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अखिल भारतीय समन्वयित खुम्ब अनुसंधान परियोजना
All India Co-ordinated Research Project on Mushroom



खुम्ब अनुसंधान निदेशालय
DIRECTORATE OF MUSHROOM RESEARCH

(भारतीय कृषि अनुसंधान परिषद्)
(Indian Council of Agricultural Research)

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Chambaghat, Solan - 173 213 (H.P.), India

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All India Co-ordinated Research Project on Mushroom

Directorate of Mushroom Research

Solan - 173 213, India

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Cover Page : Left to right
Upper row : *Volvariella volvacea*, *Agaricus bisporus*,
Pleurotus florida
Bottom row : *Lentinula edodes*, *Termitomyces* sp. on
sale, *Dictyophora indusiata*

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FOREWORD

The report contained in this document pertains to various achievements made during the financial year 2008-09 by ten Coordinating Centres and one Cooperating Centre working under the aegis of All India Coordinated Research Project on Mushroom (AICRPM) with the Headquarters at Directorate of Mushroom Research, Solan (HP). The Centres are located at Punjab Agricultural University, Ludhiana (Punjab), G.B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand), Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan), Indira Gandhi Krishi Vishwa Vidyalaya, Raipur (Chhattisgarh), Mahatma Phule Agricultural University, Pune (MS), Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu), Kerala Agricultural University, Thiruvananthapuram (Kerala), ICAR Research Complex for NEH Region, Barapani (Meghalaya), Horticulture and Agro-forestry Research Programme (ICAR Research Complex for Eastern Region), Ranchi (Jharkhand) and Dr. Y.S.Parmar University of Horticulture and Forestry, Nauni, Solan (HP). All the Coordinating Centres along with Headquarters, DMR, Solan conducted a total of 18 experiments following a common package of practices finalized and adopted at Biennial Group Meeting of Workers of AICRPM held on 26-27 October, 2006 at IGKVV, Raipur and 27-28 December, 2008 at DMR, Solan (HP).

During the year under report, attempts were made to bring out superior strains of white button mushroom, paddy straw mushroom, milky mushroom, oyster mushroom, and evaluation of locally available agro-industrial wastes as casing materials for button mushroom, post harvest technology and standardization of cultivation technology of specialty mushrooms which are needed to diversify the mushroom cultivation scenario in the country. Attempts were also made to optimize the yield of oyster, button, milky, paddy straw and shiitake mushrooms by way of using different substrates, chemicals, casing materials and supplements. Safer chemicals (EDTA-DiNa) were tried for improving the shelf life of button mushroom in replacement of potassium metabisulphite, which is already in use and banned in some developed countries. Some new experiments especially on packaging and drying of mushrooms were also taken up. Emphasis was also laid on germplasm collection and conservation and survey and surveillance for diseases and insect-pests of mushrooms in specific areas.

Strainal evaluation trials at multi-locations have helped in identification of some better strains like S-130 and CM-10 of *Agaricus bisporus*, Vv-09 and Vv-11 of *Volvariella volvacea*, CI-6 of *Calocybe indica*, PF-03 of *Pleurotus florida* and PSc-4 and PSc-5 of *Pleurotus sajor-caju*. Casing mixture prepared from 2 years old spent mushroom substrate in combination with FYM in 1:1 (v/v) ratio gave maximum yield of *A.bisporus*. The washing treatment with 200 ppm EDTA, 500 ppm EDTA and 100 ppm EDTA + 0.02% KMS has also provided a safer alternate to higher concentration of KMS for increasing shelf life of button mushroom. Packaging of button mushroom in 100 gauge PP bags has increased the keeping quality of button mushroom.



In case of oyster mushroom, spraying of different chemicals have invariably increased the yield at different Centres. The superior yield of blue oyster mushroom (*Hypsizygus ulmarius*) has improved the scope of introduction of new species in oyster mushroom scenario. The results obtained in drying experiment have also opened the gate for post harvest management of oyster and milky mushroom by using blanching treatment followed by sun drying and cabinet drying, respectively.

Use of different types of beds and different substrates has opened up options for the introducing tropical mushrooms like paddy straw and milky mushroom. The achievement made in obtaining consistently good yield of shiitake has enhanced the scope of introducing this mushroom in the country for cultivation at farmers' level. During the previous years, milky mushroom and blue oyster mushroom (*Hypsizygus ulmarius*) have shown great promise in different regions of the country and has provided a viable alternative to the much popular mushroom species. However, much needs to be done for popularizing the paddy straw, shiitake and reshi mushrooms, which are easy to cultivate and possess superior medicinal attributes. The recycling of spent mushroom substrate also needs proper attention and region specific R & D work will help in integration of different facets of Indian agriculture. The other aspects like germplasm collection and conservation, survey and surveillance of diseases and insect-pests and transfer of technology have also gained the requisite momentum, which is the need of the hour to boost the overall production of mushrooms in the country. The extension services along with supply of quality spawn have contributed significantly in popularizing the mushroom even in remote areas of the country.



(Manjit Singh)



सारांश

वर्ष 2008-09 के दौरान मुख्यालय खुम्ब अनुसंधान निदेशालय, सोलन (हि०प्र०), सहयोगी केन्द्र तथा विभिन्न राज्यों में स्थित सभी अखिल भारतीय समन्वयित खुम्ब अनुसंधान परियोजना केन्द्रों द्वारा खुम्ब अनुसंधान निदेशालय, सोलन (हि०प्र०) में दिनांक 27-28 दिसम्बर, 2008 तक आयोजित द्विवर्षीय कार्यशाला में तय किये गये तकनीकी कार्यक्रम के अनुसार प्रयोग किये गये।

विभिन्न केन्द्रों पर श्वेत बटन मशरूम (*एगोरिकस बाईसपोरस*) के कुल चार प्रयोग किये गये। श्वेत बटन मशरूम के प्रजाति मूल्यांकन पहलू पर छः परियोजना केन्द्रों पर प्रयोग किये गये। इन प्रयोगों के दौरान पाया गया कि सी०एम०-10 तथा सी०एम०-13 प्रजाति ने पूणे केन्द्र पर सार्थकतापूर्वक अधिक उपज दी। जबकि पंतनगर केन्द्र पर एस०-130, सी०एम०-16 तथा सी०एम०-10, फैजाबाद केन्द्र पर सी०एम०-13, रायपुर केन्द्र पर सी०एम०-10, उदयपुर केन्द्र पर एस०-130, एवं सी०एम०-10 तथा लुधियाना केन्द्र पर सी०एम०-10 प्रजातियों ने अन्य प्रजातियों की तुलना में अच्छी पैदावार दी। सभी केन्द्रों पर प्राप्त पैदावार पर आधारित औसतन पैदावार के अनुसार एस०-130 प्रजाति ने अन्य प्रजातियों की तुलना में सबसे अधिक पैदावार दी। उदयपुर केन्द्र पर प्रजाति सी०एम०-15, पंतनगर केन्द्र पर सी०एम०-10, सी०एम०-15, सी०एम०-16 तथा एस०-130, लुधियाना केन्द्र पर सी०एम०-10, फैजाबाद केन्द्र पर सी०एम०-12 तथा रायपुर केन्द्र पर सी०एम०-14 व सी०एम०-16 प्रजातियों का प्रथम तुड़ान में लिया गया समय सबसे कम पाया गया। सबसे कम औसतन प्रथम तुड़ान समय 12.77 दिन (सी०एम०-15) व अधिकतम औसतन समय 16.31 दिन (सी०एम०-13) पाया गया। विभिन्न प्रजातियों के फलनकाय का औसतन वजन 8.8 ग्राम से 25.08 ग्राम तक पाया गया। खुम्ब फलनकाय की गुणवत्ता तथा बीमारियों का संक्रमण क्रमशः लुधियाना तथा पंतनगर केन्द्रों पर दर्ज किया गया तथा सी०एम०-16 तथा एस०-130 प्रजातियों में अच्छी गुणवत्ता पाई गई। जबकि सी०एम०-12, सी०एम०-13, सी०एम०-15 तथा सी०एम०-16 प्रजातियों में बीमारियों का संक्रमण बिल्कुल नहीं देखा गया।

विभिन्न केसिंग अवयवों के मूल्यांकन संबंधी प्रयोगों में पाया गया कि लुधियाना व उदयपुर केन्द्रों पर गोबर की खाद व स्पेंट मशरूम कम्पोस्ट को बराबर हिस्सों में मिलाकर बनाई गई केसिंग मिट्टी ने अधिकतम उपज क्रमशः 14.80 किलोग्राम/क्विंटल व 16.78 किलोग्राम/क्विंटल कम्पोस्ट दी। दूसरी तरफ क्वायरपिथ व गोबर की खाद को बराबर हिस्सों में मिलाकर तैयार की गई केसिंग मिट्टी को प्रयोग करने पर पूणे केन्द्र पर प्रति क्विंटल कम्पोस्ट से 19.55 किलोग्राम अधिकतम उपज प्राप्त हुई। विभिन्न कृषि-औद्योगिक अपशिष्टों को केसिंग अवयवों के रूप में इस्तेमाल करने के उद्देश्य से इनके भौतिक व रासायनिक गुणों जैसे - पी०एच०, जलधारण क्षमता, चालकता व घनत्व का मूल्यांकन किया गया। कणों के घनत्व को छोड़कर, अन्य सभी गुण लुधियाना, उदयपुर व पूणे केन्द्रों पर क्वायरपिथ व गोबर की खाद के मिश्रण से तैयार केसिंग मिट्टी में अधिकतम पाये गये। तुड़ाई उपरांत श्वेत बटन मशरूम की गुणवत्ता बनाये रखने व अधिक समय तक भण्डारण करने के उद्देश्य से खुम्बों को जब 100 पी०पी०एम० सांद्रता के ई०डी०टी०ए० के घोल को 0.02 प्रतिशत

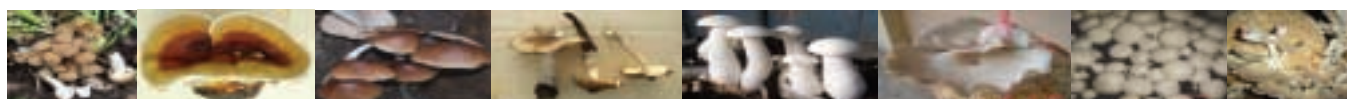


पोटाशियम मेटाबाईसल्फाईट (के०एम०एस०) के घोल के साथ मिलाकर तैयार किये गये घोल से धोया गया तो लगभग सभी केन्द्रों पर खुम्बों की सफेदी अधिक पायी गई तथा 5⁰ सेल्सियस तापमान पर 48 घण्टों तक मशरूम का भण्डारण सही तरह से किया जा सका। सामान्य तापमान पर भण्डारण करने पर 200 पी०पी०एम० व 500 पी०पी०एम० सांद्रता के ई०डी०टी०ए० घोल से धुलाई करने पर 100 पी०पी०एम० ई०डी०टी०ए० 0.02 प्रतिशत पोटाशियम मेटाबाईसल्फाईट (के०एम०एस०) के घोल के मिश्रण से धोने पर प्राप्त सफेदी के समतुल्य सफेदी फैजाबाद, लुधियाना व पूणे केन्द्रों पर प्राप्त हुई। सामान्य तापमान व रेफ्रिजरेटिड दशाओं में भण्डारण करने पर मशरूम की सफेदी, वजन में कमी व कैप का खुलना मानको को आधार मानकर पैकेजिंग पर किये गये प्रयोग में रायपुर, पूणे, फैजाबाद व उदयपुर केन्द्रों पर 100 गेज मोटाई वाली पॉलीप्रोपाईलीन बैग में पैक की गई मशरूम उपरोक्त मानकों पर खरी उतरी।

आयस्टर (ढींगरी) मशरूम वर्ग में *फ्लूरोटस फ्लोरिडा* व *फ्लूरोटस साजोर-काजू* का प्रजाति मूल्यांकन, *फ्लूरोटस* स्पी० की पैदावार पर रासायनों के छिड़काव का प्रभाव, *फ्लूरोटस फोस्यूलेटस* व *हाईपसीजाईगस अल्मेरियस* प्रजातियों की उत्पादन क्षमता का मूल्यांकन तथा मशरूम को सुखाना बिन्दुओं पर पांच प्रयोग किये गये। प्रजाति मूल्यांकन प्रयोग में पाया गया कि *फ्लूरोटस फ्लोरिडा* से तैयार संकर प्रजाति पी०एफ०-03 की अधिकतम उपज 86.4 प्रतिशत व *फ्लूरोटस साजोर-काजू* संकर प्रजातियां पी०एस०सी०-05 व 04 से सर्वोत्तम उपज क्रमशः 91.1 व 82.9 प्रतिशत प्राप्त हुई। सभी केन्द्रों पर प्राप्त पैदावार के औसतन आधार पर पाया गया कि *फ्लूरोटस फ्लोरिडा* से तैयार प्रजाति पी०एफ०-3 तथा *फ्लूरोटस साजोर-काजू* से तैयार प्रजाति पी०एफ०-04 से अधिकतम उपज प्राप्त की गई। रासायन छिड़काव का आयस्टर मशरूम की उपज वृद्धि पर प्रभाव जानने हेतु किये गये प्रयोगों में पाया गया कि कोयम्बटूर व फैजाबाद केन्द्रों पर *फ्लूरोटस फ्लोरिडा* की फसल पर 0.1 एम० सांद्रता के K_2HPO_4 के घोल का छिड़काव करने से उपज में वृद्धि हुई। *फ्लूरोटस साजोर काजू* की उपज पर भी रासायन छिड़काव का प्रभाव 4 केन्द्रों पर देखा गया। *फ्लूरोटस साजोर काजू* की फसल पर 0.1 एम० सांद्रता के K_2HPO_4 घोल का छिड़काव करने से कोयम्बटूर व पूणे केन्द्रों पर उपज में बढ़ोतरी दर्ज की गई। जबकि फैजाबाद तथा रायपुर केन्द्रों पर 100 पी०पी०एम० सांद्रता के यूरिया के घोल का छिड़काव करने पर फसल में उपज वृद्धि पाई गई।

फ्लूरोटस फोस्यूलेटस व *हाईपसीजाईगस अल्मेरियस* प्रजातियों की उत्पादन क्षमता के मूल्यांकन हेतु क्रमशः 2 व 6 केन्द्रों पर अध्ययन किये गये। रायपुर केन्द्र पर *फ्लूरोटस फोस्यूलेटस* की अधिकतम जैव क्षमता 82.36 प्रतिशत पाई गई जो कि *फ्लूरोटस फ्लोरिडा* की उपज (79.40 प्रतिशत) की तुलना में ज्यादा थी। कोयम्बटूर केन्द्र पर *हाईपसीजाईगस अल्मेरियस* प्रजाति की जैव परिवर्तन क्षमता पुआल पर बहुत ही ज्यादा (156%) पायी गई। पूणे व रायपुर केन्द्रों पर भी *हाईपसीजाईगस अल्मेरियस* प्रजाति की उत्तम उपज पाई गई जो कि 100 प्रतिशत से ज्यादा थी। सुखाने के विभिन्न तरीकों का प्रभाव आयस्टर मशरूम की गुणवत्ता पर परखा गया। उदयपुर, कोयम्बटूर, रायपुर, विल्यानी व लुधियाना केन्द्रों पर आयस्टर मशरूम को ब्लॉचिंग के बाद धूप में सुखाने से सफेदी, कड़कपन व तीन महीने बाद भण्डारण गुणवत्ता मानको के आधार पर अच्छे परिणाम प्राप्त हुए।

पराली मशरूम व दूधिया मशरूम पर प्रजाति मूल्यांकन व उत्पादन तकनीकी में सुधार हेतु अध्ययन किये गये। दूधिया मशरूम पर प्रजाति मूल्यांकन हेतु 8 केन्द्रों पर अध्ययन किये गये। सी० आई०-3 प्रजाति ने लुधियाना केन्द्र पर व



सी०आई०-6 प्रजाति ने फैजाबाद, उदयपुर, विल्यानी, कोयम्बटूर तथा पुणे केन्द्रों पर, और सी०आई०-5 प्रजाति ने रांची केन्द्र पर सबसे ज्यादा पैदावार दी। पराली मशरूम की प्रजाति Vv-11, Vv-09 व Vv-12 ने विभिन्न केन्द्रों पर अन्य प्रजातियों की तुलना में अधिकतम पैदावार दी। पराली मशरूम उत्पादन तकनीकी में सुधार हेतु किये गये अनुसंधान में पाया गया कि पराली से तैयार किये गये गोलाकार ठोस शैय्या से सबसे अधिक उपज (30.25 कि०ग्रा०/100 कि०ग्राम शुष्क माध्यम) मिली। इसके निकटतम पैदावार वर्गाकार ठोस शैय्या की रही।

दूधिया मशरूम उत्पादन हेतु पोषाधार मूल्यांकन अध्ययन बहुत से केन्द्रों पर किये गये। इनमें पाया गया कि गेहूं के भूसे से तैयार पोषाधार से पुआल से तैयार पोषाधार तथा भूसा व पुआल के विभिन्न अनुपातों से तैयार पोषाधार की तुलना में अधिकतम उपज प्राप्त हुई। दूधिया मशरूम को तुड़ाई उपरांत सुखाने हेतु पांच तरीकों को अपनाते हुए पांच केन्द्रों पर प्रयोग किये गये व उनसे ज्ञात हुआ कि उदयपुर, कोयम्बटूर व विल्यानी केन्द्रों पर दूधिया मशरूम को ब्लांचिंग करने के बाद धूप में सुखाना प्रभावी उपचार साबित हुआ तथा पंतनगर व लुधियाना केन्द्रों पर $40 \pm 2^\circ$ सेल्सियस तापमान पर केबिनेट में 7% नमी रहने तक सुखाने पर सफेदी, कड़कपन व तीन महीनों तक भण्डारण मानकों के आधार पर अच्छे परिणाम प्राप्त हुए।

शिटाके मशरूम (लेन्टीनुला इडोइस) की उत्पादन तकनीकी का मानकीकरण करने हेतु किये गये प्रयोगों से ज्ञात हुआ कि भूसे में 20 प्रतिशत की दर से गेहूं का चोकर मिलाने पर अन्य पोषाधारों की तुलना में शिटाके मशरूम की सबसे अधिक उपज पंतनगर केन्द्र पर प्राप्त हुई व लकड़ी के बुरादे में गेहूं का चोकर 5 व 10 प्रतिशत की दर से मिलाने पर ज्यादा पैदावार क्रमशः कोयम्बटूर तथा लुधियाना केन्द्रों पर प्राप्त हुई।

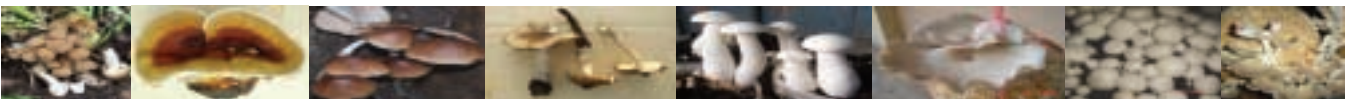
जंगली गूदे-दार कवकों को एकत्र करने, उन्हें पहचानने व संरक्षित करने के उद्देश्य से सभी परियोजना केन्द्रों पर सर्वेक्षण किये गये। जंगलों से कोयम्बटूर केन्द्र ने 12, फैजाबाद केन्द्र ने 3, पंतनगर केन्द्र ने 19, रायपुर केन्द्र ने 18, उदयपुर केन्द्र ने 131, विल्यानी केन्द्र ने 6, पूणे केन्द्र ने 16 तथा सोलन केन्द्र ने 219 गूदेदार कवकों के नमूने एकत्र किये। ज्यादातर केन्द्रों ने स्वयं ही इन कवकों की पहचान कर अपने केन्द्र पर ही संरक्षित किया जबकि कुछ केन्द्रों ने कुछ नमूने खुम्ब अनुसंधान निदेशालय स्थित जीन बैंक में संरक्षित कराने हेतु जमा कराये।

लगभग सभी परियोजना केन्द्रों द्वारा अपने-अपने क्षेत्रों में बीमारियों व कीड़ों-मकोड़ों के अध्ययन हेतु सर्वेक्षण व निरीक्षण का कार्य किया गया। कोयम्बटूर केन्द्र पर कोप्राईनस कोमाटस, एस्पेर्जील्स फ्लेविस व ट्राइकोडर्मा वीरडी कवक रोगाणु जबकि फैजाबाद केन्द्र पर कोप्राईनस स्पीसीज सूखा बुलबुला व मक्खियों का प्रकोप पाया गया। पंतनगर केन्द्र पर ट्राइकोडर्मा स्पीसीज, डहलियोमाइसिस माइक्रोस्पोरस व वर्टीसीलियम फंजीकोला रोगाणुओं का प्रकोप मिला। पूणे केन्द्र पर ग्रीनमोल्ड बीमारी पाई गई। रायपुर केन्द्र पर कोप्राईनस स्पीसीज, ट्राइकोडर्मा स्पीसीज, एस्पेर्जील्स स्पीसीज, राइजोक्टोनिआ स्पीसीज, कोप्राईनस स्पीसीज, अल्ट्रेनेरिया स्पीसीज व स्कलेरोशियम रोलफसाई रोगाणुओं का प्रकोप देखने को मिला। उदयपुर में कोप्राईनस स्पीसीज, ग्रीन मोल्ड तथा ब्राउन प्लास्टर बीमारियां पाई गईं। विल्यानी केन्द्र पर ट्राइकोडर्मा वीरडी व कोप्राईनस स्पीसीज पाई गईं। लुधियाना केन्द्र पर ट्राइकोडर्मा स्पीसीज, कोप्राईनस स्पीसीज, पापुलास्पोरा बाईसीना व ग्रीन मोल्ड बीमारियां पाई गईं। कीड़े-मकोड़ों में, सियारिड व फोरिड मक्खियों का संक्रमण सामान्य रूप से सभी केन्द्रों पर देखा गया। सोलन केन्द्र पर गीला



बुलबुला, पीली फफूंद तथा ब्राउन प्लास्टर का संक्रमण देखा गया। विभिन्न परियोजना केन्द्रों पर फलनकाय त्वचा चटकन, कलिकाओं का भूरा पड़ना तथा मशरूम का जल्दी खुलना जैसी अजैविक विषमतायें पाई गईं।

सभी परियोजना केन्द्रों ने राष्ट्रीय/राज्य स्तरीय प्रदर्शनियों तथा मेलों में अपना प्रतिनिधित्व किया, आकाशवाणी व दूरदर्शन पर वार्तायें प्रसारित की तथा किसान गोष्ठियों का आयोजन किया। किसानों व मशरूम उत्पादकों को पत्रों, फोन, ई-मेल व फार्म भ्रमण द्वारा सलाह मशवरा दिया गया। सभी केन्द्रों द्वारा बेरोजगार युवकों, किसानों, उद्यमियों व महिलाओं के लिये प्रशिक्षण कार्यक्रम आयोजित किये गये। केन्द्रों द्वारा मशरूम के शुद्ध संवर्धन व स्पॉन विभिन्न प्रयोगशालाओं व उत्पादकों को प्रदान कराया गया। मुख्यालय सोलन पर वर्ष के दौरान 3 से 10 दिन की अवधि के कुल 13 प्रशिक्षण कार्यक्रम विभिन्न वर्गों के लिये आयोजित किये गये जिसमें 3 प्रशिक्षण शिविर बाह्य परिसर, 7 प्रायोजित और तीन नियमित कार्यक्रम थे।



SUMMARY

During the year under report (2008-09), research trials were conducted at all ten Coordinating Centres, one Cooperating Centre and the Headquarters at the Directorate of Mushroom Research, Solan (HP) based upon the technical programme finalized at the Biennial Group Meeting of the Workers of All India Coordinated Research Project on Mushroom (AICRPM) held on 26-27 October, 2006 at IGKVV, Raipur and 27-28 December, 2008 at Directorate of Mushroom Research, Solan (HP).

Altogether 4 experiments were laid on white button mushroom, *Agaricus bisporus* at various Centres. In strain evaluation trial conducted at six Centres, strains, CM-13 and CM-10 gave significantly higher mushroom yield at Pune, while strains, S-130, CM-16 and CM-10 at Pantnagar, strain CM-10 at Raipur, strain CM-13 at Faizabad, strains, CM-10 and S-130 at Udaipur and strain CM-10 at Ludhiana performed better than other strains. On overall average basis, calculated by summing-up of the average yields obtained at different Centres, strain S-130 gave slightly superior yield than other strains. The time taken for first harvest (days post-casing) was lowest in strains, CM-10, CM-15, CM-16 and S-130 at Pantnagar, CM-12 at Faizabad, CM-15 at Udaipur, CM-10 at Ludhiana and strains, CM-14 and CM-16 at Raipur. On overall average basis, lowest time for first harvest was 12.77 days in strain CM-15 in comparison to highest of 16.31 days in strain CM-13. Average fruiting body weight varied in the range of 8.8 g to 25.08 g in different strains. The quality of mushroom fruiting bodies and disease incidence was recorded at only Pantnagar and Ludhiana Centre, respectively and superior quality has been reported in strains CM-16 and S-130, while no incidence of diseases in strains CM-12, CM-13, CM-15 and CM-16.

In casing materials evaluation trial, coir pith in combination with FYM in 1:1 (v/v) ratio gave highest mushroom yield of 19.55 kg/100 kg compost at Pune. At Ludhiana and Udaipur Centres, FYM with spent mushroom compost (1:1, v/v) gave highest yields of 14.8 and 16.78 kg/100 kg compost, respectively. Physico-chemical properties of casing materials *viz.* pH, water holding capacity, conductivity and particle density were evaluated at Ludhiana and Pune Centres, and all the properties excepting particle density were higher in coir pith with FYM casing material. Amongst button mushroom washing treatments, combined washing treatment of 100 ppm EDTA with 0.02 % KMS gave whitest mushrooms just after washing and 48 hours of storage at 5°C temperature at almost all the Centres. Under ambient temperature conditions, washing with 100 ppm and 500 ppm, EDTA gave whiteness at par with that of washing with 100 ppm EDTA + 0.02 % KMS at Faizabad, Ludhiana, Pune and Raipur Centres, while at Pantnagar and Udaipur, washing with 500 ppm EDTA and 100 ppm EDTA + 0.02% KMS, respectively gave superior quality. In case of packaging treatments, mushrooms packed in 100 gauge polypropylene bags gave better results with respect to retention of whiteness, lesser loss in weight and veil opening on their storage both at refrigerated and ambient temperature conditions at Faizabad, Raipur, Pune and Udaipur Centres.



Five experiments were laid out on oyster mushroom, which includes strain evaluation of *Pleurotus florida* and *P. sajor-caju*, evaluation of yield potential of *P. fossulatus*, effect of chemical sprays on yield of *Pleurotus* spp., evaluation of yield potential of blue oyster mushroom, *Hypsizygus ulmarius* and drying by different methods. In strain evaluation, *P. florida* hybrid strain, PF-03 gave highest yield of 86.4 % and *P. sajor-caju* hybrid strains, PSc-5 and PSc-4 gave superior yield of 91.1 and 82.9 %, respectively. In overall average strain, PF-03 of *P. florida* and strain, PSc-04 of *P. sajor-caju* gave highest mushroom yield. Yield potential of *P. fossulatus* was evaluated at two Centres. At Raipur Centre very high biological efficiency of 82.36% was recorded in comparison to 79.40% in *P. florida*. In experiment on effect of chemicals spray on mushroom yield; spray of 0.1M K_2HPO_4 significantly enhanced the yield of *P. florida* at Coimbatore and Faizabad Centres. Effect of chemical spray treatments on the yield of *P. sajor-caju* was also evaluated at four Centres. Enhanced yield of *P. sajor-caju* was recorded by spraying of 0.1M K_2HPO_4 on mushroom beds at Coimbatore and Pune Centers, while in 100 ppm urea treatment at Faizabad and Raipur Centres. Experiment on evaluation of yield potential of *Hypsizygus ulmarius* was conducted at six Centres. At Coimbatore Centre very high biological efficiency of 156% was recorded on paddy straw. More than 100% BE of *H. ulmarius* was also recorded on wheat straw at Pune and wheat straw, paddy straw and wheat straw + paddy straw at Raipur. In different drying methods tested for oyster mushroom, blanching followed by sun drying at Ludhiana, Vellayani, Udaipur, Raipur and Coimbatore Centres gave better results with respect to whiteness, brittleness and keeping quality after 3 months of storage.

Experiments were also conducted on milky and paddy straw mushrooms to evaluate different strains for yield and refinement in their cultivation technology. Strain evaluation trial on milky mushroom was laid out at eight Centres. Strain C.I-3 gave highest yield at Ludhiana, while strain, C.I-6 at Faizabad, Udaipur, Vellayani, Coimbatore and Pune, and strain, C.I-5 at Ranchi gave higher yield. In the strain evaluation trial on *V. volvacea*, strains, Vv-11, Vv-09 and Vv-12 gave higher yield as compared to other strains at different Centres. On average basis, cylindrical beds prepared out of paddy straw gave highest mushroom yield of 30.25 kg/100 kg dry substrate at Coimbatore.

Among different substrates evaluated for cultivation of milky mushroom, highest mushroom yield was obtained on wheat straw as compared to paddy straw and different ratios of wheat and paddy straw at majority of the Centres. Drying experiment on milky mushroom was conducted at five Centres by employing five different methods. At Udaipur, Coimbatore and Vellayani Centres, blanching proved to be an effective pretreatment for sun drying, while cabinet dried ($40 \pm 2^\circ C$ till 7 % moisture) milky mushroom gave better results with respect to retention of whiteness, brittleness and keeping quality after 3 months of storage at Pantnagar and Ludhiana Centres. Experiments were also conducted on standardization of cultivation technology of shiitake mushroom (*Lentinula edodes*). Wheat straw supplemented with 20% wheat bran gave superior yield compared to other substrates and their different combinations with wheat bran at Pantnagar, while saw dust + 5% wheat bran and wheat straw + 10% wheat bran gave higher mushroom yield at Coimbatore and Ludhiana Centre, respectively.



Surveys were conducted by various Centres for collection, identification and preservation of wild fleshy fungi. A total number of 12 fleshy fungi were collected at Coimbatore, 3 at Faizabad, 19 at Pantnagar, 18 at Raipur, 131 at Udaipur, 16 at Pune, 6 at Vellayani and 219 at Solan Centre. Most of the Centres identified and preserved the cultures at their own level, while some Centres submitted few specimens at NRCM, Gene Bank at Solan. Almost all the Centres also did the work of survey and surveillance for diseases and insect-pests in their respective areas. Among the common fungal pathogens/competitors, *Coprinus comatus*, *Aspergillus flavus* and *Trichoderma viride* and mites were recorded at Coimbatore, *Coprinus* spp., dry bubble and flies at Faizabad, *Trichoderma* spp., *Deihliomyces microsporus* and *Verticillium fungicola* at Pantnagar, green mould at Pune, *Coprinus* spp., *Trichoderma* spp., *Aspergillus* spp., *Rhizoctonia* spp., *Coprinus* spp., *Alternaria* spp. and *Sclerotium rolfsii* at Raipur, *Coprinus* spp., green mould and brown plaster mould at Udaipur, *Trichoderma viride* and *Coprinus* spp. at Vellayani, *Trichoderma* spp., *Coprinus* spp., *Papulaspora byssina*, green mould and scales at Ludhiana and wet bubble, yellow mould, brown plaster mould at Solan. Among insect-pests, sciarid and phorid flies were common at most of the farms surveyed by different Centres. Browning, scaling and gill opening in button mushroom were also recorded at different Centres.

All the Centres carried out the extension activities by participating in State/National level Exhibitions, Melas, Kisan Gosthies and mass communication through AIR & TV programmes. Replying letters, telephones, e-mails and on the spot guidance during farm visits also provided advisory services. Almost all the Centres conducted training programmes of various durations for farmers, farmwomen, unemployed youths and the entrepreneurs of their areas. The Centres also supplied pure cultures and spawn to different growers. At headquarters, a total of 13 training programmes of 3 to 10 days duration were conducted out of which three were off-campus, seven were sponsored and rest three were under regular institutional activities.



1. INTRODUCTION

The All India Coordinated Research Project on Mushroom (AICRPM) came into existence during VIth Five-Year Plan on 01.04.1983 with its Headquarters at National Centre for Mushroom Research and Training (presently Directorate of Mushroom Research), Solan (HP). The Director, DMR, Solan (HP) also functions as the Project Co-ordinator of the project. Initially the AICRPM started with six Centres one each at Punjab Agricultural University, Ludhiana (Punjab), G.B.Pant University of Agriculture and Technology, Pantnagar (Uttarakhand), C.S. Azad University of Agriculture and Technology, Kanpur (UP), Bidhan Chandra Krishi Vishwa Vidyalaya, Kalyani (West Bengal), Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu) and Mahatma Phule Agricultural University, Pune (Maharashtra). At a later stage during VIIth Plan one new Centre at Indira Gandhi Krishi Vishwa Vidyalaya, Raipur (Chhattisgarh) was added and two existing Centres viz., at Kanpur (UP) and Kalyani (West Bengal) were dropped. During VIIIth and IXth Five Year Plans, 3 Co-ordinating Centres each were added to the existing list of Centres by dropping one at Goa. One co-operating Centre was also added during IXth plan. The XIth plan gave a major boost to the number and the distribution of the Centres in different agro-climatic zones of the Country and 4 new Co-ordinating and one co-operating Centre was added to the exiting list which has raised the total number of Centre at 16. At present, 14 Co-ordinating and two co-operating Centres are working under AICRPM programme with its Headquarters at DMR, Solan and details of which is listed below:

- Punjab Agricultural University, Ludhiana (Punjab)
- Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu)
- G.B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand)
- Mahatma Phule Agricultural University, Pune (Maharashtra)
- N.D.University of Agriculture and Technology, Faizabad (UP)
- Indira Gandhi Krishi Vishwa Vidyalaya, Raipur (Chhattisgarh)
- Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan)
- College of Agriculture (Kerala Agricultural University), Thiruvananthapuram (Kerala)
- ICAR Research Complex for NEH Region, Barapani (Meghalaya)
- Horticulture and Agroforestry Research Programme (ICAR Research Complex for Eastern Region), Ranchi (Jharkhand)
- C.C.S. Haryana Agricultural University, Hisar (Haryana)
- Orissa University of Agriculture and Technology, Bhubaneswar (Orissa)
- Rajendra Agricultural University, Samastipur, Pusa (Bihar)



- College of Horticulture and Forestry, Central Agricultural University, Passighat (Arunachal Pradesh)
- Dr.Y.S.Parmar University of Horticulture & Forestry, Nauni, Solan – Co-operating Centre.
- Research and Development Centre, Haryana Agro-Industrial Corporation, Murthal (Haryana)

All the Co-ordinating Centres and HQrs. at DMR, Solan work in co-ordination on common objectives and mandate. The technical programme for conducting participatory research at all the Centres and the HQrs. is finalized in a biennial workshop organized at any of the Centres or HQrs. During the biennial workshop the progress report for the previous years are presented and discussed to monitor the progress made in the project during the previous years and the technologies generated are assessed for release and their adoption at all India level. The last Group meeting of workers of AICRPM was held on 27th and 28th December 2008 at Directorate of Mushroom Research, Solan (HP) under the Chairmanship of Dr. Umesh Srivastava, Assistant Director General (Hort.II) ICAR, New Delhi. During the meeting the progress of last two years was read

out and technical programme for 2008-2010 was finalized. The objectives of the AICRPM are also identified during the workshop and presently AICRPM is working on the following objectives:

Objectives

1. Survey, collection and identification of fleshy fungi in the area of respective co-ordinating Centre for exploitation and cultivation of new species/strains suited to different regions.
2. Regional adaptability trials for growing the promising strains/species of different edible fungi.
3. Selection of cheap and locally available agro/industrial wastes for composting, supplementation of substrate and casing.
4. Standardization of cultivation techniques for optimization of yields of different mushrooms.
5. Survey and surveillance of diseases and pests during different seasons in various regions.
6. Transfer of proven technology to mushroom growers and to impart training on mushroom cultivation.



2. TECHNICAL PROGRAMME OF WORK (2008-09)

I. CROP IMPROVEMENT

Expt. 1: Testing of different strains of White Button Mushroom, *Agaricus bisporus*

a) Participating Centre

Pune, Pantnagar, Solan (Pasteurized compost using wheat straw) Udaipur, Ludhiana, Faizabad (Long method of compost)

b) Substrate

i) Pasteurized compost formulation

Wheat straw	-	1000 kg
Poultry manure	-	500 kg
Urea	-	15 kg
Wheat bran	-	70 kg
Gypsum	-	40 kg

ii) Long method compost formulation

Wheat straw/paddy straw	-	1000 kg
Wheat bran	-	80 kg
Urea	-	18 kg
Gypsum	-	40 kg
Cotton seed meal	-	30 kg

iii) Substrate quantity - 10 kg compost /bag

iv) No. of replications - 8 for each strain in RBD

c) Strains

i) CM-10, CM-12, CM-13, CM-14, CM-15, CM-16 and S-130

d) Methodology

i) Short Method

Preparation of compost by short method in 2 phases (phase-I and phase-II) by following standard procedure (-6, -4/0, 2,4,6,8 (fill)/ phase-II (6-7 days). Compost will be ready in 18 days.

Compost should be tested for N (2.2-2.4%), colour (dark-brown), pH (6.8-7.2), moisture (67-69%), ammonia (less than 2 ppm), bulk density 80-90 kg per m³ (6-7" depth)

ii) Long Method

Long method compost to be prepared in single phase outdoors (without steam pasteurization) in 28 days (+6, 10, 13, 16, 19, 22, 25, 28 days and spawn).

The compost should be tested for N (1.6-1.7%), moisture (65-67%), pH (6.8-7.2), colour (dark brown), ammonia (less than 3 ppm) and bulk density 80-90 kg per m³ bed area @ (6-7" depth).



iii) **Spawning rate**

0.7% of wet compost

e) **Data to be recorded during cropping**

- i) Spawn run at 24±1°C, RH-90-95%, CO₂ - above 10,000 ppm in days =
- ii) Case run.....do..... in days =
- iii) Days taken to pinhead initiation after ventilation (Tempt. 15-17°C, RH 80-85%, CO₂ - below 1500ppm) =
- iv) First harvest (post-casing/No. of days taken) =
- v) Last harvest (Data for total cropping days of 6 weeks only to be recorded) =
- vi) Diseases/pests encountered, causing economic losses =

Bag size: 18"x24" (polythene - 150 gauge)

- The yield data should be recorded in tabulated form replication wise.
- The replicates should be randomized in cropping rooms in different tiers in RBD.
- Watering should be restricted to wetting of casing material. Humidifier is to be used for RH maintenance.
- Use standard casing material recommended, i.e., spent compost/FYM (both 2 years old - well decomposed in a pit).
- The casing material should be water leached for 8 hours before treatment with steam/chemicals. Uniform layer of casing

to be applied on mycelia impregnated compost, with use of 4 cm wide metal rings (4 cm thick).

- Harvest mushrooms in button form, removing the soiled stem end with knife before weighing. Do not discard the weight of open mushrooms, but the number of mushrooms opened in each harvest should be recorded to determine the quality of the fruitbody produced by a particular strain.
- Average fruiting body weight to be recorded in each treatment (Total weight of mushrooms harvested divided by No. of mushrooms harvested) to determine the quality of mushrooms produced and ultimately the dry weight of the mushroom.
- Adhering to the above instructions will facilitate generation of uniform data for assessment and final recommendation.

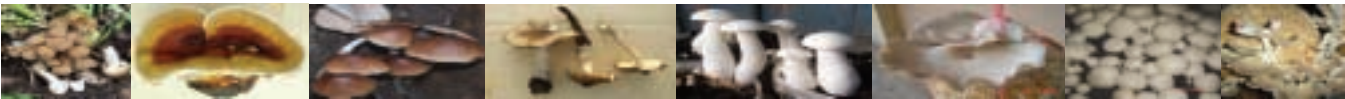
Expt. 2: Strainal evaluation of Milky Mushroom, *Calocybe indica*

a) **Participating Centre**

All Centres

b) **Substrate**

- i) Substrate quantity - 5 kg wet wt. (each bag to be cut into 2 halves)
- ii) Bag size - 30 x 90 cm poly bag
- iii) No. of replications - 8 for each strain



- iv) Substrate treatment - Hot water treated (80°C for 30 minutes)
paddy straw/
wheat straw

- (c) **Strain** - 5 strains (C.I-1, C.I-3, C.I-5, C.I-6 and C.I-8)

- (d) **Spawn rate** - 5% wet wt. basis

(e) Observations to be recorded

- Number, weight and size of the mushrooms viz., Pileus diameter and stipe length

Expt. 3: Strainal evaluation of Paddy Straw Mushroom, *Volvariella volvacea*

a) Participating Centre

Ludhiana, Faizabad, Coimbatore, Raipur, Ranchi, Barapani, Vellayani

b) Substrate

Observations and methodology as per Expt. No. 10 by using 5 bundles x 4 layers + 2 bundles opened at top

c) Strain

Vv-01, Vv-02, Vv-06, Vv-07, Vv-08, Vv-09, Vv-10, Vv-11, Vv-12 and Vv-13

Expt. 4: Strainal evaluation of Oyster Mushroom (*Pleurotus sajor-caju* and *Pleurotus florida*)

a) Participating Centre

Raipur, Barapani, Faizabad, Ranchi, Vellayani and Udaipur

b) Strain

Pleurotus florida: PF-01, PF-02, PF-03, PF-04 and PF-05

Pleurotus sajor-caju: PSc-01, PSc-02, PSc-03, PSc-04 and PSc-05

c) Substrate

Wheat straw or paddy straw

- Substrate treatment : Hot water treatment (80°C and above for 30 minutes)
- Substrate quantity : 4 kg wet wt. (with 70 % moisture)/bag
- No of replications : 5 (RBD)

d) Container

Polybag (60x30 cm)

e) Season for laying trials

Winter between Jan to March, 2009 and December 2008 to March, 2009 for *P. florida*, while summer months for *P. sajor-caju* (March –June, 2008)

f) Information to be provided

- Substrate used and substrate preparation method



- 2. Date of spawning
- 3. Date of opening of bags
- 4. Maximum and minimum temperature and RH (%) in the cropping rooms (Separate sheet is enclosed for data recording)
- 5. Daily yield record (replication wise)

g) Data to be recorded

- 1. Days taken for spawn run
- 2. Days taken for pinhead formation
- 3. Yield data (number and weight upto 4 weeks)
- 4. Time taken (days) for I, II and III flush
- 5. Fruiting body quality of individual hybrid strain (pileus size, colour, stipe length, stipe thickness, organoleptic tests-liking of the consumers and coloured photograph of each strain). Data on pileus and stipe size/thickness are to be recorded for at least 10 fruiting bodies
- 6. Pest and disease incidence (as per proforma)
- 7. Cropping room temperature (°C) and RH (%)
- 8. Photographs of each hybrid

Expt. 5: Evaluation of the yield potential of *Pleurotus fossulatus*

a) Participating Centre

Udaipur, Ludhiana, Raipur, Barapani, Faizabad, Ranchi, Pantnagar

b) Species to be used

P. fossulatus and *P. florida* (low temperature strain) and the experiment to be performed under winter conditions

c) Substrate treatment

Hot water treatment (80°C and above for 30 minutes)

d) Substrate quantity

4 kg wet weight (70% moisture)/bag

e) Container

Polybag (60x30 cm)

f) No. of replications

15 bags each of 1.0 kg dry weight

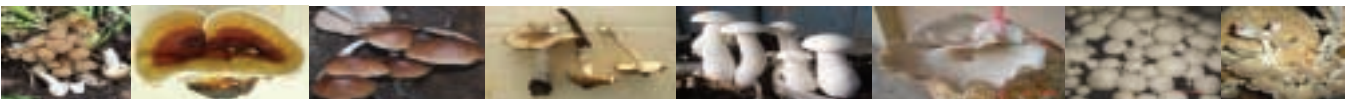
g) Cost of production

h) Information to be provided

- 1. Substrate used and substrate preparation method
- 2. Date of spawning
- 3. Date of opening of bags
- 4. Maximum and minimum temperature and RH (%) in the cropping rooms (Separate sheet is enclosed for data recording)
- 5. Daily yield record (replication wise)

i) Data to be recorded

- 1. Days taken for spawn run



2. Days taken for pinhead formation
3. Yield data (number and weight upto 4 weeks)
4. Time taken for I, II and III flush
5. Pest and disease incidence (as per proforma)
6. Cropping room temperature ($^{\circ}\text{C}$) and RH (%)
7. Photographs of both the species

II. CROP PRODUCTION

1. Button Mushroom

Expt. 6: Isolation and identification of thermophilic microorganisms from white button mushroom compost from different locations for their exploitation in faster composting process

Participating Centre

All Centres doing composting for button mushroom. Samples from composts at its different stages of preparation are to be sent to NRCM/DMR, Solan for above purpose for their analysis.

Expt. 7: To test different locally available material for there feasibility as casing materials

a) Participating Centre

Solan, Ludhiana, Pune and Udaipur

b) Treatments

- i) Farm Yard Manure (FYM) + Spent Mushroom Compost (SC) (1:1, v/v), both two year old well rotted
- ii) Spent compost (2 year old)
- iii) Coir pith + FYM (1:1, v/v)
- iv) FYM + garden soil (1:1, v/v), control-1
- v) FYM, control-2

FYM and spent mushroom compost to be used should be two year old and coir pith well decomposed

c) No. of replications

8 of 10 kg compost/bag

d) Design

RBD

e) Cost benefit ratio

f) Brief description of methodology

Cultivation method same as for Expt. 1

g) Data to be recorded

1. pH of casing material
2. Water holding capacity of casing material
3. Conductivity of casing material
4. Density of casing material
5. Yield (No. and weight of mushrooms)



2. Oyster Mushroom

Expt. 8: Effect of chemical sprays on mushroom beds on yield of *Pleurotus* spp.

a) Participating Centre

All Centres

b) Species

P.florida, *P.sajor-caju*

c) Substrate treatment

Hot water treatment (80°C and above for 30 minutes)

d) Container

Polybags (60x30 cm)

e) Substrate treatments

Spraying mushroom beds at pinning

- i) With 0.1M Dipotassium hydrogen phosphate (K_2HPO_4)
- ii) With Urea 100 ppm and 200 ppm
- iii) Second and third spray after Ist harvest and 15 days later, respectively

f) No. of replications

15 bags each of 1.0kg dry wt./treatment

g) Cost benefit ratio

h) Data to be recorded

- 1. No. of pinheads appeared
- 2. No. of mushrooms harvested/bag

- 3. Yield data (kg/100 kg dry weight basis upto 4 weeks)
- 4. Time taken for I, II and III flush
- 5. Contamination of beds (% of bags in a treatment)
- 6. Type of contamination (fungal/bacterial and the type of fungi)
- 7. Daily bed temperature
- 8. Cropping room temperature (Maximum and minimum) and RH (%)

pH of substrate at the time of spawning to be adjusted to 7.5 by addition of lime

Expt. 9: Evaluation of the yield potential of blue oyster mushroom (*Hypsizygus ulmarius*) on different substrates

a. Participating Centre

All Centres

b. Specie to be used

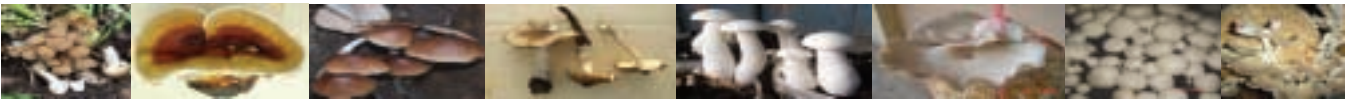
Hypsizygus ulmarius

c. Substrate Treatments

- i) Wheat straw
- ii) Paddy straw
- iii) Wheat straw + paddy straw (1:1, w/w)

d. All other details as per experiment on *Pleurotus* spp.

e. Cost of production



3. Paddy straw mushroom

Expt. 10: Cultivation of Paddy Straw Mushroom, *Volvariella volvacea*

a) Participating Centre

Coimbatore, Ludhiana, Faizabad, Raipur, Vellayani, Solan and Barapani

b) Substrate Treatments

1. Hollow bed (6" hollow dia)
2. Compact bed (Square)
3. Compact bed (Round)
4. Bundle method (hollow) (4 bundles x 5 layers + 2 bundles opened)
5. Bundle method (5 bundles x 4 layers + 2 bundles opened at top)
6. Cylindrical bed system (similar to oyster) in polybags (60x30 cm) with hanging system, round bundles of paddy straw (pre-wetting 12 hrs and hot water treatment at 80°C and above for 30 minutes)

Replication : 5

Design : RBD

c) Supplementation

2 % Horse gram powder

d) Substrate pre-treatment

For treatment 1 to 5

- Pre wetting -20 h

- Drain excess moisture/squeeze until 70 % moisture is retained

e) Substrate quantity

10 kg dry wt/bed

f) Spawn rate

2.0 % to dry weight of straw

g) Harvesting: at egg stage

Observations to be recorded

1. Daily room temperature (°C) & RH (%)
2. Substrate moisture at spawning by oven dry method
3. Daily bed temperature after spawning till end of crop
4. Days for spawn run
5. Days for pinhead formation
6. No. of fruit bodies/bed
7. Yield data (number and weight I, II, III week)
8. Average fruiting body weight
9. Biological efficiency (kg fresh mushroom per 100 kg dry straw)
10. Incidence of competitor moulds as per the scale decided in the VIIIth Mushroom Group Workers' Meet
11. Incidence of pest as per the scale decided in the VIIIth Mushroom Group Workers' Meet. The observations are to be tabulated on data sheet



4. Milky Mushroom

Expt. 11: Cultivation of Milky Mushroom, *Calocybe indica*

a) Participating Centre

Ludhiana, Faizabad, Pune, Raipur, Udaipur, Pantnagar, Vellayani and Ranchi

b) Species to be used

Calocybe indica var. APK2

c) Substrate

- i) Wheat straw alone
- ii) Paddy straw alone and in combination with wheat straw 1:1, 1:2, 2:1, w/w

d) Method of substrate preparation

Hot water treatment (80°C and above for 30 min)

e) Spawning rate

5% on wet weight basis

f) No. of replications

20 each (5kg/bag)

g) Observations to be recorded

Time taken for spawn run and total yield

h) Size of bag

90 cm x 30 cm poly bag

i) Casing soil

Clay loam or sandy loam with a standard pH of 8.0 to 8.5 (In case the pH of soil is

less, add CaCO_3), casing soil is to be steamed for 1 h at 10 p.s.i. pressure)

j) Casing layer

2 cm thick

* Cropping should preferably be conducted in polyhouse lined with blue HDP silpaulin sheet as roofing material

k) Observations to be recorded

As per Experiment 2

l) Cost benefit ratio

5. Shiitake Mushroom

Expt. 12: Cultivation of Shiitake Mushroom, *Lentinula edodes*

a) Participating Centre

Pantnagar, Coimbatore, Pune, Udaipur, Solan, Ludhiana and Raipur

b) Strain

OE-142

c) Substrate

- i) Saw dust (broad leaved hard wood trees)
- ii) Wheat straw

d) Supplement

Wheat bran @5, 10 and 20% on dry weight basis

e) Method of substrate preparation

Autoclaving at 20-22 p.s.i. for 1.5-2.0 hours



f) Spawn rate

5% on wet weight basis

g) No. of replications

20 each (2 kg/bag)

h) Observations to be recorded

Time taken (days) for spawn run and total yield

i) Production technology to be followed

Take 40 kg hard wood broad leaved trees' saw dust



Add water (65%) for thorough wetting for overnight



Add wheat bran and mix it thoroughly



Fill in polypropylene bags @ 2 kg each and put ring and cotton plug



Autoclave at 20-22 p.s.i. for 1.5 hours



On cooling max. spawn aseptically @ 5% wet weight basis



Incubate at $24 \pm 1^\circ\text{C}$



After completion of spawn run (about 60 days) allow substrate to turn brown



Remove the PP bags and dip the blocks in chilled water ($4-5^\circ\text{C}$) for about 5 minutes



Keep the block for fruiting at $<20^\circ\text{C}$

j) Cost benefit ratio**III. Post Harvest Technology****Expt. 13: Washing treatment for button mushroom, *A. bisporus*****a) Participating Centre**

All Centres who are doing Experiment on *A. bisporus*

b) Strain

Most popular strain in the region S-11 or U-3 of white button mushroom

c) Treatment

10 minutes dipping in 100 ppm EDTA – Di Na

10 minutes dipping in 150 ppm

10 minutes dipping in 200 ppm

10 minutes dipping in 100 ppm+0.02% KMS

10 minutes dipping in 500 ppm

Unwashed

d) Storage

5°C and Ambient conditions (only upto 48 h)

e) Observations to be recorded

Whiteness only (% reflectance)

Before washing

After washing

After 24 h of storage

After 48 h of storage



f) Cost benefit ratio**Expt. 14: Packaging for Button Mushroom, *A.bisporus* (washed with 0.05% KMS)****a) Participating Centre**

All Centres who are doing experiments on button mushroom

b) Treatments

Mushrooms of uniform size (3-4 cm pileus dia.) are to be used with 10 all pin holes in packaging material

- i) 75 gauge polypropylene (PP)
- ii) 100 gauge PP
- iii) 125 gauge PP
- iv) 100 polyethylene control

c) Storage

Refrigerated and Ambient conditions

d) Observation

1. Weight loss
2. Whiteness loss/gain (% reflectance)
3. Veil opening (% mushrooms opened)

e) Cost benefit ratio**Expt. 15: Drying of Oyster Mushroom (*Pleurotus* spp.)****a) Participating Centre**

Raipur, Ludhiana, Udaipur, Coimbatore, Ranchi and Vellayani.

b) Strain/species

P. florida, *P. sajor-caju* or local preference

c) Treatments

- i) Blanched (0.2% salt + 0.1% citric acid for 2 minutes)
- ii) Unblanched (0.2% salt + 0.1% citric acid for 2 minutes)
- iii) Sun drying
- iv) Cabinet drying ($40 \pm 2^\circ\text{C}$ till 7% moisture is obtained)
- v) Cabinet drying ($60 \pm 2^\circ\text{C}$ till 7% moisture)

d) Observations

1. Quality on Re-hydration / Reconstitution
2. Total microflora count
3. Weight gain/loss
4. Whiteness/yellowness
5. Brittleness
6. Keeping quality in pack of 100 gauge polypropylene after 3 months (rottag, insect attack off-flavour etc.)

e) Cost benefit ratio**Expt. 16: Drying of Milky Mushroom (*Calocybe indica*)****a) Participating Centre**

All Centres



b) Strain/species

C.I.-03 (40-50 gm size)

c) Treatments

i) Blanched (0.2% salt + 0.1% citric acid for 2 minutes)

ii) Unblanched (0.2% salt + 0.1% citric acid for 2 minutes)

iii) Sun drying

iv) Cabinet drying ($40 \pm 2^\circ\text{C}$ till 7% moisture is obtained)

v) Cabinet drying ($60 \pm 2^\circ\text{C}$ till 7% moisture)

d) Observations

1. Quality on Re-hydration / Reconstitution

2. Total microflora count

3. Weight gain/loss

4. Whiteness/yellowness

5. Brittleness

6. Keeping quality in pack of 100 gauge polypropylene after 3 months (rottag, insect attack off-flavour etc.)

e) Cost benefit ratio**Expt. 16: Wild germplasm collection, identification and conservation****Participating Centre**

All Centres

As per the standard proforma decided during last workshop and circulated time to time

IV. Crop Protection**Expt. 17: Survey and surveillance of diseases and insect-pests in mushroom farms in different regions**

As per the standard proforma decided during last workshop and circulated time to time



3. RESEARCH PROGRESS

1. Crop Improvement

1.1 Testing of strains of white button mushroom, *A. bisporus*

The trial was conducted at six Centres by using compost prepared both by long and short method of composting. At Pune Centre highest mushroom yield (18.40 kg/100 kg compost) was recorded in strain CM-13, followed by 17.95 kg in strain CM-10. At Pantnagar Centre highest yield of 18.34 kg was recorded in strain S-130, followed by 18.30 kg in strain CM-16 (Fig. 1). At Raipur Centre, strain CM-10 out-yielded other strains, while strains CM-13 at Faizabad, and strains CM-10 and S-130 at Udaipur gave higher yield than other strains tested. At Ludhiana, strain CM-12 gave highest yield (15.90 kg) which was followed by strains CM-16 and CM-13 (Table-1). In overall average mushroom yield at different Centres, strain S-130 gave the highest yield, followed by strain CM-10.



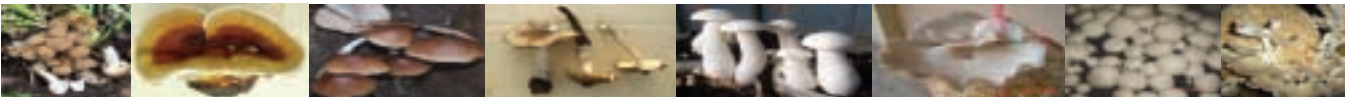
Fig. 1. Crop of brown strain CM-16 of *A. bisporus* at Pantnagar

The time taken for first harvest (days post-casing) was lowest in strains, CM-10, CM-15, CM-16 and S-130 at Pantnagar, while it was lowest in strains CM-14 and CM-16 at Raipur and CM-12 at Faizabad Centre. At Udaipur Centre, strain CM-15 took lowest time of 18 days for the first harvest. At Ludhiana Centre strain, CM-10 took 19 days for first harvest. On overall average basis, lowest time for first

Table 1. Yielding potential of different strains of white button mushroom, *A.bisporus*

<i>A. bisporus</i>	Mushroom yield (kg/100 kg compost) at different Centres						
strain	Pune	Pantnagar	Raipur	Faizabad	Udaipur	Ludhiana	Average
CM-10	17.95	18.27	8.50	13.28	19.65	14.0	15.28
CM-12	16.95	13.98	N.T.	9.34	15.34	15.9	14.30
CM-13	18.40	16.26	8.40	16.34	15.83	14.3	14.92
CM-14	16.25	16.14	3.20	10.47	14.61	11.4	12.01
CM-15	16.70	14.40	N.T.	10.60	15.89	11.7	13.86
CM-16	17.65	18.30	6.10	11.30	13.29	14.6	13.54
S-130	17.10	18.34	N.T.	12.91	18.91	11.0	15.65
CD (0.05)	1.0456	1.10	1.2022	0.84	1.90	0.67	

N.T.-not tested



harvest was 17 days in strain CM-16 in comparison to highest of 19.45 days in strain S-130. The average fruiting body weight was higher at Raipur and Faizabad Centres, where it ranged between 17.90 to 25.08g in comparison to range of 8.8 to 14.23 g at Ludhiana and Udaipur Centres. The average fruiting body weight ranged between 12.77 to 16.31 g. On overall average basis, the time taken for first harvest was lowest in strains

CM-16, while, average fruiting body weight was lowest in strain, CM-15 (Table-2).

The data on quality of fruiting bodies and incidence of diseases in different strains was recorded only at Pantnagar and Ludhiana Centres, wherein fruiting body quality from strains, CM-16 nad S-130 was reported excellent, while good in strains, CM-10, CM-12 and CM-12. Diseases incidence was recorded only in strains, CM-10, CM-14 and S-130 at Ludhiana Centre (Table 3).

Table 2. Time taken for first harvest and average fruiting body weight in different strains of *A. bisporus*

Strain	Time taken for first harvest (days post-casing) and fruiting body weight (g)													
	Pune		Pantnagar		Raipur		Faizabad		Udaipur		Ludhiana		Average	
	b	a	b	a	b	a	b	a	b	a	b	a	b	
CM-10	15.0	15.0	13.60	15.0	22.50	19.0	21.8	21.0	14.23	19.0	10.3	17.80	16.24	
CM-12	13.0	16.0	10.07	N.T.	N.T.	15.0	22.2	21.0	12.97	23.0	10.3	18.75	13.71	
CM-13	18.0	16.0	12.58	19.0	25.08	20.10	21.2	20.0	11.81	20.0	9.2	19.02	16.31	
CM-14	13.0	17.0	10.62	13.0	16.25	20.5	17.9	19.0	12.22	23.0	8.8	18.50	13.13	
CM-15	13.0	15.0	10.91	N.T.	N.T.	20.8	19.8	18.0	10.56	23.0	9.6	19.20	12.77	
CM-16	14.0	15.0	12.76	13.0	18.00	17.0	20.8	19.0	11.49	21.0	9.2	17.00	14.38	
S-130	13.0	15.0	12.81	N.T.	N.T.	20.8	23.4	20.0	12.09	22.0	11.3	19.45	14.52	
CD(0.05)	-	-	-	-	-	1.4	1.1	-	-	-	-	-	-	

a - Time taken for first harvest (days post-casing); b - Average fruiting body weight (g); N.T.-not tested

Table 3. Fruiting body quality and incidence of diseases/insect-pests in different strains of *A. bisporus*

Strain	Fruiting body quality/incidence of diseases and insect-pests			
	Pantnagar		Ludhiana	
	Quality	Disease incidence	Quality	Disease incidence
CM-10	Good	N.R.	N.R.	+
CM-12	Good	N.R.	N.R.	-
CM-13	Fair	N.R.	N.R.	-
CM-14	Fair	N.R.	N.R.	+
CM-15	Good	N.R.	N.R.	-
CM-16	Excellent	N.R.	N.R.	-
S-130	Excellent	N.R.	N.R.	+

N.R.- not recorded; + - presence of disease; - - absence of disease



1.2 Strainal evaluation of milky mushroom, *Calocybe indica*

The trial was laid out at eight Centres by including 5 different strains. Mushroom yield obtained at different Centres varied in different strains. Strain C.I-3 gave highest yield of 60.80 kg/100 kg dry substrate at Ludhiana, C.I-6 at Faizabad, Udaipur, Vellayani, Coimbatore and Pune Centres (Table-4). Highest biological efficiency of 200 per cent in strain C.I.-06 was obtained at Coimbatore, while lowest of 2.86 % at Faizabad Centre. Fruiting bodies of heavier wt were harvested at Udaipur Centre, while of lowest wt were recorded at Raipur and Pune Centres. On overall average basis highest yield and heaviest fruiting bodies (g) was recorded in case of strain C.I-6.

1.3. Strainal evaluation of paddy straw mushroom, *Volvariella volvacea*

The trial was laid out at 5 Centres and highest biological efficiency in the range of 10.8 to 29.5 % was recorded at Coimbatore Centre. Strain Vv-1 gave highest yield of 29.5 kg/100 kg dry substrate at Coimbatore, while strain Vv-9 at Ludhiana, strain Vv6 at



Fig. 2. Variations in pinning and fruiting body characteristics of strains of *V. volvacea*

Faizabad and Vv-11 at Ranchi and Raipur Centres (Table-5). On overall average basis, strain Vv-11, followed by Vv-06 gave higher yield than other strains. The average fruiting body weight in different strains ranged from 11.86 to 14.83 g and higher mushroom yield in high yielding strains was recorded to be a manifestation of higher fruiting body weight (Fig. 2).

1.4. Strain evaluation of oyster mushroom species (*Pleurotus florida* and *P. sajor-caju*)

The experiment was conducted at 7 Centres. In case of *P. florida*, strain PF-03 gave the highest yield of 79.0 kg/100 kg dry substrate, followed by strain PF-01 at Faizabad Centre. Strain PF-01 out yielded other strains at Udaipur and Ranchi Centres (Fig. 3), while strain PF-02 at Raipur, and PF-03 at Barapani and Vellayani Centres. On overall average basis strain PF-03 gave highest BE of 64.24% (Table-6). In case of *P. sajor-caju*, strain PSc-1 gave highest yield at Faizabad, while strain PSc-5 at Udaipur and Barapani, PSc-2 at Vellayani and PSc-4 at Ranchi (Fig. 4) and Raipur Centers. On overall average basis, strain PSc-4, followed by PSc-1 gave higher yield as compared to other strains. The time taken for first harvest varied from 23 to 61.4 days in case of *P. florida* at different Centres. The average fruiting body weight in different strains varied from 7.86 to 10.03 g at Faizabad, 6.50 to 11.02 g at Raipur and 4.37 to 20.12 g at Barapani Centre (Fig. 5). In case of *P. sajor-caju*, time taken for first harvest varied from 17 to 36.0 days, while average fruiting body weight ranged from 3.26 to 11.01 g (Table-7). On overall average basis, lowest time for first flush of 32.72 days was recorded in strain PF-03 of *P. florida* and of 25.83 days in strain PSc-03 of *P. sajor-caju*.



Table 4. Yielding potential of different strains of milky mushroom, *Calocybe indica*

Strain	Mushroom yield (kg/ 100 kg dry substrate)													
	Ludhiana Faizabad		Udaipur		Ranchi*		Vellayani		Pantnagar		Pune		Raipur	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b
C.I-1	38.5	49.4	53.80	48.08	36.06	60.0	53.9	168.0	40.0	46.4	32.0	40.0	38.0	63.59
C.I-3	60.8	50.2	37.55	59.83	35.90	0.00	68.9	148.0	35.0	57.1	38.0	N.T.	N.T.	72.03
C.I-5	39.8	56.8	54.15	65.79	75.91	126.6	69.5	178.0	45.0	44.8	35.0	35.0	25.0	76.71
C.I-6	38.5	52.3	63.92	81.66	81.66	N.T.	71.5	200.0	45.0	60.8	40.0	N.F.	N.T.	86.06
C.I-8*	41.7	42.1	2.86	73.04	68.47	68.8*	49.3	164.0	40.0	-	-	12.65*	29.23	66.18
CD (0.05)	3.7	-	4.97	5.433	-	-	-	-	-	4.97	-	N.S.	-	50.19

a) average mushroom yield; b) average fruiting body weight (g); NS – Non-significant

*Strain C.I.-07 was used instead of C.I.-8



Table 5. Yielding potential of different strains of paddy straw mushroom, *Volvariella volvacea*

Strain	Mushroom yield (kg/100 kg dry substrate) and average fruiting body wt (g)											
	Ludhiana		Faizabad		Coimbatore		Ranchi		Raipur		Average	
	a	b	a	b	a	b	a	b	a	b	a	b
Vv-1	0.7	5.2	5.32	11.3	29.5	20.0	N.T.	N.T.	N.T.	N.T.	11.84	12.17
Vv-2	12.7	6.2	6.59	13.8	25.0	20.0	2.24	7.8	3.30	12.45	9.97	12.05
Vv-6	NF	NF	13.53	17.9	22.0	20.0	0.98	6.6	N.T.	N.T.	12.17	14.83
Vv-7	NF	NF	4.39	10.8	15.0	20.0	0.92	10.0	N.T.	N.T.	6.77	13.60
Vv-8	8.5	5.4	8.30	13.3	10.8	18.0	N.T.	N.T.	4.58	14.43	8.05	12.78
Vv-9	18.0	6.0	6.56	10.0	14.0	20.0	N.T.	N.T.	5.70	12.25	11.07	12.06
Vv-10	7.5	5.8	6.08	9.6	15.0	20.0	6.70	5.9	0.90	18.00	7.24	11.86
Vv-11	16.2	8.0	9.56	12.0	17.0	20.0	10.62	5.2	7.82	18.30	12.24	12.70
Vv-12	N.T.	N.T.	N.T.	N.T.	18.9	18.0	N.T.	N.T.	N.T.	N.T.	-	-
CD(0.05)	2.2	-	1.27	0.9	-	-	1.24	-	-	-	-	-

a) average mushroom yield; b) average fruiting body weight (g); NF- No fruiting body; NT – Not tested

Table 6. Strain evaluation of oyster mushroom species (*Pleurotus florida* and *P. sajor-caju*)

Strain/ Hybrid	Mushroom yield (kg/ 100 kg of dry substrate)							
	Faizabad	Udaipur	Vellayani	Ranchi	Raipur	Barapani	Average	
<i>Pleurotus florida</i>								
PF-01	70.8	50.08	47.84	69.8	80.4	74.30	39.8	61.86
PF-02	64.2	47.44	47.20	70.9	57.9	79.60	55.5	60.39
PF-03	79.0	48.80	41.20	86.4	57.1	78.00	59.2	64.24
PF-04	67.1	48.96	52.32	73.3	52.8	N.F.	51.2	57.61
PF-05	55.0	48.08	64.00	77.9	51.5	45.34	35.4	53.89
CD (0.05)	7.26	8.77	18.93	7.89	18.644	2.812	NS	-
<i>Pleurotus sajor-caju</i>								
PSc-1	48.3	58.5	57.6	54.3	63.90	60.0	57.10	
PSc-2	17.9	70.08	60.2	55.7	45.72	69.9	53.25	
PSc-3	3.2	48.8	60.1	46.7	60.23	72.2	48.54	
PSc-4	14.6	53.36	52.36	78.7	72.46	82.9	59.06	
PSc-5	13.9	72.56	56.9	0.00	19.42	91.1	42.31	
CD (0.05)	1.4	24.342	3.24	10.493	-	NS	-	

NF- No fruiting body; NS – Non significant

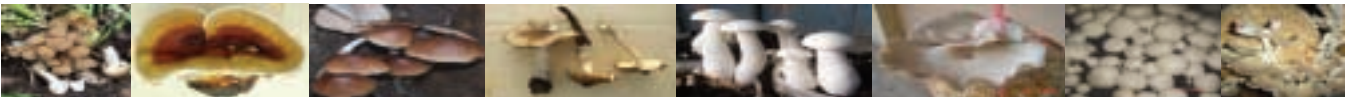




Fig. 3. Yielding pattern and fruiting body characteristics of strains of *P. florida* at Ranchi



Fig. 4. Yielding pattern and fruiting body characteristics of strains of *P. sajor-caju* at Ranchi

Table 7. Time taken for first harvest and fruiting body weight in different strains of *Pleurotus florida* and *P. sajor-caju*

Strain/ Hybrid	Faizabad		Udaipur		Raipur*		Barapani		Average	
	a	b	a		a	b	a	b	a	b
<i>Pleurotus florida</i>										
PF-01	24.0	9.48	34.0	36.0	25.0	11.02	46.6	11.02	33.12	10.51
PF-02	30.3	10.03	36.0	36.0	23.0	9.02	49.0	20.12	34.86	13.06
PF-03	24.5	8.39	35.0	36.0	24.0	7.86	44.2	7.10	32.72	7.78
PF-04	24.0	9.62	33.0	38.0	N.F.	N.F.	52.0	15.16	36.75	12.39
PF-05	36.0	9.82	33.0	35.0	25.0	9.72	61.4	16.67	38.08	12.07
CD (0.05)	2.5	0.52	-		-	2.812	2.64	8.68	-	-
<i>Pleurotus sajor-caju</i>										
PSc-1	33.5	5.50	30.0		19.0	11.01	24.0	3.26	26.63	6.59
PSc-2	33.0	4.05	30.0		26.0	6.50	22.5	9.49	27.88	6.68
PSc-3	34.5	6.15	29.0		18.0	8.75	21.8	4.54	25.83	6.48
PSc-4	33.5	5.93	33.0		21.0	10.80	19.5	4.81	26.75	7.18
PSc-5	34.5	5.72	36.0		25.0	8.50	17.0	8.84	28.13	7.87
CD (0.05)	2.8	0.41	-		-	NS	4.37	4.37	-	-

a- time taken for first flush (days); b- average fruiting body weight (g)





Fig. 5. Crop of superior yielding strain PF-04 of *P. florida* at Barapani Centre

However, fruiting body weight was also lowest in these strains.

1.5. Evaluation of yield potential of *P. fossulatus*

This trial was assigned to 5 Centres but only 2 Centres conducted the trial. At Raipur Centre very high biological efficiency of 82.36% was recorded in this mushroom in comparison to 79.40 % in *P. florida*. At Faizabad Centre, the control *Pleurotus* spp. (*P. florida*) out-yielded the test species (Table-8). On overall average basis, control species

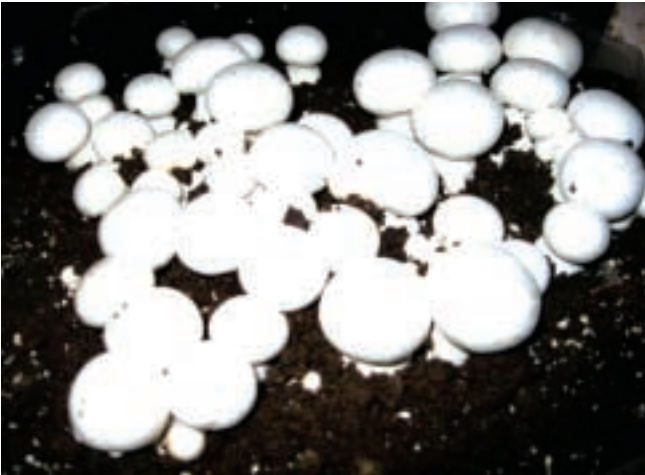


Fig. 6. Crop of white button mushroom, *A. bisporus* on coir pith + FYM based casing material

Table 8. Evaluation of yield potential of *Pleurotus fossulatus*

Pleurotus sp.	Mushroom yield (kg / 100 kg dry substrate) and fruiting body weight (g)				
	Raipur		Faizabad		Average
	a		a	b	a b
<i>P. fossulatus</i>	82.36		4.37	54.58	43.36 54.58
<i>P. florida</i>	79.40		73.80	11.63	76.60 11.63
CD (0.05)	N.S.		4.21	-	- -

a- biological efficiency (%); b- fruiting body weight

(*P. florida*) gave higher mushroom yield than *P. fossulatus*.

2. Crop Production

2.1 Evaluation of different agro-industrial wastes as casing material for white button mushroom, *A.bisporus*

The experimental trail was laid out at 3 Centres. Coirpith in combination with FYM in the ratio of 1:1 (v/v) gave highest mushroom yield of 19.55 kg/100 kg compost, at Pune (Fig. 6), whereas farm yard manure and spent compost (1:1 v/v) performed better at

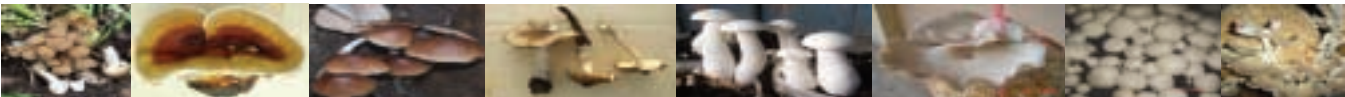


Table 9. Effect of different casing materials on yield and fruiting body weight of *A.bisporus*

Treatment	Mushroom yield (kg / 100 kg compost) and fruiting body weight						
	Pune	Ludhiana		Udaipur		Average	
	a	a	b	a	b	a	b
Farm yard manure (FYM) + spent compost (SC) (1:1, v/v)	16.48	14.8	10.7	16.78	15.80	16.02	13.25
SC (2 years old)	17.6	10.3	9.3	15.36	13.16	14.44	10.73
Coir pith + FYM (1:1, v/v)	19.55	11.4	8.1	15.75	16.35	15.57	12.23
FYM +Garden soil (1:1, v/v) Control-I	19.10	10.5	8.2	15.76	14.86	15.12	11.53
FYM, Control-II	15.40	10.9	8.8	14.83	15.18	13.71	11.99
CD (0.05)	0.74	1.7	-	1.80	-	-	-

a = total yield; b = average fruiting body weight (g)

Ludhiana and Udaipur Centres. On overall average basis, Farm yard manure + Spent compost (1:1, v/v) performed better than the other casing materials tested. (Table-9). Average fruiting body weight ranged from 8.1 to 16.35 g at Ludhiana and Udaipur Centres. The overall average fruiting body wt at different Centres was also highest in FYM + Spent compost.

2.1.2 Physico-chemical properties of agro-industrial wastes evaluated as casing materials for white button mushroom, *A.bisporus*

The experiment was laid out at 2 different Centres. At Ludhiana Centre, pH of different

casing materials ranged from 7.0- 7.5. Highest water holding capacity was recorded in case of Farm Yard Manure (FYM) +Spent compost (SC) (1:1, v/v). Conductivity and particle density were highest in Coir pith (CP) + FYM (1:1) and FYM + Garden soil (1:1), respectively. At Pune Centre, highest water holding capacity was recorded in case of CP + FYM (1:1). The pH of casing materials varied from 7.1 to 7.5, with highest in FYM control and lowest in SC. The conductivity varied between 0.90 to 1.61 m mhos/cm. The particle density was highest in FYM + garden soil, followed by plain SC and FYM (Table-10).

Table 10. Physico-chemical properties of different casing materials evaluated for white button mushroom yield

Treatment	Physico-chemical properties of casing materials							
	Ludhiana				Pune			
	pH	WHC	Cond.	Den.	pH	WHC	Cond.	Den.
FYM+SC (1:1)	7.2	138	0.9	0.73	7.3	76	0.90	0.62
SC (2 year old)	7.5	103	1.2	0.75	7.1	68	1.18	0.66
CP+FYM (1:1)	7.5	128	1.7	0.72	7.2	89	1.61	0.43
FYM + Garden soil (1:1) Control-I	7.3	89	1.0	1.02	7.2	78	0.98	0.85
FYM Control-2	7.0	10	1.0	0.75	7.5	70	1.16	0.65

WHC=Water holding capacity (%); Cond.= conductivity (m. mhos/cm); Den.= density (g/cm³)



2.1.3 Role of heterotrophic bacterium *Alcaligenes faecalis* and conditioning after casing pasteurization in button mushroom yield stimulation

When *Alcaligenes faecalis* was inoculated to different casing materials, highest mushroom yield was recorded in case of FYM + SC (1:1 v/v), both two year old well rotted which at the same time resulted in heaviest fruiting body of 13.19 g. It was followed by spent compost + inoculation with *A. faecalis* and FYM + inoculation with *Alcaligenes faecalis*. Conditioning of FYM based casing material for 12 hrs at 48-50°C after pasteurization or chemical treatment also gave higher mushroom yield as compared to other treatments (Table 11).

2.2 Effect of spray of different chemicals on yield of *Pleurotus florida* and *P. sajor-caju*

The experiment was conducted at 4 Centres. Two chemicals viz; dipotassium

hydrogen phosphate (K_2HPO_4) and Urea were applied @ 0.1M, and 100 ppm and 200 ppm, respectively on mycelium colonized substrate bags of *P. florida*. The spray of 0.1M K_2HPO_4 significantly enhanced the yield of *P. florida* at Faizabad, Pune and Coimbatore Centres, while at Raipur Centre, 100 ppm urea gave significantly higher yield than control. (Table-12). In overall average yield, the spray with 0.1M K_2HPO_4 showed slight superiority over other treatment.

The experiment with *P. sajor-caju* was conducted at 4 Centres. Enhanced yield of *P. sajor-caju* was obtained on spraying 0.1M K_2HPO_4 on mushroom beds at Pune and Coimbatore Centres, while at Raipur and Faizabad; 100 ppm urea resulted in higher mushroom yield as compared to other treatments (Table-13). There were minor variations at average mushroom yield data calculated after summing up of yield obtained at different Centres.

Table 11: Role of heterotrophic bacterium *Alcaligenes faecalis* and conditioning after casing pasteurization in button mushroom yield stimulation

Casing treatment	Mushroom yield kg/100 kg compost from 6 weeks of harvesting period		
	No.	Wt. (kg)	Wt./Fb (g)
FYM + SC (1:1 v/v), both two year old well rotted + inoculum of <i>A. faecalis</i>	1501	19.81	13.19
Spent compost (2 year old) + inoculum of <i>A. faecalis</i>	1487	18.79	12.63
Coir pith + FYM (1:1; v/v) + inoculum of <i>A. faecalis</i>	1430	18.09	12.65
Coir pith + inoculum of <i>A. faecalis</i>	1421	17.61	12.39
FYM (two year old) + inoculum of <i>A. faecalis</i>	1505	18.31	12.16
FYM conditioning for 12 hrs at 48-50°C after pasteurization or chemical treatment	1498	18.86	12.59
Coir pith + FYM (1:1; v/v) control -1	1411	17.32	12.27
CD (0.05)	0.332	0.06	—

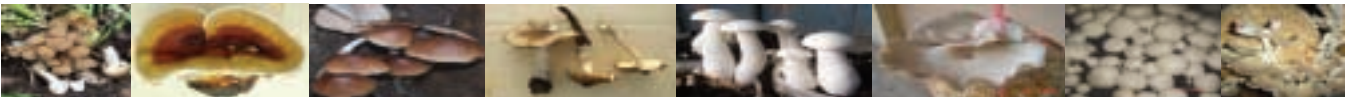


Table 12. Effect of chemical spraying on yield of *Pleurotus florida*

Treatment	Mushroom yield (kg / 100 kg dry substrate)				
	Raipur	Faizabad	Pune	Coimbatore	Average
K ₂ HPO ₄ (0.1M)	76.42	72.50	70.7	96.0	78.91
Urea (100ppm)	77.80	70.50	62.9	91.0	75.55
Urea (200ppm)	N.T.	69.50	52.1	94.0	74.47
Control	57.25	63.50	-	82.0	67.58
CD (0.05)	N.D.	5.01	4.981	-	-

NS- Non-significant

Table 13. Effect of chemical spraying on yield of *Pleurotus sajor-caju*

Treatment	Mushroom yield (kg / 100 kg dry substrate)				
	Raipur	Faizabad	Pune	Coimbatore	Average
K ₂ HPO ₄ (0.1M)	50.24	67.45	66.3	94.0	69.50
Urea (100ppm)	66.38	70.50	56.5	90.0	70.85
Urea (200ppm)	N.T.	69.95	50.1	88.0	69.25
Control	46.14	61.50	-	78.0	61.88
CD (0.05)	N.S.	4.83	5.208	-	-

NS- non-significant; NT- not tested

2.3 Evaluation of yield potential of blue oyster mushroom (*Hypsizygus ulmarius*) on different substrates

The experiment was conducted at 6 Centres. Higher biological efficiency of Blue oyster mushroom, *Hypsizygus ulmarius* was achieved on wheat straw at Pune and Ludhiana Centres, while at paddy straw at

Faizabad, Coimbatore and Udaipur Centres. The 1:1, w/w combination of wheat straw + paddy straw gave highest mushroom yield (160.50% B.E.) at Raipur Centre. At Coimbatore Centre, the mushroom yield in 3 different substrates was at par (Table 14). In overall average, highest yield was recorded in 1:1 combination of wheat straw and paddy straw.

Table 14. Evaluation of yield potential of blue oyster mushroom, *Hypsizygus ulmarius*

Substrate	Mushroom yield (kg / 100 kg dry substrate)						
	Pune	Raipur	Faizabad	Coimbatore	Ludhiana	Udaipur	Average
Wheat straw	106.8	127.0	87.85	154.0	49.4	61.3	97.73
Paddy straw	84.0	122.80	96.85	156.0	30.7	64.7	92.51
Wheat straw + paddy straw (1:1, w/w)	94.8	160.50	82.10	154.0	43.1	54.0	98.08
CD (0.05)	7.282	18.90	5.72	-	3.8	9.211	-



2.4 Evaluation of suitability of different substrates for obtaining higher yield of *Pleurotus fossulatus*

The experiment was performed only at Pantnagar Centre, wherein wheat straw as substrate gave highest mushroom yield, followed by 3:1, 2:1 and 1:1, w/w combinations of wheat straw + paddy straw, respectively (Table 15). Fruiting bodies with highest wt (27.88 g) were harvested from 1:3, w/w combination of wheat straw + paddy straw, followed by wheat straw alone.

2.5 Cultivation trial of paddy straw mushroom, *Volvariella volvacea*

The trial was conducted at 2 Centres viz., Coimbatore and Faizabad. At Coimbatore Centre, earliest flush in 15 days and highest mushroom yiled (30% B.E.) was obtained in compact square bed prepared out of paddy straw. Next highest yield was recorded in bundle method, followed by compact round bed method. The higher mushroom yielding treatment also gave mushroom fruiting bodies with highest weight. At Faizabad, earliest first flush in 19.0 days and highest mushroom yield

was obtained in beds prepared by bundle method (5 bundles x 4 layers +2 bundles opened at top). Individual fruiting body weight was again higher in treatment giving higher mushroom yield (Table 16). In overall average of mushroom yield and fruiting body weight, the compact square bed gave the highest mushroom yield as well as the average fruiting body weight followed by bundle method.

2.6 Evaluation of different substrates for cultivation of milky mushroom, *Calocybe indica*

Experimental trial was conducted at 6 Centres and at Ludhiana and Faizabad Centres; highest mushroom yield was obtained in wheat straw as substrate. However, at Raipur and Pune, highest yield was recorded on WS + PS (1:1) combination, while at Udaipur the yield was highest in paddy straw. The mushroom yield varied from lowest of 3.40 kg/100 kg dry substrate at Faizabad in 2:1 combination of wheat straw + paddy straw to highest of 111.3 kg at Ranchi Centre in same substrate (Table 17). On overall average basis superior yield was recorded in wheat straw as substrate (Fig. 7).

Table 15: Evaluation of yield potential of *Pleurotus fossulatus* on different substrate

Substrate	Mushroom yield (g/4 kg wet substrate) from 04 weeks of harvesting		Fruiting body wt. (g)
	No.	Wt.	
Wheat straw (WS)	56	741.21	13.23
Paddy straw (PS)	52	611.20	11.75
WS+PS (1:1, w/w)	53	686.22	12.94
WS+PS (2:1, w/w)	56	696.45	12.44
WS+PS (1:2, w/w)	55	666.60	12.12
WS+PS (3:1, w/w)	54	701.80	12.99
WS+PS (1:3, w/w)	53	641.30	12.10
CD at 5%	1.03	1.11	

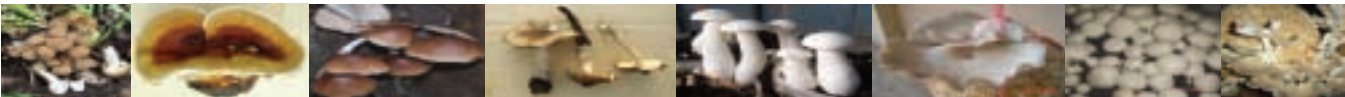


Table 16. Effect of different shapes of beds on yield of paddy straw mushroom, *Volvariella volvacea*

Bed shape	Time taken for pin head initiation (days)/ mushroom yield (kg / 100 kg of dry substrate)/ average fruiting body weight (g)								
	Coimbatore			Faizabad			Average		
	a	b	c	a	b	c	a	b	c
Hollow bed (6" hollow dia)	21.0	14.4	24.0	20.5	8.06	8.96	20.75	11.23	16.48
Compact bed (Square)	15.0	30.0	30.0	19.0	11.31	9.75	17.0	20.66	19.88
Compact bed (Round)	18.0	21.0	28.0	19.5	8.64	8.82	18.75	14.82	18.41
Bundle method (hollow – 4 bundles x 5 layers + 2 bundles opened at the top)	21.0	11.0	20.0	20.0	10.88	9.89	20.50	10.94	14.95
Bundle method (5 bundles x 4 layers + 2 bundles opened at the top)	19.0	21.6	27.0	19.0	12.81	10.01	19.0	17.21	18.51
Cylindrical method	24.0	10.0	20.0	36.5	1.85	8.75	30.25	5.93	14.38
CD (0.05)	-	-	-	1.5	0.91	0.86	-	-	-

a - time taken for first flush (days); b – biological efficiency (%); c – average fruiting body weight (g); NS- non-significant

Table 17. Cultivation of *C. indica* on different substrates

Substrate	Mushroom yield (kg / 100 kg dry substrate)						
	Ludhiana	Faizabad	Udaipur	Raipur	Pune*	Ranchi	Average
Wheat straw(WS)	61.8	64.31	30.80	13.50	51.5	108.6	55.09
Paddy straw(PS)	NF	23.27	50.50	5.25	40.2	0.00	29.81
WS + PS (1:1)	38.5	54.26	40.38	36.25	63.0	77.8	51.70
WS + PS (1:2)	NF	63.08	46.12	16.74	74.7	18.0	38.33
WS + PS (2:1)	39.4	3.40	24.20	23.10	57.3	111.3	43.12
CD (0.05)	-	4.14	10.027	3.194	2.145	32.13	-



Fig. 7. Crop of milky mushroom *C. indica* at Solan

2.7 Cultivation trial on shiitake mushroom, *Lentinula edodes*

Experimental trial was conducted at 3 Centres. Out of different substrates and supplements, wheat straw (WS) + wheat bran (WB) (20%), followed by saw dust + wheat straw (20%) gave highest mushroom yield at Pantnagar. At Coimbatore Centre, saw dust + wheat bran @ 5%, followed by saw dust + wheat bran @ 10% gave the highest yield (Table-18). At Ludhiana Centre, highest yield was recorded in WS + WB @ 10%, followed



Table 18. Evaluation of different substrates for cultivation of *Lentinula edodes*

Substrate	Mushroom yield (kg / 100 kg substrate)/ fruiting body weight (g)							
	Pantnagar		Coimbatore*		Ludhiana		Average	
	a	b	a	b	a	b	a	b
Saw dust (SD) alone	23.9	39.86	22.5	15.0	NF	NF	23.20	27.43
SD+WB (5%)	26.3	35.08	33.0	15.0	NF	NF	29.65	25.04
SD+WB (10%)	37.3	43.85	30.8	14.0	NF	NF	34.05	28.93
SD+WB (20%)	37.7	35.88	31.0	15.5	NF	NF	34.35	25.69
Wheat straw (WS) alone	24.0	36.90	7.8	13.0	NF	NF	15.90	24.95
WS+WB (5%)	24.6	49.18	12.0	15.0	23.6	13.0	20.07	25.73
WS+WB (10%)	27.4	49.84	15.5	15.5	54.4	30.0	32.43	31.78
WS+WB (20%)	46.7	49.13	15.0	15.0	40.0	21.0	33.9	28.38
CD (0.05)	0.489	-	-	-	8.2	-	-	-

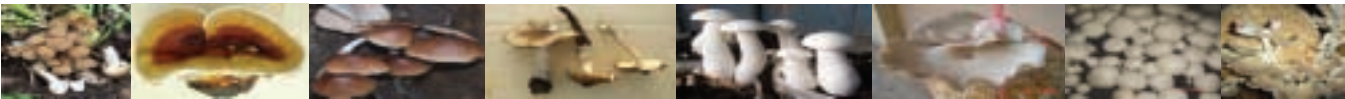
a – mushroom yield (% BE), b – average fruiting body weight (g), SD – saw dust, WB – wheat bran, WS – wheat straw

by WS + WB @ 20%. In results interpreted after taking average of yield at all 3 Centres, almost comparable yield was noticed in 10 and

20% wheat bran supplementation treatments both with wheat straw and saw dust (Fig. 8).



Fig. 8. Crop of shiitake mushroom, *L. edodes* on saw dust + 20% wheat bran at Soaln & Pantnagar



3. Post Harvest Management

3.1 Effect of washing treatment with different chemicals on whiteness of fresh and stored white button mushroom *A. bisporus*

The experiment was conducted at 6 Centres with washing treatment of button mushroom fruiting bodies with 100, 150, 200 and 500 ppm of EDTA, 100 ppm EDTA + 0.2% KMS and unwashed mushrooms as control, followed by storage at 5°C in refrigerator. The combined washing treatment of 100 ppm EDTA with 0.02% KMS gave whitest fruiting bodies just after washing and 48 hrs. of storage at 5°C at Ludhiana and Udaipur Centres, while at Pantnagar 500 ppm EDTA was the best treatment, followed by 100 ppm EDTA + 0.02 KMS. At Faizabad, Pune and Raipur, the effect was almost similar in all the washing treatments except the unwashed mushrooms (Table-19). The second best treatment at Faizabad, Raipur and Pantnagar was 500 ppm EDTA, while 200 ppm EDTA at Pune.

The results were different after storing the chemical washed mushrooms at ambient temperature conditions than at refrigerated conditions and not much difference was recorded in different treatments at Faizabad and Raipur Centres, while 500 ppm EDTA and 100 ppm EDTA + 0.02% KMS were the superior washing treatments at Pantnagar and Udaipur Centre, respectively. At Ludhiana and Pune, 3 treatments were almost at par with respect to whiteness after 48 hours of storage (Table 20).

3.2 Effect of different packaging treatments on the shelf life of white button mushroom, *A. bisporus*

The experiment was conducted at 4 Centres by using polypropylene bags of 75,

100 and 125 gauge thickness and polythene bags of 100 gauge thickness. The packed mushrooms were stored both at ambient and refrigerated temperature conditions, and the loss in whiteness, weight and opening of veil in mushrooms were recorded. At Faizabad, Pantnagar, Raipur and Udaipur Centres, the mushrooms packed in 100 gauge polypropylene gave better results with respect to whiteness, weight loss and veil opening on their storage both at refrigerated and ambient temperature conditions. At Pune Centre, superior results were obtained on packaging mushrooms in 100 and 125 gauge thick polypropylene bags (Table-21).

3.3 Effect of different packaging treatments on shelf-life of white button mushroom, *A. bisporus*

When the mushrooms were stored in different packaging materials without any hole in the packaging bags, the 100 gauge thick polypropylene bag gave better results than other materials at both the Centres (Table 22).

3.4 Effect of different drying methods on quality of dried oyster mushroom, *Pleurotus* spp.

The experiment was conducted at 5 Centres and five methods viz; blanching followed by sun drying, no blanching followed by sun-drying, simple washing followed by sun-drying, and cabinet drying at $40 \pm 2^\circ\text{C}$ and $60 \pm 2^\circ\text{C}$ were employed. The results obtained at different Centres varied and keeping quality after 3 months of storage was recorded to be better in treatment involving blanching followed by sun-drying method at Vellayani, Udaipur and Coimbatore Centres. However, at Ludhiana, the chemical treatment and cabinet drying gave better results with

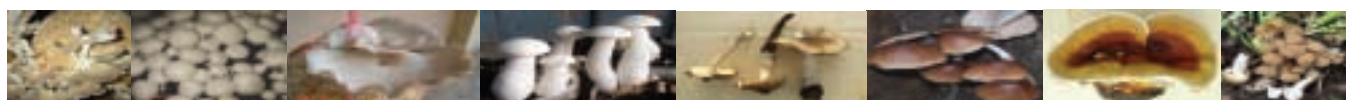


Table 19. Effect of washing treatments followed by storage at 5°C on whiteness of button mushroom, *A.bisporus*

Treatment	Faizabad				Ludhiana				Pantnagar				Pune				Raipur				Udaipur			
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
EDTA 100ppm	+3	+4	+4	+4	+3	+4	+2	+	+2	+3	+2	+2	+2	+3	+3	+2	+4	+4	+4	+4	+3	+4	+2	+1
EDTA 150ppm	+3	+4	+4	+4	+3	+3	+3	+2	+2	+3	+2	+2	+2	+3	+3	+3	+4	+4	+4	+4	+3	+4	+2	+2
EDTA 200ppm	+3	+4	+4	+4	+3	+3	+2	+2	+2	+2	+4	+2	+2	+3	+3	+3	+4	+4	+4	+4	+3	+4	+3	+2
EDTA 100 ppm + 0.02% KMS	+3	+4	+4	+4	+3	+4	+4	+2	+2	+2	+4	+4	+2	+3	+3	+3	+4	+4	+4	+4	+3	+4	+3	+3
EDTA 500 ppm	+3	+4	+4	+4	+3	+4	+3	+2	+2	+2	+4	+4	+2	+3	+2	+4	+4	+4	+4	+3	+3	+3	+1	+1
Unwashed	+3	+3	+3	+3	+3	+3	+2	+1	+2	+3	+2	+2	+2	+2	+2	+2	+4	+4	+4	+3	+3	+3	+1	+1
Water washed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+3	+4	+2	+1

a) whiteness before washing; b) whiteness after washing; c) whiteness after 24 h of storage; d) whiteness after 48 h of storage

Table 20. Effect of washing treatment followed by storage at ambient temperature conditions on whiteness of button mushroom, *A.bisporus*

Treatment	Faizabad				Ludhiana				Pantnagar				Pune				Raipur				Udaipur			
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
EDTA 100ppm	+3	+4	+4	+3	+3	+4	+3	+3	+2	+3	+2	+2	+2	+3	+3	+2	+4	+4	+4	+3	+3	+4	+2	+1
EDTA 150ppm	+3	+4	+4	+3	+3	+4	+3	+3	+2	+3	+2	+	+2	+3	+3	+2	+4	+4	+4	+3	+3	+4	+2	+1
EDTA 200ppm	+3	+4	+4	+3	+3	+3	+3	+2	+2	+3	+2	+2	+2	+3	+3	+3	+4	+3	+4	+2	+3	+4	+3	+2
EDTA 100 ppm + 0.2% KMS	+3	+4	+4	+3	+3	+4	+4	+3	+2	+2	+4	+2	+2	+3	+3	+3	+4	+4	+4	+3	+3	+4	+3	+3
EDTA 500 ppm	+3	+4	+4	+3	+3	+4	+3	+3	+2	+3	+2	+3	+2	+3	+3	+3	+4	+3	+4	+3	+3	+4	+3	+1
Unwashed	+3	+3	+3	+2	+3	+3	+2	+1	+2	+2	+2	+1	+2	+2	+2	+2	+4	+3	+4	+2	+3	+3	+1	+1
Water washed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+3	+4	+2	+1

a) before washing; b) after washing; c) after 24 h of washing; d) after 48 h of washing
+4=snow white; +3=white; +2=off white; +1=pale coloured fruting body



Table 21. Effect of different packaging treatments with holes in bags on whiteness/weight loss and veil opening of button mushroom on storage for 48 hrs. at refrigerated and ambient temperature conditions

Treatment	Whiteness/wt. loss (%) /veil opening (%) in different treatments at different Centres									
	Faizabad			Pune		Raipur		Udaipur		
	a	b	c	a	c	a	b	a	b	c
75 gauge PP (R)	++++	2.14	0.0	+++	-	++++	N.D.	+4	10.0	0.00
(A)	+++	8.59	20.0	++	3.0	++	3.44	+4	20.0	0.00
100 gauge PP (R)	++++	2.24	0.0	+++	-	++++	N.D.	+4	3.33	0.00
(A)	+++	7.96	26.7	++	2.0	+	3.33	+4	16.66	0.00
125 gauge PP (R)	++++	2.37	0.0	+++	-	++++	N.D.	+4	0.00	0.00
(A)	+++	8.81	12.7	++	2.0	+	6.98	+4	8.33	0.00
100 gauge PE (R)	++++	2.56	0.0	+++	-	++++	N.D.	+4	8.33	0.00
(A)	+++	9.12	26.7	++	5.0	+	N.D.	+4	13.33	0.00
CD (0.05%)	-	-0.78	-1.9			-	-	-	-	-

PP- polypropylene; PE - polyethylene; R- refrigerated; A - ambient; a - whiteness; b - percent weight loss; c - percent veil opening

Table 22. Effect of different packaging treatments without hole in bags on whiteness, weight loss and veil opening of button mushroom on storage for 48 hrs. at refrigerated and ambient temperature conditions

Treatment	Whiteness/wt. loss (%) /veil opening (%) in different treatments at different Centres				
	Faizabad			Pune	
	a	b	c	a	c
75 gauge PP (R)	++++	2.14	0.0	++	-
(A)	++	8.56	33.33	++	3.0
100 gauge PP (R)	++++	2.24	0.0	+++	2.0
(A)	++	8.47	33.33	+++	3.0
125 gauge PP (R)	++++	2.37	0.0	+++	2.0
(A)	++	8.02	40.0	+++	3.0
100 gauge PE (R)	++++	2.56	0.0	++	2.0
(A)	++	8.01	46.7	++	6.0
CD (0.05%)	-	0.21/0.58	-/3.8	-	-

PP- polypropylene; PE - polyethylene; R- refrigerated; A - ambient; a - whiteness; b - percent weight loss; c - percent veil opening

respect to whiteness, brittleness and keeping quality after 3 months of storage. At Raipur it was the plain water washing, followed by sundrying treatment, which gave superior results (Table-23).

3.5 Effect of different drying treatments on quality of dried milky mushroom, *Calocybe indica*

The experiment was conducted at 5 Centres and five methods viz; blanching followed by sun drying, no blanching followed by sun-drying, simple washing followed by sun-drying, and cabinet drying at 40 ± 2°C and 60 ± 2°C were employed. The results obtained at different Centres varied and keeping quality after 3 months of storage was recorded. At Ludhiana, Coimbatore, Vellayani and Udaipur Centres, the quality parameter of the dried mushrooms were superior in plain water + sundrying treatment, while at Pantnagar, it was the cabinet drying treatment



at $40 \pm 2^{\circ}\text{C}$, which gave the best results (Table-24).

3.6 Effect of different drying treatments on quality on rehydration and micro flora count of the dried oyster mushroom, *Pleurotus* spp.

This experiment was conducted at only 2 Centres and quality on rehydration was almost similar in all the treatment at Ludhiana Centre, while at Udiapur it was superior in plain water washing + sundrying treatment. The microflora was highest on mushrooms washed with plain water, followed by sundrying at Ludhiana, however, no such study was carried out at the Udaipur Centre (Table 25).

3.7 Effect of different drying treatments on quality on rehydration and micro flora count of the dried milky mushroom, *Calocybe indica*

This experiment was conducted at 4 Centres. At Ludhiana Centre, among the different treatments, plain water washing followed by sun drying resulted in the development of maximum number of mycoflora. At Faizabad Centre all the treatments resulted in very poor quality of mushrooms. At Pantnagar, Cabinet drying ($40 \pm 2^{\circ}\text{C}$ till 7% moisture is obtained) proved best treatment, whereas, no significant difference was observed in different treatments. At Udaipur Centre all sundrying treatments gave results at par with each other (Table 26).

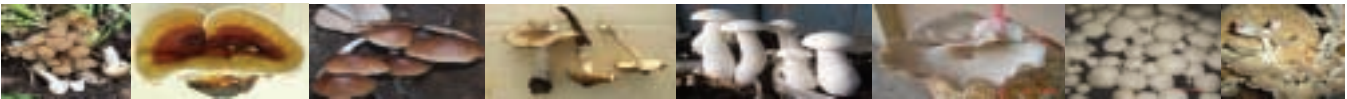


Table 23. Effect of different drying treatments on quality of dried oyster mushroom, *Pleurotus* spp.

Treatment	Quality characteristics of dried mushrooms																			
	Ludhiana				Vellayani				Udaipur*				Coimbatore				Raipur			
	a	b	c	d	a	b	c	d	a	b	c	d*	a	b	c	d	a	b	c	d
Blanched (0.2% salt + 0.1% citric acid for 2 minutes)	+++	+++	+++	0.00	+++	+++	+++	85.0	+	++++	Good	78.0	++	++	++	++	85.0	Brown	+	2.06
Unblanched (0.2% salt + 0.1% citric acid for 2 minutes)	+++	++	++	5.00	+++	+++	+++	82.0	++	++	Good	76.0	+	++	+	+	83.0	Golden white	+	3.54
Sun drying	++	++	++	0.00	+++	+++	+++	85.0	+++	++	Good	74.0	+	+++	+	+	83.0	Dull white	+	2.81
Cabinet drying (40 ± 2°C till 7% moisture is obtained)	+++	+++	+++	0.00	+++	++	++	86.0	++	++	Good	74.0	+	++	+	+	85.5	Dark brown	+	7.42
Cabinet drying (60 ± 2°C till 7% moisture)	-	-	-	-	+	+	+	88.0	+	++++	Good	80.0	+	++	++	++	86.0	N.D.	N.D.	N.D.

a) whiteness (++++ snow white, +++ white, ++ off white, + pale)
b) brittleness (++++ maximum brittle, + minimum brittle)
c) keeping quality after 3 months
d) weight loss (%)
* *P. sajor-cajú*



Table 24. Effect of different drying treatments on quality of dried milky mushroom, *Calocybe indica*

Treatment	Quality characteristics of dried mushrooms															
	Pantnagar				Ludhiana				Udaipur*				Coimbatore			
	a	b	c	d	a	b	c	d	a	b	c	d*	a	b	c	d
Blanched (0.2% salt + 0.1% citric acid for 2 minutes)	+3	+2	++	85.0	+3	+3	+4	0.00	+++	+	Good	81.0	+++	+	++	81.5
Unblanched (0.2% salt + 0.1% citric acid for 2 minutes)	+	++	++	83.5	+4	+4	+4	0.00	++++	+	Good	81.50	+	+	++	79.0
Sun drying	-	-	-	-	+4	+4	+4	0.00	++++	+	Good	81.70	+	+++	++	79.5
Cabinet drying (40 ± 2°C till 7% moisture is obtained)	+4	+	+++	83.0	+3	+4	+4	0.0	++	-	Good	82.3	++	++	++	84.0
Cabinet drying (60 ± 2°C till 7% moisture)	+3	+	+++	84.5	-	-	-	-	+	-	Good	82.5	++	++	+++	85.0

- a) whiteness (++++ snow white, +++ white, ++ off white, + pale)
- b) brittleness (++++ maximum brittle, + minimum brittle)
- c) keeping quality after 3 months
- d) weight loss (%)



Table 25. Effect of different drying treatments on quality on rehydration and micro-flora count of the dried oyster mushroom, *Pleurotus* spp.

Treatment	Quality on rehydration and micro flora count			
	Ludhiana		Udaipur*	
	a	b	a	b
Blanched (0.2% salt + 0.1% citric acid for 2 minutes)	+++	0.5 x 10 ²	+	—
Unblanched (0.2% salt + 0.1% citric acid for 2 minutes)	+++	0.8 x 10 ²	++	—
Sun drying	+++	1.2 x 10 ²	+++	—
Cabinet drying (40 ± 2°C till 7% moisture is obtained)	+++	0.8 x 10 ²	++	—
Cabinet drying (60 ± 2°C till 7% moisture is obtained)	+++	0.8 x 10 ²	+	—

Table 26. Effect of different drying treatments on quality on rehydration and micro-flora count of the dried milky mushroom, *Calocybe indica*

Treatment	Quality on rehydration and micro flora count							
	Pantnagar		Ludhiana		Udaipur*		Faizabad	
	a	b	a	b	a	b	a	b
Blanched (0.2% salt + 0.1% citric acid for 2 minutes)	++	—	+++	0.5 x 10 ²	+++	—	Very poor	-
Unblanched (0.2% salt + 0.1% citric acid for 2 minutes)	++	—	+++	0.7 x 10 ²	+++	—	Very poor	-
Sun drying	-	-	+++	1.2 x 10 ²	+++	—	Very poor	-
Cabinet drying (40 ± 2°C till 7% moisture is obtained)	+++	—	+++	0.8 x 10 ²	++	—	Very poor	-
Cabinet drying (60 ± 2°C till 7% moisture is obtained)	+++	—	+++	0.8 x 10 ²	+	—	Very poor	-

a - quality on rehydration; b – micro flora count



4. COLLECTION, IDENTIFICATION AND CONSERVATION OF WILD EDIBLE MUSHROOMS

COIMBATORE CENTRE

One isolate each of *Polyporus*, *Ganoderma*, *Lycoperdon esculentum*, *Calocybe indica*, *Pleurotus djamor* var. *roseus*, two isolates of *Volvariella volvacea* (Fig. 9) were collected, and pure cultured and deposited in the germplasm bank of Mushroom Research and Training Centre, Department of Plant Pathology, TNAU, Coimbatore (Table 27).

FAIZABAD CENTRE

Surveys were carried out in Faizabad and Barabanki districts during rainy season of the

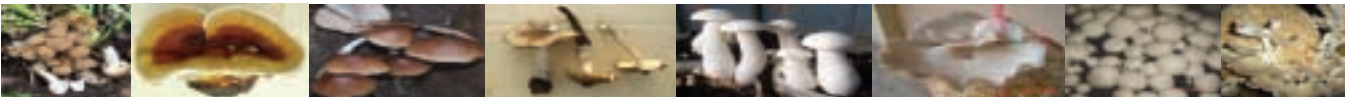
year 2008. During survey, several naturally growing mushrooms were collected, out of which *Volvariella*, *Termitomyces*, and *Ganoderma* are important. No new mushroom species was recorded.

PANTNAGAR CENTRE

Forays were conducted at Kotdwar, Lansdowne, Dehradun districts of Uttarakhand and adjacent forest areas during rainy season (July and August, 2008) and 43 specimens were collected (Table 28) out of which, 19 were indentified tentively which are listed as under:

Table 27. Wild germplasm collection, identification and conservation at Coimbatore Centre

S.No.	Mushroom species	Place of collection	Status of culture
1	<i>Volvariella volvacea</i> – PSM 6	PBS,CBE	Pure culture
2.	<i>Volvariella volvacea</i> – PSM 7	Anaikatti, CBE	Pure culture
3.	<i>Pleurotus platypus</i>	Anaikatti	Pure culture
4	<i>P. sajor-caju</i>	Anaikatti	Pure culture
5	<i>Pleurotus djamor</i> var. <i>roseus</i>	TNAU, Campus	Pure culture
6	<i>Ganoderma lucidum</i> – (GL I)	TNAU, Campus	Pure culture
7	<i>Agaricus bisporus</i>	Ooty	Pure culture
8.	<i>Lycoperdon esculentum</i>	Kodaikanal	Not cultured
9.	<i>Pcystidiosus</i>	Anaikatti	Cultured
10.	<i>Termitomyces</i> sp.	Thondamuthur	Pure culture
11.	<i>Polyporus</i> sp.	Kovaipudur, Cbe	Pure culture
12	<i>Calocybe indica</i>	Thondamuthur,Cbe	Pure culture





(a)



(b)



(c)



(d)



(e)



(f)

Fig. 9. Wild mushroom germplasm collected at Coimbatore Centre; (a) *Termitomyces* spp., (b) *P. platypus*, (c) *C. indica*, (d) *L. edodes*, (e) *V. volvacea* and (f) *Paxillus involutans*



Table 28. Details of mushroom germplasm collected by Pantnagar Centre (2008-2009)

Sl.No.	Fungus	Location	Period
1.	<i>Clitocybe flaccida</i>	Kotdwar	July, 2008
2.	<i>Coriolus versicolor</i>	Kotdwar	July, 2008
3.	<i>Ganoderma lucidum</i>	Lansdowne	July, 2008
4.	<i>Ganoderma lucidum</i>	Kotdwar	July, 2008
5.	<i>Ganoderma lucidum</i>	Lansdowne	July, 2008
6.	<i>Coriolus</i> spp.	Kotdwar	July, 2008
7.	<i>Coriolus</i> spp.	Lansdowne	July, 2008
8.	<i>Lepiota cristata</i>	Lansdowne	July, 2008
9.	Jelly fungus	Lansdowne	July, 2008
10.	<i>Daldinia</i> spp.	Dehradun	Aug, 2008
11.	<i>Ganoderma lucidum</i>	Dehradun	Aug, 2008
12.	<i>Lycoperdon</i>	Dehradun	Aug, 2008
13.	<i>Lactarius</i> spp.	Dehradun	Aug, 2008
14.	<i>Schizophyllum</i> spp.	Dehradun	Aug, 2008
15.	<i>Fomes rosea</i>	Dehradun	Aug, 2008
16.	<i>Omphalina ericetorum</i>	Dehradun	Aug, 2008
17.	<i>Polyporus squamosus</i>	Dehradun	Aug, 2008
18.	<i>Lenzites</i> spp.	Dehradun	Aug, 2008
19.	<i>Polyporus</i> spp.	Dehradun	Aug, 2008

PUNE CENTRE

Forays were conducted at different locations of Western Ghat region during 2008-09 monsoons and a total of 16 specimens of

wild fleshy fungi were collected (Fig. 10). They were identified up to genus level based on mycological characteristics. Some wild fleshy fungi collected are listed below in Table 29.



Fig. 10. Wild mushroom (*Termitomyces* sp.) growing under natural habitat & on sale in market

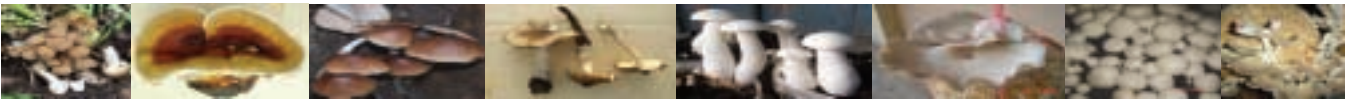


Table 29: List of wild fleshy fungi collected at Pune Centre (2008-09)

Sr. No.	Fungus	Culture code
1	<i>Agaricus</i> spp.	PP-1
2	<i>Agaricus</i> spp. 1	PP-2
3	<i>Ganoderma</i> spp.	PP-3
4	<i>Ganoderma</i> spp. 1	PP-4
5	<i>Clavaria</i> spp.	PP-5
6	<i>Ramaria</i> spp.	PP-6
7	<i>Onnia</i> spp.	PP-7
8	<i>Pleurotus</i> spp.	PP-8
9	<i>Rusulla</i> spp.	PP-9
10	<i>Albatrellus</i> spp.	PP-10
11	<i>Geastrum</i> spp.	PP-11
12	<i>Macrolepiota</i> spp.	PP-12
13	<i>Inocybe</i> spp.	PP-13
14	Unknown 1	PP-14
15	Unknown 2	PP-15
16	Unknown 3	PP-16

RAIPUR CENTRE

Extensive forays were made to collect the mushroom from different localities of Chhattishgarh state. Special emphasis has been given to old Baster zone, which is rich in all type of flora and fauna. Its thick forest provides congenial conditions for mushroom growth under natural habitats. The mushrooms were collected and identified on the basis of local information and still need scientific confirmation. The collected mushrooms were: Kanaki Futu, Bans Futu, *Russula* sp. (pink), *Russula* sp. (black), *Russula* sp. (red), *Termitomyces* spp., *Amanita* spp., *Lactarius* spp., *Lepiota* spp., *Calocybe indica*, milky mushroom, *Pleurotus* spp., *Volvariella volvacea*, *Bovista vigrescens* (Dhela putu), *Coprinus* sp. and *Ganoderma lucidum* (Table 30).

UDAIPUR CENTRE

During monsoon season of 2008 a total of 7 forays were conducted for collection of wild fleshy fungi. The surveys were carried out during pre-monsoon, monsoon and post-monsoon season to collect the wild fleshy fungi appearing during different periods. The areas surveyed were Ramkunda forest, Kumbalgarh forest, Malgarh forest, Som area, Kevre ki Nal forest. Sajjangarh forest, back of Lake Pichola, Jhadol areas, Ranakankar, Jarga forest, Haldighati areas, Khamnor area and Dungarpur area. Total of 131 different specimens of wild fleshy fungi were collected, cultured, preserved and identified. Some important genera are *Hexagonia hirata*, *Phellinus gilvus*, *Ramaria* spp., *Calocybe* spp., *Pleurotus* spp., *Auricularia* spp., *Pisolithus tinctorius*, *Hericium erinaceum*, *Fistulina hepatica*, *Phellorinia inquinans*, *Boletus* spp., *Agaricus bisporus*, *Geastrum saccatum*, *Lenzites* spp., *Hygrophorus* spp., *Xylaria* spp., *Daldinia concentrica*, *Cortinarius* spp., *Clavaria* spp., *Favolus canadenses*, *Thelephora* spp., *Aleurica aurantica*, *Ceriporia spissa*, *Ganoderma luciduim* and *Volvariella* spp. (Table 31).

Out of 131 wild fleshy fungi collected, only 87 were identified. The cultures of 26 were prepared and sent to Dr S.K. Singh, Principal Scientist, Plant Pathology, C.A.Z.R.I. Jodhpur (Rajasthan), for their DNA isolation and molecular characterization.

VELLAYANI CENTRE

Collections have been made from forest areas as well as urban dwellings. Spore points of all of the collected mushrooms have been taken and the species isolated have been



Table 30. Wild mushroom germplasm collected at Raipur Centre (2008-09)

S. No.	Fungus	Habitat/Substrate	Place	Date of collection	Edibility
1.	Kanaki Futu	Sandy red soil in saal forest	Kondagaon (Bastar)	Oct.08	Edible
2.	Bans Futu (<i>Cantherallus</i> spp.)	Bamboo plantation (Bastar)	Keshkal	Oct.08	Edible
3.	<i>Russula</i> sp. (pink)	High humus thick saal forest	Darbha ghati	Oct.08	-
4.	<i>Russula</i> sp. (black)	High humus thick saal forest	Darbha ghati	Oct.08	-
5.	<i>Russula</i> sp. (red)	High humus thick saal forest	Darbha ghati	Oct.08	-
6.	<i>Astreatus hygrometricus</i> (Sal bonda)	Saal forest with high humus	Bastar Jagdalpur	July 08	Edible
7.	<i>Termitomyces heimii</i>	Termitorium or mounds	Horticulture garden and before PG hostel COA, market of Raipur, Bastar etc.	July-August	Edible
8.	<i>Termitomyces</i> spp.	On soil	Farm COA, Raipur	July-August	Edible
9	<i>Amanita</i> spp.	Red soil	Narayanpur	October	-
10.	<i>Lactarious</i> spp.	Red soil	Narayanpur	October	-
11.	<i>Lepiota</i> spp.	Red soil	Narayanpur	October	Edible
12.	<i>Calocybe indica</i> Milky mushroom	Farmer's field under tree shade	Tendua, Raipur	October	Edible
13.	<i>Pleurotus</i> spp.	On wood logs	Narayanpur	October	Edible
14	<i>Volvariella volvacea</i>	On paddy straw heap	IGKV research farm, Raipur	August	Edible
15.	<i>Bovista vigrescens</i> (Dhela putu)	Leaf litter	Raipur	August	Edible
16	<i>Coprinus</i> sp.	Experimental huts and COA farm at Raipur	Raipur	August	Non-edible
17.	<i>G. lucidum</i>	Palas tree, Gulmohar tree	Malhotra Farm, Tendua and VIP Road, Raipur	Sept -October	Medicinal
18.	<i>Ganoderma lucidum</i>	Gulmohar tree	Narayanpur, Bastar Dharampura , COA, Raipur	Sept -October	Medicinal

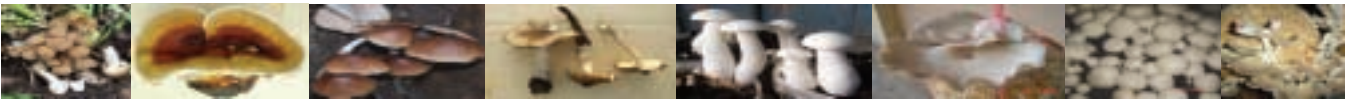


Table 31. Wild mushroom germplasm collected at Udaipur Centre (2008-09)

S. No.	Name of Mushroom	Date of collection	Locality	Substrate
1.	<i>Agaricus</i> spp.	29.07.08	Khamnor area	Soil
	<i>Agaricus</i> spp.	29.07.08	Haladi ghati area	Soil
	<i>Agaricus bernardus</i>	29.07.08	Haladi ghati area	Soil
	<i>Agaricus</i> spp.	29.07.08	Kelwara rout	Soil
	<i>Agaricus</i> spp.	05.08.08	KKN	Leaf litter
	<i>Agaricus</i> spp.	05.08.08	Piladar	On soil
2.	<i>Aleuria aurantia</i>	07.08.08	Kolyari	Dead wood
3.	<i>Auricularia</i> spp.	07.08.08	Som area	Dead ratanjot twig
	<i>Auricularia</i> spp.	29.07.08	Kelwara rout	Dead wood
	<i>Auricularia</i> spp.	05.08.08	Som- Kherwada	Dead wood
4.	<i>Boletus</i> spp.	05.09.08	Kalka mata	Soil
5.	<i>Bovista</i> spp.	29.07.08	Haladi ghati area	Soil
6.	<i>Calocybe</i> spp.	07.08.08	Jhadol area	Near roots of tree
	<i>Calocybe</i> spp.	16.09.08	Ambamata area	Soil
7.	<i>Ceriporia spissa</i>	07.08.08	Sandol mata area	On dead karanj plant
8.	<i>Chlorophyllum molybdites</i>	07.08.08	Jhadol area	Soil
9.	<i>Clavaria</i> spp.	29.07.08	Haldighati area	On soil
	<i>Clavaria oronoienses</i>	07.08.08	Som area	On soil
10.	<i>Coprinus</i> spp.	17.07.08	Animal farm, RCA, Udaipur	Wheat straw
11.	<i>Clitocybe</i> spp.	17.07.08	Doodh talai	Soil
12.	<i>Coletinarius</i> spp.	27.08.08	Malgarh forest	Leaf litter
13.	<i>Daldinia concentrica</i>	27.08.08	Malgarh forest	Dead log
14.	<i>Entoloma</i> spp.	07.08.08	Som area	On soil
15.	<i>Favolus canadenis</i>	07.08.08	Som area	Dead dhak plant
16.	<i>Phellinus gilvus</i> (sulphur colour)	27.08.08	Malgarh forest	On dead wood
17.	<i>Fistulina hepatica</i>	05.09.08	Sajjan garh forest	On dead wood
18.	<i>Ganoderma</i> spp.	17.07.08	RCA, Udaipur	On Sisham tree
	<i>Ganoderma</i> spp.	29.07.08	Khamnor area	On dead wood
	<i>Ganoderma</i> spp.	27.08.08	Malgarh forest	On dead wood
19.	<i>Geaster</i> spp.	06.08.08	RCA, Udaipur	On leaf litter
	<i>Geastrum triplex</i>	27.08.08	Malgarh forest	On soil
	<i>Geastrum saccatum</i>	27.08.08	Malgarh forest	On soil
20.	<i>Hericium erinaceum</i>	05.09.08	Back of Pichola lake	On dead wood of Bargad tree
21.	<i>Hexagonia hirta</i>	27.08.08	Malgarh forest	On dead wood
22.	<i>Hygrophorus</i> spp. (grey)	27.08.08	Malgarh forest	On soil
	<i>Hygrophorus</i> spp. (olive colour)	16.09.08	Jarga forest	On soil
23.	<i>Laitoporus</i> spp.	07.08.09	Palia kheda	On dead wood
24.	<i>Lenzites</i> spp.	27.08.08	Malgarh forest	On dead wood
25.	<i>Lepiota</i> spp.	29.07.08	Kamnor area	On soil
	<i>Lepiota</i> spp.	29.07.08	Akodara	Soil
	<i>Lepiota</i> spp.	17.07.08	Gariyawas	Soil
	<i>Lepiota</i> spp.	17.07.08	Doodh talai	Soil
	<i>Lepiota</i> spp.	29.07.08	Haldighati area	Soil



S. No.	Name of Mushroom	Date of collection	Locality	Substrate
	<i>Lepiota cristata</i>	05.08.08	Aspur, Sabala	On leaf litter/ soil
	<i>Lepiota</i> spp.	05.08.08	Salumbar	Leaf litter
	<i>Lepiota procera</i>	07.08.08	Som area	On soil
26.	<i>Leucocoprinus brebbisomii</i> <i>Leucocoprinus luteus</i>	29.07.08	Haldi ghati area	On dead wood of Oke
27.	<i>Marasmius oreades</i>	07.08.08	Som area	Dead dhak plant
28.	<i>Microlepoita gracilentia</i>	17.07.08	Gariyawas	Cow dung
29.	<i>Mycenia</i> spp.	17.07.08	Gariyawas	Soil
30.	<i>Mycenia</i> spp. (dark brown)	07.08.08	Malgarh forest	Dead dhak wood
31.	<i>Panealus</i> spp.	29.07.08	Cosmopolitan	On cow dung
32.	<i>Phellinus punctatus</i>	27.08.08	Malgarh forest	Wood log
33.	<i>Phellorinia inquenens</i>	08.09.08	Sajjan garh forest	On soil
34.	<i>Pisolithus</i> spp.	05.09.08	Back of Pichola lake	On soil
35.	<i>Pleurotus</i> spp.	29.07.08	Haldi ghati area	Dead twig of Ratanjot
	<i>Pleurotus</i> spp.	29.07.08	Kelwara rout	
	<i>Pleurotus</i> spp.	07.08.08	Som area	Dead ratanjot
	<i>Pleurotus</i> spp. (pink)	07.08.08	Som area	Dead ratanjot
	<i>Pleurotus</i> spp.	16.09.08	Ranakankar forest	Color region of plant
36.	<i>Podaxis pistillaris</i>	29.07.08	Haldi ghati area	Soil
37.	<i>Polypore</i> spp. (brown)	07.08.08	Malgarh forest	Dead dhak plant
38.	<i>Polypore</i> spp. (thick)	07.08.08	Som area	On dead dhak
39.	<i>Polypore</i> spp. (tubes)	27.08.08	Malgarh forest	Dead log
40.	<i>Ramariopsis runsci</i>	07.08.08	Som area	On collarr region
41.	<i>Ramaria</i> spp.	16.09.08	Ranakankar forest	On collarr region
42.	<i>Schizophyllum cummienae</i> <i>Schizophyllum</i> spp.	29.07.08 16.09.08	Kelwara rout Isval	Dead wood On dead wood
43.	<i>Serpulla lacrima</i>	05.09.08	Back of Pichola lake	On dead date palm
44.	<i>Stropharia</i> spp.	29.07.08	Khamnor area	On cow dung
45.	<i>Termitomyces</i> spp.	29.07.08	Haldi ghati area	Dead Wood
46.	<i>Termitomyces</i> spp.	29.07.08	Kelwara rout	On termite nest
47.	<i>Thelephora</i> spp.	07.08.08	Som area	On coler region of karanj
48.	<i>Trichoderma portentosum</i>		Vani village	On soil
49.	<i>Tricholoma</i> spp.	27.08.08	Malgarh forest	Color region of Ber tree
50.	<i>Tricholoma</i> spp. (iodine colour)	27.08.08	Malgarh forest	On soil
51.	<i>Volvariella speciosa</i> <i>Volvariella glococephala</i> <i>Volvariella glococephala</i> <i>Volvariella</i> spp. <i>Volvariella</i> spp.	17.07.08 17.07.08 05.08.08 05.08.08 05.08.08	Gariyawas Doodh talai Aspur, Sabala Aspur KKN	Cow dung On soil On leaf litter On soil On soil
52.	<i>Xylaria</i> spp. <i>Xylaria</i> spp.	27.08.08 07.08.08	Malgarh forest Som area	On dead wood On dead dhak





(a)



(b)



(c)



(d)



(e)



(f)

Fig. 11. Wild mushroom germplasm collected at Vellayani Centre; (a) *Boletus* sp., (b) *Squorrosulus* sp., (c) *Dictyophora indusiata*, (d) *Clitocybe flaccida*, (e) *Auricularia auricula* and (f) *Ramasia* sp.



preserved in museum attached to the AICRP at Department of Plant Pathology, College of Agriculture, Vellayani. Natural collection of *Pleurotus eous*, *Auricularia*, *Hydnum*, *Boletus*, *Tuber*, *Lycoperdon* etc. have been preserved (Fig. 11). A few are yet to be identified. A giant sized *Pleurotus* obtained is being domesticated.

SOLAN CENTRE

Fungal forays were undertaken in the forest areas of Himachal Pradesh, Uttarakhand, Delhi, Punjab, Haryana and Chandigarh. A total no of 219 specimens were collected and 202 specimens identified upto genus level. All the specimens have been preserved in the Herbarium of DMR, Solan.

1. All the specimens were examined for their macroscopic features in the field along with their field photographs.
2. We have identified some collection upto species level i.e. *Cantharellus appalachinesis*, *C. cibarius*, *Tricholoma ponderosus*, *T. auranticum*, *Lepiota sordida*, *Pleurotus djamore* var. *cyathiformis*, *Ganoderma lucidum*, *Grifola frondosa*, *Descolea flavo annulata*, *Stropharia rugoso annulata*, *S. coronilla*, *Amanita subglobosa*, *Amanita*

umbrinolutea, *A. hemibapha* var. *ochracea*, *A. hunanensis*, *A. hemibapha* subsp. *hemibapha* and *Coprinus comatus*.

There were 3 specimens belonging to Ascomycetous and rest Basidiomycetous fungi. Among basidiomycete, 172 specimens belongs to order Agaricales, 2 Boletales, 2 Gasteromycetes and 23 genera of order Aphyllophorales. Rest of the collections (17) are still under examination for their proper identification. *Agaricus* (10), *Albatrellus* (1), *Amanita* (9), *Armillaria* (3), *Auricularia* (6), *Chlorophyllum* (4), *Cantharellus* (5), *Clitocybe* (4), *Coltricia* (1), *Collybia* (1), *Coprinus* (2), *Cortinarius* (15), *Crepidotus* (1), *Descolia* (5), *Gomphus* (3), *Grifola* (2), *Gymnopilus* (3), *Hebeloma* (3), *Hericius* (1), *Hygrocybe* (2), *Hohenbuhelia* (1), *Inocybe* (9), *Kuehneromyces* (1), *Laccaria* (8), *Lactarius* (2), *Lentinula* (3), *Lepiota* (6), *Lepista* (3), *Leucoagaricus* (1), *Leucocoprinus* (2), *Lyophyllum* (1), *Marasmius* (2), *Mycena* (1), *Melanogaster* (1), *Nematoloma* (8), *Oudemansiella* (2), *Pholiota* (4), *Phaeocollybia* (2), *Phaeomarasmius* (1), *Pleurotus* (6), *Podaxis pistillarius* (1), *Phyllotopsis* (1), *Psathyrella* (2), *Rhodocybe* (1), *Russula* (1), *Stropharia* (4), *Strobilomyces* (1), *Sparaxis crispa* (1), *Trametes* (2), *Tricholoma* (10), *Volvariella* (1) and *Xerula* (2).



5. SURVEY AND SURVEILLANCE OF DISEASES AND INSECT PESTS

COIMBATORE CENTRE

In oyster mushroom farms, *Coprinus comatus* was observed from spawn running till mushroom harvest, which is mainly due to chemical method of substrate sterilization (Table 32). The moulds viz., *Trichoderma*

viride and *Aspergillus niger* were also observed in oyster mushroom beds (Table 33), whereas in milky mushroom farms only scaling of mushrooms and infestation of mites were observed (Table 34, 35). In paddy straw mushroom beds, *Coprinus comatus* was the dominant mould (Table 36).

Table 32. Biotic and abiotic disorders observed in *P. florida*

Biotic/Abiotic disorders	No. of bags /trays		Stage of the crop	Diseases	Scale	CST	HWT
	Prepared	Infected					
Moulds	30	2	Spawn running	<i>Coprinus comatus</i>	2	+	-
		2	Pinhead formation	-	-	-	-
		2	After II harvest	<i>Aspergillus flavus</i>	2	+	+
Abiotic	30	1	At pinning	Browning	2	+	+
Insect pests	30	2	Spawning	-	-	-	-
		3	After I & II harvest	Mites	2	+	+

CST-chemical sterilization treatment; HWT-hot water treatment

Table 33. Mycoparasitic moulds observed in Oyster mushroom farms

Name of the Farm	Type of moulds observed	Source of contamination
Sakthi mushroom Farm, Jothipuram, Coimbatore dt.	Spawn: <i>Aspergillus niger</i> , <i>Trichoderma viride</i>	Poor hygiene in the spawn room
Maga mushroom Farm, Thenamanallur, Coimbatore dt.	Nil	-
Sakthi mushroom Farm, Gobi,Erode dt.	Beds: <i>Coprinus comatus</i>	Chemical method of sterilization
SRG Mushroom farm, Namakkal, Namakkal dt.	Spawn: Bacteria Beds: <i>Aspergillus flavus</i>	Over cooking of cholan grains Moulds in the thatched roofs
Srinivas mushroom Farm, Madurai dt.	Beds: <i>Coprinus comatus</i> <i>Sclerotium oryzae</i>	Chemical method of sterilization and old paddy straw
Karpagam mushroom farm, Kurumbapalayam Coimbatore dt.	Spawn: <i>Aspergillus flavus</i> Beds: <i>Trichoderma viride</i>	Very old paddy straw, dusty environment
Kongu Mushroom Farm, Erode	Beds: <i>Coprinus comatus</i>	Chemical method of sterilization
Anand Agro Tech, Coimbatore	Beds: <i>Coprinus comatus</i>	Chemical method of sterilization
Pothigai Mushrooms, Coimbatore	Beds: <i>Coprinus comatus</i>	Chemical method of sterilization



Table 34. Biotic and Abiotic disorders observed in Milky mushroom, *Calocybe indica*

Biotic/Abiotic disorders	No. of bags /trays		Stage of the crop	Diseases	Scale	CST	HWT
	Prepared	Infected					
Moulds	30	2	Spawn running	-	-	-	-
		4	After casing	-	-	-	-
Abiotic disorders	30	1	After I and II harvest	Scales	2	+	+
Insect pests	30	2	After II harvest	-	-	-	-
		3	After III harvest	Mites	40*	+	+

CST-chemical sterilization treatment; HWT-hot water treatment

Table 35. Mycoparasitic moulds observed in Milky mushroom Farms

Name of the Farm	Types of moulds observed	Source of contamination
Sakthi mushroom Farm, Erode Dt.	Beds: <i>Trichoderma viride</i> , <i>Aspergillus flavus</i> Casing: <i>Stemonitis</i> , <i>Dactylium</i> sp.	Improper sterilization of paddy straw and unhygiene inside the sheds, improper sterilization of casing soil
Maga mushroom Farm, Thenamanallur Coimbatore Dt.	Beds: <i>Coprinus comatus</i>	Chemical method of sterilization
A Prince 5 mushroom Farm, Erode Dt.	Beds: <i>Trichoderma viride</i>	Very old paddy straw, improper sterilization of casing soil
Sahay Mushroom Farm, Trichy Dt.	-	-
Sujji mushroom world, Ganapathipalayam	Beds: <i>Aspergillus flavus</i> ,	Moulds in the roofs
Sun Mushroom Farm, Erode	Beds: <i>Coprinus comatus</i>	Chemical method of sterilization
Kongu Mushroom Farm, Erode	Beds: <i>Coprinus comatus</i>	Chemical method of sterilization

Table 36. Biotic and Abiotic disorders observed in Paddy straw mushroom

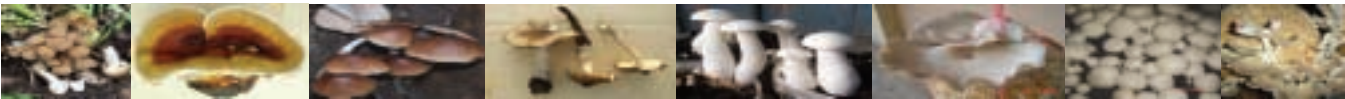
Biotic/Abiotic disorders	No. of bags /trays		Stage of the crop	Diseases	Scale	CST	HWT
	Prepared	Infected					
Moulds	25	14	Spawn running	<i>Coprinus</i> sp.	4	+	-
		5	During cropping	<i>Coprinus</i> sp.	3	+	-
Abiotic disorders	-	-	-	-	-	-	-
Insect pests	25	10	During spawning	-	-	-	-

CST-chemical sterilization treatment; HWT-hot water treatment

FAIZABAD CENTRE

Surveys for recording of data on incidence of diseases and insect pests in milky mushroom, *Calocybe indica*, during summer

were carried out at farmers’ units in Barabanki and Faizabad districts. Bacterial rotting of fruiting bodies was most common and pinhead death ranging 60-85% was recorded. In another case, the casing soil was



recorded to be infected with *Coprinus* spp. Flies were the most common insect-pest in milky mushroom farms.

During winter, surveys were conducted in and around Faizabad and data on incidence of diseases and insect pests in button mushroom, *Agaricus bisporus* was recorded. Dry bubble was the most common fungal disease, while flies were among the most common insect-pests.

LUDHIANA CENTRE

Survey and surveillance work was carried out in button mushroom at the mushroom

experimental station. Among the fungal pathogens, infection due to *Trichoderma* spp., *Coprinus* spp. and *Papulaspora byssina* were the most common and they affected the mushroom yield in the range of 2-3 %. Open veil and crocodile scales were the most common abiotic disorders in button mushroom. Hardly 2-4% mushroom fruiting bodies were recorded to be affected from the abiotic disorders. No incidence of insect-pests was recorded (Table 37).

PANTNAGAR CENTRE

The survey and surveillance work for diseases and insect-pests infection/infestation

Table 37. Incidence of different diseases/moulds/insect pests at Ludhiana Centre (2008-09)

Disease	No. of Bags	Stage of crop	Scale
(A) Biotic disorder			
<i>Verticillium fungicola</i>	-	-	-
<i>Cladobotryum dendroides</i>	-	-	-
<i>Mycogone perniciosa</i>	-	-	-
<i>Trichoderma</i> spp.	3	Over cased beds	Less than 2% fruiting bodies affected
<i>Diehliomyces microsporus</i>	-	-	-
<i>Chaetomium</i> spp.	-	-	-
<i>Coprinus</i> spp.	10	During spawn run and after casing	Up to 2% yield
Cinnamon mould	-	-	-
<i>Sporendonema purpurescens</i>	-	-	-
<i>Cephalothecium roseum</i>	-	-	-
<i>Oedocephalum</i> spp.	-	-	-
<i>Papulaspora byssina</i>	2	On cased beds	Affected yield up to 3%
<i>Myceliophthora lutea</i>	-	-	-
<i>Chrysosporium luteum</i>	-	-	-
<i>C. sulphureum</i>	-	-	-
<i>Sepedonium</i> spp.	-	-	-
<i>Scopulariopsis fimicola</i>	-	-	-
(B) Abiotic disorders			
Stroma	-	-	-
Weepers	-	-	-
Open veil	8	At the end of crop	Less than 4%
Hollow cone and Brown pith	-	-	-
Purple stem	-	-	-
Rose comb	-	-	-
Scales or crocodiles	5	Seen at the end of crop	Less than 2%
Brown discoloration	-	-	-
(C) Incidence of insect pests			
Sciarid fly	-	-	-
Phorid fly	-	-	-
Cecids	-	-	-
Springtails	-	-	-
Mites	-	-	-
Beetles	-	-	-
Nematodes	-	-	-



was carried out in button mushroom crop during winter months of 2008-09 on marginal & small-scale mushroom farms located in the district Udham Singh Nagar and Nainital of Uttarakhand. It was observed that green mould caused by *Trichoderma* spp. prevailed to the extent of 26.25% in marginal scale mushroom growing under hut conditions. Of the mushroom growing units surveyed, *Deihliomyces microsporus* was observed in 6.28% growing units in the month of Feb.-March, 2009. *Verticillium fungicola* was observed in 12.19% marginal & small scale growing units visited. Infestation of sciarid and phorid flies were observed @ 9.12% and 6.12%, respectively in last lag of the crop in most of the mushroom huts. During the month of March/April, beetles were observed in 9% of the cropping rooms (huts). Browning of the pin heads of *C. indica* was also observed @ 40.56%. In some of the cases, it was observed that *Pleurotus* spp. did not fructify after first flush.

PUNE CENTRE

Survey and surveillance for diseases and insect-pests was carried out at AICMIP, Pune Centre and in different private mushroom farms.

A) AICMIP, Pune Centre

1. Button Mushroom

Total 380 beds of button mushroom were observed in which only 20 were found contaminated. Among the insects, mainly phorid flies (5/bed) were recorded. The green mould incidence was up to 10% (Table 38).

2. Oyster Mushroom

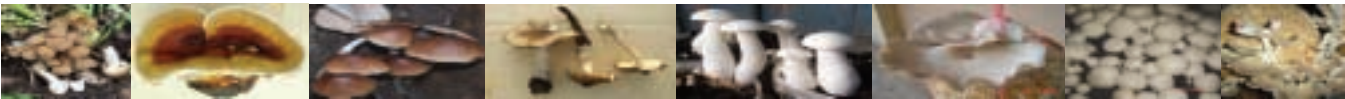
In oyster mushroom experimental trials, total 250 beds were observed out of which 30 were found contaminated. The incidence of green mould was observed to the maximum of 10% on substrate (Table 38).

Table 38. Incidence of pests and diseases observed at AICMIP, Pune Centre

Sr. No.	Crop	No. of beds tested		Types of contamination					
		No. of beds	Contamination	Insect	Scale	Bed no.	Disease	Scale	% incidence
1.	Button Mushroom	380	20	Phorid flies	2 Browning of pin heads	-	Green mould	2	10% on substrate
2.	Oyster Mushroom	250	30	-	-	-	Green mould	2	10% on substrate

Table 39. Incidence of pests and diseases observed on the private farms

Sr. No.	Crop	No. of beds tested		Types of contamination					
		No. of beds	Contamination	Insect	Scale	Bed no.	Disease	Scale	% incidence
1.	Button Mushroom 2 farms	1000	-	-	-	-	-	-	-
2.	Oyster Mushroom 2 farms	400	70	-	-	60	Green mould	2	10% on substrate



B) Private farms

1. Button Mushroom

Two private button mushroom farms were surveyed. Total 1000 beds were observed and all theses were found free from pests and diseases (Table 39).

2. Oyster Mushroom

Total 400 beds of oyster mushroom were surveyed at two private farms. Only 70 beds were found to be contaminated up to 10% with green mould diseases (Table 39).

RAIPUR CENTRE

Extensive forays were made to work out the pathogens causing diseases/contamination during spawn production, mushroom cultivation and on dry mushrooms. Major contaminants in almost all laboratories and mushroom production houses were *Trichoderma* spp., *T. viride*, *T. harzianum*, *Aspergillus* spp., *Alternaria* spp., *Fusarium* spp., *Rhizoctonia* spp., *Rhizopus* spp., *Tricothecium* spp. *Coprinus* spp. and *Sclerotium rolfsii*, bacteria and nematodes. The phorid and cecid flies were observed at many locations surveyed (Table 40).

Table 40. Survey and surveillance of diseases and insect pests of mushrooms at Raipur Centre

Sl. no.	Locality	Mushroom grown	Contaminants	Insects
1.	Mushroom lab. COA, Raipur	Oyster mushroom	<i>Trichoderma viride</i> , <i>T. hamatum</i> , <i>Trichoconis</i> spp., <i>Alternaria</i> spp. and <i>Aspergillus</i> spp. and Bacterial bloch	Phorid and Cecid flies
		Button mushroom	<i>Aspergillus</i> spp., <i>Fusarium</i> spp., <i>Tricothecium</i> spp., <i>T. viride</i> , <i>Coprinus</i> spp. and Bacterial blotch	Phorid and Cecid flies
		Milky mushroom	<i>Aspergillus</i> spp., <i>T. viride</i> , <i>T. harzianum</i> , <i>Pythomyces</i> spp., <i>Rhizoctonia</i> spp. and <i>Sclerotium rolfsii</i> , Bacteria and Nematodes	Cecid flies
		Paddy straw mushroom	<i>Aspergillus</i> , <i>Rhizopus</i> , <i>Pythomyces</i> and <i>Coprinus</i> spp.	No
2.	Madhav Baghmar Jora, Raipur	Oyster mushroom	<i>Aspergillus</i> spp., <i>Rhizopus</i> spp., <i>Rhizoctonia</i> spp. <i>T. viride</i>	No
3.	Namrata Premji Ydu Farm, Tendua, Raipur	Oyster mushroom	<i>Aspergillus</i> spp. and <i>Trichoderma</i> spp.	Phorid and Cecid flies
4.	Tarra, Raipur	Oyster mushroom	<i>Aspergillus</i> spp., <i>Alternaria</i> spp., <i>Rhizopus</i> spp., <i>Trichoderma</i> spp., and bacterial growth	No
5.	Goverdhan, Sahu, Dhamtari	Oyster mushroom	<i>Trichoderma</i> spp., <i>Aspergillus</i> spp. and <i>Coprinus</i> spp.	No
6.	Govt. Spawn production, Ambikapur	Oyster and Parafutu mushrooms	<i>Trichoderma</i> spp., <i>Aspergillus</i> spp. and <i>Coprinus</i> spp.	Phorid flies



RANCHI

It has been observed that *Coprinus* spp., *Aspergillus* sp., *Trichoderma* spp. were the most prevalent contaminants in the bags of oyster and milky mushrooms, and *Sclerotium rolfsii* in paddy straw mushroom. Sciarid flies were the pests during summer at oyster mushroom farms.

UDAIPUR CENTRE

Different mushroom farms located at Udaipur and Jodhpur districts were visited for survey and surveillance of diseases and insect pests. Total of 25 mushroom farms were

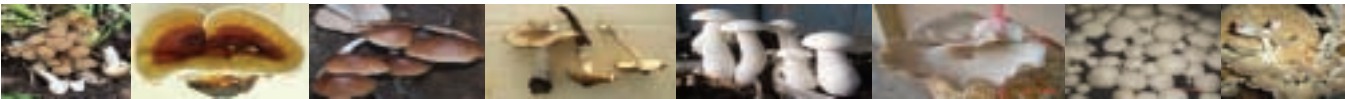
visited for occurrence of diseases and insect pests (Table 41).

It was observed that in tribal areas, no disease and insect pest were found. Further, only at 2-3 farms in Jhadol area of Udaipur district, infection of *Coprinus* spp. and green mould were observed in traces only.

In winter season 11 farms of button mushroom were visited around Udaipur districts. The most common diseases observed were false truffle, brown plaster mould and inky caps. Among insect pests, Dipterien flies were observed in 2-3 farms.

Table 41. Survey and surveillance of diseases and insect pests for button, oyster and milky mushroom

Sl. No.	Name of Farm	Mushroom	Substrate treatment	Diseases/insect-pests		
				Diseases	Insect-pests	Abiotic disorder
1.	AICRP, Udaipur	<i>Pleurotus florida</i>	Hot water/CST	Green mould, Inky caps	Dipterian flies	Nil
2.	Shri Ishwar Garg, Vill. Manva Kheda, Udaipur	<i>P. sajor-caju</i>	Hot water/CST	Nil	Nil	Nil
3.	Mr. Sukh lal, Vill. Pai, Udaipur	<i>P. sajor-caju</i>	Hot water/CST	Nil	Nil	Nil
4.	Mrs Jamuna Bai, Village Dhimadi, Jhadol, Udaipur	<i>P. sajor-caju</i>	Hot water/CST	Nil	Nil	Nil
5.	Mrs Saroj Devi	<i>P. sajor-caju</i>	Hot water/CST	Green mould (4%)	Nil	Nil
6.	Mrs Kesar Devi, Baghpura, Jhadol	<i>P. sajor-caju</i>	Hot water/CST	Green mould (8%)	Nil	Nil
7.	Mrs Ganga Bai W/o Sh Bhuraji, Village, Goran, Jhadol	<i>P. sajor-caju</i>	Hot water/CST	Green mould (4%)	Nil	Nil
8.	Mr Radha Charan, Bicchiwara, Dungarpur.	<i>P. sajor-caju</i>	Hot water/CST	Nil	Nil	Nil
9.	CAZRI, Jodhpur (Raj.)	<i>P. sajor-caju</i>	Hot water/CST	Nil	Dipterian flies	Nil



Sl. No.	Name of Farm	Mushroom	Substrate treatment	Diseases/insect-pests		
				Diseases	Insect-pests	Abiotic disorder
10.	AICRP (Mushroom), Udaipur (Raj.)	<i>A. bisporus</i>	N.M.	Brown plaster mould – 1.0%, Green mould – 20 %, False truffles-85%	Dipterian flies	Nil
13.	Sh. N.K. Baya Ji, Vill.-Nai, Udaipur (Raj.)	<i>A. bisporus</i>	N.M.	Brown plaster mould – 1 %, <i>Coprinus</i> spp.– 0.5%	Dipterian flies	Nil
14.	Sh. Hitesh ji, Sunderwas, Udaipur	<i>A. bisporus</i>	N.M.	<i>Coprinus</i> spp. (Traces)	Dipterian flies	Nil
15.	M/s Tribal Women Cooperative Society, Jhadol Area, Udaipur	<i>A. bisporus</i>	N.M.	Nil	Nil	Cracks/ open mushroom
16.	M/s Tribal Women Cooperative Society, Pai, Udaipur (Raj.)	<i>A. bisporus</i>	N.M.	Nil	Nil	Cracks
17.	Sh. Chunni Lal Ji, Nayakheda, Udaipur (Raj.)	<i>A. bisporus</i>	N.M.	<i>Coprinus</i> spp.	Dipterian fly	Cracks, Stroma
18.	AICRP (Mushroom), Udaipur (Raj.)	<i>Calocybe indica</i>	N.M.	Green mould– 3.0%, <i>Coprinus</i> spp.–2.0%	Dipterian flies	Nil

VELLAYANI CENTRE

A total of 500 beds were observed in different localities of the State in 25 different mushroom farms. At some of the villages, where women do the entire cultivation, no trace of insect pests or diseases was observed. In some urban areas, incidence of *Coprinus* and *Trichoderma* were observed. The pink variety, *Pleurotus eous* was more prone to pest attack. Phorids and sciarids were the main insect pests. Swabbing the vicinity of mushroom beds with garlic paste and use of yellow light traps could effectively tackle the pest problem in the region. At farms, where

Calocybe was grown at large scale, bacterial infestation could be noted in beds (5 to 10%), mainly because of excessive watering.

SOLAN CENTRE

Survey of different farms surrounding Murthal (Haryana) revealed the widespread incidence of wet bubble, yellow mould and brown plaster mould. Severe incidence of scarids, phorids and red pepper mite *Pygmephorus sellnicki* was recorded in most of the farms surveyed during the year. These mites were observed to make pits in the fruiting bodies and resulted in browning of the cap.



6. EXTENSION ACTIVITIES

BARAPANI CENTRE

Training: Army Jawans of 264 Fd wkshp, PIN-906264, c/o 99APO, Barapani, Meghalaya were given one day free of cost training on ‘Oyster Mushroom Cultivation’ on 12/02/09.

A free of cost ‘Practical Training on Oyster Mushroom Cultivation’ was organized for 20 SHGs members on 23/3/09 in collaboration with a charitable society NECORD Laitumukhrah, Shillong (Fig. 12).

Sale: Mushrooms (63.96 kg) were sold @Rs.50/kg and 271 Pkt (200 g each) of spawn were sold @ Rs.10/Pkt during 1st April 08-31 March 09.



Fig. 12. Training programme on oyster mushroom cultivation at Barapani

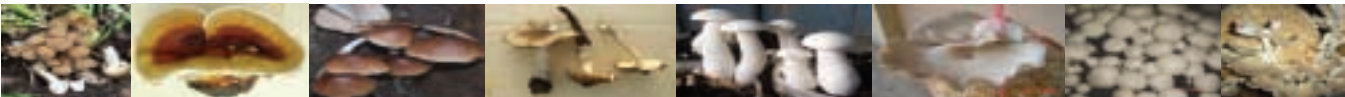
COIMBATORE CENTRE

I. Training and spawn supply

During the year 2008-2009, twelve “One day training programmes” on mushroom

Table 42. Details of one day training programmes and spawn supplied by Coimbatore Centre

Month	Training Date	Persons attended	No. of spawn packets supplied	No. of visitors visited Mushroom Theme Park
April 2008	08.04.08	40	4717	150
May	05.05.08	19	547	130
June	05.06.08	31	1140	150
July	07.07.08	31	956	180
Aug	05.08.08	21	860	250
Sept	05.09.08	22	218	220
Oct	06.10.08	25	216	156
Nov	05.11.08	41	200	124
Dec	05.12.08	50	689	65
Jan 2009	05.01.09	79	300	100
Feb	05.02.09	40	626	200
March	05.03.09	82	1101	250
Total		481	11,570	1975



cultivation were continued as usual on 5th of every month. So far 312 such programmes have been conducted and more than twenty thousand people have been trained on oyster mushroom and milky mushroom production. During the period of report, twelve one day trainings were conducted for 481 people and five 5 day-training programmes were organized on advanced mushroom cultivation techniques and about 30 people were benefited. These training programmes were organized during the month of April, June, October, December 2008 and January 2009 in which 5, 8, 5, 8 and 4 participants, respectively participated (Table 42). During the report period, about 11,570 spawn bags were supplied to the growers of Tamil Nadu Open and Distance Learning Certificate course on Mushroom Cultivation was also offered to 25 participants.

II. Exhibition/ Seminar

Conducted National Seminar on “Advances in Plant Pathology for sustainable Agriculture” on 24-25th Nov. 2008 organised by Indian Phytopathological Society at the Department of Plant Pathology, TNAU, Coimbatore. In this seminar a separate session on Biodiversity of edible fungi and their importance was organized.

FAIZABAD CENTRE

In order to promote mushroom cultivation concerted efforts were made through trainings, demonstrations, advisory services, participation in Kisan Mela and by supplying ready spawn to growers for cultivation of mushrooms. In total 7 training programmes on milky, oyster and button mushroom cultivation, a total of 257 participants participated (Table 43).

Table 43. Details of training programmes organized at Faizabad Centre

S. No.	Date	Duration (Days)	Title	No. of participants	Place
1	24.04.2008	1	Milky mushroom production and consumption	08	Mushroom Laboratory,
2	27.05.2008	1	Milky mushroom production and consumption	05	NDUAT, Kumarganj, Faizabad
3	22-23.07.08	2	Milky mushroom production and consumption	55	
4	24-25-07.08	2	Milky mushroom production and consumption	52	
5	21.11.2008	1	Milky mushroom production and consumption	35	
6	03.03.2009	2	Button and oyster mushroom production and consumption	50	KVK, Hydergarh, Barabanki
7	06.03.2009	2	Button and oyster mushroom production and consumption	52	KVK, Masodha, Faizabad



Training

B. Spawn supply: In total 811.0 kg mushroom spawn was prepared, out of which 483 kg was supplied to farmers and rest was used in experiments.

C. Front-line demonstration: 115 of milky, 100 of oyster and 2 of button mushroom were laid down at village level in Barabanki and Faizabad districts.

LUDHIANA

A total of 5 training programmes of 1-6 days duration were organized in which 113 participants participated (Table 44). Seventeen demonstrations were also organized at different places of the state in which more than 500 participants participated. Students from different areas of the state also visited the mushroom farm. Several seminars/workshops were also organized/attended and one TV talk was also delivered.

PANTNAGAR CENTRE

1. Training

- i) A 3 days training programme on different aspects of mushroom cultivation was organized from Aug. 18-20, 2008 at the University. A batch of 30 trainees, from Kotdwar and Uttarakhand attended the training course.
- ii) A 3 days training programme on different aspects of mushroom cultivation was organized from Aug. 26-28, 2008 at the University. A batch of 30 trainees, from Kotdwar and Uttarakhand attended the training course.

iii) A 6 days training programme on different aspects of mushroom cultivation was organized in two batches at the University. A total of 13 trainees from Uttarakhand, U.P. and Bengak attended the training programme from Sept. 15-20, 2008.

iv) A 2 days training programme on different aspects of mushroom cultivation was organized at the University. A total of 25 retired army officers from Dehradun, Uttarakhand attended the programme from Nov. 07-08, 2008.

v) A 6 days training programme on different aspects of mushroom cultivation was organized at the University. A total of 13 Horticulture officers from Lucknow, Uttar Pradesh attended the programme from Nov. 17-22, 2008.

vi) A 3 days training programme on different aspects of mushroom cultivation was organized at the University. A total of 43 farmers from Panipat, Harayana attended the programme from March 13-15, 2009.

2. Spawn Supply: Mushroom spawn (20.38 quintals), master spawn (187 bottles) and culture tubes (136 Nos.) of different species/strains were supplied to the growers and spawn producers during 2008-09.

3. Compost supply: The centre has supplied 402.00 Qtl. of compost to farmers during season from Oct., 2008-March 2009.

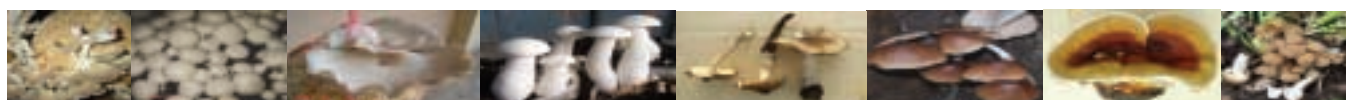
PUNE CENTRE

The various types of extension activities were undertaken in order to promote and popularize mushroom cultivation in Maharashtra (Table 45). These activities were as follows.



Table 44. Details of training programmes /demonstrations/farm visits/TV Talks and Workshops organized at Ludhiana Centre

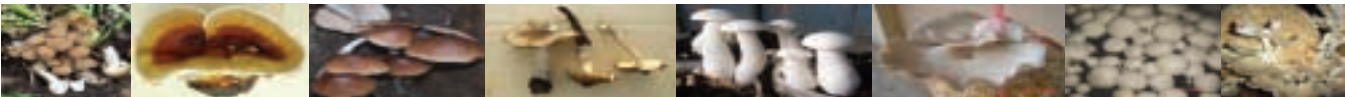
Date	Venue	No. of participants
Training Courses		
08-04-2008	Mushroom training course for gardener's training class, PAU, Ludhiana	24
13-05-2008 to 15-05-2008	Mushroom training course on tropical mushroom cultivation for farmers/farm women of Punjab, PAU, Ludhiana.	08
22-09-08 to 26-09-2008	Mushroom training course, PAU, Ludhiana.	38
23-01-2009	Mushroom training course at PNB Training Centre, Mehraj, Bathinda.	19
26-02-2009 to 27-02-2009	Mushroom training course for Horticulture Supervisors, PAU, Ludhiana.	24
Lectures-cum-Demonstrations		
15-04-2008	Lecture on prospects and potential of mushroom production to IFFCO officers	50
10-06-08	SWOT analysis on mushroom production and its value addition, PAU, Ludhiana.	30
29-07-2008 to 30-07-2008	Lecture and exhibition on mushroom production technology at workshop for vegetables, fruits and flower crops, PAU, Ludhiana	Many
10-09-2008	Regional Kisan Mela at Ballawal	Many
15-09-2008	Regional Kisan Mela at Rauni	
18-09-2008 to 19-09-2008	Kisan Mela at PAU, Ludhiana	
23-09-2008	Regional Kisan Mela at Gurdaspur	
24-09-2008	Lecture-cum-demonstration on mushroom cultivation for young farmers training class, PAU, Ludhiana	
25-09-2008	Regional Kisan Mela at Bathinda	
14-10-2008	Lecture-cum-demonstration on mushroom cultivation, KVK, Bathinda.	25
21-10-2008 to 22-10-2008	Lecture-cum-demonstration on mushroom cultivation for unemployed youth of Punjab, PAU, Ludhiana	27
04-12-2008	Demonstration on mushroom production technology at annual meeting of Punjab Kisan Club, PAU, Ludhiana	Many
06-03-2009	Regional Kisan Mela at Rauni	
13-03-2009	Regional Kisan Mela at Ballawal	
19,20-03-2009	Kisan Mela at PAU, Ludhiana	
24-03-2009	Regional Kisan Mela at Bathinda	
26-03-2009	Regional Kisan Mela at Gurdaspur	



Date	Venue	No. of participants
Visits		
25-09-2008	Visit of science students from Khalsa college for Women, Sidhwan Khurd at Mushroom Research Centre, PAU, Ludhiana	80
08-02-2009	Visit of Director, Directorate of Mushroom Research (DMR), Solan to assess AICMIP experimentation, PAU, Ludhiana	-
13-02-2009	Visit of PAU Mushroom farm by students of Doaba College, Jalandhar.	39
Seminar/Workshop		
10-06-2008 to 13-06-2008	Workshop on farming system approaches, PAU, Ludhiana	
26-12-2008 to 28-12-008	Seminar-cum-biennial workshop on AICMIP, DMR, Solan.	
07-02-2009 to 09-02-2009	12 th Punjab Science Congress, PAU, Ludhiana	
16 to 19-02-2009	Workshop on mushroom production at Kisan mela organized by the state deptt. of Horticulture and Punjab Govt. at Dhariwal	
TV Talk		
13-05-2008	Garam rutt dian khuban di kasht, DDK, Jalandhar	

Table 45. Details of extension activities carried out at Pune Centre

Sr. No.	Activity	Number	Beneficiaries
1.	Participation in Krishi Exhibition	04	-
2.	Oyster Mushroom Cultivation training	07	45
3.	Mass demonstration	02	-
4.	Postal quarries	40	40
5.	T. V. programme	04	-
6.	Scientific articles	02	-
	Popular articles	02	-
7.	Visitors to mushroom project (Including school and college students, farmers, mushroom growers, research workers, teachers etc.)	3800	3800
8.	Spawn supply	450 Kg	-



1. Mushroom cultivation trainings

The technology of mushroom cultivation was transferred through regular training programmes (7 Nos.) being organized on first Saturday of every month.

2. Mass communication

The information on mushroom cultivation was communicated through pamphlets, popular articles as well as through exhibitions and farmers rallies organized at different places.

RAIPUR CENTRE

A total of 3 training programmes of 1-6 days duration were organized in which 229 participants participated (Table 46). Out of 3, 2 programmes were sponsored by Chhattisgarh Council of Science and Technology (CGCOST), while the 3rd was University sponsored.

RANCHI CENTRE

A total of 281.59 quintals spawn was made available to farmers, used for on farm mushroom trails and training from 2002-03 to 2008-09. However, during 2008-09 only 63.01 quintals spawn was made available to

farmers (57.878 q) and used in experimental research trials (5.132 q). During this year, the revenue of Rs 3,75,924.00 was generated through sale of spawn (Rs 3,47,268.00) and mushrooms (Rs 28,656.00). Five numbers of mushroom training was conducted in which 128 ladies farmers were trained during the year under report (Fig.3).

UDAIPUR CENTRE

Seven training programmes of 1-day duration each were organized on Oyster mushroom cultivation for entrepreneurs, farmers and students in which a total of 65 participants participated (Table 47). The participants were from 4 different districts of Rajasthan state.

RAWE PROGRAMME

Three months training programme was organized for 14 students of B.Sc. (Ag.) final year of RCA, Udaipur (Rajasthan) under RAWA Programme from 01.04.2008 to 30.06.2008.

- Total of 40 letters pertaining to cultivation of button, oyster, milky, spawn production and marketing of mushrooms were replied.

Table 46. Details of training programmes organized at Raipur Centre

Sl. No.	Training programme	Duration (days)	No. of participants	Locality	Financed by
1.	Mushroom production Technology for entrepreneurs and growers	Six	60	Cherbeda, Kondagaon, Bastar	CGCOST
2.	Demonstration of Mushroom Production Technology	Four	160	Cherbeda, Kondagaon, Bastar	CGCOST
3.	Mushroom Production Technology for growers, youths and entrepreneurs	One	09	Mushroom lab. CoA, Raipur	IGKV, Raipur



Table 47. Training programmes organized at Udaipur Centre (2008 – 2009)

Sl. No.	Date and duration	Topic	No. of Trainees	Native of Trainees
1	1.4.2008	Oyster mushroom cultivation	6 Entrepreneurs	Jodhpur, Bhilwara and Udaipur
2	10.4.2008	Oyster mushroom cultivation	3 Farmers	Rajsamand
3	20.6.2008	Oyster mushroom cultivation	2 Farmers	Udaipur
4	29.8.2008	Oyster mushroom cultivation	6 Farmers	Udaipur
5	6.1.2009	Oyster mushroom cultivation	2 Entrepreneurs	Udaipur
6	20.1.2009	Oyster mushroom cultivation	2 Farmers	Udaipur
7	6.3.2009	Oyster mushroom cultivation	42- Students of 11 standard	Sh. Muna Sr. Sec. School, Dabok, Udaipur
Total			65	

Seed Production and Revenue Generation

1. Rs. 10580.00 were earned by sale of spawn and training programme
2. Rs. 16693.00 were earned by sale of experimental produce

Kisan Mela

- a. Dr. Anila Doshi, Participated in Mewar Kisan Mela and Exhibition (18th – 22nd October, 2008) at Rajsamand district-

sponsored by District Administration and Agriculture Department, Rajsamand.

- b. Dr. Anila Doshi and Pokhar Rawal Participated in Agricultural Development Workshop and Exhibition (26th – 01st March, 2009) at MPUAT, Udaipur- sponsored by DOA, ATMA, Udaipur.

VELLAYANI CENTRE

Vellayani Centre organized a total of 10 training programmes of 1- 2 days duration for educated unemployed youths, rural women and the students in which a total of 355 participants participated (Table 48).

Table 48. Details of trainings organized at Vellayani Centre during 2008-09

Category	Date	No. of days	No. of participants
Educated unemployed youths	19 - 20 May 2008	2	21
Educated unemployed youths	28 - 29 Aug. 2008	2	34
Educated unemployed youths	25 Oct. 2008	2	40
Students (Std XII) of Kendriya Vidyalaya	29 Nov. 2008	1	55
Educated unemployed youths	25 - 26 Nov. 2008	2	40
Educated unemployed youths	28 - 29 Jan. 2009	2	44
Educated unemployed youths	12 - 13 Feb. 2009	2	41
Training on spawn production	28 Feb. 2009	1	25
Educated unemployed youths	20 - 21 Mar. 2009	2	49
Rural women	24 - 25 Mar. 2009	2	6



A total number of 2500 spawn packets were distributed to farmers and participants in the training. Sale of spawned beds was launched on Nov. 3 2008 and beds were sold @ Rs.40/- per bed to house wives. 135 beds were sold so far.

Smt. Janaki Sreekumar one of our trainee received the Progressive Mushroom Grower Award at a grand function held at NRCM during Sept. 2008.

SOLAN CENTRE

Training Programmes

During 2008, the Centre organised a total number of 13 on and off campus training programmes for farmers, farmwomen, entrepreneurs, State Govt. officers & researchers.

Mushroom Mela-2008

One day Mushroom Mela was organised on 10th September, 2008 as a regular activity of the Centre. It was inaugurated by Dr. Rajeev Bindal, Hon'ble Minister of Health, Ayurveda and Health Education, Govt. of HP. It was attended by about 550 farmers, farmwomen, mushroom growers, researchers, extension workers and businessmen from Himachal Pradesh, Haryana, Punjab, Uttar Pradesh, Maharashtra, M.P., Chhattishgarh, Bihar, Jharkhand, Delhi, Uttarakhand, Assam, Gujrat, Kerala, Karnataka and Tamil Nadu.

An exhibition on improved mushroom cultivation technologies and other related aspects was also organised in which different Govt. Organizations, ICAR Institutes/ University, Govt. financial organisations, compost and spawn producers, mushroom

product manufacturers, seed, pesticides and chemicals suppliers and NGOs displayed their valuable informations/technologies/products and provided their services to the participants of Mushroom Mela.

In order to create awareness among participants about various improved technologies/practices of mushroom cultivation, a visit of Centre's mushroom growing unit along with demonstrations on improved technologies was conducted.

During post-lunch session of Mushroom Mela, a Kisan Goshthi was organised to sort out the mushroom growers problems in mushroom cultivation. The issues raised by mushroom growers were sorted out by experts in a very logistic manner.

During Mushroom Mela, the Centre bestowed award to 10 progressive mushroom growers for adopting innovative practices in mushroom cultivation on a larger scale and mobilizing other farmers to adopt mushroom cultivation as a new venture.

Participation in National/State level exhibitions

In order to create awareness about mushroom cultivation, the Centre participated in Regional Kisan Mela organised by IIVR, Varansi from 28-31 Jan., 09 at Vanarasi, Kisan Mela at UHF, Nauni, Solan (HP) on 28 Jan., 2009, AGRO TECH-2008 organized by CII(NR), Chandigarh, at Prade Ground, Chandigarh from 28 Nov., to 1st Dec. 2008 and "Bharat Nirman Jan Soochana Abhiyan" Exhibition organised by Press Information Bureau, Min. of Inf. & Broadcasting, Shimla(HP) at Kunihar (Solan) from 27 June-1 July, 2008.

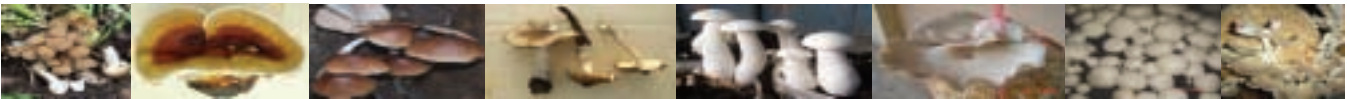


Foreign Consultancy

Dr M.P. Sagar, Senior Scientist (Extension Education) imparted training to field officers, youths and mushroom growers in mushroom cultivation technology under a joint training programme organized by Commonwealth Youth Programme Asia Centre, Chandigarh (India) and Min. of Youth & Sport, Dhaka, Bangladesh from 25th to 31st May, 2008 at Youth Centre, Savor, Dhaka.

Advisory services to farmers/Mushroom growers/businessman/unemployed youths

Advisory services on various aspects of mushroom cultivation, training and marketing were provided through postal extension letters. Queries on mushroom cultivation and training were also replied through telephone and e-mail. On an average 4 queries per day were received and replied accordingly.



7. PUBLICATIONS

COIMBATORE CENTRE

1. Prakasam, V. (2008). Biodiversity of mushrooms in different forest eco systems. In: National Seminar on “*Advances in Plant Pathology for Sustainable Agriculture*”, 24-25th Nov., 2008 organised by Indian Phytopathological Society at the Department of Plant Pathology, TNAU, Coimbatore.
2. Thiribhuvanamala, G., Prakasam, V., Krishnamoorthy, A.S., Chandrasekar, G. and Karthikayini, B. (2008). Antimicrobial activity of *Lentinula edodes* against phytopathogens. In : National Seminar on “*Advances in Plant Pathology for Sustainable Agriculture*”, 24-25th Nov., 2008 organised by Indian Phytopathological Society at the Department of Plant Pathology, TNAU, Coimbatore.
3. Thiribhuvanamala, G., Prakasam, V., Krishnamoorthy, A.S., Chandrasekar, G., Karthikayini, B. and Salunkhe, P.B. (2008). Improved cultivation techniques to enhance the yield of paddy straw mushroom (*Volvariella volvaceae*). In: National Seminar on “*Advances in Plant Pathology for Sustainable Agriculture*”, 24-25th Nov., 2008 organised by Indian Phytopathological Society at the Department of Plant Pathology, TNAU, Coimbatore.
4. Thiribhuvanamala, G., Prakasam, V., Krishnamoorthy, A.S., Chandrasekar, G. and Karthikayini, B. (2008). Improvement in quality and shelf life of mushrooms. In: National Seminar on “*Advances in Plant Pathology for Sustainable Agriculture*”, 24-25th Nov., 2008 organised by Indian Phytopathological Society at the Department of Plant Pathology, TNAU, Coimbatore.
5. Malarkkodi, B., Prakasam, V., Thiribhuvanamala, G., Karthikayini, B. and Salunkhe, P.B. (2008). Mushroom cultivation – A viable venture. In: National Seminar on “*Advances in Plant Pathology for Sustainable Agriculture*”, 24-25th Nov., 2008 organised by Indian Phytopathological Society at the Department of Plant Pathology, TNAU, Coimbatore.
6. Krishnamoorthy, A.S. (2008). Fungal biomolecules - Challenges and oppurtunities through mushroom biotechnology. In: National Seminar on “*Advances in Plant Pathology for Sustainable Agriculture*”, 24-25th Nov., 2008 organised by Indian Phytopathological Society at the Department of Plant Pathology, TNAU, Coimbatore.
7. Radhajeyalakshmi, R., Prakasam, V. and Velazhahan, R. (2008). PCR based molecular characterization of straw mushroom with reference to its ribosomal DNA. In : National Seminar on “*Advances in Plant Pathology for Sustainable Agriculture*”, 24-25th Nov., 2008 organised by Indian Phytopathological Society at the



Department of Plant Pathology, TNAU, Coimbatore.

8. Amutha, G., Krishnamoorthy, A.S., Prakasam, V. and Chandrasekar, G. (2008). Milky mushrooms - A boon to Indian farmers of tropical regions. In: National Seminar on “*Advances in Plant Pathology for Sustainable Agriculture*”, 24-25th Nov., 2008 organised by Indian Phytopathological Society at the Department of Plant Pathology, TNAU, Coimbatore.

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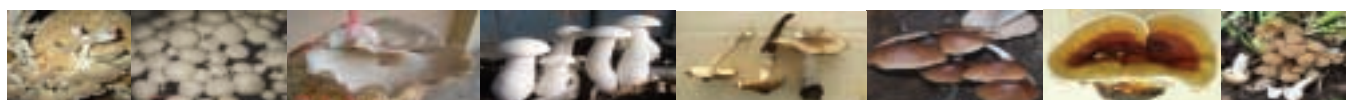
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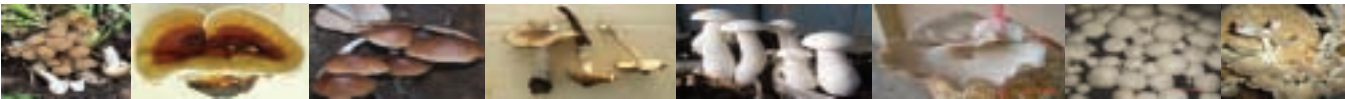
E. Popular/ Technical Articles

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PERSONNELIA

Staff position at various AICRPM Centres during 2008-09

Post	Coimbatore	Ludhiana	Faizabad	Pantnagar	Pune	Raipur	Udaipur	Thrissur
Mycologist	Dr. V. Prakasam	Dr. (Mrs.) S. Dhanda (Sr. Mycologist)	—	—	Dr. S.G. Sawashe	Dr. G.K. Awadhiya	Dr. Anila Doshi	Dr. (Mrs.) Lulu Das
Asstt. Mycologist	Dr. G. Thiribhuva-namala	Dr. H.S. Sodhi (Sr. Mycologist)	Dr. PK. Shukla	Dr. K.K. Mishra Assoc. Director	Dr. S.S. Wange	Dr. S.S. Chand-ravanshi	Dr. Pokhar Rawal	—
Technical Assistant	Th. M. Nagendran	Sh. Harjit Singh	Sh.G.P. Gautam	Mr. Rupesh Arora (Contractual)	Sh. VK. Bhalerao	Vacant	Sh. Vikram Singh Meena	Sh. D. Sivaprasad (Contractual)
Jr.Assistant /Fieldman	Th. C. Sundara- rajan	Sh. Gurdev Singh	Sh. Vijay Kant	Sh. Ramakant Singh	Sh. N.G. Desai	Sh. B.L. Sinha	Miss. Kala Nath	—
Lab. Asstt.	Th. M. Munusamy	—	—	—	—	—	—	—
Typist cum Clerk	—	Vacant	Sh. S.G. Yadav	Sh. Vishnu Ray Hingmire	Sh. S.G.	Sh. R.K. Baghel	Sh. Nathu Singh	—
Beldar	Th. P. Selvaraj	Sh. Ram Kumar	Sh. Lalta Prasad	Sh. Deo Kumar	Sh. Y.S. Bhawe	Sh. A.R. Sahu	Sh. Kishan Singh	—

BUDGET (2008-09)

Head	Udaipur		Faizabad		Coimbatore		Ludhiana		Pantnagar		Vellayani		Pune		Raipur		Ranchi		UHF, Nauni		Barapani	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
RECURRING																						
CONT																						
Estt.	12.75	12.75	10.15	10.15	11.15	11.15	17.65	17.65	11.15	11.15	2.51	2.51	14.55	14.55	8.06	8.06	-	-	-	-	-	-
Charges																						
T.A.	0.20	0.20	0.20	0.20	0.15	0.15	0.10	0.10	0.20	0.20	0.10	0.10	0.15	0.15	0.11	0.11	0.20	0.20	0.15	0.15	0.20	0.20
Recur-	0.90	0.90	0.90	0.90	0.67	0.67	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.00	1.00	7.30	7.30
ring																						
contingencies																						
including FLD																						
NON-REC. CONT																						
a) Equip-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ments																						
b) Vehicle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-																						
c) Works	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-																						
Total	13.85	13.85	11.25	11.25	11.97	11.97	18.65	18.65	12.25	12.25	3.51	3.51	15.60	15.60	9.07	9.07	1.20	1.20	1.15	1.15	7.50	7.50

a- sanctioned amount
b- actual expenditure

