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Effects of Casing Soil Amendments and Nutrient Supplementation on Mushroom Cropping

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Abstract. Three strains of *Agaricus bisporus*, i.e, Albidus, Avellanum and Horst U-3 were cultivated in controlled environments. The effect of some nutrient supplementation in the casing material on crop productivity, was studied. The number and yield of mushrooms increased when leucine, sodium chloride and yeast extract were added to the casing at 10 ppm at three day intervals for seven weeks. The size of the fruiting bodies were, also, found to be larger than that of check treatment. The best yield was obtained when the trays were treated with yeast extract. The addition of spawn-run compost (compost fully colonized by fungal mycelium) to casing material resulted in early initiation and development of sporophores, early completion of cropping, and a yield of mushrooms higher by 18-25% depending on the strain. The number of days required for appearance of fruiting bodies primordia and for the harvest was, also reduced by 4-5 days. Horst U-3 was found to be the best strain as far as the period of cropping and total yeild were concerned. These results offer good prospects for increasing the production of mushrooms in commercial farms.

Introduction

The cultivation of mushrooms follow certain steps, such as preparation of the compost, pasteurization, addition of the spawning, and casing. Sporophore initials usually appear within 15-18 days after casing and are ready to be cropped about 7 days later [1].

A technique termed "spawned casing", involving the application of compost fully colonized by the mushroom mycelium (spawn-run compost) to the casing material has been reported to accelerate cropping and to increase the yield of mushrooms [2,3].

Supplementation of compost at casing with various ground seeds and various refined and crude seed oils has caused large increases in mushroom yield [4]. The

increase in the number and the yield of mushrooms has, also, been reported when certain chemicals were sprayed as nutrient supplementation in casing [5].

The purpose of this study was to see the effects of casing soil amendments and some nutrient supplementation in casing on the yield of mushrooms.

Materials and Methods

The cultivation of *Agaricus bisporus* was carried out under controlled environments on the compost. Three strains of *Agaricus bisporus:* Albidus, Avellanum and Horst U-3; were cultivated. The first two strains were obtained from Central Bureau Voor Sehimmel Cultures, Holland and Horst U-3 was supplied by R.C. Cooke, University of Sheffield, England.

According to the methods suggested by Atkins [1], Gerrits [6] and Khan *et al* [7], compost consisted of:

Horse manure	= 50 kg
Chicken manure	= 25 kg
Wheat straw	= 30 kg
Gypsum	= 2.5 kg

After mixing the components, the compost pile (stack) was left on the floor of the preparatory room for microbial degradation. The compost was then pasteurized and after cooling put into wooden flats (2 × 1.5 × 1.5 feet). At this stage the temperature of the compost was 25°C, with 2% nitrogen content and 70% moisture content.

Spawns were prepared on sorghum grains from pure cultures of the fore mentioned strains. Sorghum grain spawns of the three strains, were mixed separately with the compost at a rate of 2% of the fresh weight of the compost. The inoculated compost was covered with dark plastic sheets and the flats were placed in a growing room for mycelial growth at 24 ± 1°C.

Spawn-run compost was added to casing peat moss at the rate of 4% by fresh weight. Pasteurized compost used for amending the casing peat was the same as that used to fill the flat but without the spawn. As a check treatment, only peat moss was used for the casing. Four replicates were used for each treatment. Harvested mushrooms were weighed and the percentage increase in yield was determined.

A trial on nutrient supplementation in casing through spraying was conducted to see the effect of sodium chloride, yeast extract and leucine on the yield of fruiting bodies. In this experiment, only spawns of strain Horst U-3 were used. The supplements were used at the rate of 10 ppm and were sprayed at intervals of 3 days, followed by water spraying, for seven weeks. The flats without supplements (Check) were sprayed only with water. The production rates for the various supplements were recorded and compared.

Results and Discussion

Results obtained for the effect of adding spawn-run compost to the casing peat are shown in Table I. The results show a reduction in the number of days required for the appearance of primordia and for the first harvest. The yield of fruiting bodies increased when spawn run compost was added to the casing peat. The reduction in the number of days was found to be from 4 to 5 and the increase in yield percentage was between 18 and 25% depending on the strain.

Table 1. Effects of adding spawn-run compost to casing material on the yield of three strains of *A. bisporus*.

Mushroom strain	Casing amendment	Days to first appearance of primordia	Days to first harvest	Total period of cropping (days)	Yield(gms/tray)	Increase(%) in yield
Albidus	Unamended (control)	19	24	40	830	
	Spawn-run compost	14	19	35	980	18.0
Avellanum	Unamended (control)	19	24	40	820	
	Spawn-run compost	15	20	35	965	17.2
Horst U-3	Unamended (control)	18	22	38	880	
	Spawn-run compost	14	18	32	1090	25.0

Each value represent the mean of four replicates.
Mean value highly significant at 0.0001 level.

Statistical analysis was carried out and 'T' test at 5% level for equal variances (P=0.0001) showed that the yield was highly significant in all the strains, when casing material was amended with spawn-run compost.
Horst U-3 was found to be the best strain as far as the period of cropping and total yield was concerned.

Nair and Hayes]3] reported that the population of Pseudomonads in the casing layer was increased by the addition of spawn-run compost to the casing peat.

The increase in the level of the Pseudomonad population was associated with an increase in the yield of mushrooms in the amended series. The influence of Pseudomonads in the casing layer on the formation of sporophores has, also, been shown by other workers [8-10].

Aeration of the casing layer is also a significant factor in fruiting bodies formation [11]. The addition of spawn-run compost to the casing peat increases the aeration of the casing layer, which, in turn, increases the activity of aerobic Pseudomonads in the casing layer. Moreover, the rate of water loss from mixtures of peat and spawn-run compost is higher than from peat alone. Mushroom mycelia colonized amended casing more rapidly than the unamended casing, reflecting a better aeration conditions in the amended casing layer.

MacCanna and Flanagan [2] suggested that the reason for the reduction in cropping period as a result of using the "spawned casing" technique is simply that the spawn-run compost facilitates the colonization of the casing peat by the compost mycelia. However, according to Nair and Hayes [3], it depends on the interaction of several factors, of which the degree of aeration of the casing layer and the activity of Pseudomonads in that layer are important.

Irrespective of the strain added to the casing peat, the sporophores which fromed were of the strain cultivated in the compost. This may be due to the greater availibility of nutrients to the strain in the compost than to that in the casing peat.

Results obtained from supplementation experiments are shown in Table 2. The number and yield of mushrooms was increased when the supplements were added to the casing at 10 ppm and three day intervals. GLM procedure ($F=16.18$ has $P=0.0002$) showed that the yield was significant when nutrient supplements were added to the casing material. The best yield was obtained when the flats were treated with yeast extract. This confirms the results of Singh and Jain [5], who reported that the addition of yeast extract produced more mushrooms and gave a higher yield than the addition of chemicals.

Table 2. Effect of supplements on number and yield of *A. bisporus*. (Results shown are the average of two trays* for each treatment).

No. of	Control		Leucine		Sodium chloride		Yeast extract	
	**	***						
crops	No.	wt.	No.	wt.	No.	wt.	No.	wt.
1	48	406	61	552	54	462	68	656
2	58	415	65	605	62	542	83	682
3	42	351	60	561	47	416	75	619
4	28	201	36	219	31	282	43	306
Total	176	1373	222	1937	194	1702	269	2263

* Flat size (2×1.5×1.5 feet).
** Number of mushrooms.
*** Weight in grams.
GLM [F=16.8] highly significant
[P=0.0002]

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التأثيرات الناتجة عن إضافة بعض المركبات الغذائية إلى الطبقة المغطية لبيئة النمو على إنتاجية ونوعية الأجسام الثمرية لفطر عيش الغراب

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ملخص البحث. تم زراعة ثلاث سلالات من فطر أجاريكس بايسبوراس (ألبيدس، أفيلانم وهورست يو-٣) تحت ظروف بيئية محكمة، وذلك لغرض دراسة تأثير إضافة بعض المركبات الغذائية إلى مكونات الغطاء على إنتاجية المحصول ونوعيته. وقد أظهرت النتائج زيادة في الكمية المنتجة من الأجسام الثمرية للفطر وذلك عند إضافة بعض المركبات الغذائية إلى الطبقة المغطية لبيئة النمو بمعدل ١٠ أجزاء في المليون كل ثلاثة أيام لمدة ستة أسابيع. وقد وجد أن حجم الأجسام الثمرية كان أكبر مما هو عليه في المعاملة المقارنة، وأن أفضل إنتاجية تم الحصول عليها عندما عوملت الأدراج الخشبية النامي بداخلها الفطر بمستخلص الخميرة. وقد أثبتت الدراسة كذلك أن إضافة الغطاء المعامل بالغزل الفطري لفطر أجاريكس بايسبوراس إلى بيئة النمو (الكمبوست) ينتج عنه تكوينًا مبكرًا للأجسام الثمرية وإنتاجية عالية للمحصول بمعدل زيادة تراوحت بين ١٨ - ٢٥٪ حسب نوع السلالة، إذا ما قورن ذلك بالغطاء غير المعامل (المقارنة)، كما أن المدة الزمنية ما بين ظهور بدايات الأجسام الثمرية للفطر وأول محصول قد انخفضت بمقدار ٤ - ٥ أيام. وقد وجد أن السلالة (هورست - يو٣) كانت من أفضل السلالات المستخدمة من الناحية الإنتاجية وسرعة النمو، وهذه النتائج تحمل في طياتها مدلولات جيدة لزيادة إنتاج فطريات عيش الغراب في المزارع الفطرية التجارية.