly over the mushrooms.

### 15th January

Used some "Pellet spawn" and will closely observe any changes in growth or fruiting pattern.

### 16th January

Decided with all the current weather problems, no-one would be able to go to the "Spawnmate Seminar" which will be a sad loss as the programme looked to be very varied.

### 17th January

Pleased to receive two reviews on "Hungarian Mushroom Growing" for the F. C. Atkins library, and as always material is most welcome.

Reading the trade press I can't make up my mind if the Lee Valley EHS is "closing" or "opening". Then I suppose the situation of not knowing if you are coming or going is not unusual in the mushroom world!

### 19th January

Spawn growing slowly this week, with a few grains turning a horrible green colour! Still it was so cold during spawning and with the moisture coming out

of the compost, freezing on the press plate, it can't be surprising. No doubt when these crops and those being composted at present come in we can expect some yield losses! Making compost at present is not easy, ice doesn't seem to wet as good as water . . .

### 20th January

"Every organisation has its share of dead end employees, men and women, who for one reason or another, have gone as far as they can go and are destined not to go further" *Quote!* As said many times it's a *people problem* . . .

### 21st January

Cost control becoming far more important and narrow thinking towards only production will not be successful in today's commercial mushroom farm.

### 22nd January

Dropped all chemical treatment for "flies" and hope to be without usage until April, it seems *essential* these days to be able to protect chemicals. It is unlikely that new groups of chemicals will readily appear and any pest tolerances to the small range we have at present could prove to be a problem.

### 23rd January

Must learn from Paul Richardson how the commercial adaptation of the immensely important work on biological control is progressing. It has reached the development farm trial stage then it can't be long before commercial packages are available.

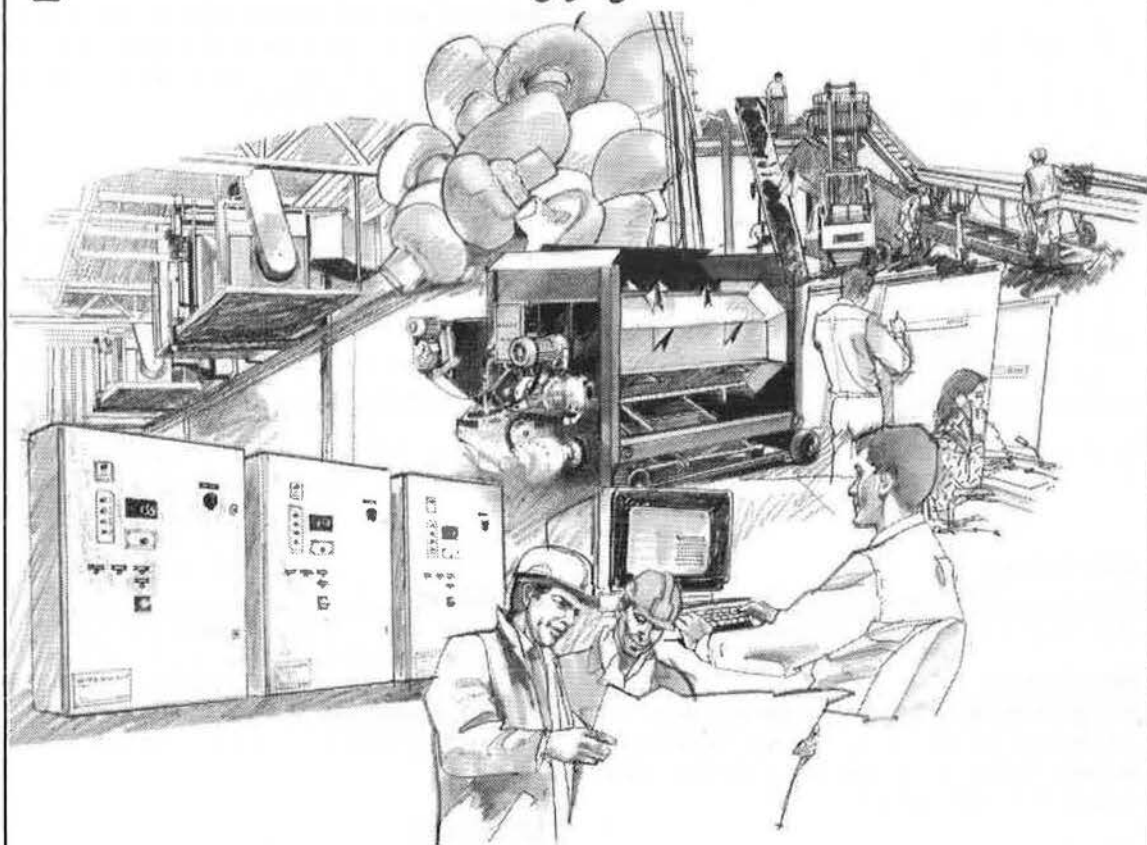
### 25th January

Mite damage at fourth flush with poorly anchored mushrooms caused us to revise "killing off" and spraying out procedures. Spraying out plastic sheds requires careful consideration to the surface tensions or of the materials used.

### 26th January

Re-occurrence of *Piziza ostracoderma* (brown mould or botrytus) caused some head scratching as to where it had come from. In fact, growing around the edge of the compost prior to casing was a common sight this week and one could clearly see that this would easily make its way to the casing surface. Little is positively known about cause or

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if any significant loss in yield occurs. This is probably a result of temperature checks in the severe weather earlier in the month. Other types of growth checks can cause similar results! Casing is not pasteurised so no inhibitor agents have been lost. Must watch to see if the trend continues or the problem disappears.

#### 27th January

Poor quality in third flush this week appeared to be caused by an abiotic disorder (**a disorder caused by physical, chemical or environmental factor!**). Bound to be in there somewhere . . .

#### 28th January

Excess water laying on the top of the casing layer after two heavy waterings explaining why we have suffered from small mushrooms!! Interface deficit is bad enough but total moisture exodus from a peat casing layer is totally unacceptable.

#### 29th January

Casing depth crept up to 2¼" which as well as upsetting timing is going to cost! Can't really understand why every strain needs the same depth of casing layer? Probably why timing is different on some strains?

#### 30th January

Compost coming down too short and this has reduced volumes coupled with the required "dry matter fill". Consideration to the "cost loss" based on Phase I reduction has been much discussed but the true effect on production costs is little understood.

#### 31st January

Short "New Year" message from George Carapiet, **"The worst day's fishing is still better than the best day's working!!"** These mushrooms are a bit like fishing, you never do know what you will get George . . .



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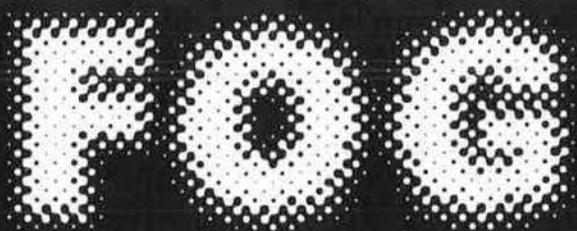
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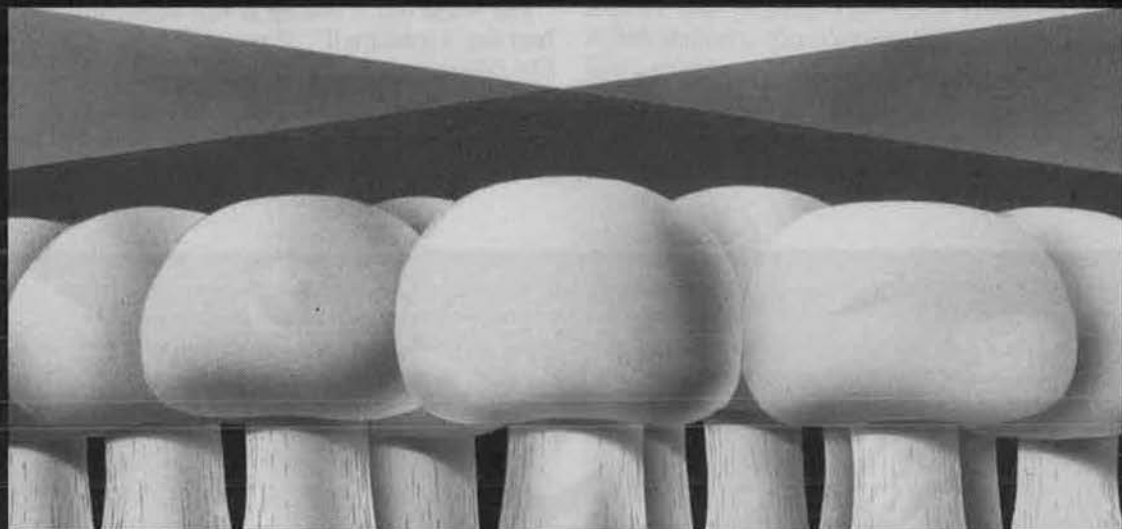


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# 1986 Sinden Award Lecture

by Peter Stanley-Evans

The notion that I should be given the Sinden Award never even entered my head, but it came as the nicest compliment that the MGA has ever paid me.

Old men's reminiscences are often rather boring, but as this is a very nostalgic occasion for me perhaps you will bear with me if I start by going back over fifty years. I will spare you my childhood anecdotes which are only of interest to one's female relatives, except to say that when most small boys were supposed to want to drive trains, I wanted to farm, with no family background in that direction at all.

I was the only member of the first and last "Agricultural Sixth" at my Public School, and duly went to Wye College afterwards, where I must admit I was so frustrated by the lack of interest shown by most of my fellow students, that I left after passing my first year exams, to work as a nursery hand-trainee on a large nursery near Worthing, this was in 1935. I had my first experience of mushrooms the year before at Wye, where one of my abiding memories was of compost heaps about ten feet wide and two feet high — how they ever heated up, if indeed they did, puzzles me to this day.

The nursery which I had joined was a very big one for those days and grew mushrooms as a catch crop in shaded glasshouses. Trainees were put onto turning compost by hand for six months on end and if they were still there after that! they were reckoned to have at least some potential.

By 1937 I had graduated through charge hand and foreman to managing an independent branch of the company, in harness with another erstwhile trainee, who had joined the firm at the same time, and who is now one of the leading flower growers in the country and a life long friend. I was fishing as his guest on the Test recently and he was mine on the Itchen three weeks ago: we shall be shooting driven pheasants in each other's company this winter as we always do.

This branch was a real mixture having twelve so called specialised mushroom sheds built of timber with earth floors, at a time when no-one had heard of a cook out: several acres of glass, and a mixed farm.

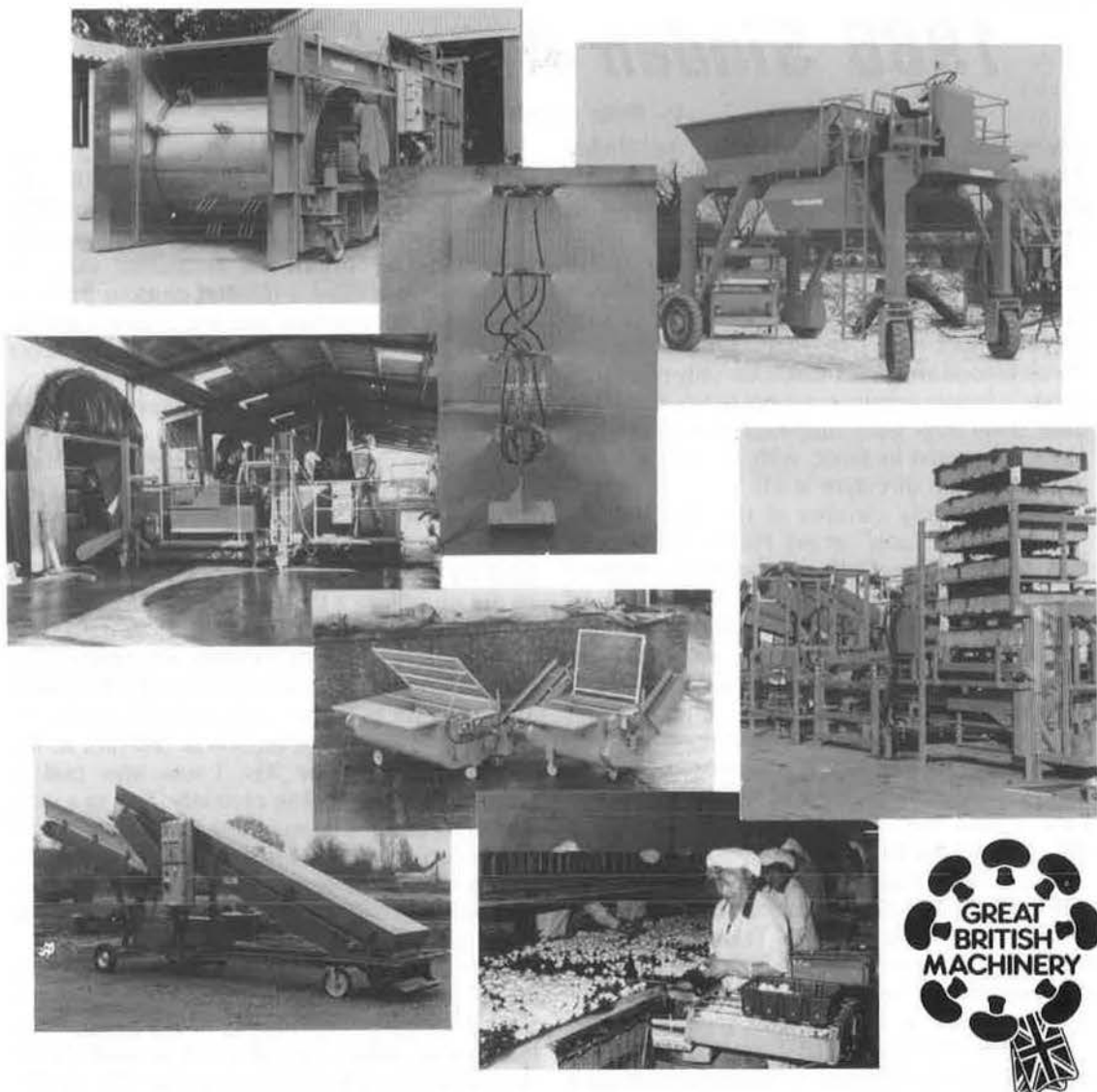
When we took over, at the age of 21, the average yield of mushrooms was down to ½lb a square foot, and despite boundless youthful confidence and enthusiasm, tons of quick lime and countless drums of formalin, there it remained. We filled a disused chicken house a hundred yards upwind and did 3½lb a square foot. A lesson in basic hygiene that I have never forgotten.

I went to work at the Cheshunt Research Station, the forerunner of the GCRI, early in 1939 to polish up on the latest scientific ideas before starting on my own in 1940; where some of my happiest memories are of the afternoons when Dr. Bewley used to seek me out with "let's get some fresh air" and we would collect *Mycogone* samples or dig up people's diseased tomato roots. I met many of the household names of those days, and I particularly remember Harnet who grew a lot of mushrooms, and the head of the Rochford empire, who told me "pay well and stand no nonsense", a piece of advice as relevant in the 80s as it was in the 30s. I was also told at Cheshunt with complete certainty, that in a very few years none of us would be working with soil or mushroom compost but everything would be grown by hydroponics, I had the dubious distinction of killing the tomatoes in one of the early experiments, by overfeeding them.

Then Hitler intervened, and six years later, the family fortunes having declined dramatically I started literally at the bottom of the garden with 400 cloche. Which was about all I could afford, determined to make up for lost time my "staff" consisted of my father's gardener, already an old age pensioner, three days a week.

I am afraid that I can't claim to having been one of the founder members of the MGA although I grew my first crop of mushrooms in my first greenhouse in 1947 — you guessed it, on ridge beds, which to my surprise and delight did 4lb a square foot. I was working all the hours that God made, loving every moment of it, but too busy to know what was going on around me.

I managed to build my first glasshouses and mushroom shed although I am probably the world's worst handyman, making full use of war



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time beach defence poles and clamps which were very rusty but cheap!

I joined the MGA as soon as I became aware of its existence, and we were still growing mushrooms on a shoestring using army beds supported on concrete blocks to form shelves in thatched glass houses. At that time we were also growing a number of other crops. When my son, David, joined me, everything was still very basic, however, we did start welding the beds together into racks, and moving them with a buck-rake. Peak heats and cook outs were done with the aid of coke braziers in 40 gallon drums which often cracked the glass and singed the straw covering them, although we never had a major fire which was a miracle — we carried the braziers on long poles and you had the choice of singeing your front or your back.

David, who was a lousy glasshouse grower, soon made up his mind that we were going to specialise in mushrooms, and he had the bottom line on his side, we replaced all our glasshouses with Crendon type sheds by degrees, although I still have nostalgic memories of tens of thousands of large chrysanthemum blooms, with a stinging frost or a howling gale outside, just as I do the fields of ripe corn of my very early days.

We soon set about discovering how much compost we could get into a box: David's somewhat hair raising philosophy was that if we didn't put more compost into a box than we could handle, we should never learn. We had our excitements. Eventually coming up with some basic rules for this kind of growing for our conditions.

The compost must be fairly wet, between 72 per cent and 74 per cent at spawning. It must be pressed hard — we increased our yield by 11b a square foot when we went from treading to a hydraulic press, and another 11b when we used a 28 ton press. Our next one will have the capability to press much harder, because we may not have reached the optimum yet, this is partly to avoid overheating.

We space our boxes as for cropping in our holding rooms so that we can get plenty of cool air around them, it also makes management of them more efficient. Which brings me to cooling. We need enough to take the air below 50°F (10°C) against an average box temperature in excess of 85°F (30°C), (and with 40lb+ of

compost per square foot, these give off an amazing amount of heat), against an outside air temperature up to 90°F (33°C). If you lose control you may end up with a complete crop failure. We take 50 per cent of our box temperatures every day from spawning to pinning and occasionally make holes in a few which are too high. There is far less room for error than seems to be the case with normal growing. We monitor the amount of water added to the compost between delivery and the start of Phase II. Having taken a lot of care to assess the moisture content at delivery, we then use a rain gauge and have water meters. We alter our stack dimensions over a wide range according to conditions, and record all these details for analysis, together with any other relevant facts and it is amazing how much it has improved our average yields, especially stack dimensions and the timing of our addition of water.

We have found that contrary to usual practice the CO<sub>2</sub> during case run is highly important, concentrations above 0.4 per cent give us drastically reduced yields and malformation. We also need a large air-bed temperature differential to obtain satisfactory initiation, and a lot of evaporation from the casing.

Why do we continue to make life so difficult for ourselves?

I suppose if one was truthful there is a certain satisfaction in having world record yields for fifteen years. But there is much more to it than that. We have specialised in the production of large open mushrooms for 30 years and two thirds of our cropping time is now devoted to it. It is undoubtedly the most difficult grade to produce well consistently, if only for the hygiene hazard, but the best quality is grown on a wet compost and a dry casing and on very deep beds. It can also only be done satisfactorily with very few spawn strains, which does not include the highest yielding ones.

Douglas Miller suggested that I talked about philosophy and perhaps I have been philosophising a little.

Barry Howes suggested that I talked on our conversion from shelves back to boxes and I now propose to deal with that, it is probably somewhat unusual, and I shall try to tell you our reasoning behind this move.

My son and I visited Holland at the invitation of Pieter Vedder, having had a look at the Dutch



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industry several times with fairly large parties. With the general idea of getting the Dutch system out of our calculations for the future; we came back converted to it! To the surprise and dismay of the rest of our management.

We still think that the shelf system is highly ingenious and very suitable for certain types of growing. But we have not managed to crop as well on deep shelves as on deep boxes. Primarily we believe because no-one has yet managed to solve the problem of pressing a shelf as hard as you can press a box — an absolute must for deep growing — and the shelf system has inherent weaknesses concerning hygiene, which are exaggerated when you crop for nine weeks and produce large flats for two thirds of that time.

To be fair to the shelf system we have had yields of up to 10lb per square foot and we have — dangerous thing to say — had routine virus checks clear. But our average yields have been down against boxes from the same weight of compost and the precautions we take against virus are costly and not nearly as effective as a well planned box farm can be made; in addition we have failed to get such good quality open on them, and have failed to handle the large amount of air needed for deep growing as effectively in shelf sheds despite endless experiments.

We had originally intended to convert the box part of our farm to shelves, because running two sets of machinery on one fairly small farm is time consuming and also very expensive.

I would like to thank the many Dutchmen for all the help they have given us, they have always been a little shocked when I tell them that I think that they have a wonderful system but lousy hygiene on the whole. I suppose that I could be described as a hygiene fanatic — I am sure my staff think so — but I am equally certain that it is a fault in the right direction when you are cropping for nine weeks, a lot of that time producing all opens!

Apart from lack of pressing which automatically leads to heating problems with deep beds, and lower yields per ton of compost, we have had to go over to tunnel weight nets as we were having endless trouble with standard nets breaking, both at fill and empty with 35-40lb of compost pressed as hard as we can, and these nets cost £1,000 each; once the friction problems had been solved — they are much rougher than normal growing nets and are also very much heavier to manhandle

around — they have worked perfectly and they also have a higher temperature tolerance which means improved cook outs.

We have our head end filler inside a large shed running on rails and pressurised with filtered air — not surprisingly known as the “Wendy House”. With compost delivered through an aperture way above ground by a conveyor which is supported by a hydraulically adjusted piece of equipment which reminds me of the huge catapults used in the middle ages to hurl rocks at castle walls. The compost then descends through an adjustable canvas chute, the nickname of which I shall not disclose in mixed company, to the head end filler. All the conveyors used are covered as is the Volvo bucket which takes the peak heated compost from a pressurised canopy with a curtain which is only pulled back for the Volvo to load from a raised platform — to avoid contamination from its wheels. This all gives something like 85 per cent protection, against as near 100 per cent as one is ever likely to get from a carefully planned box operation.

The conversion will be based on our old box farm with nine cropping sheds holding 3,700 square feet each augmented by fifteen new polysheds which together will give us two crops a week picking for nine weeks each.

These will be supplied with peak heated compost from our existing tunnels which will be spawned into boxes in a new work area, pressurised with filtered air attached to the clean ends of our tunnels — the boxes will be carried through a pressurised corridor to our existing shelf sheds which will be used as the holding rooms for the new set up, as at present with our box farm the boxes will not see the light of day until they are pinned and ready to be moved into the croppers and as at present the fans will be turned off on the other croppers while the moving takes place. Incidentally, we now have a five ton truck which will easily move four of our boxes at a time instead of the two we move now.

The whole operation is intended to be very much on the lines of our present box farm, but streamlined in a number of ways, and filling two sheds a week instead of one as at present.

However, it will take several years to complete and we have worked out a method of taking it in at least three steps, which will give us a better chance to get the marketing side sorted out, apart from being less strain on the overdraft!



# THE BUSH TELEGRAPH

## Letter to the Editor

Ministry of Agriculture, Fisheries and Food  
Agricultural Development and Advisory Service,  
South East Region Sub-Centre,  
Olantigh Road, Wye, Ashford, Kent TN25 5EL.  
Dear Sir,

I always enjoy reading Geoff Ganney's notes and was interested to see his comment for 3rd November. This question has come my way from various different directions during the last month so I thought it might be worth letting you know the results of my investigations. Hypochlorite, or more correctly sodium hypochlorite, is used as a disinfectant by many mushroom growers and is also applied to mushroom beds to control bacterial blotch. Almost all of the liquid formulations currently available are produced for the dairy industry. They are used to clean milking equipment, dairy parlours, etc. The concentration is expressed as available chlorine as it is this that is the active ingredient. Ten per cent is the most common concentration available, although it may

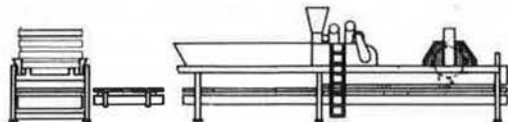
be as high as 12 per cent. The concentration is usually clearly stated on the label. For the control of bacterial blotch one pint of the 10 per cent material is added to 80 gallons of water and this diluted material applied every watering. It is important to start applications before the disease builds-up if control is to be achieved. For general disinfection two pints is added to 100 gallons.

Chlorine is a very powerful biocide and is effective against all micro-organisms. It is however, very rapidly absorbed into organic material and then is ineffective. So when used as a disinfectant, it is most likely to do a good job if the area is first power hosed to remove debris. When applied to a mushroom bed for blotch control it only prevents the build-up of the bacterial population on the surface of the developing mushrooms and in this way helps to prevent blotch.

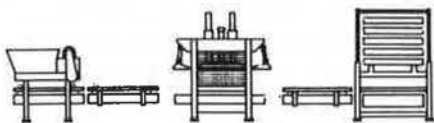
Two other questions about hypochlorite have been asked lately; why does it contain sodium chlorate and sodium hydroxide and what effect will these have on cropping?

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## OBITUARIES

Readers will learn, with regret, of the death of Prof. Horst Reithus, reported in a recent issue of *Der Champignon*, No. 304. Formerly head of the Institut für Gemusebau (Institute of Vegetable Growing) of the Technical University, Berlin, he worked for a while in the 1950s and 60s on the casing layer and the water requirement of the mushroom.

A few months previously *Der Champignon*, No. 298, reported the death of Prof. Dr. Gerlind Eger-Hummel. British Mushroom growers will remember Dr. Eger-Hummel particularly for her work on the part played by bacteria in the casing layer on mushroom fruiting. She was also very active in the breeding of *Pleurotus* strains.

She will be greatly missed in the world of mushroom science and mushroom growing.

All formulations of dairy hypochlorite must by law contain a minimum of 0.7 per cent sodium chlorate. This chemical is added as a marker because it is very easy to assay and its presence can be detected at very low concentrations. In this way it is possible to determine how effectively dairy equipment has been rinsed after hypochlorite treatments. The sodium hydroxide is added as a stabiliser usually at a concentration of one or two per cent. Without this additive a slow chemical reaction results in the sodium hypochlorite decomposing to sodium chlorate and hydrochloric acid. The production of the acid

speeds up the decomposition but this self-accelerating reaction is checked by the sodium hydroxide.

Neither of these additives in the diluted hypochlorite will affect the crop. Sodium chlorate is a well known plant poison but as a weedkiller is used at one or two per cent. When hypochlorite is diluted to  $\frac{1}{4}$  per cent or less, the amount of sodium chlorate in the diluted solution is 0.001 per cent. Obviously any increase in the chlorate content of the concentrate by decomposition will slightly reduce the safety margin.

Hypochlorite must be stored in a cold store and

## OBITUARY

Horace Kilian, of Baddow Park, Great Baddow in Essex, one of the most experienced mushroom growers in the country and a long-standing member of the MGA, died in hospital on Tuesday, 23rd December, and was buried a week later. He had been ill for only a day or two but some time ago he sustained a heart attack from which he recovered. He was 77 and leaves a widow, Ruby, daughter Annie, two granddaughters, Henrietta and Deirdre, the former living in Oregon, USA, and the latter at Hawkhurst in Kent. There are four great-grandchildren.

In many ways Horace Kilian was a quite remarkable man, quiet, unassuming and with a great sense of purpose, shy and something of a loner, but quite dedicated to whatever main task was at hand. It was fitting that the vicar of Great Baddow, at the burial service, said of Horace that he was quite indomitable and an individualist, adding that one of his favourite sayings was "If you have to push a wheelbarrow make sure it is your own barrow".

It was in the latter part of the 1940s that he bought Baddow Park with its splendid house, thirty acres of land and a herd of Jersey cows. Throughout the war the house had been occupied by the army. Earlier he had a nursery in the Chingford area of Essex. He started growing mushrooms in 1947 after getting rid of the cows, first experimenting in disused farm buildings and then in purpose-built production houses situated on sloping ground, much favoured in those days. An innovator,

he experimented early on with two-storeyed American-type houses. He mechanised one of the old Salopians, using a  $\frac{1}{2}$ hp electric motor through a motor unit and afterwards built his own large composting machine. He used former boards made out of three-ply wood and was to say nearly thirty years ago that if he started again it would be on a flat farm site with the entire unit constructed under one main roof. By 1963, on the tray-system, his production houses each contained 5,000sqft of beds.

It was in the early sixties that he founded the wholesale packaging concern of H. Kilian Ltd., which at first concentrated on the production of cardboard chip baskets for the mushroom industry but which has now diversified into packaging for confectionery, for fish and has an expanded polystyrene enterprise in Lincolnshire. In all, including the production of mushrooms, the labour force amounts to 150 people, with Mrs. Annie Gough as Company Chairman, Peter Pryke, Managing Director, and Peter Cracknell holding a similar position with Baddow Park Mushrooms Ltd.

The MGA was represented at the funeral by the Chairman, Douglas Miller, and other well known growers present included Bob Pinkerton with Mrs. Pinkerton, Roy Speller and John Maxwell. Much sympathy is felt for Mrs Kilian — she and Horace had been married for well over fifty years — and for the family.

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in the dark to minimise decomposition. The available chlorine concentration can be easily checked using chemical or colorimetric methods.

One last point, whilst we are on this subject, remember that undiluted formalin and undiluted sodium hypochlorite when mixed together form a very dangerous cancer inducing substance (bis-chloro-methyl). Even the diluted chemicals may produce very small quantities of this chemical so should always be kept well apart.

Yours sincerely,

**J. T. Fletcher,**

Regional Plant Pathologist.

... Mr. Peter Sargeant has been appointed Managing Director, James A. Gooding Group Limited.

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Mr. Sargeant joined the company in 1985 as



*Peter Sargeant newly appointed Managing Director of James A. Gooding Group Ltd.*

General Manager of the Catfield farm. It is planned that his wide ranging skills gained both as a professional engineer, and in a number of general management roles, will augment the existing Board of Directors.

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