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A SURVEY OF MUSHROOM CASING MATERIALS AND PRACTICES

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SUMMARY

A survey of casing materials and practices and their effects on crop yield and quality and casing cost was undertaken covering 48 different casings on 40 farms. A wide range in casing materials (ready mixed and on-farm mixes) and casing practices were found, although the technique of spawned-casing ('Caccing') was used on 83% of the casings. There was a significant trend for blacker peats to produce cleaner mushrooms than brown peats, and this was a major reason for several farms changing from black to brown peat. The resistance of blacker peats to surface hardening ('panning') was also a factor. Blacker-peat casings also resulted in more uniform sporophore distribution than brown-peat casings, although they were generally more expensive. Casings mixed on the farm had a lower materials cost than ready mixed casing but the labour cost was usually higher. The factor in the survey which was most closely correlated with mushroom yield was casing depth, with the optimum in the range 45-55 mm. Casing moisture content increased with casing depth and peat blackness. The independent effects of chalk/lime source could not be clearly identified since sugar beet lime was usually used with blacker peats.

Active compost during case-running, resulting from short spawn-runs and possibly supplementation, necessitated low air temperatures, sometimes causing deep pinning and dirty mushrooms. Cinnamon mould (*Peziza ostracoderma*) was more frequently found on tray farms but no other casing or cultural factors were found to be related to the occurrence of casing weed moulds. Due to the large number of different materials and limited replication of individual brands, no conclusions could be drawn regarding the best 'brand' or 'type' of casing material within a particular category of blackness. Of particular interest is the

difference between 'wet' black peats and the partially dried and re-wetted black peats. The indication from this survey was that good results can be achieved with both types of material; the materials cost of the former being higher, whereas the latter has higher preparation costs, particularly where the peat is pre-wetted before mixing.

This survey was not commissioned to resolve all the questions regarding casing, but rather to indicate the questions which will be answered by development work.

INTRODUCTION

Since the work of Edwards and Flegg in the 1950s, mushroom casing in the UK, and many other countries, has been based on mixtures of peat and chalk. However, within these two ingredients, there is a wide range of materials available. Unlike the Netherlands, where casing is prepared centrally by specialist producers, much of the casing in the UK is prepared by individual farms, further adding to the variation in the properties of the casing.

The objectives of the present survey were:

1. Determine which casing materials are currently used in the UK

2. Determine which casing management techniques are currently used

3. Determine as far as possible how (1) and (2) influence the yield and quality of mushrooms and the cost of the casing.

Since the ingredients, the preparation of the casing mix, subsequent casing management and other cultural conditions all influence the performance of the casing, a wide range of factors, both directly and indirectly associated with the casing, were assessed.

SURVEY METHOD

The survey was conducted during May, June and July 1993, and covered 48 different casings on 40 farms distributed throughout England. Of the casings examined, 27 were on trays, 13 on shelves and 8 on bags or blocks. The survey was divided into the following groups of questions and assessments:

(a) casing ingredients, preparation and subsequent management

(b) other cultural practices and environmental conditions within cropping sheds

(c) specific properties of the casing

(d) effects of (a) to (c) on mycelial growth, crop productivity and quality and casing cost.

Casing Ingredients, Preparation and Subsequent Management

(i) **Ingredients**

Peat:

brand, type, degree of decomposition (peat 'blackness') according to the von Post scale (Bunt, 1976). Where a blend of peat types was used, an average score for peat decomposition, according to the proportions used in the casing, was used.

Chalk/lime:

Type ('hard' or 'soft' chalk, limestone, lime, sugar beet lime), particle size, quantity used.

Spawned casing/caccing:

Type (proprietary product or spawn-run compost), rate of use.

(ii) **Preparation**

Type of mixing equipment; method of mixing and adding water; delay between mixing and use; method of adding caccing material, if used.

(iii) **Application of casing and subsequent treatment**

Method of applying casing to the beds; use and method of levelling or ruffling. The depth of the casing was assessed within 48 hours of application (after levelling if practised) on a random distribution of 8 sampling points. Where the casing was ruffled, casing depth was assessed before ruffling.

(iv) **Watering**

Method of application; timing of waterings and quantities of water applied to the casing on the beds.

Other Cultural Practises and Environmental Conditions in the Cropping Sheds

(i) Environmental conditions

Temperature, relative humidity and air velocity 50 mm above the beds were assessed in sheds at the following stages:

(a) before airing

(b) 24-48 hours after airing

(c) at the beginning of the first flush

Temperature and humidity were recorded with a whirling wet and dry bulb hygrometer; air velocity was recorded with a hot-wire anemometer.

The following additional questions were asked regarding the environmental conditions and regime used on the farm:

- ratio of air: bed volume
- timing and method of airing in terms of air and bed temperatures and CO_2 level.

(ii) Cultural practices

- production system (trays, shelves, bags, blocks)
- type and weight of compost filled per unit of cropping area (Phase I, II or

spawn-run compost)

- duration of spawn-running
- predominant spawn strain(s) used
- use of compost supplements
- use of pesticides in the casing
- cropping duration and number of flushes picked

(iii) **Casing properties:**

Samples of casing (about 500 g) were taken immediately after application to the beds and at the beginning of the first flush. The pH was obtained by diluting a 150 ml casing sample in 900 ml distilled water. The moisture content was obtained by oven-drying a 300 g sample of fresh casing at 75°C for four days and re-weighing.

A subjective assessment of the texture of the casing was made after application to the beds: openness of the surface, lumpiness, evenness. Problems such as 'panning' of the casing surface, excessive drying-out and 'corking' during cropping were also recorded.

Effects of the Measured or Assessed Parameters on Cropping Performance and Casing Cost

(i) Mycelial growth and uniformity of fruiting

Mycelial growth in the casing was assessed at the time of airing and at the beginning of the first flush on a 1 (little mycelium present) to 5 (casing fully colonised with mycelium) scale. The distribution of the first flush fruitbodies on the casing was also assessed on a 1-5 scale, where 1 = even distribution of fruitbodies, 5 = uneven distribution of fruitbodies, clumping and/or bare patches. The presence of weed moulds on the casing was recorded.

(ii) Mushroom yield

The average yield of mushrooms, per unit of bed area and per unit weight of compost, was obtained from farm records. The grade-out in terms of open and closed mushrooms, and the distribution of the yield between the flushes were also recorded.

(iii) Mushroom quality

Mushroom cleanliness (freedom from casing material) was assessed on a 1 (mushrooms almost free of casing material) to 5 (mushrooms heavily soiled) scale. Mushrooms assessed on this scale are shown in Figure 1. Assessments were made on first flush mushrooms before picking and in the marketing container. The average picking rate was also recorded since this could have influenced the cleanliness of the picked product. Other quality defects such as cap-scaling, bacterial blotch or other discolouration, watery stipe and premature opening were also recorded.

(iv) **Casing cost**

The cost of the raw materials, per unit volume (after wetting) and per unit bed area covered, were recorded.

RESULTS

The units most widely used in the UK mushroom industry have been used, and where appropriate the SI equivalents are shown.

Casing Ingredients, Preparation and Subsequent Management

(i) Ingredients

Peat:

All the peats used in the casings were sphagnum peat although one casing included deep sphagnum with some sedge peat. Peat was supplied either as partially dried peat in bags/bales or bulk, or as ready mixed casing. The ready mixed casings consisted either of 'wet' bog peat or re-wetted blends of partially dried peats, together with a chalk/lime source. Where casings were mixed on the farm, one, two or three types or brands of peat were used. The peat types or brands of ready mixed casing are shown in Table 1, together with the assessment of their 'blackness'.

Chalk/Lime:

The following types were used:

Chalk (minimum 95% $CaCo_3$) - 'hard' and 'soft' sources depending on the particle density

Limestone (minimum 50% $CaCO_3$)

Lime (minimum 50% CaO)

Sugar beet lime (minimum 90% $CaCO_3$)

The most typical quantity of chalk/lime used was around 80 kg/m^3 casing (Figure 2), although quantities exceeding 200 kg/m^3 were used in some casings. With one exception, sugar beet lime was only used on 'blacker' peat casings (blackness score 3.5 or higher).

The following particle sizes of chalk or lime were used:

Coarse ground or screened, passing a 6 mm mesh; medium ground, passing a 1.5-3mm mesh; fine ground, passing a 1 mm mesh; superfine or 'flour' grade, passing a 150 μ sieve.

With the exception of 3 casings, pH was in the range 7.5 - 7.9. Three 'brown' peat casings with chalk contents of 57, 83 and 300 kg/m^3 casing had a pH of 7.3, 7.4 and 8.1 respectively. However, casing chalk content and peat blackness were not significantly correlated with casing pH.

(ii) **Spawned casing or 'Caccing'**

Of the 48 casings examined, 40 were with 'caccing', of which 37 were with proprietary caccing material and three with spawn-run compost. Spawn-run compost was added at a rate of 9-12 kg/m^3 casing whereas proprietary 'caccing' was usually added at a lower rate (Figure 3).

Where caccing was used, this was either added to the casing mix 10-30 seconds before emptying of the mixer, added to the casing head-filler or ruffled/rotovated into the casing after spreading over the surface of the casing on the bed.

(iii) **Preparation**

The most widely used mixing equipment was a twin-screw auger, followed in number by rotary paddle mixers. A range of other concrete-type mixing equipment was used. Due to wide differences in the size and power of equipment, and volume of casing mixed, there was insufficient replication of mixing equipment for conclusions to be drawn on the effects of different types. The duration of mixing was usually 1-2 minutes, although longer and shorter durations were used for atypically large and small quantities of casing.

There was a wide variation in methods used for applying water to the casing. The following treatments were used for ready mixed casing:

a) wetted on arrival using spray line, further water added during application, if needed (3 farms).

b) water added during application (on casing line, or to head-filler) (2 farms).

c) mixed for 30 seconds - 2 minutes with water, if needed (5 farms).

d) no mixing or further water added (2 farms).

For casing mixed on the farm, the following wetting procedures were used:

a) Peat and chalk/lime ingredients mixed dry for up to 1 minute before water was added (9 farms).

b) Water added during the initial part of the mixing process before a further mixing of the wetted ingredients (4 farms).

c) Water added throughout the mixing process (8 farms).

d) Peat partially or fully wetted before mixing with chalk/lime, using spray lines over a concrete floor (2-14 days) or soaking tanks (24 hours) (7 farms).

The latter method of wetting produced casing with a uniformly high moisture content but was more labour intensive than using mixing equipment for wetting.

The moisture content of the casings are shown in Figure 4. Most of the casings had a moisture within the range 66-75% at the time of application; the black-peat casings were applied with a significantly higher moisture content than the brown-peat casings. Casings which were applied deeper were generally applied with a higher moisture content than shallower casings.

On most farms there was no delay between mixing/wetting and application on the beds, although 14 of the casings were stored (1-7 days) before use.

(iii) Application, levelling and ruffling of casing

With the exception of one farm where casing was applied on to shelf beds with buckets, casing was applied to shelves using retracting nets. On three tray farms, casing was applied using buckets or shovels, but all the other tray farms had a mechanised casing line, which involved casing falling 0.2-0.7 m on to the trays. Casing was applied to bags by hand, with or without the use of buckets/bowls.

Although a wide range in casing depths were found, the most typical casing depth was 39-45 mm (Figure 5). Some form of firm levelling after application of the casing, excluding light levelling by hand, was used on 25% of the casings examined.

Machine or hand ruffling, other than for incorporating caccing material, was used on only 6 out of 48 casings. Ruffling was conducted 6-9 days after the application of casing.

(iv) Watering

Watering trees were used on 11 out of 13 casing on shelves but only 4 out of the 27 casings on trays. All the other casings examined were watered with a hand-held rose. Four 'groups' of watering techniques were identified:

a) Water applied to the beds before 'airing' but no further water applied until the first flush was picked (13 casings).

b) Water applied to the beds before airing. Further watering delayed until after the pins of the first flush were 'pea' size (25 casings).

c) Most water applied before airing, but further light waterings applied throughout the period leading to the first flush (7 casings).

d) Casing applied after pre-soaking the peat. Very little water applied between application of the casing and picking the first flush (3 casings).

There was a wide variation in the number of waterings and amount of water applied. In groups (a), (b) and (c) water was applied in 4 to 16 applications before airing, and groups (b) and (c) in 1 to 5 waterings before the first flush. There was no significant difference in the number of waterings applied to black- or brown-peat casings. The number of waterings applied to deeper casings was more variable than the number applied to shallower casings. Examples of deeper casings were found which received large and small numbers of waterings, whereas shallower casings only received smaller numbers of applications of water. The casing moisture content during the first flush is shown in Figure 4. The most typical value was 66-70%.

Other Cultural Practices and Environmental Conditions in the Cropping Sheds

(i) Environmental conditions

Air temperature, humidity and velocity are shown in Figures 6-8, for the situations before and after airing and during the first flush. Before airing, all except two farms controlled the environment on bed temperature (usually 26-30°C). The wide variation in air temperature measured before airing (Figure 6) is therefore partly due to differences in compost activity. Farms which controlled according to bed or air temperature during airing were equally divided. Where bed temperatures were used for control, a minimum air temperature was usually imposed. Bed temperatures were dropped over a 2-3 day period, whereas air temperatures were dropped over periods ranging from 5 to 48 hours.

On farms where ruffling was practised, airing of the shed was conducted 8-13 days after casing. On farms where spawned casing was used, there was some variation in the timing of airing, but most farms aired 5-7 days after casing. On three farms, trays were kept in 'case-running' rooms until airing, at which time they were transferred to the cropping sheds.

(ii) Cultural practices

A wide range of strains were grown on the farms in the survey with many farms growing two or more strains. Where different strains were grown on the same farm, the cultural technique was often modified according to the requirements of each strain. This involved differences in the watering regime and environmental control setpoints. However, there was insufficient replication of strains to enable conclusions to be drawn about their effects on yield and quality.

The weight of Phase II compost filled into trays or shelves was in the range 18-23.5 lb/ft^2 (88-115 kg/m^2) for all except two farms. Supplements in the compost were used on 42% of the farms.

Most farms picked 3 or 4 flushes, although 5 or more flushes were picked on 9 of the farms.

The following pesticides were incorporated into or applied to the corresponding number of casings: Sporgon (31), Dimilin (29), Bavistin (6), Benlate (5), Hymush (1), Malathion (1), Methyl Bromide* (1), Formaldehyde* (1).

* Treatment before mixing.

Effects of the Measured or Assessed Parameters on Cropping Performance

(i) Analysis

For continuous variates (e.g. casing depth, moisture content) the analysis consisted of a series of linear regressions of the responses (i.e. mushroom yield, cleanness and sporophore distribution) on the different variates. For discrete variates (e.g. use or absence of ruffling, caccing) a t-test was used for comparing the mean value of responses.

(ii) Yield

Yield per unit of bed area was considered to be a more reliable figure than yield per weight of compost for analysing yields obtained from different cropping systems. Yields after the fifth flush, where picked, were not included in the analysis. The most typical mushroom yield was about 4.8 lb/ft^2 bed area (23.4 kg/m^2) although average yields ranged from less than 3.6 lb/ft^2 to over 5.5 lb/ft^2 (Figure 9).

The factor which was most closely correlated with mushroom yield was casing depth (Figure 10). Mushroom yield was also significantly correlated with casing moisture content at the time of the first flush (Figure 11). However, casing depth and moisture content were correlated, with moisture content increasing with casing depth. Multivariate regression analysis showed that once the influence of casing depth had been accounted for, the independent effect of casing moisture content was not significant.

The effect of lime source could not easily be distinguished from peat type since sugar beet lime was used on only one 'brown' peat casing. The use of supplements increased yield by 9.5% (significant at $P < 0.05$); farms using spawned casing yielded 15.9% higher than farms without spawned casing (significant at $P < 0.01$). However, the sample number of farms not using spawned casing was small compared with the number of farms using the technique. None of the other casing or cultural factors had a significant effect on the recorded yield.

(iii) Mushroom Cleanness

A wide range in mushroom cleanness was recorded, although the most typical assessment scores were 2-2.9 before picking and 2.5-2.9 after picking (Figure 12). Mushrooms grown on most casings were dirtier after picking, although the picking rate was not correlated with mushroom cleanness after picking. This was in spite of a wide range in picking rates (Figure 13). The factor which was most closely correlated with mushroom cleanness was peat 'blackness' with a significant trend for blacker peats to produce cleaner mushrooms (Figure 14). However, examples of 'clean' mushrooms grown on brown peat casing, and 'dirty' mushrooms grown on black peat casing were found. On two farms where short spawn-runs were used (casing 7 days after spawning), low air temperatures were used to control the active spawn-running compost. This resulted in deep-pinning and dirty mushrooms. Mushroom cleanness was significantly correlated with casing moisture content at the time of application. However, multivariate regression analysis showed that nearly all of the effect of casing moisture was explained by casing peat blackness, with blacker-peat casings having a higher moisture content at application. The use of supplements resulted in significantly dirtier mushrooms ($P < 0.01$) but none of the other factors measured or assessed had a significant effect on cleanness.

(iv) Other quality factors

Cap scaling of mushrooms often occurred on areas of the bed where the air velocity exceeded 0.35 m/s. As well as in areas where no consistent reading could be recorded with the anemometer, cap discolouration was noted on two farms where a casing moisture content of over 81% was recorded. Four farms which had changed from a brown to a black peat casing reported an improvement in the weight and firmness of mushrooms. However, no direct measurements of mushroom weight or firmness were made in this survey.

(v) Sporophore distribution

There was a significant correlation between casing peat blackness and sporophore distribution, with blacker peats producing more uniform crops (Figure 15). On the six farms where ruffling was practised, the sporophore distribution was uniform (score 2.5 or better), but there was insufficient replication to determine if this effect was significant.

(vi) **Physical properties of casing**

The occurrence of hardening of the casing surface or 'panning' was a problem associated with brown peats, particularly after heavy watering or during later flushes. The black peat casings which were examined were fairly resistant to panning. The black peats often produced a very lumpy surface, but this did not usually affect the cleanness of the picked mushrooms.

(vii) **Weed moulds**

Cinnamon mould (*Peziza ostracoderma*) was found on 13 casings of which 11 were on trays. *Trichoderma* spp. were found on 5 casings. No other cultural factors, including the use of pesticides in the casing, were found to be related to the occurrence of these weed moulds on the casing.

Casing Cost

The range in cost of the ingredients of the casings per cubic metre is shown in Figure 16. The ready mixed materials were more expensive than the casing materials mixed on the farm (excluding labour costs). The black peats were more expensive than brown peats, although actual prices and differences between grades depended on the quantities used and the suppliers. The chalk/lime content of the casing typically accounted for 10-20% of the materials cost, but increased to 30% where large quantities of sugar beet lime were used. Sugar beet lime was about 30% more expensive than fine grade chalk. The casing cost per square foot of bed area, which takes account of casing depth, is shown in Figure 17. The most typical casing cost was around 13p/ft^2 (£1.40/m^2).

DISCUSSION

The results of this survey have confirmed that within England, a wide range of casing materials and practices are used. A large variation in the performance of different farms, in terms of mushroom yield and quality, and casing cost, was also recorded.

Mushroom cleanness was a major quality factor influenced by the casing, and there was a significant trend for blacker peats to produce cleaner mushrooms. The blacker peats, having a small particle size, tended to bind together, whereas the younger brown peats had larger particles which tended to stick to the caps. Mushroom cleanness was the main reason for several farms changing from brown to black peat, although the resistance of black peats to panning was also a factor. The distribution of mushrooms on the beds was more uniform with black peat than with brown peat casing. A major reason for the continuing use of brown peats in casing was the lower cost, compared with that of black peats. On smaller farms, casing made from the denser black peats was difficult to mix in small equipment.

The factor most closely correlated with mushroom yield was casing depth. There was no clear effect of casing depth within the range 45 to 55 mm, although this represents a 22% difference in casing cost. The results follow those of Kalberer (1983) who found that a 60 mm deep casing resulted in a 16.2% higher mushroom yield than a 30 mm deep casing. The independent effect of casing moisture content could not clearly be determined since casing moisture content was correlated with casing depth and peat blackness. Several distinct methods of wetting the casing and watering the crop were identified, although no clear effects on crop yield or quality emerged.

The independent effects of chalk/lime source could not be clearly identified since sugar beet lime was usually used in conjunction with black peat. The indication from this survey was that sugar beet lime was at least as good as find ground chalk, in terms of mushroom yield and quality, although somewhat more expensive. Sugar beet lime has been used in casing in the Netherlands following the work of Visscher (1975). The material produces a dense casing structure, and Visscher (1989) found that an increasing quantity in a peat-based casing led to a smaller number of larger mushrooms.

Spawned casing ('caccing') was used on the majority of farms due to the significantly shorter production cycle. There was insufficient replication of farms using ruffling to be able to accurately compare the effects of caccing and ruffling on yield and quality. However, there was evidence from one farm where both techniques were being used, that ruffling resulted in a more uniform distribution of mushrooms. This has also been reported in Holland, where the use of caccing was found to increase the duration of a flush (van Gils, 1993).

Several other cultural factors related to mushroom quality were identified in the survey. Active compost, resulting from short spawn-runs and possibly supplementation, necessitated low air temperatures during case-running. This resulted in pinning below the surface of the casing and dirty mushrooms. Several farms had uneven or inadequate airflow systems resulting in cap scaling or discolouration.

Due to the large number of different materials and limited replication of individual brands, no conclusions could be drawn regarding the best 'brand' or 'type' of casing material within a particular category of blackness. It is likely that more controlled comparisons would have to be made for these differences to be determined. Of particular interest and importance is the difference between 'wet' black peats and the partially dried and re-wetted black peats. The indication from this survey was that good results can be achieved with both types of material; the materials cost of the former being higher, whereas the latter has higher preparation costs, particularly where the peat is pre-wetted before mixing.

CONCLUSIONS

1. A wide range of casing materials and practices are currently used in England.

2. A significant correlation was found between peat blackness and mushroom cleanness.

3. The factor in the survey which was most closely correlated with mushroom yield was casing depth; the optimum depth was in the range 45-55 mm.

4. Casings prepared with blacker peats resulted in more uniform sporophore distribution than brown peats.

5. Casing moisture content increased with casing depth and peat blackness; this was mainly due to more water being applied to deeper and blacker-peat casings before application, although some deeper casings received large numbers of waterings after application.

6. Black peats were generally more expensive than brown peats; casing mixed on the farm had a lower materials cost than ready mixed casing but the labour cost was usually higher, particularly if pre-wetting before mixing was practised.

7. Active compost during case-running, resulting from short spawn-runs and possibly supplementation, necessitated low air temperatures, causing deep pinning and dirty mushrooms.

8. Cinnamon mould was more frequently found on tray farms but no other casing or cultural factors were found to be related to the occurrence of casing weed moulds.

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Table 1. Brands and types of peat and ready mixed casings used on farms in the survey

	Type	Country of Peat Source	Blackness*
Peat			
Bord na Mona 'Medium'	Baled	Ireland	2
Bord na Mona 'Black'	Bulk	Ireland	4
Bulrush 'Medium'	Baled	Ireland	1.5
Fisons	Bulk	UK	2
L & P (Deep sphagnum/sedge)	Bulk	UK	5
L & P (Standard)	Bulk	UK	4
L & P 'Economy' (wetter than standard)	Bulk	UK	4
L & P Sphagnum	Baled	UK	2
Midland	Baled	Ireland	2
Novobalt	Baled	CIS	1
Vapo 'Black'	Baled	Finland	5
Vapo 'D.C. Blend'	Baled	Finland	1.5
Westland	Baled	Ireland	2
Westland 'Black'	Baled	Ireland	4
Wilmslow	Bulk	UK	3.5
Ready Mix			
Euroveen 'Carbo'	Bulk (re-wetted)	Germany	4.1
Euroveen 'Euromix'	Bulk (re-wetted)	Germany	4.1
Harte	'Wet' Bulk	Ireland	4
Nooyen	Bag	Germany	4.2
SEM	'Wet' Bulk	Ireland	4

* 'Blackness' = $\left(\frac{\text{von Post grade - 1}}{1.5} \right)$

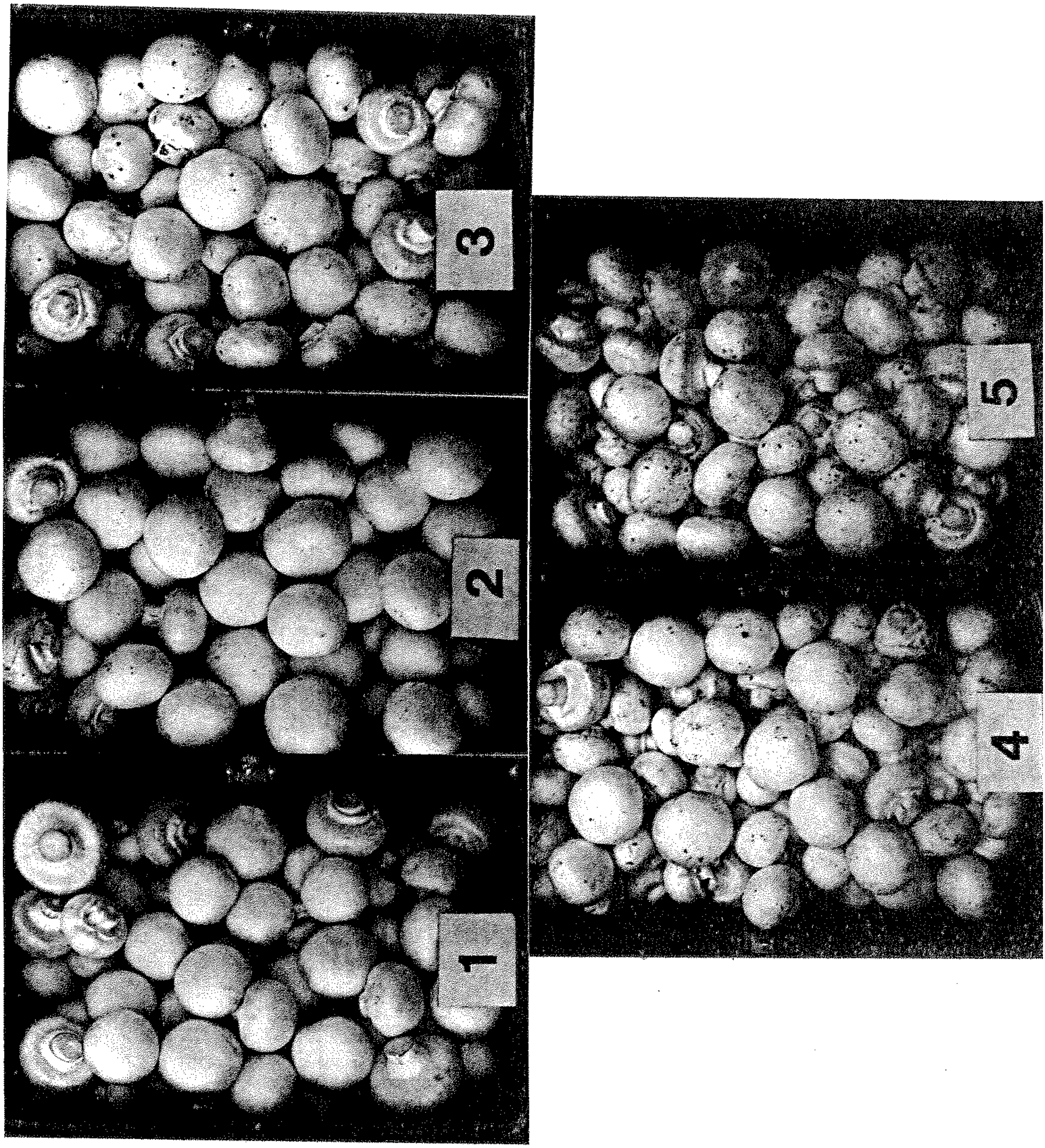


Fig. 1 Mushroom cleanness scale

Fig. 2 Casing chalk / lime content

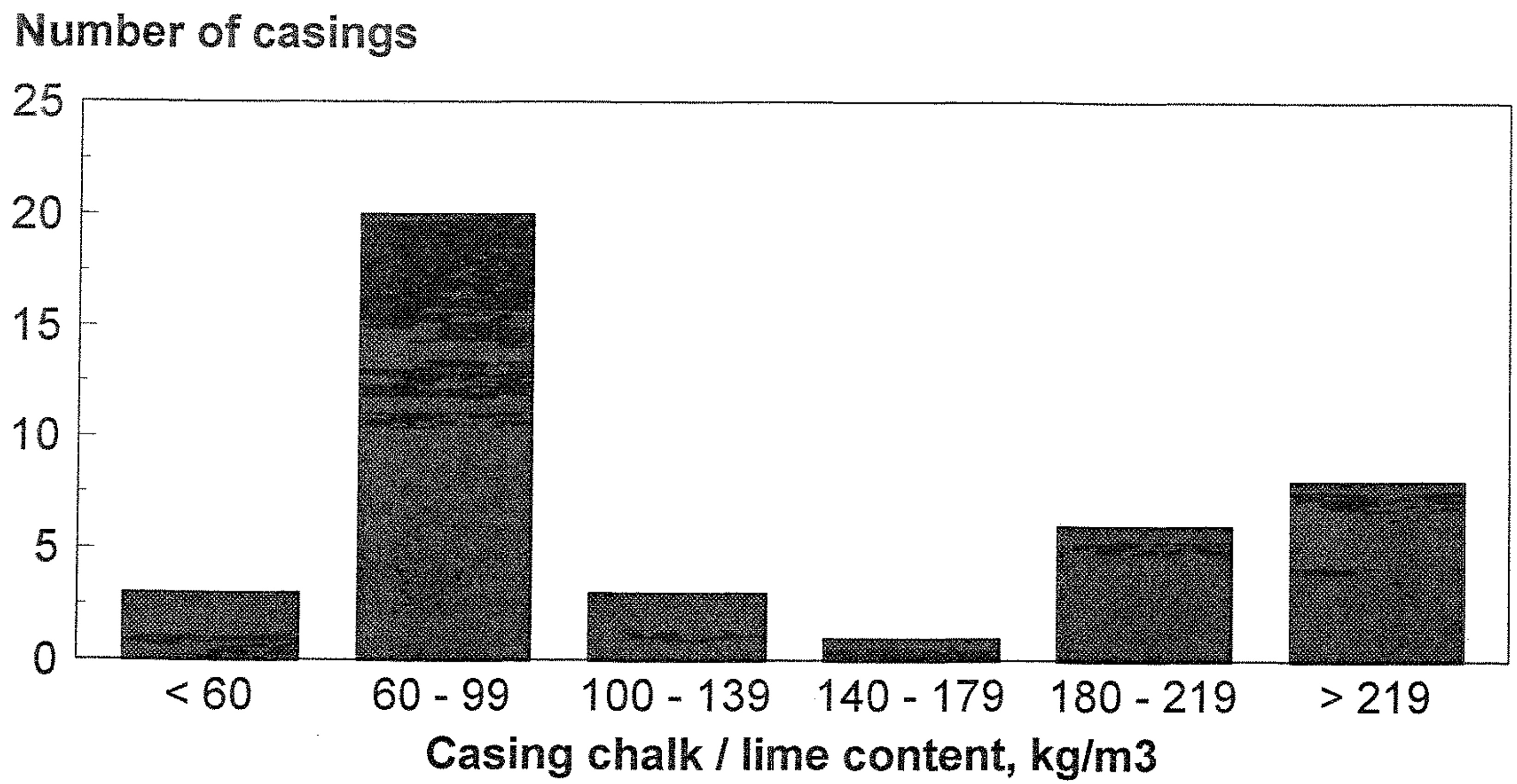
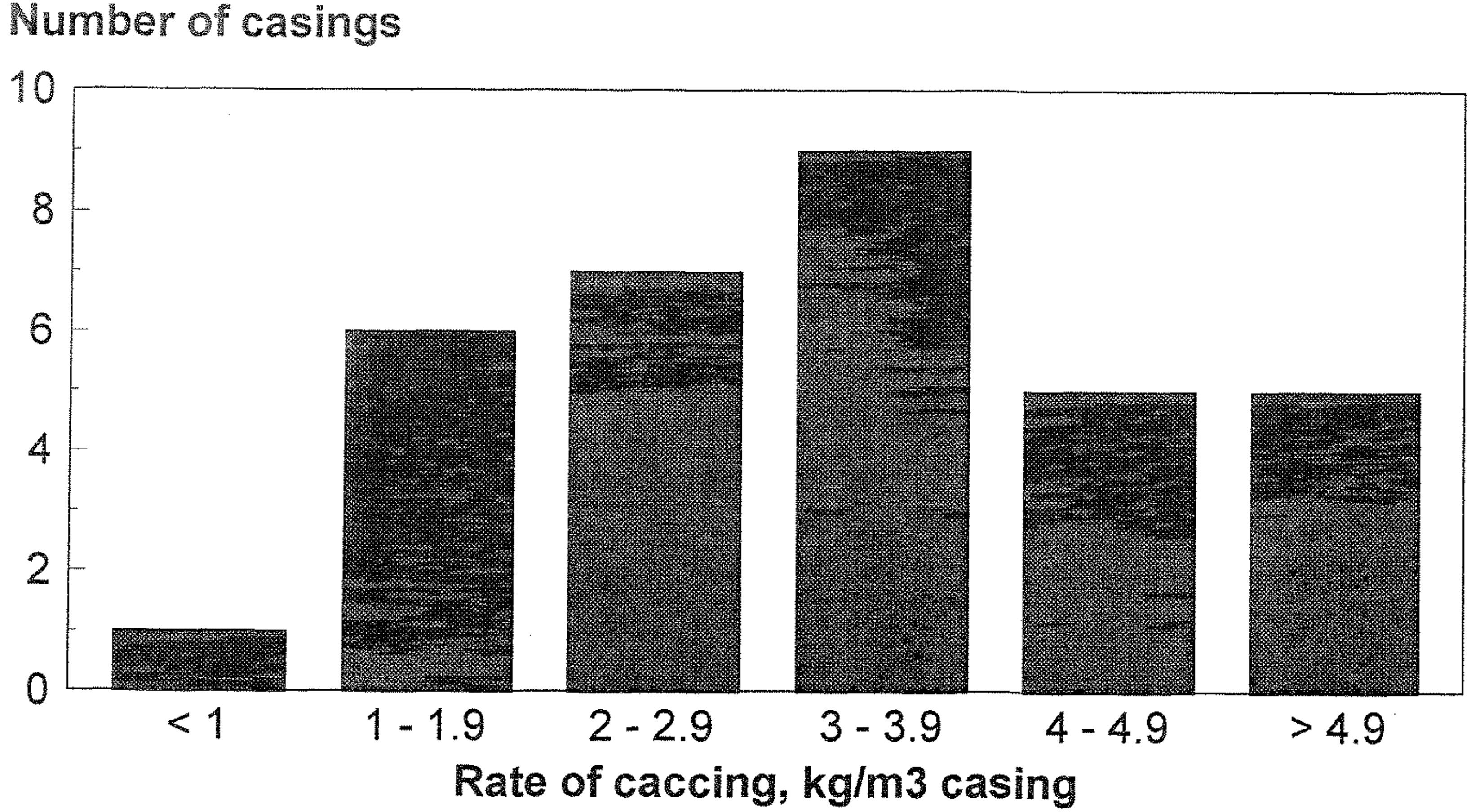
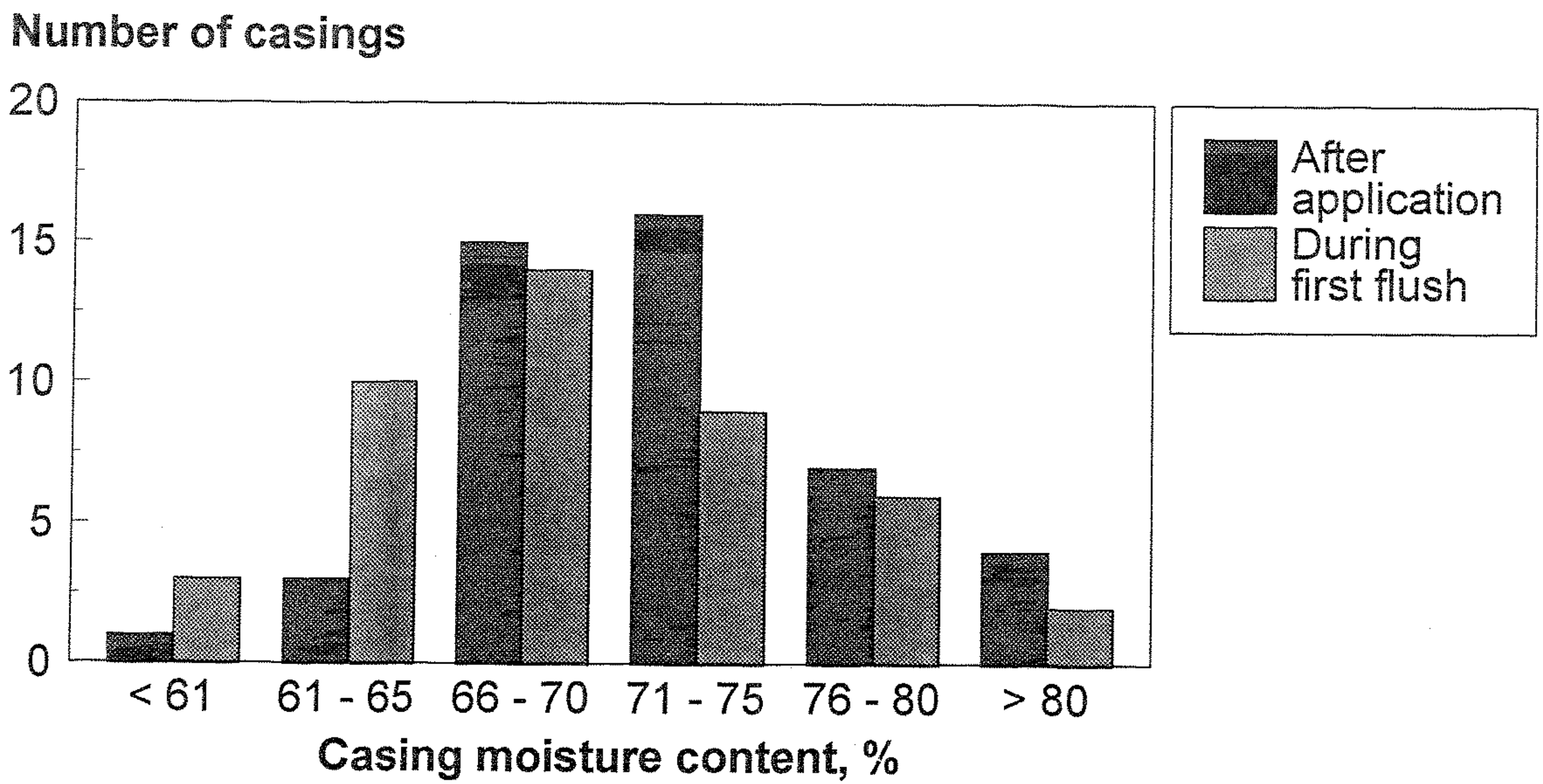


Fig.3 Rate of proprietary caccing



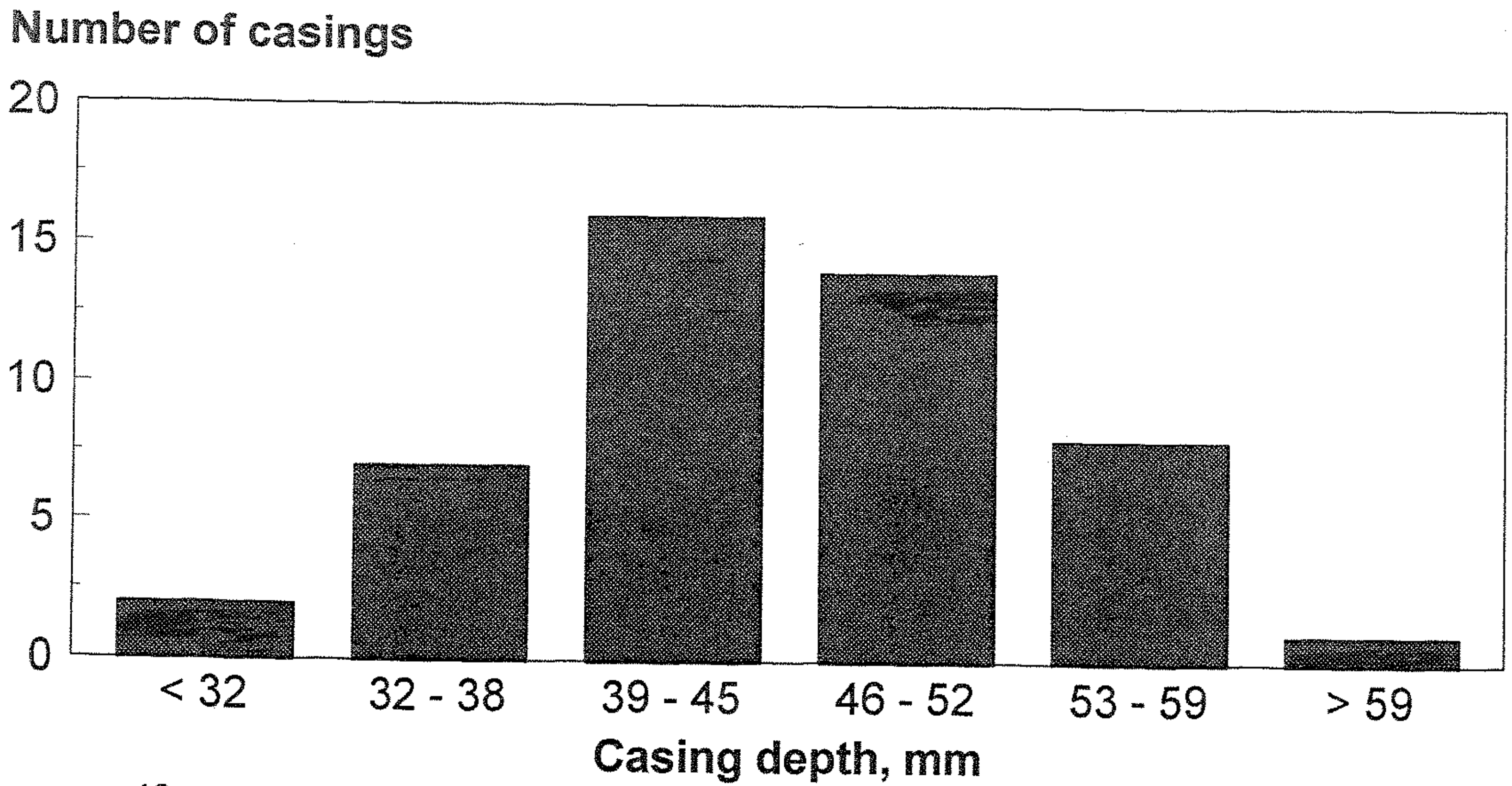
mean = 4.0 kg/m3

Fig.4 Casing moisture content



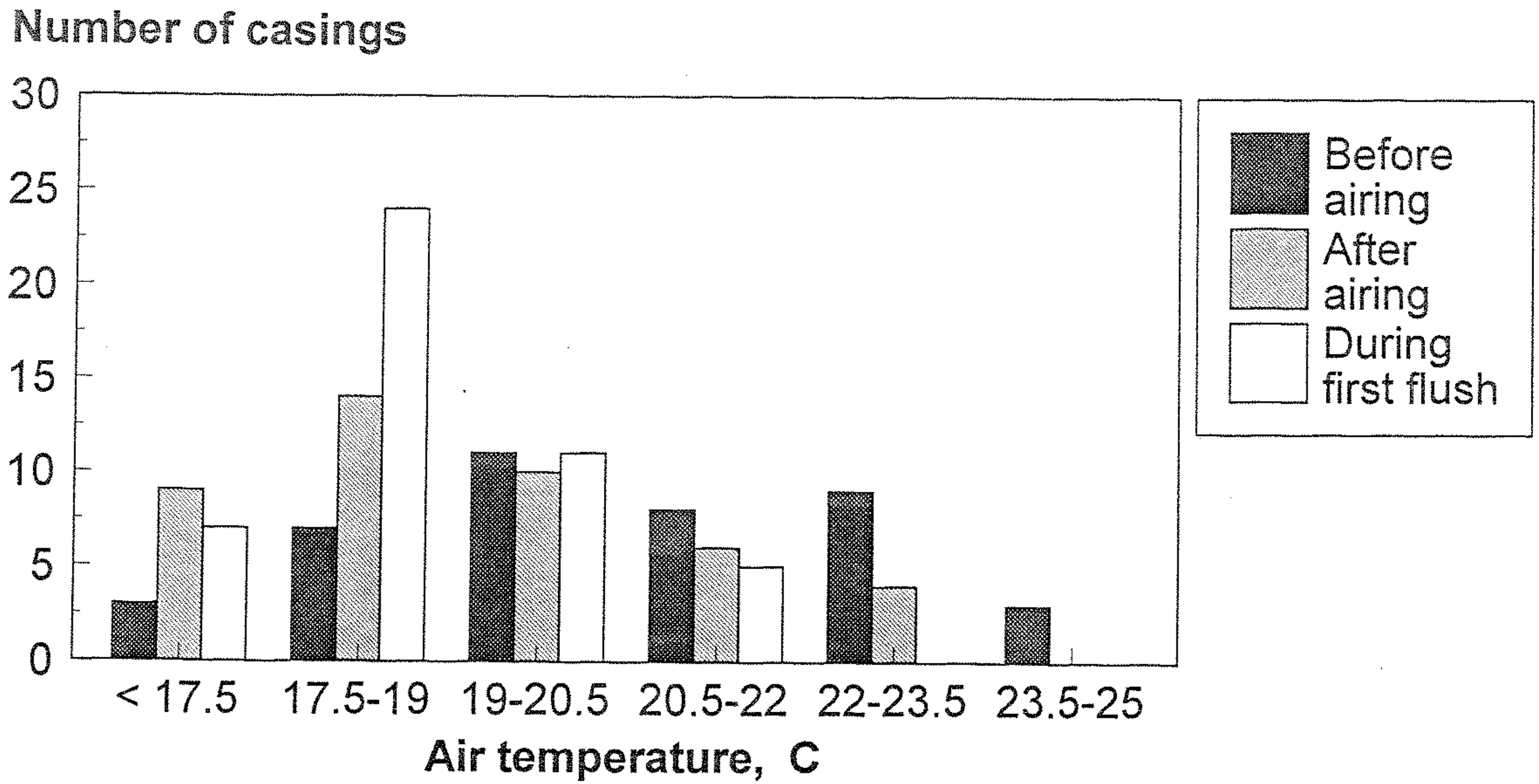
mean, after application = 72.3%
mean, during first flush = 70.2%

Fig.5 Casing depth



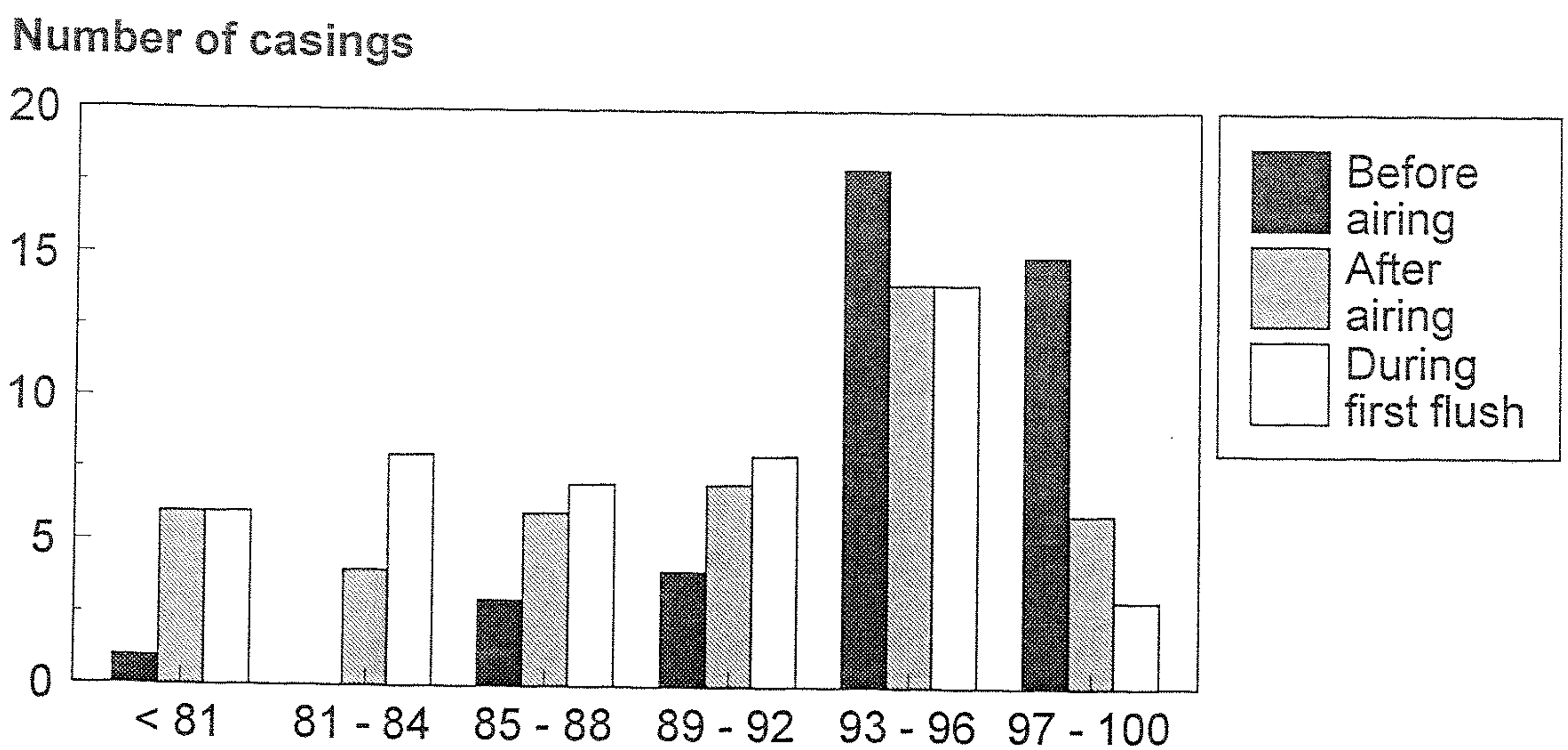
mean = 46mm

Fig.6 Air temperature



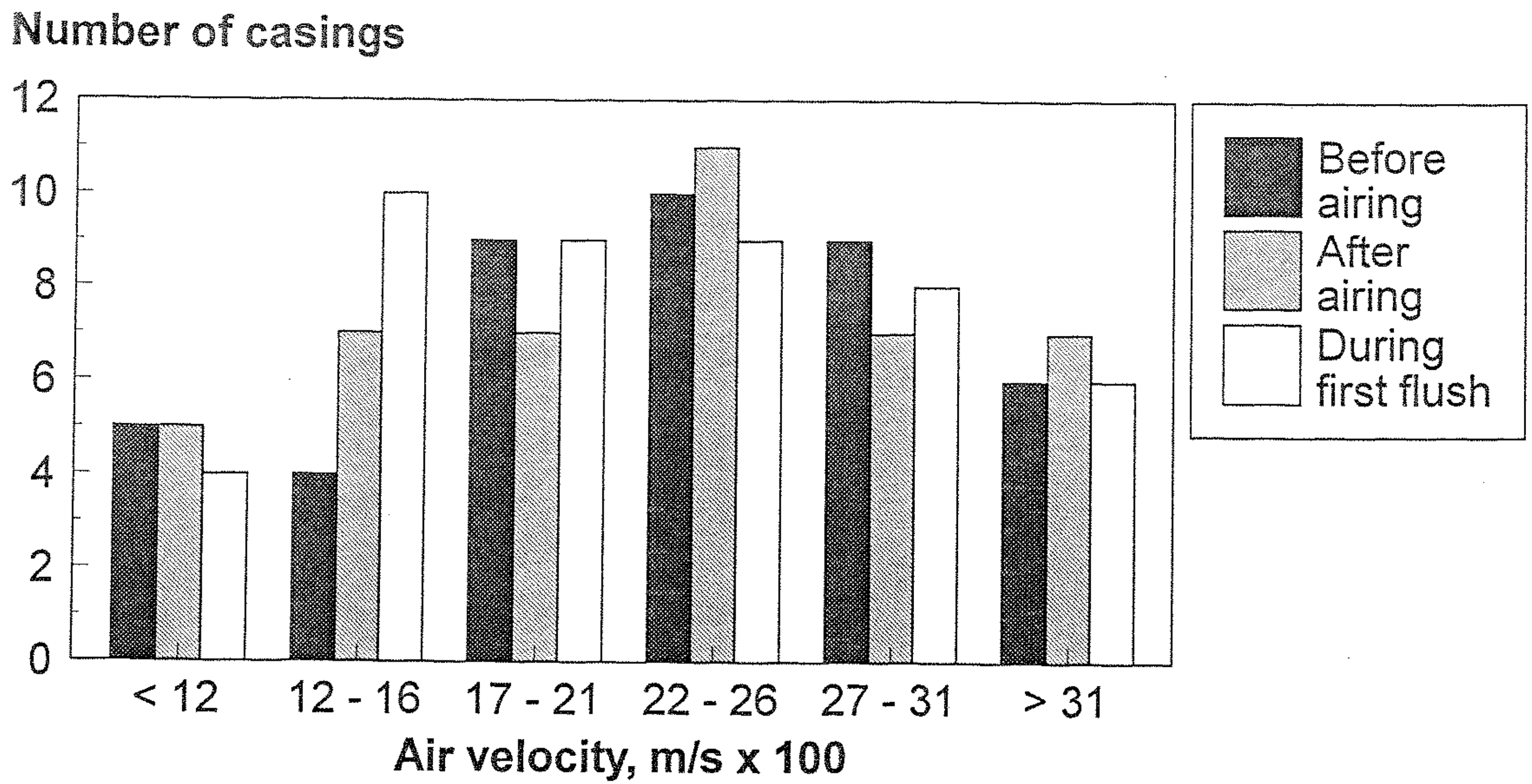
means: before airing = 20.6 C; after airing = 19.0 C
during first flush = 18.5 C

Fig.7 Relative humidity



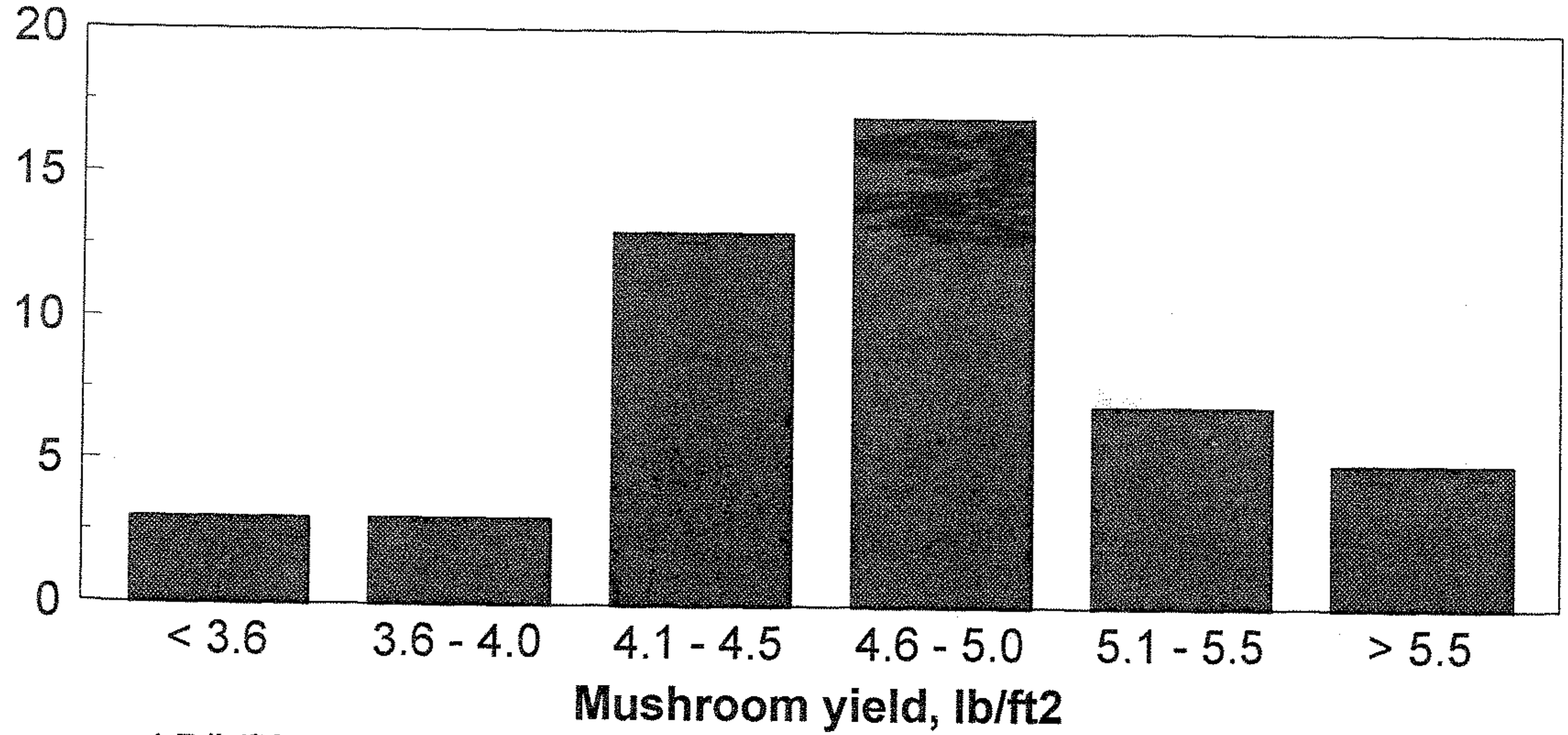
means: before airing = 94.7%; after airing = 90.5%
during first flush = 89.8%

Fig.8 Air velocity across the beds



means: before airing = 0.23 m/s; after airing = 0.24 m/s
during first flush = 0.23 m/s

Fig.9 Mushroom yield per square foot of bed area



mean = 4.7 lb/ft2

Fig. 10 Casing depth and mushroom yield

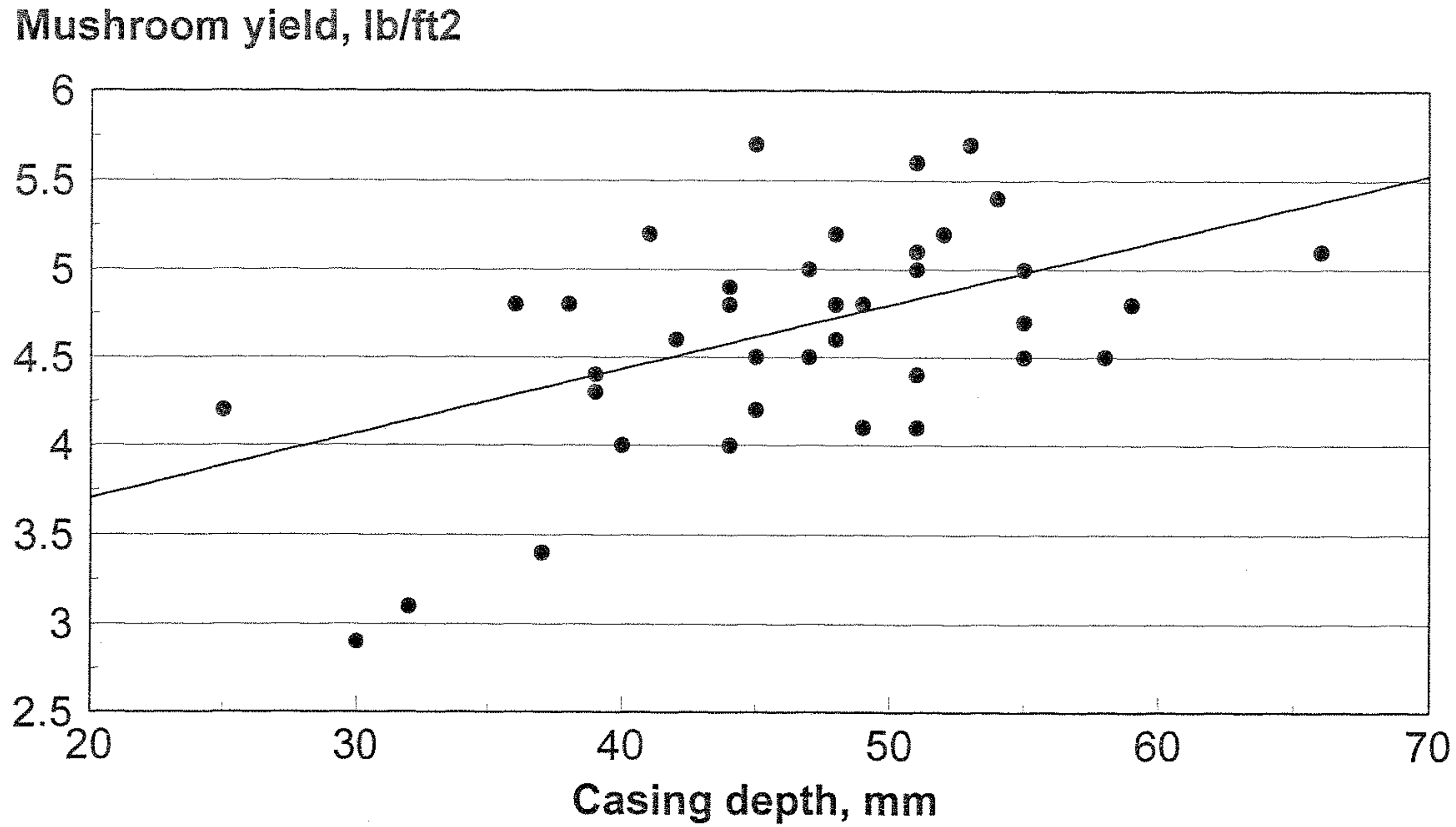


Fig.11 Casing moisture at first flush and mushroom yield

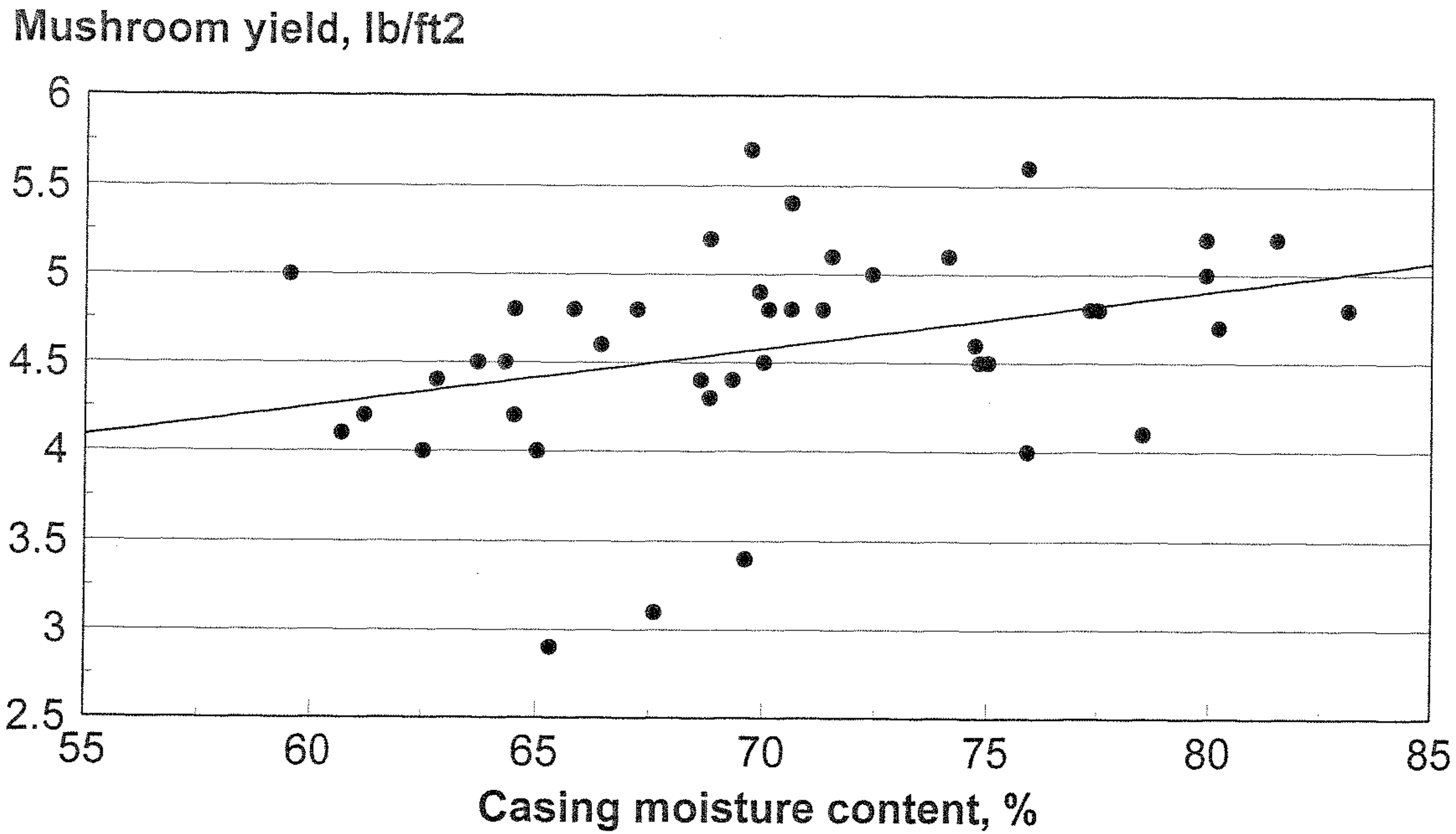
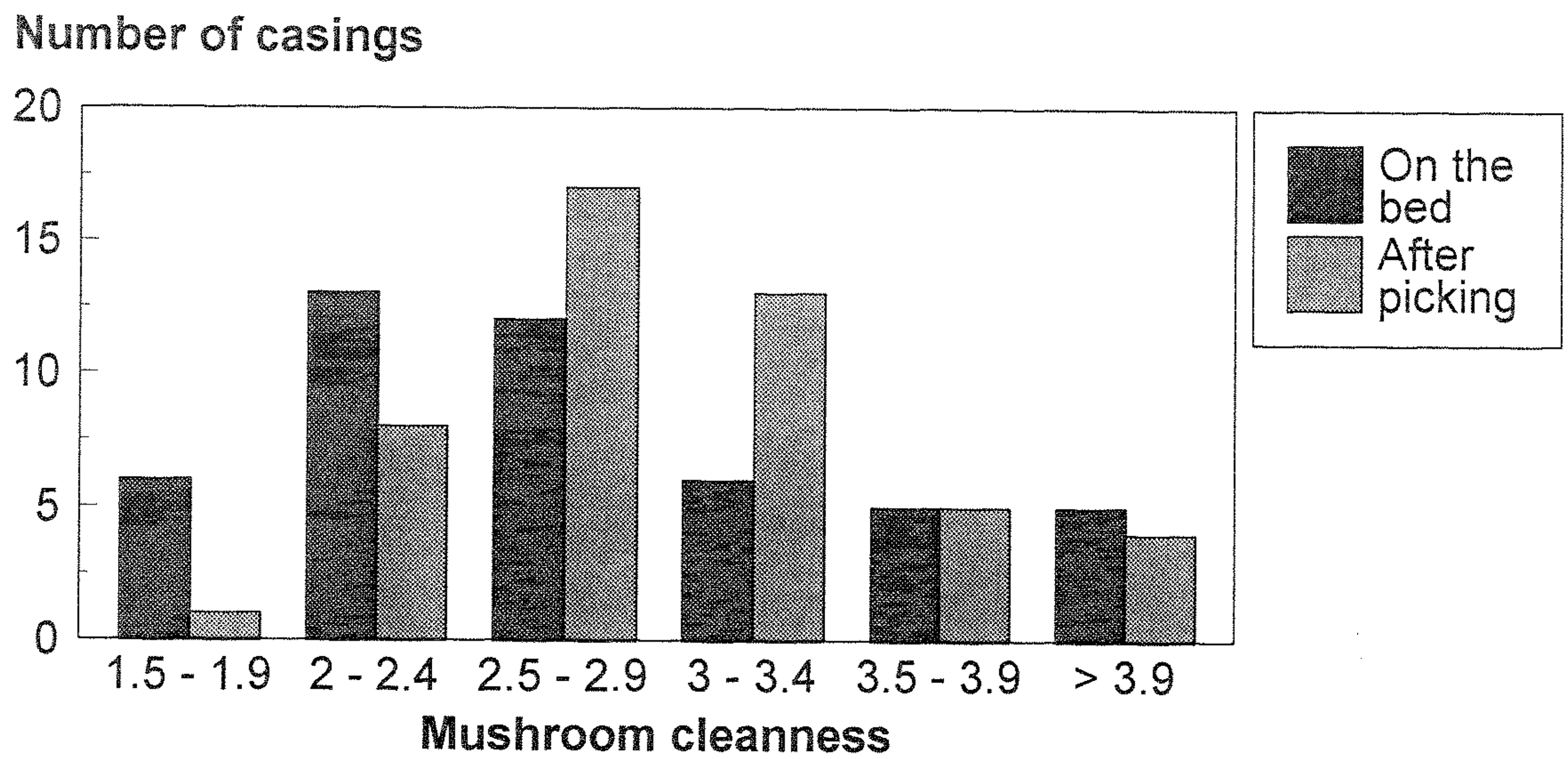
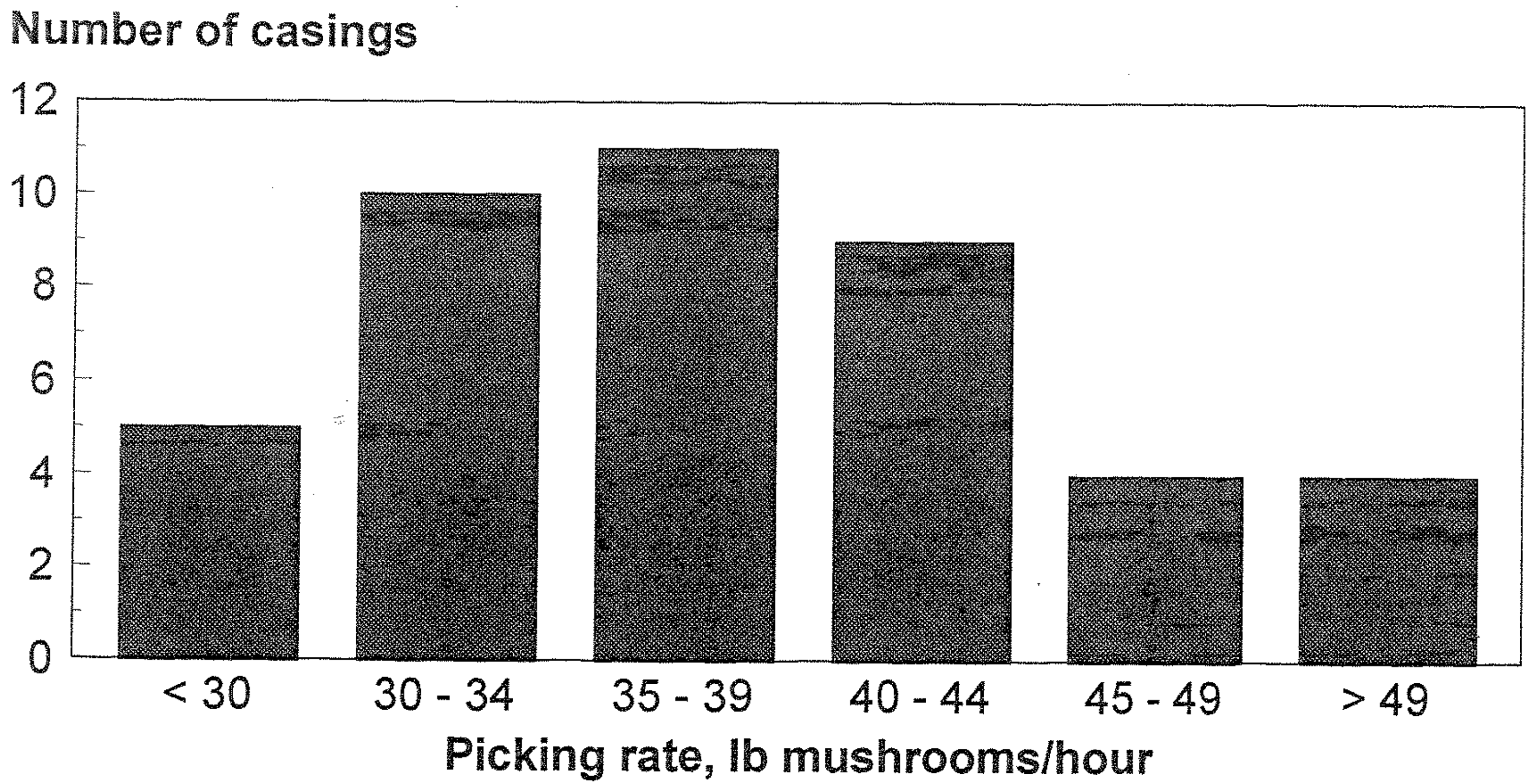


Fig.12 Mushroom cleanness



Cleanness scale, 1 = clean, 5 = dirty
mean, on the bed = 2.6
mean, after picking = 2.8

Fig.13 Mushroom picking rate



mean = 38.2

Fig.14 Blackness of casing and mushroom cleanness

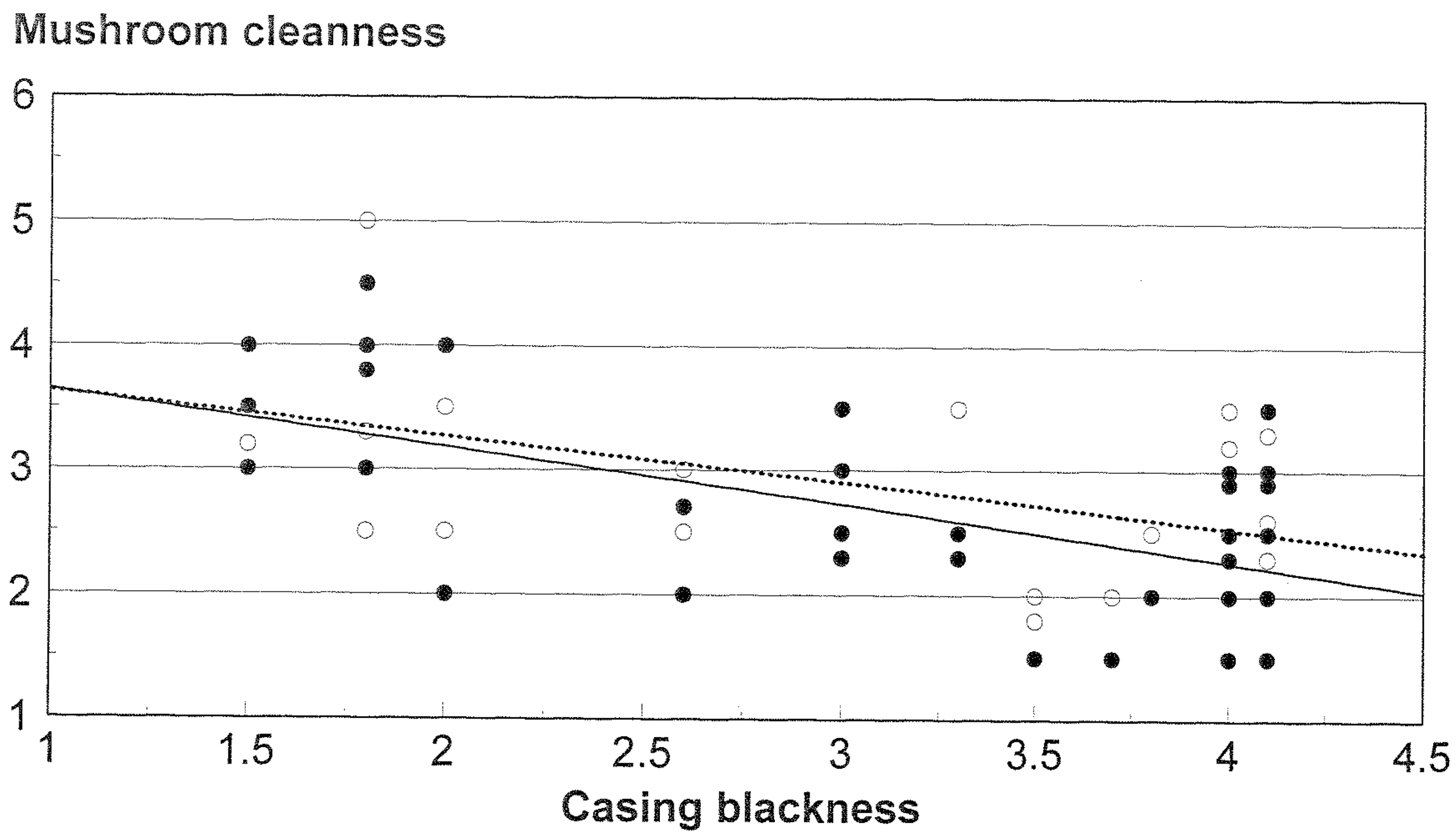


Fig.15 Peat blackness and sporophore distribution

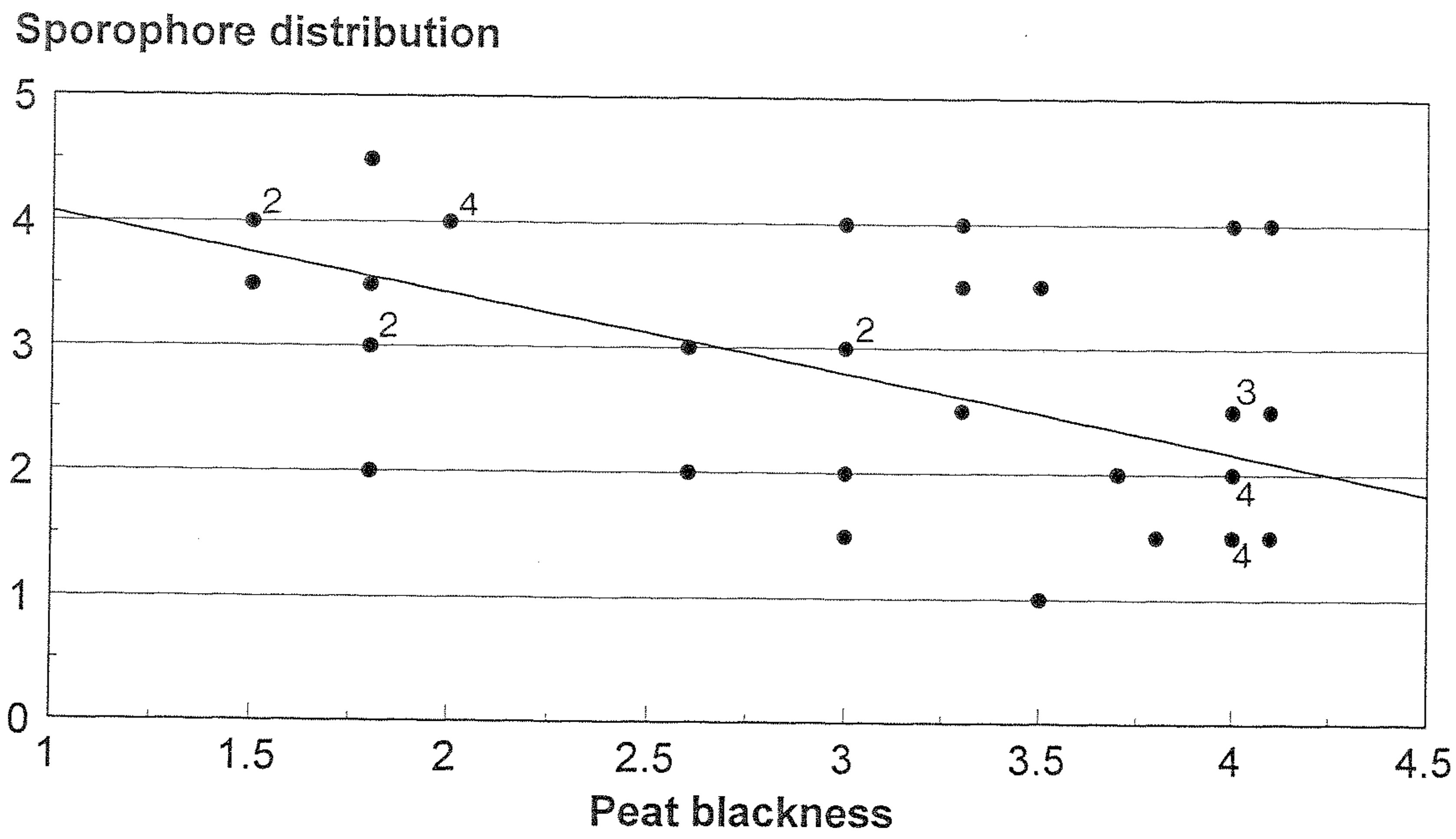
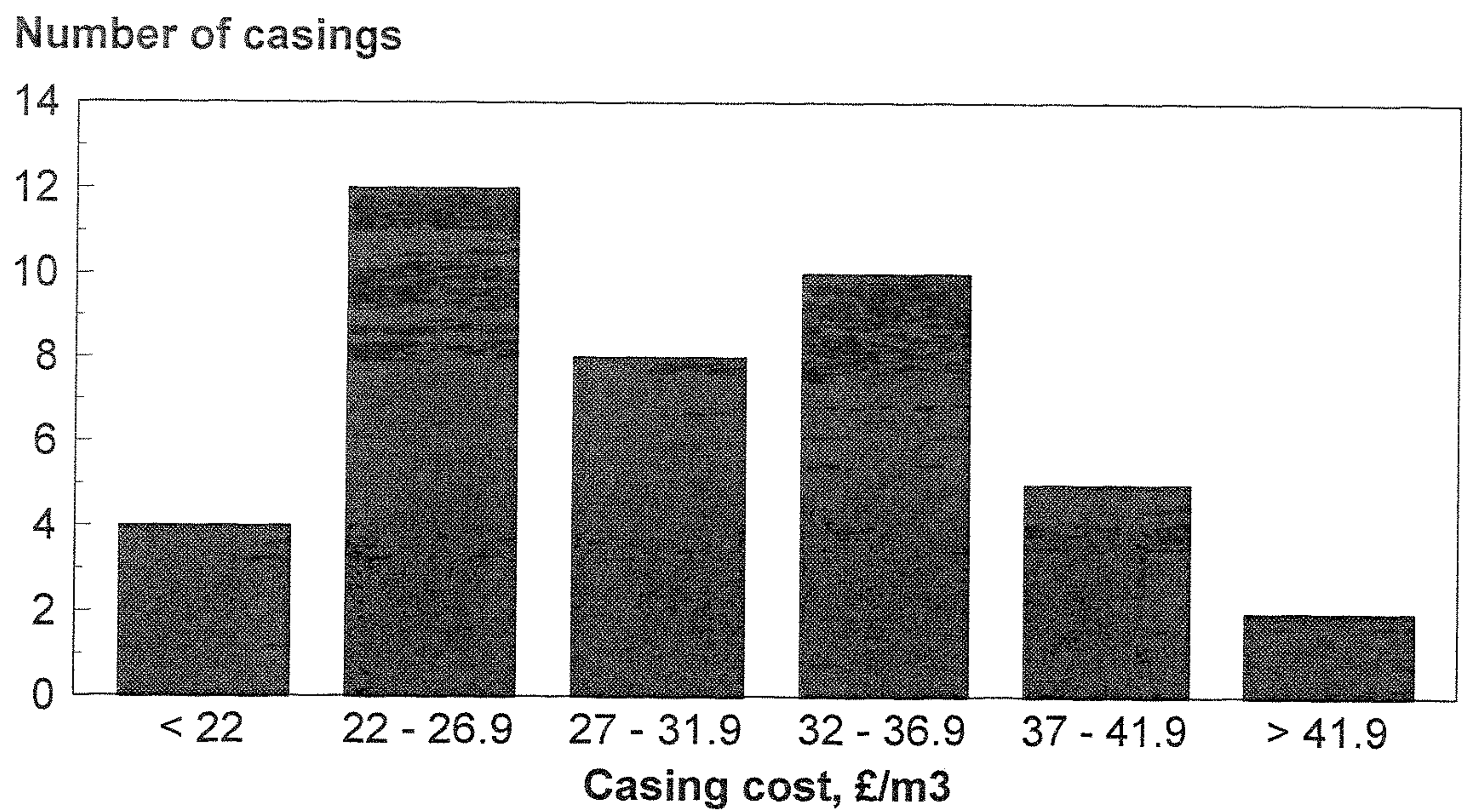
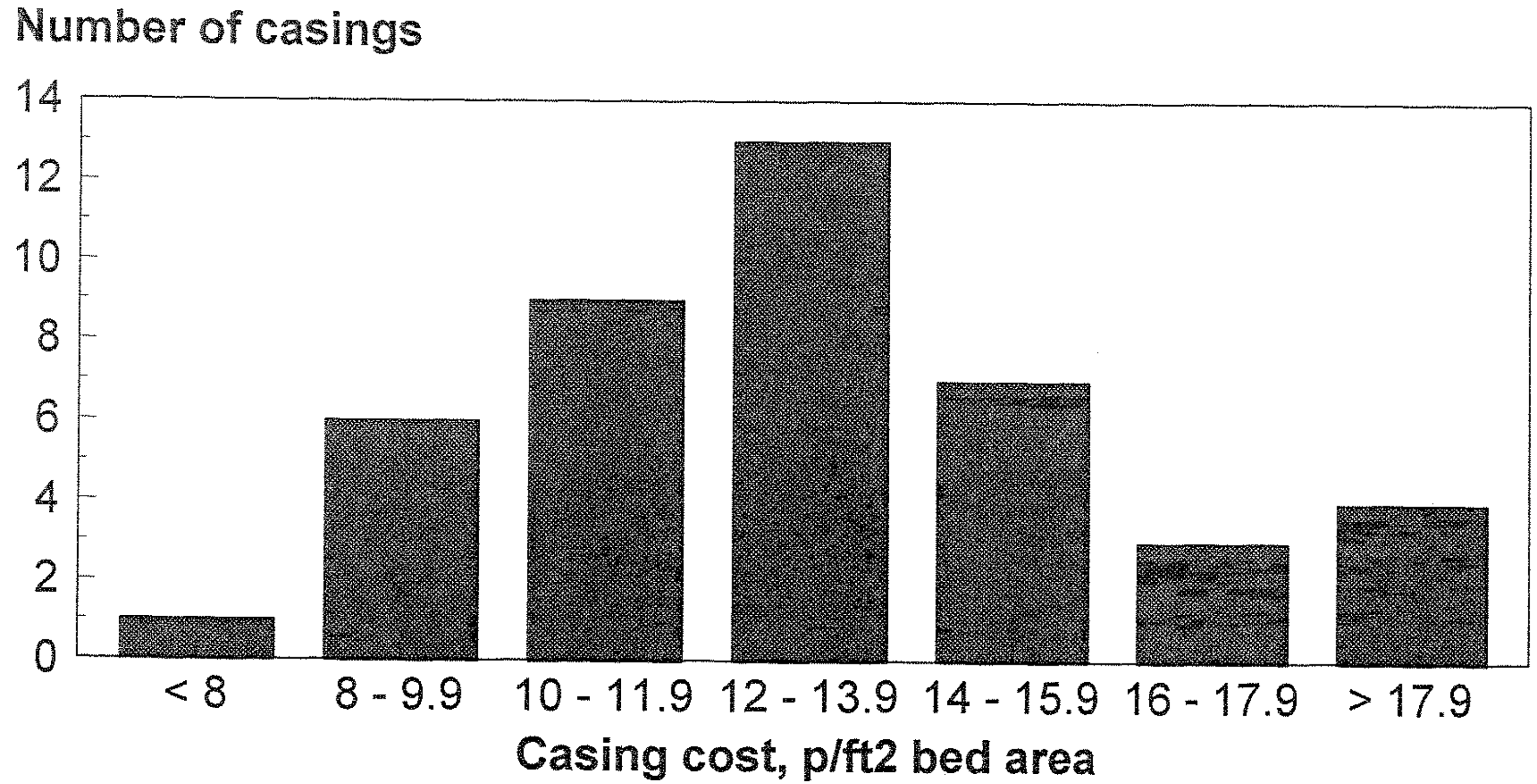


Fig.16 Casing cost per cubic metre



mean = £ 29.9/m3

Fig.17 Casing cost per square foot of bed area



mean = 13.2p/ft2

A	HDC CASING SURVEY 1993	Farm code
1	CASING INGREDIENTS a) Type of peat b) Lime source c) Proportions	
2	MIXING EQUIPMENT a) Mixer b) Conveyors etc	
3	MIXING REGIME a) Time mixer used b) When water added incl. presoak c) How much water d) Time from mix to application	
4	APPLICATION METHOD a) Trayline & detail b) Nets onto shelves c) Bucket d) etc e) other techniques i.e. levelling ruffling	

5	SPAWNED CASING a) Yes b) No c) If yes: type rate methodology	
6	RUFFLING a) Yes b) No c) If yes detail time depth method	
7	DEPTH & pH measured a) b)	see assessment sheet
8	GROWING SYSTEM a) Shelves b) Trays c) Bags etc d) Weight of compost/ft^2 e) Type of compost phase I/II/III	
9	HOUSING a) Type b) Air:bed ratio	
10	AIRING a) Timing b) Regime i.e. 1°C drop/day air/bed temps aimed for	

11	ENVIRONMENTAL REGIMES aspired to levels a) CO_2 b) RH c) Temp d) Air speed	 note and see assessment sheet (b) see assessment sheet (d)
12	WATERING a) Type hose watering tree b) Quantity & timing c) Moisture level at casing & pre 1st fl.	 see assessment sheet (c)
13	PESTICIDES to casing a) what b) when c) how	
14	SUPPLEMENTATION a) Type b) Time i.e. at spawning or casing c) Rate	
15	COST/ft^2 probably only raw materials and estimate of labour and machinery	

B		
16	DURATION OF CASING a) from casing to finish b) No of flushes	
17	YIELD lb/ft^2	
18	FLUSH CHARACTERS a) Yield profile b) Duration c) Interflushing	
19	GRADE OUT a) buttons ↓ b) flats	
20	SPOROPHORE DISTRIBUTION a) clumping b) evenness	see assessment sheet
21	CLEANLINESS a) on beds b) packed c) other quality assessments	see assessment sheet
22	PICKING RATES	
23	PROBLEMS a) panning b) drying out c) corking etc	see assessment sheet

24	MYCELIAL GROWTH a) at pinning b) prior to 1st flush c) 1st-2nd flush	} } see assessment sheet }
25	WEED MOULDS 1 wk after casing onwards	see assessment sheet
26	CHANGES recently made to ingredients, regimes etc	
27	SEASONAL CHANGES made regularly with seasons or effected by season	
28	SUBJECTIVE ASSESSMENT grower comment a) on constraints b) likes c) dislikes	
29	ANY OTHER COMMENT	