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All India Co-ordinated Research Project on Mushroom



राष्ट्रीय खुम्ब अनुसंधान केन्द्र
NATIONAL RESEARCH CENTRE FOR MUSHROOM

(भारतीय कृषि अनुसंधान परिषद्)
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National Research Centre for Mushroom
Solan - 173 213, India

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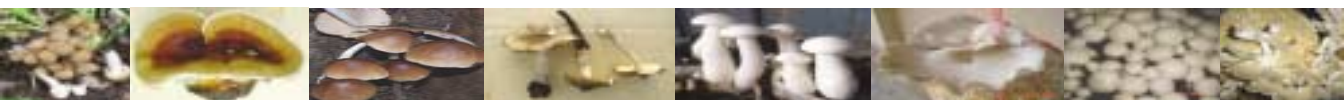
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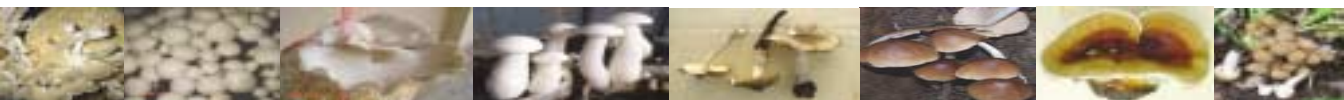
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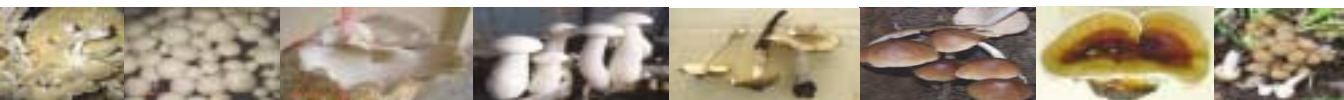


FOREWORD

The report contained in this document pertains to the achievements made during the financial year 2006-07 by the ten Coordinating Centres and one Cooperating Centre working under the aegis of the All India Coordinated Research Project on Mushroom (AICRPM) with the Headquarter at NRC for Mushroom, Solan (HP). The Centres are located each at Punjab Agricultural University, Ludhiana (Punjab), G.B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand), Maharana Pratap University of Agriculture and Technology, Udaipur (Raj.), Indira Gandhi Krishi Vishwa Vidyalaya, Raipur (Chhattisgarh), Mahatma Phule Agricultural University, Pune (MS), Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu), Kerala Agricultural University, Thrissur (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 Headquarter, NRCM, Solan conducted a total of 18 experiments following a common package of practices finalized and adopted at Xth Biennial Group Meeting of Workers of AICRPM held on 26-27 October, 2006 at IGAU, Raipur.

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 material 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 shelf-life of button mushroom in replacement of potassium metabisulphite which is already in use. Some new experiments especially on packaging and drying of mushrooms were also taken up. Emphasis was also laid on germplasm collection, conservation, and survey and surveillance for diseases and insect-pests of mushrooms in specific areas.

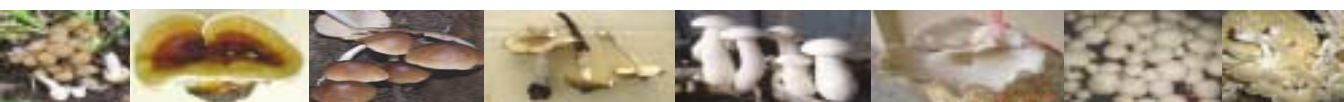
Strainal evaluation trials at multi-locations have helped in identification of some better strains like CM-15 of *Agaricus bisporus*, Vv-1 and Vv-2 of *Volvariella volvacea*, C-3 and C-6 of *Calocybe indica*, PF-01 of *Pleurotus florida* and PSc-01 of *Pleurotus sajor-caju*. Casing mixture prepared from 2 year old recomposted spent mushroom substrate alone and 1:1, v/v mixture of coir pith with FYM gave maximum yield of *A.bisporus*. The washing treatments with 200 ppm EDTA and 100 ppm EDTA + 0.02% KMS have 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 also increased the keeping quality of button mushroom.



In case of oyster mushroom, spray application 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 mushroom by using simple chemical treatment followed by sun-drying.

Use of different types of beds and different substrates has provided options for introducing tropical mushrooms like paddy straw and milky. 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 traditionally 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 success of paddy straw mushroom in Orissa is the best example, by following of which, tropical mushrooms can be popularized in the country. 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 has contributed significantly in popularizing the mushroom even in remote areas of the country.

(R.P. Tewari)
Project Coordinator



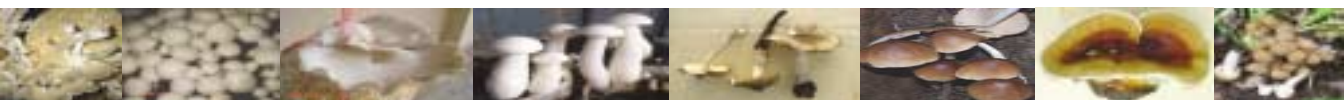
सारांश

वर्ष 2006-07 के दौरान मुख्यालय राष्ट्रीय खुम्ब अनुसंधान केन्द्र, सोलन (हि०प्र०) तथा विभिन्न राज्यों में स्थित सभी अखिल भारतीय समन्वयित मशरूम अनुसंधान परियोजना केन्द्रों द्वारा इंदिरा गांधी कृषि विश्वविद्यालय, रायपुर (छत्तीसगढ़) पर दिनांक 26-27 अक्टूबर, 2006 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 छः प्रयोग किये गये। श्वेत बटन मशरूम के प्रजातिय मूल्यांकन पहलू पर छः परियोजना केन्द्रों पर प्रयोग किये गये। इन प्रयोगों के दौरान पाया गया कि सी०एम०-10 तथा सी०एम०-13 प्रजातियों ने पूणे केन्द्र पर सार्थकतापूर्वक अधिक उपज दी। जबकि रायपुर केन्द्र पर एस०-130, फैजाबाद केन्द्र पर सी०एम०-13, पंतनगर केन्द्र पर सी०एम०-10 एवं एस०-130, उदयपुर केन्द्र पर सी०एम०-10 एवं एस०-11, तथा सोलन मुख्यालय पर सी०एम०-15 तथा सी०एम०-12 प्रजातियों ने अन्य प्रजातियों की तुलना में अच्छी पैदावार दी। सभी केन्द्रों पर प्राप्त पैदावार पर आधारित औसतन पैदावार के अनुसार सी०एम०-15 व सी०एम०-16 प्रजातियों ने अन्य प्रजातियों की तुलना में अधिक पैदावार दी। उदयपुर केन्द्र पर सी०एम०-10, रायपुर व पंतनगर केन्द्रों पर एस०-130, सोलन केन्द्र पर सी०एम०-15 तथा फैजाबाद केन्द्र पर सी०एम०-13 प्रजातियों का प्रथम तुड़ान में लिया गया समय सबसे कम पाया गया। विभिन्न प्रजातियों के फलनकाय का औसतन वजन 12.77 ग्राम से 20.20 ग्राम तक पाया गया।

श्वेत बटन मशरूम कम्पोस्ट से थर्मोफीलिक सूक्ष्मजीवों के पृथकीकरण व पहचान हेतु विभिन्न केन्द्रों से कम्पोस्ट के 29 नमूने एकत्र किये गये तथा उनमें थर्मोफीलिक कवक की उपस्थिति व विविधता के अध्ययन हेतु विश्लेषण किये गये। लगभग 14 कवकों को पृथक किया गया। *स्काईटेलिडियम थर्मोफिलम* तथा *ह्यूमिकोला इन्सोलेंस* अधिकतर नमूनों से प्राप्त हुये।

विभिन्न केसिंग अवयवों के मूल्यांकन संबंधी प्रयोगों में पाया गया कि लुधियाना में गोबर की खाद व स्पेंट कम्पोस्ट को बराबर हिस्सों में मिलाने पर अधिकतम उपज 13.6 किलोग्राम/क्विंटल कम्पोस्ट के हिसाब से प्राप्त हुई जबकि उदयपुर केन्द्र पर दो साल पुरानी कम्पोस्टिड स्पेंट कम्पोस्ट से निर्मित केसिंग मिट्टी, में अधिक मशरूम 14.47 किलोग्राम/क्विंटल कम्पोस्ट की दर से पैदावार मिली। 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 17.65 किलोग्राम अधिकतम उपज प्राप्त हुई। विभिन्न कृषि औद्योगिक अपशिष्टों को केसिंग अवयवों के रूप में इस्तेमाल करने के उद्देश्य से भौतिक व रसायनिक गुणों जैसे - पी०एच०, जलधारण क्षमता, चालकता व घनत्व का मूल्यांकन किया गया। कणों के घनत्व को छोड़कर, अन्य सभी गुण लुधियाना, उदयपुर व पुणे केन्द्रों पर क्वारपिथ व गोबर की खाद के मिश्रण में अधिकतम पाये गये। तुड़ई उपरांत श्वेत बटन मशरूम की गुणवत्ता बनाये रखने व अधिक समय तक भण्डारण करने के उद्देश्य से मशरूम को जब 100 पी०पी०एम० सांद्रता के ई०डी०टी०ए० घोल को 0.02 प्रतिशत पोटेसियम मेटाबाईसल्फाईट (के०एम०एस०) घोल के साथ मिलाकर तैयार किये गये घोल से धोया गया तो लगभग सभी केन्द्रों पर सफेदी अधिक पायी गई तथा 5° सेल्सियस तापमान तथा सामान्य तापमान पर 48 घण्टों तक मशरूम का भण्डारण किया जा सका। सामान्य तापमान व रेफ्रिजरेटिड दशाओं में मशरूम की सफेदी,



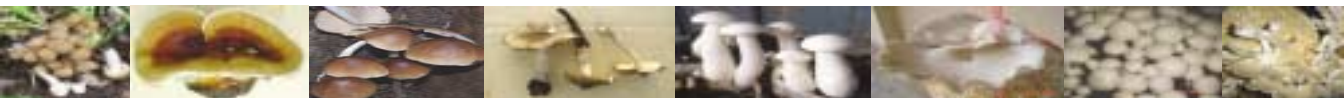
वजन में कमी व कैप का खुलना मानकों को आधार मानकर किये पैकेजिंग के प्रयोग में कोयम्बटूर, पुणे, फैजाबाद व उदयपुर केन्द्रों पर 100 गेज की पॉलीप्रोपाईलीन बैग में पैक की गई मशरूम उपरोक्त मानकों पर खरी उतरी।

आयस्टर (ढींगरी) मशरूम वर्ग में *प्लूरोटस फ्लोरिडा* व *प्लूरोटस साजोर-काजू* का प्रजाति मूल्यांकन, *प्लूरोटस* स्पी० की पैदावार पर रसायनों के छिड़काव का प्रभाव, *प्लूरोटस फोस्यूलेटस* व *हिपसीजाईमस अल्मेरियस* प्रजातियों की उत्पादन क्षमता का मूल्यांकन तथा मशरूम को सुखाना बिन्दुओं पर पांच प्रयोग किये गये। प्रजाति मूल्यांकन प्रयोग में पाया गया कि *प्लूरोटस फ्लोरिडा* से तैयार संकर प्रजाति पी०एफ०-01 की अधिकतम उपज 81.8 प्रतिशत व *प्लूरोटस साजोर-काजू* संकर प्रजातियां पी०एस०सी०-01 व 05 से सर्वोत्तम उपज क्रमशः 74.8 व 74.4 प्रतिशत प्राप्त हुई। रसायन छिड़काव का आयस्टर मशरूम की उपज वृद्धि पर प्रभाव जानने हेतु किये गये प्रयोगों में पाया गया कि कोयम्बटूर, फैजाबाद, सोलन व रायपुर केन्द्रों पर *प्लूरोटस फ्लोरिडा* की फसल पर 0.1 एम० सांद्रता के K_2HPO_4 के घोल का छिड़काव करने से उपज में वृद्धि पाई गई। *प्लूरोटस साजोर काजू* की उपज पर भी रसायन छिड़काव का प्रभाव 11 केन्द्रों पर देखा गया। *प्लूरोटस साजोर काजू* की फसल पर 0.1 एम० सांद्रता के K_2HPO_4 घोल का छिड़काव करने से रायपुर, फैजाबाद, बड़ापानी, कोयम्बटूर, विल्लयानी व सोलन केन्द्रों पर उपज में बढ़ोत्तरी पाई गई। जबकि लुधियाना तथा उदयपुर केन्द्रों पर रसायन छिड़काव रहित फसल में उपज वृद्धि पाई गई।

प्लूरोटस फोस्यूलेटस व *हिपसीजाईमस अल्मेरियस* प्रजातियों की उत्पादन क्षमता के मूल्यांकन हेतु क्रमशः 5 व 9 केन्द्रों पर अध्ययन किये गये। *प्लूरोटस फोस्यूलेटस* की अधिकतम जैव क्षमता (88.60 प्रतिशत) उदयपुर केन्द्र पर पाई गई जो *प्लूरोटस फ्लोरिडा* की उपज (96.66 प्रतिशत) से काफी कम थी। कोयम्बटूर केन्द्र पर *हिपसीजाईमस अल्मेरियस* प्रजाति की जैव परिवर्तन क्षमता पुआल पर बहुत ही ज्यादा (148%) पायी गई। पूणे व रांची केन्द्रों पर भी *हिपसीजाईमस अल्मेरियस* प्रजाति की उत्तम उपज पाई गई। सुखाने के विभिन्न तरीकों का प्रभाव आयस्टर मशरूम की गुणवत्ता पर परखा गया। कोयम्बटूर केन्द्र पर आयस्टर मशरूम को ब्लांचिंग के बाद धूप में सुखाने तथा उदयपुर व लुधियाना केन्द्रों पर रसायनिक उपचार उपरांत धूप में सुखाना तथा साधारण धुलाई उपरांत धूप में सुखाना विधियों ने सफेदी, कड़कपन व तीन महीने बाद भण्डारण गुणवत्ता मानकों के आधार पर अच्छे परिणाम दिये।

पराली मशरूम व दुधिया मशरूम पर प्रजाति मूल्यांकन व उत्पादन तकनीकी में सुधार हेतु अध्ययन किये गये। पराली मशरूम की प्रजाति Vv-01, Vv-02 व Vv-07 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 टोस शैल्या से सबसे अधिकतम उपज (30.7 कि०ग्रा०/100 कि०ग्राम शुष्क माध्यम) मिली। इसके निकटतम पैदावार वर्गाकार टोस शैल्या की रही।

दूधिया मशरूम प्रजाति मूल्यांकन अध्ययन पांच केन्द्रों पर किये गये। अध्ययन के दौरान पाया गया कि प्रजाति सी०आई-06 ने फैजाबाद, उदयपुर, पंतनगर, कोयम्बटूर व रांची केन्द्रों पर सबसे अधिक पैदावार दी जबकि प्रजाति सी०आई०-03 ने लुधियाना व विल्लयानी केन्द्रों पर अधिक पैदावार दी। दूधिया मशरूम उत्पादन हेतु पोषाधार मूल्यांकन अध्ययन में पाया गया कि भूसे से तैयार पोषाधार से पुआल से तैयार पोषाधार तथा भूसा व पुआल के विभिन्न अनुपातों में तैयार पोषाधार की तुलना में अधिकतम उपज प्राप्त हुई। दूधिया मशरूम को तुड़ाई उपरांत सुखाने हेतु कोयम्बटूर केन्द्र



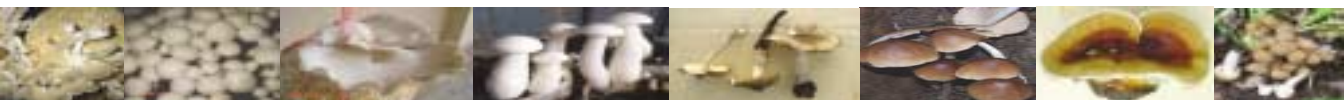
पर प्रयोग किये गये। ब्लांचिंग करने के बाद धूप में सुखाने पर ज्यादा सफेदी मिली। परन्तु साधारण धुलाई के बाद धूप में सुखाने पर कड़कपन व वजन में कमी सर्वोत्तम पाई गई।

शिटाके मशरूम (*लेन्टीनुला इडोइस*) की उत्पादन तकनीकी का मानकीकरण करने हेतु किये गये प्रयोगों से ज्ञात हुआ कि पंतनगर केन्द्र पर भूसे में 20 प्रतिशत की दर तथा कोयम्बटूर केन्द्र पर बुरादे में 20 प्रतिशत की दर से गेहूं का चोकर मिलाने पर शिटाके मशरूम की सबसे अधिक उपज मिली।

जंगली गूदे-दार कवकों को एकत्र करने, उन्हें पहचानने व संरक्षित करने के उद्देश्य से सभी परियोजना केन्द्रों पर सर्वेक्षण किये गये। जंगलों से फैजाबाद केन्द्र ने 42, पंतनगर केन्द्र ने 25, रायपुर केन्द्र ने 26, उदयपुर केन्द्र ने 103, विल्लयानी केन्द्र ने 50 तथा सोलन केन्द्र ने 315 गूदेदार कवकों के नमूने एकत्र किये गये। ज्यादातर केन्द्रों ने स्वयं ही इन कवकों की पहचान कर अपने केन्द्र पर ही संरक्षित किया जबकि कुछ केन्द्रों ने कुछ नमूने राष्ट्रीय खुम्ब अनुसंधान केन्द्र 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 कार्य किया गया। कोयम्बटूर केन्द्र पर *कोप्राईनस* स्पीसीज व *टी० स्यूडोकोनिनजाई* बीमारियों का प्रकोप पाया गया। *पेनिसीलियम* स्पीसीज, *ट्राईकोडर्मा वीरडी*, *क्लेडोस्पोरियम क्लूडोस्पोरियोइड्स*, *कोप्राईनस* स्पीसीज व *एस्पेर्जीलस* स्पीसीज नामक बीमारियां फैजाबाद केन्द्र पर पाई गयीं। लुधियाना केन्द्र पर *ट्राईकोडर्मा* स्पीसीज, *कोप्राईनस* स्पीसीज, *पापुलास्पोरा बाईसीना* व *स्कोपुलेरियोपसिस फिमीकोला* नामक संक्रमण पाये गये। पंतनगर केन्द्र पर *ट्राईकोडर्मा* स्पीसीज, *डेहलियोमाइसिस माईक्रोस्पोरस*, *पापुलास्पोरा बाईसीना* व *वर्टीसीलियम फंजीकोला* बीमारियों का प्रकोप मिला। पूणे केन्द्र पर, हरा फफूंद बीमारी पाई गई। रायपुर केन्द्र पर *ट्राईकोडर्मा* स्पीसीज, *स्कलेरोशियम रोटफसाई*, *कोप्राईनस* स्पीसीज व यलो ब्लॉच बीमारियों का प्रकोप देखने को मिला। उदयपुर केन्द्र पर *कोप्राईनस* स्पीसीज व ब्राउन प्लास्टर मोल्ड तथा सोलन केन्द्र पर वेट बबल, ग्रीन मोल्ड, कीटोमियम, ब्राउन प्लास्टर मोल्ड व इंक कैप्स बीमारियां पाई गईं। कीड़े-मकोड़ों में, सियारिड व फोरिड मक्खियों का संक्रमण सामान्य रूप से सभी केन्द्रों पर देखा गया। विभिन्न परियोजना केन्द्रों पर फलनकाय त्वचा चटकन, कलिकाओं का भूरा पड़ना तथा मशरूम का जल्दी खुलना 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, किसान गोष्ठियों का आयोजन किया। किसानों व मशरूम उत्पादकों को पत्रों, फोन, ई-मेल व फार्म भ्रमण द्वारा सलाह मशवरा दिया गया। कुछ केन्द्रों द्वारा मशरूम पर फोल्डर व पत्रिकायें प्रकाशित की गईं। 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 14 प्रशिक्षण कार्यक्रम विभिन्न वर्गों के लिये आयोजित किये गये जिसमें 5 प्रशिक्षण शिविर बाह्य परिसर, 6 प्रायोजित और तीन नियमित कार्यक्रम थे। सोलन केन्द्र पर 'राष्ट्रीय मशरूम मेला' का भी आयोजन 10 सितम्बर, 2006 को किया गया जिसमें पिछले वर्षों की भांति इस वर्ष भी हिमाचल प्रदेश व उसके पड़ोसी राज्यों से बड़ी संख्या में किसानों, मशरूम उत्पादकों व विस्तार कार्यकर्ताओं ने भाग लिया।



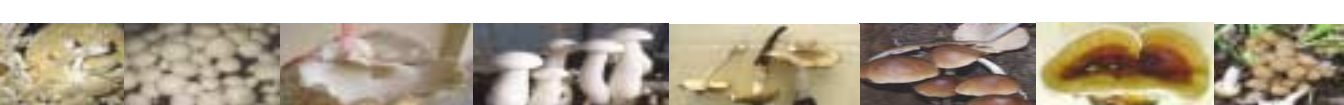
SUMMARY

During the year under report (2006-07), research trials were conducted at all ten Coordinating Centres, one Cooperating Centre and the Headquarters at the National Research Centre for Mushroom, Solan (HP), based upon the technical programme finalized during the Xth Biennial Group Meeting of the Workers of All India Coordinated Research Project on Mushroom (AICRPM) on 26th-27th October, 2006 at Indira Gandhi Krishi Vishwa Vidyalaya, Raipur (Chhattisgarh).

Altogether 5 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 strain, S-130 at Raipur, CM-13 at Faizabad, CM-10 and S-130 at Pantnagar, CM-10 and S-11 at Udaipur, and CM-15 and CM-12 at Solan performed better than other strains. On overall average basis, calculated by summing up the average of yields obtained at different Centres, strains, CM-15 and CM-16 gave superior mushroom yield than other strains. The time taken for the first harvest (days post-casing) was lowest in strain S-130 at Raipur and Pantnagar, CM-13 at Faizabad, CM-15 at Solan and CM-10 at Udaipur. Average fruiting body weight varied in the range of 12.77 g to 20.20 g in different strains. Under the experiment on Isolation and identification of thermophilic microorganisms from white button mushroom compost, 29 compost samples received from various Centres were analysed for the presence of thermophilic fungi to assess the variability among them. Around 14 fungi were isolated and *Scytalidium thermophilum* followed by *Humicola insolens* were dominantly isolated from these samples. Among different casing materials evaluated, coir pith in combination with FYM in 1:1 (v/v) ratio gave highest mushroom yield of 17.65 kg/ 100 kg compost at Pune. At Ludhiana, FYM with spent compost (1:1, v/v) gave highest mushroom yield of 13.6 kg/100 kg compost, while at Udaipur Centre, the highest yield of 14.47 kg was obtained in two years old spent compost.

Physico-chemical properties viz., pH, water holding capacity, conductivity and particle density were also analysed for different agro-industrial wastes used as casing materials. All the properties other than particle density were recorded highest in casing soil prepared with coir pith + FYM at Ludhiana, Udaipur and Pune Centres. In button mushroom washing treatment, 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 and at ambient temperature conditions at almost all the Centres. In case of packaging treatment, mushrooms packed in 100 gauge polypropylene bags gave better results with respect to retention of whiteness, weight and shape of mushrooms on their storage both at refrigerated and ambient temperature conditions at Coimbatore, Faizabad, Pantnagar, Pune and Udaipur Centres.

Five experiments were laid on oyster mushroom, which includes strain evaluation of *Pleurotus florida* and *P. sajor-caju*, effect of chemical spray on yield of *Pleurotus* spp., evaluation

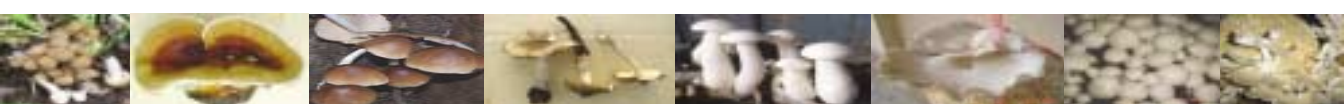


of yield potential of *P. fossulatus* and *Hypsizygus ulmarius* and drying by different methods. In strain evaluation, PF-01 hybrid strain of *P. florida*, and PSc-1 and PSc-5 hybrid strains of *P. sajor-caju* gave highest yield of 81.8%, 74.8% and 74.4%, respectively. In effect of chemical spray experiment, spray of 0.1M K_2HPO_4 significantly enhanced the yield of *P. florida* at Raipur, Faizabad, Coimbatore and Solan Centres. In *P. sajor-caju* enhanced yield with spray of 0.1M K_2HPO_4 was obtained at Raipur, Faizabad, Barapani, Coimbatore, Vellayani and Solan Centers, while in plain water treatment at Ludhiana and Udaipur. Yield potential of *P. fossulatus* was evaluated at five Centres. At Udaipur Centre, very high biological efficiency of 88.60% was recorded which was far less than 96.66% in *P. florida*. Yield potential of *Hypsizygus ulmarius* was evaluated at nine different Centres. At Coimbatore Centre, highest biological efficiency of 148% was recorded on paddy straw. Superior yield of *H. ulmarius* was also recorded at Ranchi and Pune Centres. Effect of different drying methods on the quality of dried oyster mushroom revealed that blanching followed by sun-drying at Coimbatore and Raipur Centres, while chemical treatment with sun-drying and simple washing with sun-drying at Udaipur and Ludhiana Centres gave better results with respect to retention of whiteness, brittleness and keeping quality after 3 months of storage.

Experiments were also conducted on paddy straw and milky mushrooms to evaluate different strains for higher yield and refinement in their cultivation technology. In the strain evaluation trial on *V. volvacea*, strains, Vv-01, Vv-02 and Vv-07 gave higher yield as compared to other strains at different Centres. Compact round bed prepared out of paddy straw gave highest mushroom yield of 30.7 kg/100 kg dry substrate, which was closely followed by compact square bed at Coimbatore Centre. Strain evaluation trial on milky mushroom was laid out at five Centres. Strain C.I-6 gave highest yield at Faizabad, Udaipur, Ranchi, Pantnagar and Coimbatore Centres, while strain C.I-3 at Ludhiana and Vellayani Centres. Among different substrates evaluated, highest mushroom yield was obtained on wheat straw as compared to paddy straw alone and its combinations with wheat straw. Drying experiment on milky mushroom was conducted at Coimbatore Centre only. Blanching of mushrooms, followed by sun-drying gave better whiteness to the dried mushrooms but the brittleness and weight loss was superior in simple washing followed by sun-drying treatment.

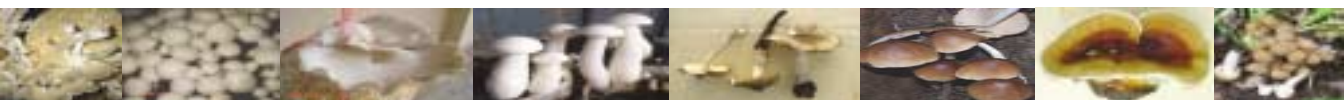
Experiments were also conducted on standardization of cultivation technology of shiitake mushroom (*L. edodes*). Wheat straw supplemented with 20% wheat bran gave superior yield at Pantnagar, while saw dust substrate supplemented with 20% wheat bran at Coimbatore Centre.

Survey was conducted by various Centres for collection, identification and preservation of wild fleshy fungi. A total number of 42 fleshy fungi were collected at Faizabad, 25 at Pantnagar, 26 at Raipur, 103 at Udaipur, 50 at Vellayani and 315 at Solan. 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 survey and surveillance of diseases and insect-pests. Among the common fungal pathogens/competitors, *Coprinus* sp., *T. pseudokoningii* were recorded at Coimbatore, *Trichoderma viride*, *Penicillium* spp., *Coprinus* spp., *Cladosporium cladosporioides* and *Aspergillus* spp. at Faizabad, *Trichoderma* spp.,



Deihliomyces microsporus, *Papulaspora byssina* and *Verticillium fungicola* at Pantnagar, green mould at Pune, *Trichoderma* spp., *Sclerotium rolfsii*, *Coprinus* spp. and yellow blotch at Raipur, *Coprinus* spp. and brown plaster mould at Udaipur, *Trichoderma* spp., *Coprinus* spp., *Papulaspora byssina* and *Scopulariopsis fimicola* at Ludhiana and wet bubble, green mould, *Chaetomium*, brown plaster mould and ink caps 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 and TV programmes, letters, telephone, e-mail and on the spot guidance during farm visits. Almost all the Centres conducted training programmes of different durations for farmers, farmwomen, unemployed youths and the entrepreneurs of their areas. The Centres also supplied pure mushroom cultures and spawn to mushroom growers in their respective areas. At headquarters, a total of 14 training programmes of 3 to 10 days duration were conducted, out of which five were off-campus, 6 sponsored and rest three were under regular institutional activities.



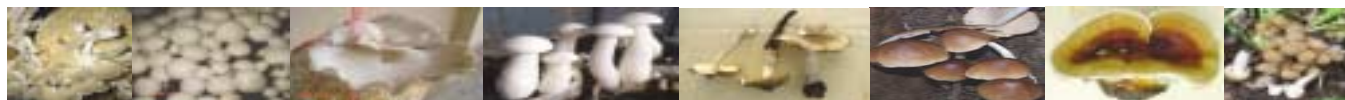
1. INTRODUCTION

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 Research Centre for Mushroom, Solan (HP). The Director of NRC for Mushroom, Solan (HP) also functions as the Project Co-ordinator of the project. Initially, the AICRPM was 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 (Chattisgarh) was added and two existing Centres at Kanpur (UP) and Kalyani (West Bengal) were dropped. However, three new Centres during VIIIth Five Year Plan and 3 Co-ordinating and one Co-operating Centres during IXth Five Year Plan have been added to the existing list of Centres by dropping one at Goa. At present, 10 Co-ordinating and one Co-operating Centres are working under AICRPM programme with its Headquarters at NRCM, Solan, which are 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 (Chattisgarh).
- Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan).
- Kerala Agricultural University, Vellayani, Thrissur (Kerala).
- ICAR Research Complex for NEH Region, Barapani (Meghalaya).
- Horticulture and Agroforestry Research Programme (ICAR Research Complex for Eastern Region), Ranchi (Jharkhand).
- Dr.Y.S.Parmar University of Horticulture and Forestry, Nauni, Solan – Co-operating Centre.

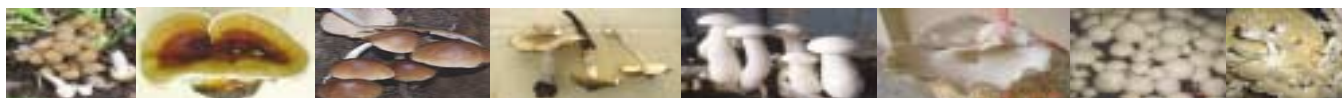
All the Co-ordinating Centres and HQrs. at NRCM, Solan work in co-ordination on common objectives and mandate. The technical programme for conducting participatory research at all the Centres and HQrs. is finalized in a biennial workshop organised at any of the Centres or HQrs. During the biennial workshop the progress reports for the previous two years are presented and discussed to monitor the



progress made in the project and the technologies generated are assessed for their release and adoption at all India level. The last Group meeting of workers of AICRPM was held on 26th and 27th October, 2006 at Indira Gandhi Krishi Vishwa Vidyalaya, Raipur under the Chairmanship of Dr. K.V. Ramana, Assistant Director General (Hort.II) ICAR, New Delhi. During the meeting the progress of last two years was read out and technical programme for 2006-2008 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 optimizing the yield of different mushrooms.
5. Survey and surveillance of diseases and insect-pests of mushrooms 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 FOR 2006-07

I. CROP IMPROVEMENT

Expt.No.1: Testing of different strains of white button mushroom, *Agaricus bisporus*

a) Participating Centres:

Pune, Pantnagar, Solan (Pasteurized compost using wheat straw)

Udaipur, Ludhiana, Faizabad (Long method of composting)

b) Substrate: Pasteurized compost

i) Compost formula:

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

ii) Substrate quantity - 10 kg compost wt./bag

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

c) Strains to be evaluated

CM-10, CM-12, CM-13, CM-14, CM-15, CM-16 and S-130 for pasteurized compost

CM-10, CM-12, CM-13, CM-14, CM-15, CM-16 and S-11 for long method compost

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).

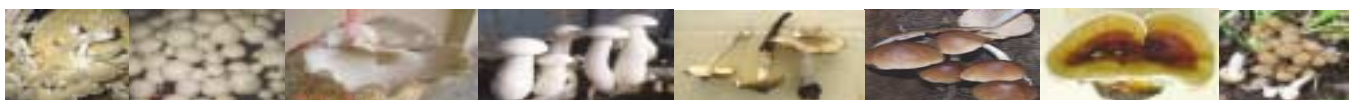
Compost will be ready in 18 days.

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 80-90kg 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).

Ingredients to be used are wheat/paddy straw-1000kg, wheat bran-80kg, Urea-18kg, Gypsum-40kg and cotton seed meal 30kg. The compost prepared 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 80-90kg per m³ bed area (6-7" depth).



ii) Spawning rate: 0.7% of wet compost

e) Data to be recorded during cropping (days taken)

i) Spawn run at $24 \pm 1^\circ\text{C}$, RH-90/95%, CO_2 - above 10,000 ppm. =

ii) Case run.....do..... =

iii) Days taken to pin after ventilation (Temp. $15-17^\circ\text{C}$, RH 80-85%, CO_2 - 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 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 4cm wide metal rings (4cm thick).

- Harvest mushrooms at button stage, removing the solid 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 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.

Expt.No.2: Strainal evaluation of Milky Mushroom, *Calocybe indica*

a) Participating Centres:

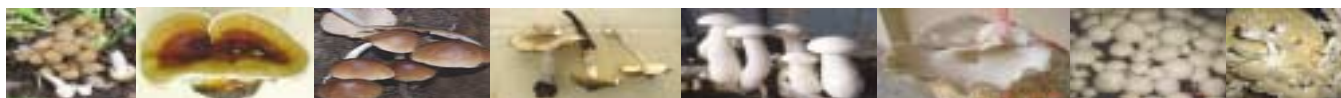
All Centres

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 min) paddy straw/ wheat straw

c) Strains

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.No.3: Strainal evaluation of Paddy Straw Mushroom, *Volvariella volvacea*

a) Participating Centres

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) Strains

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

Expt.No.4: Strainal evaluation of Oyster Mushroom (*Pleurotus sajor-caju* and *Pleurotus florida*)

a) Participating Centres

Raipur, Barapani, Faizabad, Ranchi, Vellayani and Udaipur

b) Strains

Pleurotus florida: (H-4, H-25, H-35, H-38 and control/parent strain)

Pleurotus sajor-caju: Four hybrid strains and one parent

c) Substrate

Wheat straw or paddy straw

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

d) Container

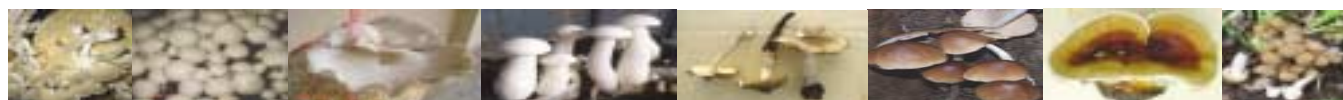
Polybag (60x30 cm)

e) Season for laying trials

Winter between Jan. to March, 2007 and December 2007 to March, 2008 for *P. florida*, while summer months for *P. sajor-caju* (March –June, 2007)

f) Information to be provided

1. Substrate and substrate preparation method used
2. Date of spawning
3. Date of opening of bags
4. Max. and minimum temperature and RH% in the cropping rooms
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 for I, II and III flushes
5. Fruit body observations for individual hybrid strain (pileus size, colour, stipe length, stipe thickness, organoleptic tests-liking of the consumers and coloured photograph of each strain). The data on pileus and stipe size/thickness are to be recorded for at least 10 fruitbodies
6. Pests and diseases incidence (as per proforma)
7. Photographs of each hybrid

Expt. No. 5: Evaluation of the yield potential of *Pleurotus fossulatus***a) Participating Centres**

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

b) Species

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 min)

d) Substrate quantity

4 kg wet weight (70% moisture)/bag

e) Container

Polybag (60x30 cm)

f) No. of replication

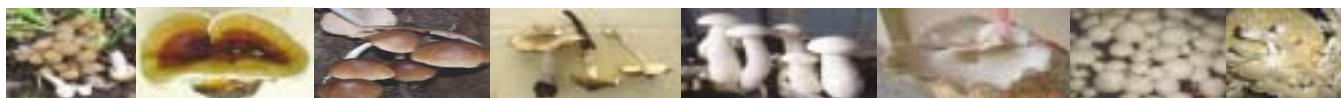
15 bags each of 1.0 kg dry weight

g) Cost of production**h) Information to be provided**

1. Substrate and substrate preparation method used
2. Date of spawning
3. Date of opening of bags
4. Max. and minimum temperature and RH% in the cropping rooms
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 flushes
5. Pests and diseases incidence (as per proforma)
6. Cropping room temperature (°C) and RH (%)
7. Photographs of both the species



II. CROP PRODUCTION

1. Button Mushroom

Expt. No. 6: Isolation and identification of thermophilic microorganisms from white button mushroom compost from different locations for their exploitation in faster composting process

Participating Centres

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

Expt. No. 7: To test different locally available materials for their feasibility as casing materials

a) Participating Centres

Solan, Ludhiana, Pune and Udaipur

b) Substrate treatment

- i) FYM + SC (1:1, v/v), both two years old well rotted
- ii) Spent compost (2 years 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 compost to be used should be two years old and coir pith well decomposed

c) No. of replications

8 of 10 kg compost/bag

d) Design

RBD

e) Physical parameters to be analysed at NRCM, Solan

f) Cost benefit ratio

g) Methodology

Cultivation method same as for Expt. No. 1

h) Data to be recorded

1. pH
2. Water holding capacity
3. Conductivity
4. Density
5. Mushroom yield (No. and weight of mushrooms)

2. Oyster Mushroom

Expt. No. 8 Effect of Chemical sprays on yield of *Pleurotus* spp.

a) Participating Centres

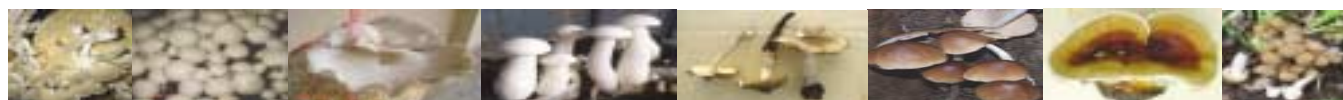
All Centres

b) Species to be used

P. florida and *P. sajor-caju*

c) Substrate treatment

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



d) Container

Polybag (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
3. Yield data (kg/100kg dry weight basis upto 4 weeks)
4. Time taken for I, II and III flushes
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 (Max. and min in °C) and RH (%)

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

Expt. No. 9: Evaluation of the yield potential of blue oyster mushroom (*Hypsizygus ulmarius*) on different substrates

a) Participating Centres

All Centres

b) Specie to be used

Hypsizygus ulmarius

c) Substrate

- 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**

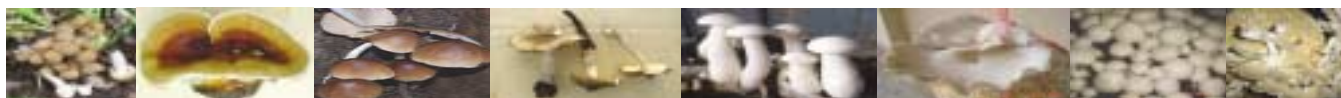
Expt. No. 10: Cultivation of Paddy Straw Mushroom, *Volvariella volvacea*

a) Participating Centres

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 at top)
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 min)

Replication : 5

Design : RBD

c) Supplementation

2 % Horse gram powder

d) Substrate treatment

For 1 to 5 methods

- Pre wetting -20 h
- Drain excess moisture/squeeze until 70 % moisture is retained

e) Substrate quantity: 10kg dry paddy straw

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
7. Yield data (number and weight after I, II, III week)
8. Average fruit 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 Worker's Meet
11. Incidence of pest as per the scale decided in the VIIIth Mushroom Group Worker's Meet.

4. Milky Mushroom

Expt. No. 11: Cultivation of milky mushroom, *Calocybe indica*

a) Participating Centres

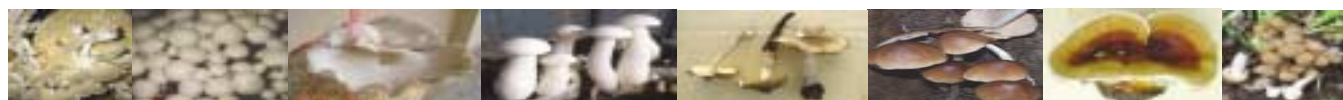
Ludhiana, Faizabad, Pune, Raipur, Udaipur, Pantnagar, Vellayani and Ranchi.

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



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 replication

20 each (5kg/bag)

g) Observation to be recorded

Time taken for spawn run and total yield

h) Size of bag

Poly bag (90 x 30 cm)

i) Casing soil

Clay loam or sandy loam with a standard pH of 8.0 to 8.5 (In case the pH of the 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 No.2.

l) Cost benefit ratio**5. Shiitake Mushroom****Expt. No. 12: Cultivation of shiitake mushroom, *Lentinula edodes*****a) Participating Centres**

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

b) Strain

Malaysian

c) Substrate

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

d) Supplement

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

e) Method of substrate preparation

Autoclaving

f) Spawn rate

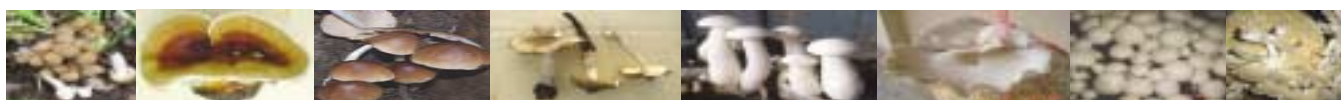
5% on wet weight basis

g) No. of replication

20 each (2kg/bag)

h) Observation to be recorded

Time taken for spawn run and total yield



i) Production technology to be followed

Take 40kg hard wood broad leaved tree's saw dust
 ↓
 Add water for thorough wetting overnight (65% moisture)
 ↓
 Add wheat bran and thoroughly mix
 ↓
 Fill in polypropylene bags in 2kg quantity/ bag and put ring and cotton plug
 ↓
 Autoclave at 121°C for 30 min
 ↓
 On cooling spawn aseptically @ 5% wet weight basis
 ↓
 Incubate at 24±1°C
 ↓
 After completion of spawn run (about 60 days) allow them to turn brown
 ↓
 Remove the PP bags and dip the blocks in chilled water (4-5°C) for about 5 min
 ↓
 Keep the block for fruiting at <20°C

j) Cost benefit ratio

III. Post Harvest Technology

Expt. No.13: Washing treatment for button mushroom, *A. bisporus*

a) Participating Centres

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

100 ppm EDTA – Di Na

150 ppm EDTA – Di Na

200 ppm EDTA – Di Na

100 ppm + 0.02% KMS

500 ppm EDTA – Di Na

Unwashed

d) Storage

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

e) Observations to be recorded

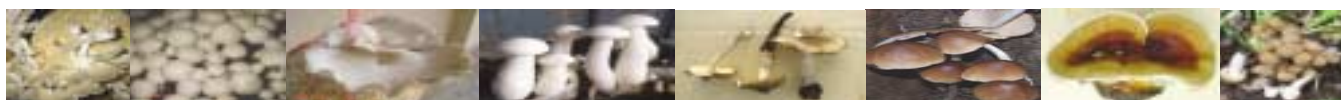
Whiteness only (% reflectance)

Before washing

After washing

After 24 h of storage

After 48 h of storage



f) Cost benefit ratio

Expt. No. 14: Packaging for button mushroom, *A. bisporus* (washed with 0.05% KMS)

a) Participating Centres

All Centres who are doing experiments on button mushroom

b) Treatments

Mushrooms of uniform size 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 (PE)-control

c) Storage

Refrigerator and Ambient conditions

d) Observation

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

e) Cost benefit ratio

Expt. No. 15: Drying of oyster mushroom (*Pleurotus* spp.)

a) Participating Centres

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

d) Observations

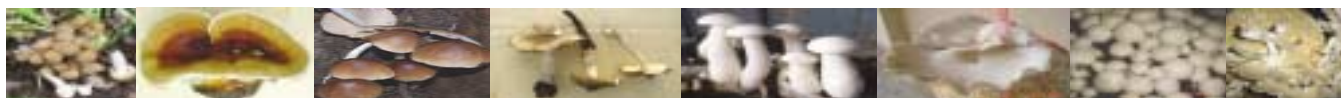
- 1. Quality on Re-hydration / Reconstitution
- 2. Total microflora count
- 3. Weight gain/loss
- 4. Whiteness/yellowness
- 5. Brittleness
- 6. Keeping quality in pack of 100 gauge PP (3 months – rottage, insect attack, off-flavour etc.)

e) Cost benefit ratio

Expt. No. 16: Drying of milky mushroom (*Calocybe indica*)

a) Participating Centres

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 min)

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

iii) Sun drying

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

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

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 PP (3 months – rottage, insect attack, off-flavour etc.)

e) Cost benefit ratio

Expt. No. 17: Wild germplasm collection, identification and conservation

Participating Centres

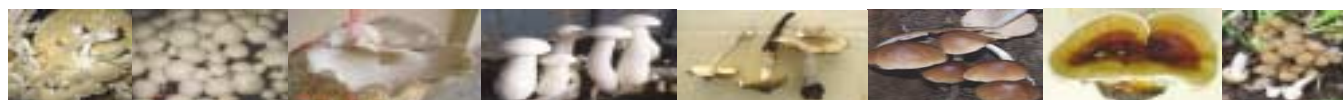
All Centres

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

IV. Crop Protection

Expt. No. 18: 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 assigned to six Centres including the Headquarters by using compost prepared by long and short methods of composting. At Pune Centre, highest yield of 15.80 kg/100 kg compost was recorded in strain CM-13 followed by strain CM-10. At Pantnagar highest yield of 17.96 kg/100 kg compost was recorded in strain CM-10, followed by 16.77 kg in strain S-130. At Raipur Centre, strain S-130 out-yielded other strains, while strain, CM-13 at Faizabad, and strains, CM-10 and S-11 at Udaipur gave higher yield than other strains tested. At Headquarters, strain CM-15 gave highest yield (20.78 kg) and it was followed by strain CM-12 and CM-16 (Table-1). In overall average strain CM-15 out performed others.

The time taken for first harvest (days post-casing) was lowest in strain S-130 at Pantnagar, while it was lowest in strain CM-13 at Faizabad Centre. At Udaipur Centre strain, CM-10 took 25 days for the first harvest. On overall average basis lowest time for first harvest was 12.5 days in strain CM-13 at Faizabad in comparison to highest of 29 days at Udaipur Centre. The average fruiting body weight was higher at Faizabad and Udaipur Centres, where it ranged between 19.76 to 24.10 g in comparison to a range of 9.34 g to 16 g at Pantnagar and Pune Centres. At Solan Centre, the time taken for first harvest ranged between 16.9 to 19.9 days. Except strain CM-16, the difference in time taken for first harvest was insignificant. The average fruiting body weight ranged between 13.5 g to 14.5 g. On overall average basis, the time taken for first harvest was lowest in strains, CM-13 and CM-16. The average fruiting body weight also did not show much variation in different strains except strain S-11 (Table-2).

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

<i>A. bisporus</i> strain	Pune	Pantnagar	Solan	Raipur	Faizabad	Udaipur	Average
CM-10	14.80	17.96	17.81	-	12.65	17.69	16.18
CM-12	14.10	12.33	20.63	3.05	-	-	12.53
CM-13	15.80	13.93	16.45	2.60	16.65	-	12.98
CM-14	13.30	12.37	17.82	1.39	-	-	11.22
CM-15	13.60	-	20.78	-	-	-	17.19
CM-16	14.60	-	19.26	-	-	-	16.93
S-11	-	-	-	-	12.90	14.35	13.62
S-130	14.10	16.77	17.86	5.00	-	12.27	13.20
CD (0.05)	0.84	2.40	2.04	1.80	-	2.82	-

-, not conducted

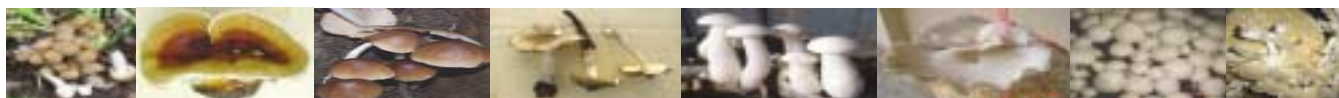
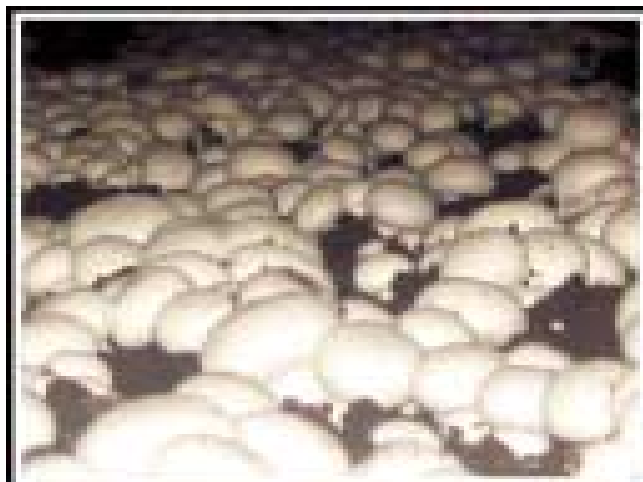


Table 2. Time taken for first harvest and average fruiting body weight in different strains of *A. bisporus*

Strain	Time taken for first harvest (days post-casing) and fruiting body weight										
	Pune	Pantnagar		Solan		Faizabad		Udaipur		Average	
	b	a	b	a	b	a	b	a	b	a	b
CM-10	13.0	16.0	8.14	18.4	14.1	14.5	23.65	25.0	19.76	18.47	15.73
CM-12	15.0	17.0	10.41	18.3	14.5	-	-	-	-	17.65	13.30
CM-13	16.0	16.0	9.59	19.9	13.9	12.5	24.10	-	-	16.13	15.90
CM-14	15.0	17.0	9.82	19.0	13.5	-	-	-	-	18.00	12.77
CM-15	12.0	-	-	17.3	14.4	-	-	-	-	17.30	13.20
CM-16	14.0	-	-	16.9	14.2	-	-	-	-	16.90	14.10
S-11	-	-	-	-	-	19.0	23.90	27.0	16.50	23.00	20.20
S-130	13.0	15.0	9.34	17.9	14.0	-	-	29.0	16.46	20.63	13.20
CD(0.05)	-	-	-	1.2	2.1	3.6	-	-	-	-	-

a = Time taken for first harvest (days post-casing)

b = Average fruiting body weight (g)

**Fig. 1. White button mushroom crop raised with different strains at Pantnagar and Solan**

1.2 Strain evaluation of milky mushroom, *Calocybe indica*

The trial was laid out at seven Centres by including 5 different strains. The mushroom yield obtained at different Centres varied in different strains. Strain C.I-3 gave highest yield at Ludhiana, Ranchi and Vellayani, while strain, C.I.-6 at Faizabad, Udaipur, Pantnagar and Coimbatore Centres (Table-3). Highest biological efficiency of 198 per cent was

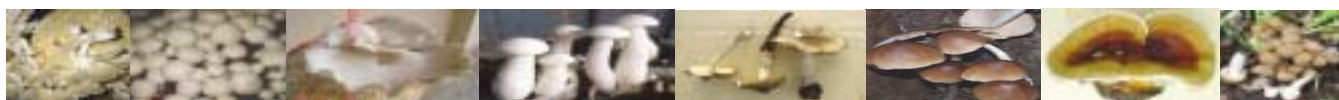
**Fig. 2. Crop of superior yielder strain, C.I-6 of *Calocybe indica* at Pantnagar**

Table 3. Strain evaluation of milky mushroom, *Calocybe indica*

Strain	Mushroom yield (kg/ 100 kg dry substrate)														
	Ludhiana		Faizabad		Udaipur		Ranchi		Vellayani	Pantnagar		Coimbatore		Average	
	a	b	a	b	a	b	a	b	a	a	b	a	b	a	b
C.I-1	31.5	47.3	48.44	27.85	33.8	42.25	98.0	48.9	-	40.83	35.8	170.8	42.0	70.56	40.68
C.I-3	63.8	45.6	41.35	27.20	45.95	31.70	110.6	35.6	51.9	31.57	33.5	160.0	43.0	72.17	36.10
C.I-5	39.5	58.8	23.37	26.71	41.04	39.46	-	-	41.3	27.08	31.3	178.0	47.5	58.38	40.75
C.I-6	35.5	50.7	55.60	26.61	59.50	46.48	94.8	51.8	-	52.32	40.1	198.0	42.5	82.62	43.03
C.I-8	45.0	42.9	16.49	26.81	59.10	35.18	-	-	33.5	30.39	39.9	152.0	47.0	56.08	38.36
CD (0.05)	4.7	-	4.16	-	9.23	-	NS	-	3.01	1.51	-	9.76	NS	-	-

a- average mushroom yield; b- average fruiting body weight (g) ; NS – Non-significant; - not done

obtained at Coimbatore, while lowest of 23.37% at Faizabad Centre. On overall average basis, highest yield and heavier fruiting bodies were recorded in strain C.I-6.

1.3 Strain evaluation of paddy straw mushroom, *Volvariella volvacea*

The trial was laid out at 5 different Centres and highest biological efficiency in the range of 20.80 to 24.62 % was recorded at Coimbatore Centre, followed by Ludhiana Centre. Strain, Vv-01 gave highest yield of 24.62 kg/100 kg dry substrate at Coimbatore, while strain, Vv-02 at Ludhiana and Faizabad, Vv-07 at Ranchi and Vv-1 at Vellayani Centres (Table-4). On overall average basis strains,

Vv-1 and Vv-2 gave higher mushroom yield than other strains.

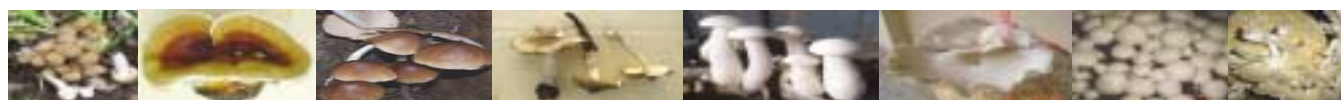
1.4 Strain evaluation of oyster mushroom species (*Pleurotus florida* and *P. sajor-caju*)

The trial was conducted only at the headquarters at Solan by using four hybrids and their parent strain each of *P. florida* and *P. sajor-caju* using pasteurized wheat straw. Five replications of 1kg dry straw were kept for each strain. In case of *P. florida* hybrids, the strain, PF-01 gave highest mushroom yield of 81.8 % biological efficiency, while rest other

Table 4. Strainal evaluation of paddy straw mushroom, *Volvariella volvacea*

Strain	Mushroom yield (kg/ 100 kg of dry substrate)											
	Ludhiana		Faizabad		Coimbatore		Ranchi		Vellayani		Average	
	a	b	a	b	a	b	a	b	a	b	a	b
Vv-1	0.7	5.0	-	-	24.62	20.5	-	-	12.5	10.9	12.61	12.13
Vv-2	13.1	6.2	13.32	12.11	20.80	20.0	-	-	3.80	4.0	12.76	10.58
Vv-6	NF	NF	6.37	6.37	-	-	2.33	10.58	3.60	10.4	4.10	9.12
Vv-7	11.8	6.8	-	-	-	-	2.5	13.30	11.0	7.45	8.43	9.18
CD(0.05)	0.9	-	1.21	0.9	-	-	-	-	1.28	0.85	-	-

a) average mushroom yield; b) average fruiting body weight (g); NF- No fruit body



strains were poor yielder. In case of *P. sajor-caju* hybrids, the strain, PSc-1 and PSc-5 gave superior yield of 74.8 % and 74.4 %, respectively over other strains (Table-5). The fruiting body morphology varied in different strains and the superior yielder strains also had superior fruiting body quality.

Table 5. Strain evaluation of oyster mushroom species (*Pleurotus florida* and *P. sajor-caju*)

S. No.	Mushroom yield (kg/ 100 kg dry substrate)			
	<i>Pleurotus florida</i>		<i>Pleurotus sajor-caju</i>	
	Strain	BE (%)	Strain	BE (%)
1	PF-01	81.8	PSc-1	74.8
2	PF-02	57.2	PSc-2	49.3
3	PF-03	52.7	PSc-3	73.2
4	PF-04	54.7	PSc-4	41.0
5	PF-05	24.2	PSc-5	74.4

1.5 Evaluation of yield potential of *Pleurotus fossulatus*

The experiment was conducted at 5 different Centres. Highest biological efficiency of 88.60% in this mushroom was recorded at Udaipur Centre, which was far less to 96.66 % in *P. florida*. At

Faizabad and Raipur, the control *Pleurotus* spp. (*P. florida*) out-yielded the test species (Table-6). However, at Ludhiana Centre no fruiting was recorded in either of the species. On overall average basis, control (*P. florida*) species performed much better than the test species.

2. Crop Production

2.1 Isolation and identification of thermophilic microorganisms from white button mushroom compost received from different locations for their exploitation in faster composting process

Under this experiment compost samples were analysed for variability in their thermophilic fungi population. For the above purpose, samples were received from Ludhiana (10 nos.), Udaipur (5 nos.), Raipur (5 nos.), Barapani (1 no.), Ranchi (4 nos.) and Solan (4 nos.). Thermophilic fungi were isolated from these samples at 47 and 52°C, respectively. Around 14 fungi were isolated and *Scytalidium thermophilum* followed by *Humicola insolens* were the dominating fungi. *S. thermophilum* and *H. insolens* isolates showed variability in terms of morphology and spore size (Table-7).

Table 6. Evaluation of the yield potential of *Pleurotus fossulatus*

<i>Pleurotus</i> sp.	Mushroom yield (kg / 100 kg dry substrate)					Average
	Udaipur	Ludhiana	Raipur	Faizabad	Pantnagar	
<i>P. fossulatus</i>	88.60	No fruiting	65.38	4.76	64.88	55.91
<i>P. florida</i>	96.66	-	74.94	63.81	62.84	74.56
CD (0.05)	7.43	-	15.72	9.28	0.96	-

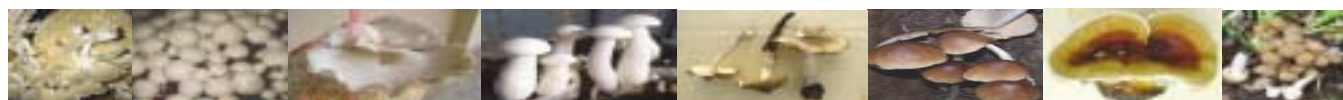


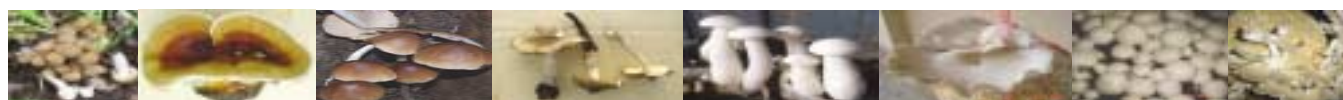
Table 7. Thermophilic fungi and their colony count in different compost samples

S. No.	Source	Colony count (cfu x 10 ⁴)/ (fungi)			Av.cfu/g compost	Dominant fungi \$
		42°C	47°C	52°C		
1	Solan	—	4.3 (1)	—	4.3	1
2	Solan	—	21.33 (1,6)	23.66 (1,6)	22.49	1
3.	Solan	31 (6,7,8)	23.9 (9,6)	1.0 (8,6)	18.6	4
4.	Solan	20.6(4,1,6)	3.6 (6,7,12)	16.3(7,6,10)	13.5	4
5.	Solan	—	3.0 (1)	1.0 (1)	2.00	1
6.	Ranchi 1	—	9.6 (1,2)	—	9.6	1
7.	Ranchi 2	—	64.3 (2,1)	—	64.3	2
8.	Ranchi 3	—	15.0 (2)	—	15.0	2
9	Ranchi 4	—	27.3 (1,2)	—	27.3	1
10.	Barapani	—	13.33 (2,3,1)	12.33(2,3,1)	12.8	2
11.	Raipur 1	—	17.66 (5)	12.33 (5)	14.95	5
12.	Raipur 2	—	9.0 (2,5)	5.3 (2,5)	7.15	2
13.	Raipur 3	—	19.0 (2,5)	13.0 (2)	16.0	2
14.	Raipur 4	—	28.66 (2)	20.0 (2)	24.3	2
15.	Raipur 5	—	16.66 (5,2)	8.6 (5,2)	12.6	5
16.	Udaipur 1	—	0.3 (3)	1.3 (3)	0.8	3
17.	Udaipur 2	—	0.0	0.0	0.0	-
18.	Udaipur 3	—	1.3 (1)	0.0	0.65	1
19.	Udaipur 4	—	11.33(2,1,11)	10.33(2,3,10)	10.8	2
20.	Udaipur 5	—	0.0	0.0	0.0	-
21.	Ludhiana 1	—	0.0	0.0	0.0	-
22	Ludhiana A2	—	2.0 (4,6,13)	2.6 (4,6)	2.3	4
23.	Ludhiana A3	—	0.0	0.0	0.0	-
24.	Ludhiana B1	—	7.6 (1,6)	7.0 (1,6,7)	7.3	1
25.	Ludhiana B2	—	2.0 (1)	3.6 (1)	2.8	1
26.	Ludhiana B3	—	14.33 (1,6,7)	18 (1,6,7)	16.15	1
27.	Ludhiana C1	—	14.33 (1)	11.33 (1,14)	14.45	1
28	Ludhiana C2	—	16.33 (1)	10.33 (1)	13.3	1
29.	Ludhiana C3	—	12.33 (1,4)	4.3 (1,4)	8.3	4
30.	Ludhiana D1	—	36.33 (1)	23.33 (1)	29.8	1
31.	Ludhiana D2	—	41.0 (1,6)	23.66 (1,6)	32.3	1
32.	Ludhiana D3	—	3.3 (4)	6.33(1,4,6,7)	4.815	4
33.	Ludhiana E1	—	54.33 (1,8,4)	59.33 (1,4,8)	56.8	4
34.	Ludhiana E2	—	54.3 (1,4,8)	55.6 (1,4,8)	54.95	1
35.	Ludhiana E3	—	51.0 (1,8)	49.66 (8,1)	50.5	8

Figures in parentheses are the names of fungi as given below, isolated in order of their dominance.

\$ Fungi isolated

1. *Scytalidium thermophilum*(strains), 2. *Humicola insolens* (strains), 3. *Humicola grisea* (strains), 4. *Thermomyces lanuginosus*, 5. *Chaetomium thermophile*, 6. *Aspergillus fumigatus*, 7. *Mucor pusillus*, 8. *Mycelia steriata*, 9. *Penicillium* sp., 10. *Gilmaniella* sp., 11. *Paecilomyces variotii*, 12. *Rhizopus* sp., 13. *Sporotrichum thermophile*, 14. Unidentified sp.



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

The experimental trail was laid out at three Centres. Coir pith in combination with FYM in the ratio of 1:1 (v/v) gave highest mushroom yield of 17.65 kg/100 kg compost, at Pune, whereas farm yard manure in combination with spent compost (1:1, v/v) performed better at Ludhiana Centre. Two years old spent compost gave highest yield of 14.47 kg at Udaipur Centre. On overall average basis, Farm yard manure (FYM) + spent compost (SC) (1:1, v/v) performed better than the other casing materials tested (Table-8).

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

The experiment was laid out at 3 different Centres. The pH, water holding capacity and conductivity were recorded highest in coir pith and its combination with FYM at Ludhiana, Udaipur and Pune Centres, while the particle density was in lower range, and the highest particle density was in casing material prepared with FYM + garden soil (1:1, v/v) at Ludhiana and Pune Centres. The pH of better performing casing material (coir pith, coir pith + FYM (1:1, v/v) and FYM + SC (1:1, v/v)) varied from 7.4 to 7.8. The

Table 8. Effect of different casing materials on the yield and fruiting body weight of *A. bisporus*

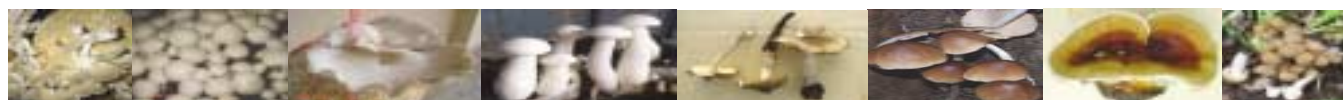
Treatment	Mushroom yield (kg / 100 kg compost)							
	Pune		Ludhiana		Udaipur		Average	
	a		a	b	a	b	a	b
Farm Yard Manure (FYM) + Spent Compost (SC) (1:1, v/v)	14.35		13.6	1320	12.75	863	13.57	1092
SC (2 years old)	14.70		9.90	1160	14.47	993	13.02	1077
Coir Pith + Farm Yard Manure (1:1, v/v)	17.65		10.70	1340	8.30	668	12.22	1004
Farm Yard Manure + (Garden soil (1:1, v/v), Control-I	15.45		7.50	920	9.07	310	10.67	615
Farm Yard Manure, Control-II	11.50		5.40	640	14.06	1041	10.32	841
CD (0.05)	1.15		0.80	123	3.48	-	-	-

a = Total yield, b = No. of fruiting bodies

Table 9. Different quality parameters of casing materials

Treatment	Centres											
	Ludhiana				Pune				Udaipur			
	pH	WHC	Cond.	Den.	pH	WHC	Cond.	Den.	pH	WHC	Cond.	Den.
FYM+SC (1:1)	7.8	100	0.7	0.75	7.2	76	0.95	0.60	7.66	43.87	3.77	0.605
SC (2 years old)	7.5	102	1.3	0.78	6.9	80	1.21	0.64	6.9	62.89	3.37	0.662
CP + FYM (1:1)	7.4	255	1.4	0.38	7.2	90	1.59	0.45	7.9	94.95	2.58	0.457
FYM + Garden soil (1:1), Control-I	7.7	54	0.8	1.08	7.3	65	0.93	0.87	8.3	52.66	1.87	0.804
FYM, Control-2	7.2	135	1.2	0.65	7.4	72	1.20	0.63	8.3	44.25	2.69	0.714

WHC- Water holding capacity (%), Cond- conductivity (mhos/cm²), Den.- density (g/cm³)



conductivity varied between 1.4 to 2.58 in coir pith + FYM (1:1, v/v). The particle density increased with increased proportion of garden soil in the casing material (Table-9).

2.3.1 Effect of spray of different chemicals on yield of *Pleurotus florida* and *Pleurotus sajor-caju*

The experiment was conducted at 10 different 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* and *P. sajor-caju*. The spray of 0.1M solution of K_2HPO_4 significantly enhanced the yield of *P. florida* at Raipur, Faizabad, Coimbatore and Solan Centres. At Ludhiana, Pune, Udaipur and Ranchi Centres, the control treatment gave significantly higher yield than chemical sprayed substrate bags (Table-10). However, in overall average, control treatment showed significantly enhanced mushroom yield.

2.3.2 Effect of chemical spray on yield of *Pleurotus sajor-caju*

The experiment with *P. sajor-caju* was conducted at 11 Centres. Enhanced yield of *P. sajor-caju* was obtained on spraying 0.1M solution of K_2HPO_4 on mushroom beds at Raipur, Faizabad, Barapani, Coimbatore, Vellayani, and Solan Centres, while the mushroom yield at Ludhiana, Raipur, Pune and Udaipur was significantly less in chemical sprayed treatments in comparison to control (Table-11). There were minor variations in average mushroom yield calculated after summing up of yield obtained at different Centres.

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

The experiment was conducted at 9 different Centres. Blue oyster mushroom, *Hypsizygus ulmarius* gave more than 90% biological efficiency on wheat straw at Coimbatore, Ranchi and Pune Centres. At Coimbatore Centre highest biological efficiency of 148% was recorded on paddy straw in comparison to 134.00% and 138.00% on wheat straw and 1:1, w/w combination of wheat straw and paddy straw, respectively. At majority of the Centres, wheat straw outperformed other substrates, except at Coimbatore Centre, where higher yield was recorded on paddy straw. The cumulative average yield data did not show much variations in mushroom yield (Table-12).

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

The trial was conducted at 4 Centres. At Coimbatore Centre, the compact round beds prepared out of paddy straw gave highest mushroom yield of 30.7 kg/100 kg dry substrate. It was closely followed by compact square beds. At Ludhiana, again the highest mushroom yield was obtained on compact round beds and it was followed by beds prepared with 5 bundles each in 4 layers and two bundles opened on the top (Table-13). At Raipur Centre, compact beds followed by hollow beds gave highest yield of 17.40 and 16.77 kg/100 kg dry substrate, respectively. Average fruiting body weight was also highest (45.5 g) from compact round beds and it was followed by compact square beds.

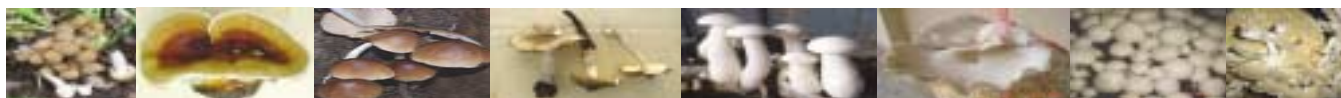


Table 10. Effect of chemical spray on yield of *Pleurotus florida*

Treatment	Mushroom yield (kg / 100 kg dry substrate)									
	Ludhiana	Raipur	Faizabad	Pune	Pantnagar	Coimbatore	Vellayani	Udaipur	Ranchi	Average
K ₂ HPO ₄ (0.1M)	36.3	54.23	68.31	54.5	67.44	98.0	25.3	112.77	93.40	67.80
Urea (100 ppm)	39.5	60.93*	69.72	45.0	65.02	87.0*	29.8*	102.97	97.12	66.34
Urea (200 ppm)	28.5	-	71.64	35.0	61.85	-	-	110.0	-	61.40
Control	60.5	56.33	63.73	-	-	84.0	24.25	129.73	142.74	80.18
CD (0.05)	6.9	NS	3.15	4.1	0.64	-	2.64	8.33	14.25	-

* Experiment was conducted with 1.0 % Urea spraying; NS- Non-significant, - not done

Table 11. Effect of chemical spray on yield of *Pleurotus sajor-caju*

Treatment	Ludhiana	Raipur	Mushroom yield (kg / 100 kg dry substrate)								
			Faizabad	Barapani	Pune	Pantnagar	Coimbatore	Vellayani	Udaipur	Ranchi	Average
K ₂ HPO ₄ (0.1M)	29.0	54.30	64.59	33.3	57.5	92.06	92.0	23.0	117.77	143.46	70.70
Urea (100 ppm)	35.5	42.0*	69.93	33.0	48.5	85.17	83.0*	22.0*	115.20	50.08*	58.44
Urea (200 ppm)	28.8	-	68.81	37.8	33.5	54.48	-	-	123.30	-	57.78
Control	55.0	52.76	61.18	31.1	-	-	78.0	22.7	130.17	57.58	61.06
CD (0.05)	5.3	NS	2.97	NS	3.70	0.18	-	2.64	7.73	NS	-

* Experiment was conducted with 1.0 % Urea spraying; NS- Non-significant; - not done

Table 12. Evaluation of yield potential of blue oyster mushroom, *Hypsizygus ulmarius*

Substrate	Mushroom yield (kg / 100 kg dry substrate)									
	Pune	Raipur	Faizabad	Pantnagar	Ranchi	Coimbatore	Vellayani	Ludhiana	Udaipur	Average
Wheat straw	95.0	66.50	70.20	69.40	131.66	134.0	69.72	45.0	57.8	82.14
Paddy straw	68.0	-	-	-	-	148.0	-	35.5	-	83.83
Wheat straw + paddy straw (1:1, w/w)	78.5	-	-	-	-	138.0	-	40.0	-	85.50
CD (0.05)	5.7	-	-	-	19.87	-	3.90	3.3	-	-

-, did not conducted the trial

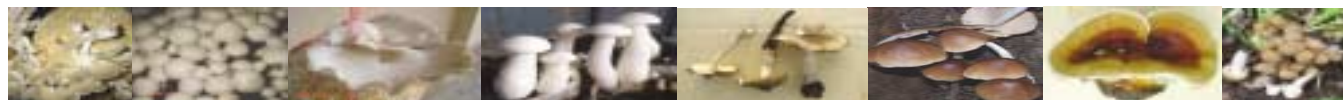
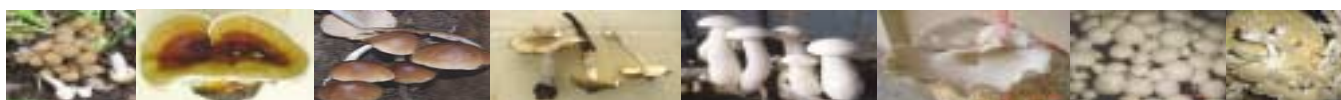


Table 13. Effect of different shapes of beds on yield of paddy straw mushroom, *Volvariella volvacea*

Bed shape	Mushroom yield (kg / 100 kg of dry substrate)				
	Coimbatore	Ludhiana	Faizabad	Raipur	Average
Hollow bed (6" hollow dia)	12.7	14.8	9.81	16.77	13.52
Compact bed (Square)	23.4	14.0	11.71	17.40	16.63
Compact bed (Round)	30.7	15.5	9.78	16.64	18.16
Bundle method (hollow – 4 bundles x 5 layers + 2 bundles opened at the top)	10.1	13.5	11.34	15.28	12.56
Bundle method (5 bundles x 4 layers + 2 bundles opened at the top)	13.0	15.0	13.53	12.16	13.42
Cylinder method	12.1	-	-	-	12.10
CD (0.05)	-	0.6	0.81	NS	-

NS- Non-significant

**Fig. 3. *Pleurotus florida* and *P. sajor-caju* species grown at Vellayani****Fig. 4. Blue oyster mushroom (*Hypsizygus ulmarius*) grown at Pantnagar and Vellayani**

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

The experimental trial was conducted at 5 Centres and at all the Centres, highest mushroom yield was obtained on wheat straw used as the substrate. The mushroom yield varied from lowest of 7.50 kg/100 kg dry substrate at Raipur to highest of 64.35 kg at Faizabad Centre. The yield levels obtained at Pantnagar and Udaipur were comparable, while yield was significantly low at Raipur Centre (Table-14). On overall average basis much better yield was recorded on wheat straw as compared to paddy straw and its different combinations with wheat straw.

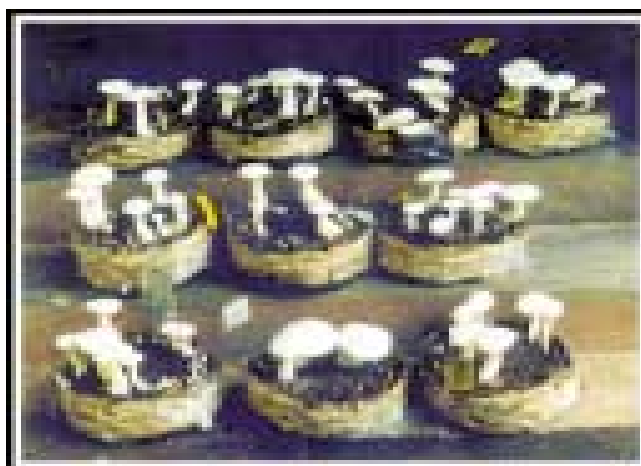


Fig. 5. Crop of milky mushroom (*Calocybe indica*) raised by using different substrates at Vellayani

Table 14. Cultivation of milky mushroom (*Calocybe indica*) on different substrates

Substrate	Mushroom yield (kg / 100 kg dry substrate)					
	Ludhiana	Pantnagar	Faizabad	Udaipur	Raipur	Average
Wheat straw (WS)	63.8	54.30	64.35	58.98	11.85	50.66
Paddy straw (PS)	NF	17.96	13.86	42.74	10.35	21.23
WS + PS (1:1)	35.8	36.38	27.63	56.65	7.50	32.79
WS + PS (1:2)	NF	51.32	18.33	45.68	-	38.44
WS + PS (2:1)	41.6	24.38	44.01	48.44	7.50	33.19
CD (0.05)	-	1.04	5.71	4.71	NS	-

NF-No fruit body

NS-Non-significant

2.6 Cultivation trial on shiitake mushroom, *Lentinula edodes*

The experimental trial was conducted at 2 Centres only. Out of different substrates and supplements tried, wheat straw (WS) + 20% wheat bran (WB), followed by saw dust (SD) + 20% wheat bran (WB) gave highest mushroom yield at Pantnagar. At Coimbatore

Centre, saw dust mixed with wheat bran @ 20% and 10% gave the highest yield (Table-15). Average fruiting body weight (27.98 to 85.31g) was comparatively higher at Pantnagar than at Coimbatore Centre (14.8 to 21 g). On overall average basis SD + 20% WB gave significantly higher yield as compared to other substrates supplemented with different levels of wheat bran.

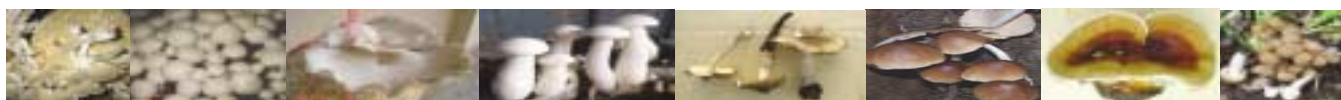


Table 15. Evaluation of different substrates for the cultivation of shiitake, *Lentinula edodes*

Substrate	Mushroom yield (g / 2 kg substrate)					
	Pantnagar		Coimbatore		Average	
	Yield	Av. Fruiting body wt. (g)	Yield	Av. Fruiting body wt. (g)	Yield	Av. Fruiting body wt. (g)
(SD) alone	18.73	83.25	24.0	18.0	21.37	50.63
SD+WB (5%)	42.54	56.34	24.8	18.6	33.67	37.47
SD+WB (10%)	52.77	51.48	26.5	19.8	39.64	35.64
SD+WB (20%)	62.09	31.83	28.5	21.0	45.30	26.42
Wheat straw alone	24.53	85.31	5.0	14.8	14.77	50.05
WS+WB (5%)	31.35	59.14	5.8	16.5	18.58	37.82
WS+WB (10%)	58.00	38.92	6.0	16.0	32.00	27.46
WS+WB (20%)	69.89	27.98	7.0	15.5	38.45	21.74
CD (0.05)	0.11	-	-	-	-	-

SD – saw dust; WB – wheat bran; WS – wheat straw

**Fig. 6. Spawn run and fruiting stages of shiitake mushroom (*Lentinula edodes*) at Raipur and Pantnagar**

3. POST HARVEST TECHNOLOGY

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

The experiment was conducted at 6 Centres by involving washing treatment of button mushroom fruiting bodies with 100,

150, 200 and 500 ppm of EDTA, 100 ppm EDTA + 0.02% KMS and unwashed mushroom as control. The washing treatment with 100 ppm EDTA + 0.02% KMS gave highest whiteness just after washing and after 48 hrs. of storage at 5°C at almost all the Centres. The second best treatment at Coimbatore, Raipur and Pantnagar was 500 ppm EDTA, while 200 ppm EDTA at Faizabad, Ludhiana, Pune and Udaipur (Table-16).

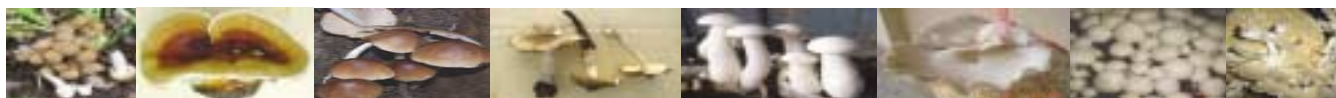
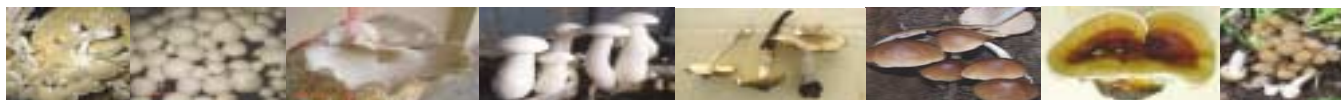


Table 16. Effect of washing treatment followed by storage at 5°C on whiteness of button mushroom, *A. bisporus*

Dipping 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 100 ppm	++	++	++	++	++	++	++	+	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
	+	+	+	+	+	+	+										+	+	+	+	+	+	+	+
EDTA 150 ppm	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
	+	+	+	+	+	+	+										+	+	+	+	+	+	+	+
EDTA 200 ppm	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
	+	+	+	+	+	+	+				+						+	+	+	+	+	+	+	+
EDTA 100 ppm + 0.02% KMS	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
	+	+	+	+	+	+	+				+						+	+	+	+	+	+	+	+
EDTA 500 ppm	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
	+	+	+	+	+	+	+				++	++					+	+	+	+	+	+	+	+
Unwashed	++	++	++	++	++	++	++	+	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
	+	+	+	+	+	+	+										+	+	+	+	+	+	+	+
Water washed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

a- whiteness before washing, b- whiteness after washing, c- whiteness after 24 h of storage, d- whiteness after 48 h of storage



The results were different after storing the washed mushrooms at ambient temperature conditions and washing with 200 ppm EDTA gave whiteness at par with 100 ppm EDTA + 0.02% KMS at Coimbatore, Faizabad, Ludhiana, Pune and Raipur Centres. It was only the Pantnagar Centre, where superior whiteness was retained in 100 ppm EDTA + 0.02% KMS washing treatment than other EDTA washing treatments. The second best treatment was 500 ppm EDTA (Table-17).

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

The experiment was conducted at 7 Centres by using polypropylene bags of 75, 100 and 125 gauge thickness and polythene bags of 100 gauge thickness. The packed mushrooms were stored at ambient and refrigerated temperature conditions separately and the loss in whiteness, weight and opening of veil were recorded. At Coimbatore, Faizabad, Pantnagar, Pune and Udaipur Centres, mushrooms packed in 100 gauge polypropylene bag gave better results with respect to retention of superior whiteness, weight and lower level of veil opening on their storage both at refrigerated and ambient temperature conditions. At Ludhiana and Raipur Centres, better results were obtained on packaging mushrooms in 125 gauge thick polypropylene bags, while at Pantnagar Centre, no significant differences were recorded in either of the packaging treatment (Table-18). When the mushrooms

were stored in different packaging materials without any hole, the 75 and 100 gauge polypropylene bags gave better results than other materials at Faizabad and Pune Centre, respectively (Table-19).

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

The experiment was conducted at 4 Centres and four methods viz., blanching followed by sun-drying, no blanching followed by sun-drying, simple washing followed by sun-drying and cabinet drying were employed. The results obtained at different Centres varied and keeping quality after 3 months of storage was better in treatment involving blanching followed by sun-drying at Coimbatore and Raipur Centres. However, at Udaipur and Ludhiana, the chemical treatment followed by sun-drying and simple washing followed by sun-drying gave better results with respect to whiteness, brittleness and keeping quality after 3 months of storage (Table-20).

3.4 Effect of different drying methods on quality of dried milky mushroom, *Calocybe indica*

The experiment was only conducted at Coimbatore Centre and blanching of mushrooms followed by sun-drying gave more whiteness to the dried mushrooms but the brittleness and weight retention was superior in treatment with simple washing followed by sun-drying (Table- 21).

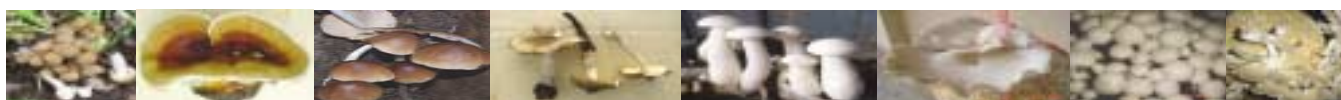


Table 17. Effect of washing treatment followed by storage at ambient temperature conditions on whiteness of button mushroom, *A. bisporus*

Dipping 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 100 ppm	+++	+++	+++	++	+++	+++	+++	+++	++	+++	+++	++	++	+++	+++	++	+++	+++	++	++	+++	+++	++	++
		+	+	+		+																+		
EDTA 150 ppm	+++	+++	+++	++	+++	+++	+++	+++	++	+++	+++	+	++	+++	+++	++	+++	+++	++	++	+++	+++	++	++
		+	+	+																		+		
EDTA 200 ppm	+++	+++	+++	++	+++	+++	+++	+++	++	+++	+++	++	++	+++	+++	++	+++	+++	++	++	+++	+++	++	++
		+	+	+																		+		
EDTA 100 ppm +0.02% KMS	+++	+++	+++	++	+++	+++	+++	+++	++	+++	+++	++	++	+++	+++	++	+++	+++	++	++	+++	+++	++	++
		+	+	+		+						+										+		
EDTA 500 ppm	+++	+++	+++	++	+++	+++	+++	+++	++	+++	+++	+++	++	+++	+++	++	+++	+++	++	++	+++	+++	++	++
		+	+	+		+						+										+		
Unwashed	+++	+++	+++	++	+++	+++	+++	+++	++	+++	+++	++	++	+++	+++	++	+++	+++	++	++	+++	+++	++	++
Water washed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+

a- before washing, b- after washing, c- after 24 h of washing, d- after 48 h of washing

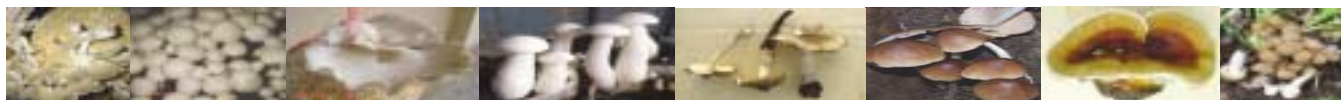


Table 18. Effect of different packaging treatments with holes on whiteness, weight loss and veil opening of button mushroom on storage for 48 hrs. at refrigerated and ambient temperature conditions

Treatment	Faizabad			Ludhiana			Pantnagar			Pune			Raipur			Udaipur		
	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c
75 gauge PP (R)	+++	4.90	0.00	++	5.00	-	++	0.00	0.00	++	1.62	-	++++	0.00	++++	+++	0.00	0.00
(A)	+++	13.50	8.00	++	5.00	-	+	0.45	0.00	++	4.44	3.00	+	0.00	++	+++	0.00	0.00
100 gauge PP (R)	+++	4.70	0.00	++	5.00	-	++	0.05	0.00	+++	1.66	-	++++	0.00	++++	+++	0.00	0.00
(A)	+++	12.80	4.00	++	5.00	-	++	0.35	0.00	+++	3.82	2.00	+	0.00	+	+++	0.00	0.00
125 gauge PP (R)	+++	4.50	0.00	++	5.00	-	++	0.00	0.00	+++	2.35	-	++++	0.00	++++	+++	0.00	0.00
(A)	+++	14.50	4.00	+++	5.00	-	++	0.25	0.00	+++	4.32	2.00	+	3.80	+	+++	0.00	0.00
100 gauge PE (R)	+++	3.90	0.00	+++	5.00	-	++	0.00	0.00	++	4.57	-	++++	0.00	++++	+++	0.00	0.00
(A)	+++	13.30	4.00	+++	5.00	-	+	0.25	0.00	+++	5.88	3.00	+	4.16	+	+++	0.00	0.00

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

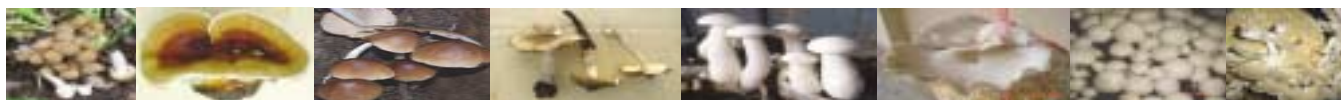


Table 19. Effect of different packaging treatments without holes on whiteness, weight loss and veil opening of button mushroom on storage for 48 hrs. at refrigerated and ambient temperature conditions

Treatment		Faizabad			Pune		
		a	b (%)	c (%)	a	b (%)	c (%)
75 gauge PP	(R)	++++	4.10	0.00	+++	0.25	1.00
	(A)	++	9.80	8.00	++	2.98	3.00
100 gauge PP	(R)	++++	3.80	0.00	+++	0.57	3.00
	(A)	++	9.50	12.00	++	3.33	2.00
125 gauge PP	(R)	++++	3.70	0.00	+++	0.57	2.00
	(A)	++	9.70	12.00	++	0.18	2.00
100 gauge PE	(R)	++++	4.00	0.00	+++	2.28	2.00
	(A)	++	9.40	8.00	++	2.89	4.00

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

Table 20. Effect of different drying treatments on quality of dried oyster mushroom, *Pleurotus* spp.

Treatment	Quality characteristics of the dried product														
	Coimbatore				Raipur			Udaipur				Vellayani			
	a	b	c	d	a	c	d	a	b	c	d*	a	b	c	d
Blanched (0.2% salt + 0.1% citric acid for 2 min.) + sun-drying	+++	-	++	30.0	+	+	2.63	+++	+++	+++	87.0	+++	+++	+++	85.0
Unblanched (0.2% salt + 0.1% citric acid for 2 min.) + sun-drying	+	-	+	0.00	+++	+	1.59	+++	+++	+++	92.2	+++	+++	+++	89.0
Washing with plain water + sun-drying	-	++++	++	85.0	+++	+	1.16	+++	+++	+++	91.0	-	-	-	-
Cabinet drying (40±2°C till 7% moisture)	-	-	-	-	+++	+	2.62	+++	+++	+++	86.5	-	-	-	-
Cabinet drying (60±2°C till 7% moisture)	+	++	+	60.00	+	+	0.74	+++	+++	+++	89.2	+	++	++	89.0

a- whiteness (++++ snow white, ++++ white, +++ half white, + pale)

b- brittleness (++++ maximum brittle, + minimum brittle)

c- keeping quality after 3 months, d- weight loss (%)

*- weight loss after 3 months of storage

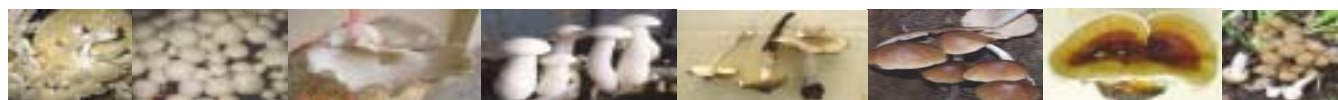




Fig. 7. Dried oyster mushroom by using cabinet and sun-drying methods at Vellayani

Table 21. Effect of different drying treatments on quality of dried milky mushroom, *Calocybe indica*

Treatment	Quality characteristics of dried mushrooms			
	Coimbatore			
	a	b	c	d
Blanched (0.2% salt + 0.1% citric acid for 2 min.) + sun-drying	+++	0.00	++	25.00
Unblanched (0.2% salt + 0.1% citric acid for 2 min.) + sun-drying	+	0.00	+	0.00
Plain water washing + sun-drying	-	++++	++	85.00
Cabinet drying ($40 \pm 2^\circ\text{C}$ till 7% moisture)	-	-	-	-
Cabinet drying ($60 \pm 2^\circ\text{C}$ till 7% moisture)	+	++	+	65.00

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

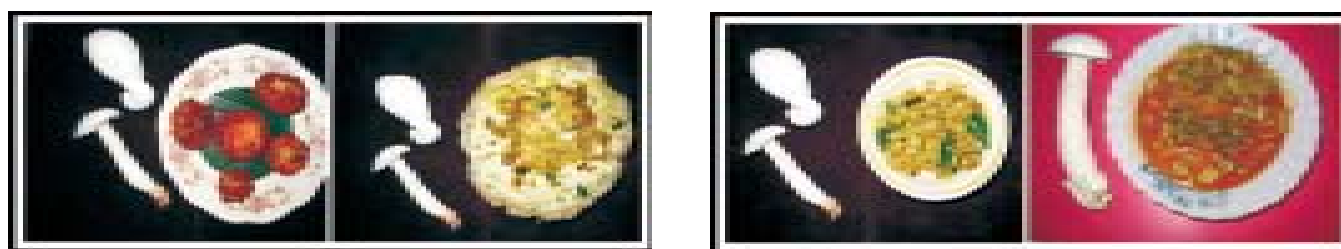
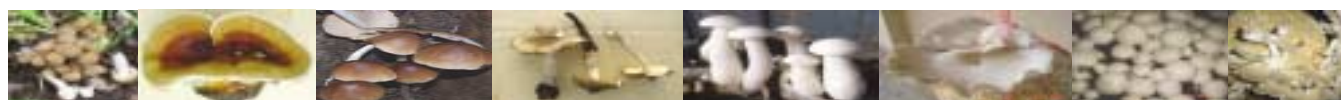


Fig. 8. Different food preparations prepared from milky mushroom (*Calocybe indica*) at Vellayani



4. COLLECTION AND PRESERVATION OF FLESHY FUNGI

FAIZABAD CENTRE

Forays were conducted during July to September 2006 in the gardens, forest areas and hills of Faizabad, Sultanpur, Jaunpur, Varanasi, Mirzapur, Allahabad and Pratapgarh districts. A total of 42 samples were collected, out of which, 14 were of *Volvariella* spp., 12 of *Termitomyces* spp., 5 of *Ganoderma* spp., 4 of *Calocybe indica* and 7 of unidentified edible mushrooms. Selected fruiting bodies were tissue cultured for further studies.

PANTNAGAR CENTRE

Twenty five specimens were collected, out of which, 10 were identified tentatively. The identified mushroom species were *Boletus* spp., *Lapota* spp., *Ganoderma lucidum*, *Polyporus* spp., *Cordyceps sinensis*, *Russula* spp., *Amanita phalloides*, *Amanita* spp., *Auricularia* spp. and *Daldinia* spp.

RAIPUR CENTRE

Forays for wild mushroom flora were conducted during monsoon season in two districts of Chhattisgarh i.e. Raipur and Jagdalpur. Mushroom flora occurring in the vicinity of College of Agriculture and around the farm was regularly surveyed from June to October months. In all, 26 species of edible, inedible, medicinal and poisonous mushrooms were collected from soil, termite mounds, wood logs, live plants, rotten leaves and market areas. The various wild mushrooms, namely, *Bovista vigrescens* (Dhela putu), *Entoloma rhodopolium*, *Bovista* spp. (Puft balls), *Coprinus* spp., *Volvariella volvacea*, *Termitomyces clypeatus*, *Termitomyces heimii*, *Astreatus hygrometricus* (Sal bonda), *Calocybe* spp.,

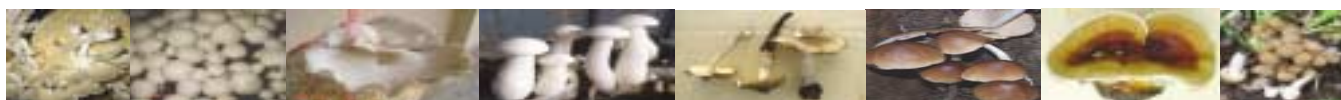
Piptoporus betulinum, *Coprinus* spp., *Ganoderma lucidum*, *G. applanatum*, *Shyzyphyllum commune*, *Polyporus* spp. and *Termitomyces* spp. were collected and identified.



Fig. 9. Wild mushroom locally known as Kanki phutu growing in forest areas of Raipur

UDAIPUR CENTRE

Total of 8 forays were made in the month of August and September 2006. This year rain started late in the last week of July only. Therefore, the collection was done only in August month in different districts of Rajasthan such as Udaipur, Sirohi, Pali, and Chittorgarh. The major areas surveyed were Badgoan, Iaswal, Gogunda, Madar, Oogna, Vas, Falasia, Jhadol, Pai, Peepalvas, Bari, Undri, Nai, Sisarma, Jaswanthgarh, Saira, Malgarh, Pindwara, Sai, Malva Ka Chora, Dhar, Goralla, Morvania, Kapasan, Mungana, Chirwal, Fathnagar, Bhupalsagar, Mavali, Veerpura, Sagatoda, Saria, Salumber, Gotamesvar and Kotada. A total of 103 different wild specimens were collected and out of which 67 were identified. Their data base, culture and spore prints were prepared. The



specimens were preserved in dry form only. The most common occurring genera were *Agaricus* spp., *Auricularia*, *Podaxis pistillaris*, *Lepiota* spp., *Volvariella* spp., *Pleurotus* spp., *Ganoderma* spp., *Schizophyllum commune*, *Geastrum* spp., *Pisolithus tintorius*, *Polypores*, *Mycena*, *Marasmius* spp. and *Phellorina* spp.

VELLAYANI CENTRE

Forays were conducted in and around Trivandrum district of Kerala State. Around 50 wild specimens including *P. eous*, *P. squarrosulus*, *Schizophyllum comma*, *Boletus*, *Ganoderma* and *Termitomyces* were collected. The collections obtained were isolated and preserved in the mushroom museum attached to the Centre.



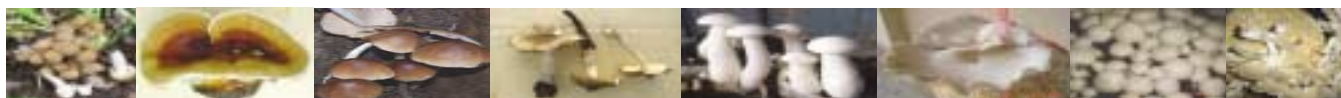
Fig. 10. Wild mushroom *Boletus lunidus* growing at the base of mango tree in forests of Kerala

SOLAN CENTRE

Each major locality and sub-locality was visited, as a result of which a total no. of 315 collections of fleshy fungi were collected (June, 2006 to September, 2006). All the specimens were examined for their macroscopic features in the field along with their field photographs. The ecology of each taxa was also studied in which it was found growing. Of the total 315 collections, 210 collections (majority of which belong to order Agaricales), have been tentatively

identified. The genera identified are listed here along with no. of collection of that genus made and the family they belong: Family Tricholomataceae- *Marasmius* (3), *Mycena* (9), *Oudemansiella* (2), *Tricholoma* (4), *Laccaria* (3), *Lyophyllum* (3), *Clitocybe* (4), *Lepista* (3), *Melanoleuca* (3), *Hohenbuehelia* (2), *Collybia* (5), *Armillaria* (2), *Leucopaxillus* (1); Family Polyporaceae – *Polypores* (8), *Pleurotus* (4), *Lentinus* (3), *Panus* (1); Family Amanitaceae- *Amanita* (14), *Limacella* (1); Family Pluteaceae- *Pluteus* (5), *Volvariella* (2); Family Hygrophoraceae- *Hygrophorus* (8), *Camarophyllum* (2); Family Agaricaceae- *Agaricus* (8), *Chlorophyllum* (1), *Lepiota* (5), *Macrolepiota* (3), *Leucocoprinus* (1); Family Coprinaceae- *Psathyrella* (3), *Paneolus* (2); Family Bolbitaceae- *Descolea* (3); Family Strophariaceae- *Alnicola* (1), *Pleuroflammula* (2), *Naematoloma* (3), *Pholiota* (4), *Stropharia* (1); Family Cortinariaceae- *Cortinarius* (7), *Inocybe* (9), *Gymnopilus* (3), *Hebeloma* (3), *Galerina* (3); Family Crepidotaceae- *Crepidotus* (1); Family Entolomataceae- *Entoloma* (5); Family Paxillaceae- *Paxillus* (3); Family Gomphidiaceae- *Gomphidius* (1); Family Boletaceae- *Boletus* (8), *Leccinum* (2), *Suillus* (1), *Strobilomyces* (3); Family Russulaceae- *Lactarius* (3), *Russula* (1); Order Aphyllophorales and Gasteromycetales- *Auricularia* (3), *Hydnum* (3), *Ganoderma* (5), *Scleroderma* (6), *Lenzites* (2), *Leotia* (1), *Schizophyllum* (1), *Albatrellus* (1). Ascomycete; *Morchella* sp. and *Cordyceps* spp (2).

Some of these interesting genera were collected for the 1st time like *Cordyceps* and *coremia* forming *Pleurotus* spp. which are yet to be identified. During this research work, wild relatives of commercial cultivated mushrooms genera such as *Pleurotus*, *Stropharia*, *Volvariella*, *Lentinula*, *Hericium*, *Auricularia* etc. have been obtained, which may have great potential in breeding programmes for strain improvement of these mushrooms.



5. SURVEY AND SURVEILLANCE OF DISEASES AND INSECT PESTS

FAIZABAD CENTRE

Survey for recording of data on incidence of diseases and insect-pests were carried out at farmer's units in Barabanki, Faizabad and Varanasi districts. Studies indicated that competitor moulds are the major constraints in mushroom cultivation in this area. Few insects were also observed in or on substrate / fruiting bodies. Cultivation of button mushroom was found affected by *Trichoderma viride*, *Penicillium* spp., *Coprinus* spp. and *Cladosporium cladosporioides* and presence of nematodes in compost was also confirmed. Cultivation of oyster mushroom was badly affected by *Trichoderma* spp., *Aspergillus* spp. and *Coprinus* spp., bacterial infection in beds was also observed. Paddy straw and milky mushrooms were most affected by *Coprinus* spp. and *Trichoderma* spp., and occurrence of insects in compost, straw and on fruiting bodies was also observed.

PANTNAGAR CENTRE

Marginal and small-scale mushroom farms located in U.S. Nagar and Nainital districts of Uttarakhand were surveyed periodically during crop season 2006-07. It was observed that green mould caused by *Trichoderma* spp. prevailed to the extent of 40.33% in marginal scale mushroom growing under hut conditions. Out of the mushroom growing units surveyed, *Deihliomyces microsporus* and *Papulaspora byssina* were observed in 8.11% and 10.42% growing units, respectively in the month of Feb.-March, 2007. *Verticillium fungicola* was observed in 6.49%

out of 110 marginal and small growing units visited. Infestation of sciarid and phorid flies were observed in 11.34% and 7.50% units, respectively in last stage of the crop in most of the mushroom huts. During the month of March/April, mushroom beetles were observed in 13.00% cropping rooms (huts) of *Pleurotus* spp. Browning of the pin heads and Rose comb were also observed in 27.54% and 1.32% beds, respectively

PUNE CENTRE

Total 350 beds of button mushroom were observed in which only 10 were found contaminated. Among the insects, mainly phorid fly (10/bed) were recorded. The green mould incidence was up to 3 %. In oyster mushroom experimental trials, total 150 beds were observed, out of which 10 were found contaminated. The incidence of green mould was observed upto the maximum of 5% on substrate.

Two private button mushroom farms were surveyed. Total 600 beds were observed and all these were found free from pests and diseases. Total 100 beds of oyster mushroom were surveyed on two private farms out of which only 10 beds were found to be contaminated up to 10 % with green mould.

RAIPUR CENTRE

The work on survey and surveillance of various diseases and insect-pests of oyster mushroom was carried out in five mushroom farms at Bilaspur and Raipur districts during

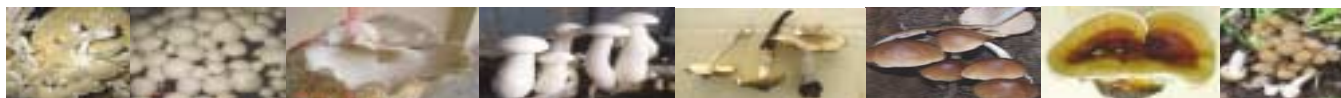




Fig. 11. Women and unemployed youths undergoing practical training in paddy straw and oyster mushroom cultivation at Raipur

Kharif season. In all the cases, bags were found contaminated with *Coprinus* sp., patchy growth, *Trichoderma* sp., *Sclerotium rolfsii* and yellow blotch. The infestation of phorid and cecid fly in traces was also observed at almost all the places.

UDAIPUR CENTRE

Different mushroom farms located at Udaipur, Sirohi, and Bhilwara districts were visited for survey and surveillance of diseases and insect-pests. Total of 40 mushroom farms were visited for occurrence of diseases and insect-pests. It was observed that in tribal areas no diseases and insect-pests were found. Further, only at 2-3 farms in Dhimadi village, infection of *Coprinus* spp. and green mould was observed in traces only. In winter season, 40 farms of button mushroom were visited around Udaipur districts. In Udaipur district *Coprinus comatus*, brown plaster mould and Dipterian flies were observed at 1-2 farms.

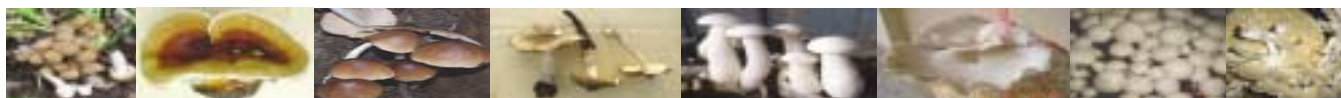
VELLAYANI CENTRE

Survey was conducted on the incidence of mushroom pests in the region during early

summer months of 2006-2007 at five locations. Two growing houses were selected in each location, where both oyster and milky mushrooms were grown. The commonly found pests were mushroom flies, namely, phorids, sciarids and cecids. Mild to medium level infestation and 5 to 20 per cent damages were noticed. No regular occurrence of diseases was noticed in any of the growing areas. Milky mushroom farms were almost free from diseases. The use of blue and yellow light traps in growing houses gave tremendous protection to these houses. Maintaining hygienic conditions in and around the growing houses also could ward off the diseases and pests problems in the region.

LUDHIANA CENTRE

During the survey conducted on the incidence of mushroom pests and diseases, it was noticed that few bags were contaminated with *Trichoderma* spp., *Coprinus* spp., *Papulaspora byssina* and *Scopulariopsis fimicola*. It affected the yield up to 2 %. Among the various abiotic disorders, stroma, open veil and scales or crocodiles skin were observed in

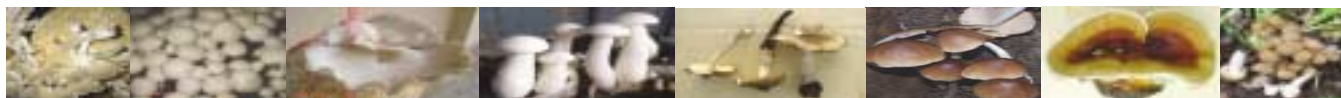


very few bags. Sciarid and phorid flies were also observed in some bags.

SOLAN CENTRE

Survey was conducted to seasonal mushroom growing farms at Shimla, Kufri, Theog, Nalagarh, Phagu, Shoghi and Mamlig in Himachal Pradesh, Morni Hills, Sonapat, and Kurukshetra in Haryana and Kurali, Kharar and Zirakpur in Punjab. Wet bubble (10-15%), green mould (0-30%), *Chaetomium*

(0-5%), brown plaster mould (2-8%) and ink caps (0-70%) were the predominant diseases associated with button mushroom. Among the abiotic disorders, long stipes, crocodile skin and pin head death were common in H.P. Among the insect-pests, sciarids, phorids, mites and springtails were common in most of the farms visited. Nematodes were detected in all the compost samples collected from different sources. During rainy season slugs were observed to feed on shiitake mushroom.



6. EXTENTION ACTIVITIES

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. During the year 47 school children and 447 visitors including mushroom growers, several national and international scientists and professors visited the Centre.

(i) Spawn supply: In total 915 kg mushroom spawn was prepared out of which 536 kg was supplied to farmers and rest was used in experiments.

(ii) Front-line Demonstration: Ten each for oyster and milky mushroom were laid down at village level in Ambedkarnagar, Deoria, Hardoi, Faizabad, Pratapgarh and Sultanpur districts. Two demonstrations of button mushroom were conducted at Jaunpur and Deoria districts.

(iii) Training: Four training programmes were conducted on milky, oyster and button mushroom cultivation during the year under report and 103 participants were trained.

(iv) TV Talk:

a) A TV Talk on 'Cultivation techniques of different species of oyster mushroom' (Hindi) was recorded on 20.12.2006 and 17.03.2007 by e-TV, Uttar Pradesh.

b) A TV Talk on 'Hygiene and diseases care in cultivation of Oyster mushroom' (Hindi) was recorded on 28.01.2007 by e-TV, Uttar Pradesh.

c) A TV Talk on 'Cultivation technology of Milky mushroom' (Hindi) was recorded on 27.02.2007 by e-TV, Uttar Pradesh

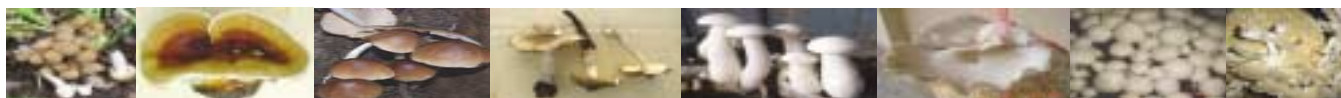
PANTNAGAR CENTRE

(i) Training: Four training programmes on different aspects of mushroom cultivation were organized and a total of 334 participants including Indo-Tibbet Border Police jawans(GOI) from Uttarakhand and Uttar Pradesh were trained at the Centre.

(ii) Spawn supply: Mushroom spawn (49.38 quintals), master spawn (31 bottles) and culture tube (34 Nos.) of different species/ strains were supplied to the mushroom growers and spawn units during the year under report.

(iii) Compost supply: The Centre supplied 38.84 MT compost to farmers in the year 2006-07.

(iv) Field day and Front Line Demonstration: Mushroom field days were organized at grower's farm and front line demonstrations (FLD) of milky mushroom (*Calocybe indica*) were laid down in Nainital, U.S. Nagar and Almora districts of Uttarakhand.



PUNE CENTRE

Constant efforts were made for the popularization of mushroom growing by using different mass communication methods, like, mass demonstration, TV programmes and publication of scientific and popular articles. During the year under report, the Centre participated in 7 Krishi exhibitions. The Centre imparted 10 training programmes and 46 participants were benefited. A total of 4300 visitors including school and college students, farmers, mushroom growers, research workers and teachers were guided at the Centre. Five hundred kg spawn was prepared

and distributed to 100 beneficiaries.

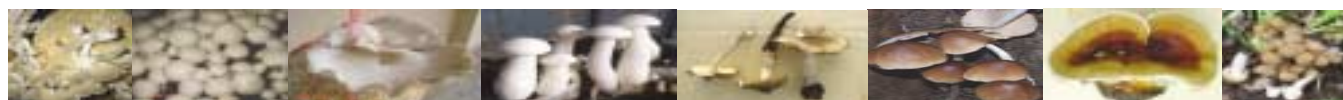
RAIPUR CENTRE

During the year under report the Centre participated in three Kisan melas, and mushroom production technology and preparation of mushroom recipes were demonstrated.

(i) **Training:** The Centre organized 17 training programmes in the year 2006-07 and the details of the training programmes are given in the following Table-22.

Table 22. Training programmes organized at Raipur Centre

S. No.	Name of the Training	Period	Funding Agency	Place	No. of participants
1.	Mushroom production technology	2.8.06 30.8.06	Self	Government Science College, Raipur	2
2.	Mushroom processing technology	6.8.06 8.8.06	Deptt. of Horticulture, Kabeerdham	Pandaria Block (Mohtara)	25
3.	Mushroom spawn production technology	19.9.06 25.9.06	Deptt. of Horticulture, Raipur	Raipur distt.	29
4.	Mushroom processing technology	5.10.06 7.10.06	Deptt. of Horticulture, Kabeerdham	Kawardha Block (Beejabairagi)	26
5.	Mushroom spawn production technology	5.12.06 11.12.06	Deptt. of Horticulture, Raipur	Chhura Block (Raipur)	29
6.	Mushroom spawn production technology	2.1.07 8.1.07	Deptt. of Horticulture, Kabeerdham	Pandaria Block (Mohtara)	28
7.	Mushroom spawn production technology	24.1.07 30.1.07	Deptt. of Horticulture, Kabeerdham	Pandaria Block	25
8.	Mushroom spawn production technology	12.02.07 18.02.07	Deptt. of Horticulture, Dhamtari	Kurud Block	17
9.	Mushroom spawn production technology	21.02.07 27.02.07	Deptt. of Horticulture, Raipur	Dharsiva Block	29
10.	Mushroom spawn production technology	27.02.07 7.03.07	Deptt. of Horticulture, Dhamtari	Dhamtari Block	22
11.	Mushroom processing technology	8.5.06 10.5.06	DBT	Dondekhurd	20
12.	Mushroom processing technology	23.5.06 24.5.06	DBT	Tarra	23
13.	Mushroom spawn production technology	18.7.06 21.7.06	DBT	Raipur	13
14.	Mushroom production technology	17.8.06 19.8.06	DBT	Dondekhurd	37
15.	Mushroom production technology	2.8.06 4.8.06	DBT	Tarra	25
16.	Mushroom production technology	27.12.06 30.12.06	DBT	Matiya	30
17.	Mushroom production technology	27.12.06 30.12.06	DBT	Dondekala	30



(ii) Spawn supply: Mushroom spawn (2063 packets), mother culture (97 bottles) and culture tube (51 Nos.) of different species/ strains were supplied to the growers and spawn units during the year under report.

In the year 2006-07, Dr. M.P. Thakur delivered talks on “Identification of diseases and their possible management, Mushroom production technology, Mushroom spawn production technology, Mushroom production in Chhattisgarh, Mushroom diversity of Central India, Recent advances in oyster mushroom production technology and Varieties of oyster mushroom and crop management” during various on-campus and off-campus training programmes. Extension materials in the form of Flexi boards were developed on topics namely Oyster Mushroom utpandan takniki, Safed dudhia mushroom utpandan takniki, Para mushroom utpandan takniki, White button mushroom utpandan takniki, Mushroom takniki ka hitgrahiyon par



Fig. 12. Scientists at Raipur Centre participating in exhibition

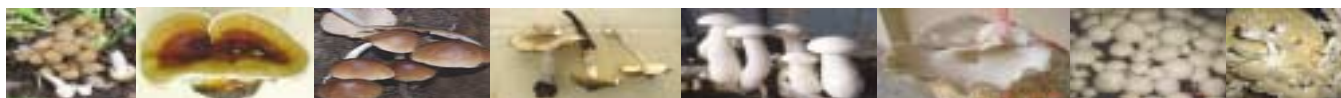
prabhav and Indira Sweta (Om-1), a new variety of Oyster mushroom –At a Glance.

LUDHIANA CENTRE

Details of training programmes organized by the Centre during the year 2006-07 are presented in the following Table 23. In addition, 14 lectures cum demonstration

Table 23. List of training programmes organized by Ludhiana Centre

S. No.	Training course	Duration	No. of participants
1	Mushroom training course on tropical mushroom cultivation and processing for ADO's/HDO's/KVK teachers from Punjab at PAU, Ludhiana	25-04-06 – 27-04-06	17
2	Mushroom training course for young farmers for generating self employment (95th Batch)	05-09-2006	50
3	Mushroom training course at PAU, Ludhiana	11-09-06 – 15-09-06	18
4	Mushroom training course at PAU, Ludhiana	25-09-06 – 29-09-06	35
5	Capsule training course on Scientific Agriculture involving Mushrooms for farmers at PAU, Ludhiana	24-10-2006	50
6	Mushroom training course on EDP Agribusiness for ASI, KVK staff and PAU, Ludhiana	14-11-06 – 16-11-06	25
7	Mushroom training course for Kisan Call Centre experts	30-01-07	21
8	Mushroom training course for young farmers for generating self employment	14-03-07 – 16-03-07	50



programmes were conducted at many places of Punjab and New Delhi. The Centre also conducted 3 Workshops for Horticulture Development Officers and Agriculture Officers. During the year under report, 276 visitors were attended at the Centre. A T.V. Talk on “Cultivation of mushrooms in Punjab” was telecasted by Doordarshan Kendra, Jalandhar on 3rd October 2006.

RANCHI CENTRE

Efforts were made for popularization of mushroom cultivation in Eastern India by making available quality spawn to farmers of Jharkhand and other states. A total of 3836.24 kg spawn was made available to the farmers. Total revenue of Rs. 255121.00 was generated through sale of spawn and mushroom in the year 2006-07.

UDAIPUR CENTRE

(i) **Spawn supply:** A commercial spawn laboratory funded with CSS scheme (11.465 lakhs) was established and a revenue of Rs. 38,637 was generated during the year under report. In the year

2006-07, 550 kg mushroom spawn was supplied to the growers.

(ii) **Training:** In addition to the training programmes listed in Table 24, a total of 40 letters were replied concerning cultivation of button, oyster and milky mushrooms, their spawn production and marketing.

VELLAYANI CENTRE

(i) **Spawn supply:** More than 6000 mushroom spawn bags were supplied to growers as part of the revolving fund scheme. Spawn bags were also supplied to students for distribution among farmers as part of their demonstration programme.

(ii) **Training:** For popularizing the mushroom cultivation, trainings programmes were conducted for various categories, namely, VHSC students, B.Sc. (Ag.) students, Kudumbasree units, Senior citizens and Women in polytechnique.

Table 24. Training programmes conducted at Udaipur Centre during 2006-07

S. No.	Date	Training course	Funding Agency	No. of participants
1	20-7-06	Oyster mushroom cultivation	Rajsamand District	65 Farmers
2	23-8-06	Oyster mushroom cultivation	Urban Home Makers	2 Women
3	20-9-06	Oyster mushroom cultivation	Self	9 Farmers & 28 Students
4	3-10-06	Button mushroom cultivation	Self	6 Entrepreneurs
5	28-11-06	Oyster / Button mushroom cultivation	Anupagash	40 Farmers
6	11-12-06	Oyster / Button mushroom cultivation	Self	35 Students
7	16-1-06	Oyster mushroom cultivation	CSS, Govt.of Rajasthan	50 Women
8	20-1-06	Oyster mushroom cultivation	CSS, Govt.of Rajasthan	4 Entrepreneurs
9	2-2-06	Oyster mushroom cultivation	CSS, Govt.of Rajasthan	40 Farmers
10	8-3-06	Button / Oyster mushroom cultivation	CDFST, MPUAT	28 Students

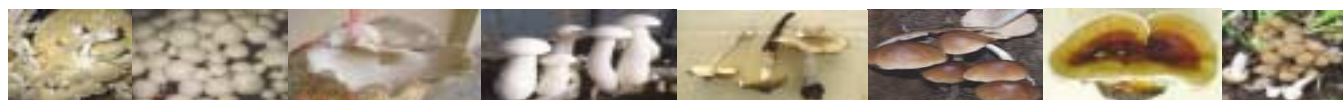




Fig. 13. Training and demonstration programmes conducted at Vellayani Centre

In the year 2006-07, Centre participated in exhibition conducted during the Golden Jubilee Celebrations of CSRC at Karamana. Dr. B. Balakrishnan participated in five regional seminars on mushrooms organized by NGOs and delivered lectures on various aspects of mushroom cultivation.

BARAPANI CENTRE

(i) Spawn supply: A revenue of sum of rupees four thousand five hundred and

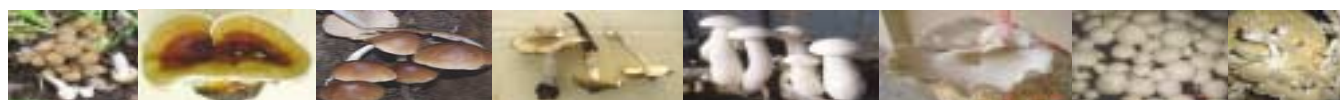
twenty six (Rs.4526/=) was generated during 2006-07 through sale of spawn (511 packets), culture tubes (2 Nos.) and fresh mushrooms (24.8 kg).

(ii) Training: The Centre conducted 4 training programmes on oyster mushroom cultivation and spawn production in the year 2006-07 and 30 participants were trained.

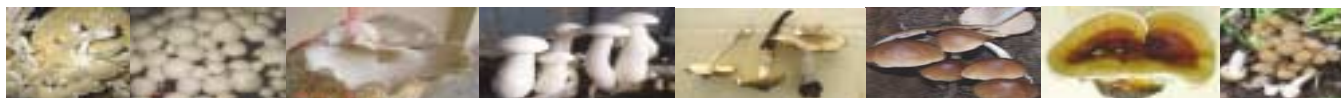
SOLAN CENTRE

Table 25. Training programmes conducted during the year 2006-2007 at Soaln Centre

S. No.	Name of training programme	Sponsoring agency	No. of trainees
1.	Ten days training programme on mushroom production technology for Entrepreneurs w.e.f. 9 th to 18 th May, 2006.	Paid training programme	23
2.	Three days training programme on mushroom production technology for farmers of Rampur Bushar(H.P) w.e.f. 15 th to 17 th April, 2006	Dept. of Forest, Rampur Bushar (H.P) DFID project	9
3.	Seven days training on mushroom production for farmers and unemployed youths w.e.f. 13 th to 19 th June, 2006.	NRCM, Solan	54



S. No.	Name of training programme	Sponsoring agency	No. of trainees
4.	Seven days training on mushroom production for farmers w.e.f. 22 to 28 th August, 2006.	NRCM, Solan	47
5.	Seven days training programme on mushroom production technology for HDO's of Haryana State w.e.f. 19 th to 25 ^h Sept, 2006.	Directorate of Horticulture, Panchkula	20
6.	Seven days training programme on mushroom production technology for HDO's of Haryana State w.e.f. 10 th to 16 th Oct, 2006.	Directorate of Horticulture, Panchkula	16
7.	Seven days training on mushroom production for supervisors, ADOs and Hort. Inspectors of Dept. of Horti. Ranikhet (UA) w.e.f. 7 th to 13 th November, 2006.	Dept. of Horti. (UA)	21
8.	Ten days training programme on mushroom production technology for Entrepreneurs w.e.f. 29 th Nov to 7 th Dec., 06 & 28 th Dec, 2006.	HP-STEP, Shimla	20
9.	Three days off campus training programme on mushroom production technology for farmers of Mau (U.P.) w.e.f. 22 nd - 24 th July, 2006.	NBAIM, Mau (U.P.)	100
10.	Three days off campus training programme on mushroom production technology for mushroom growers/farmers at Itanagar (Arunachal Pradesh), w.e.f. 5 th to 7 th Dec, 2006	MM-I Scheme	40
11.	Eight days training programme on mushroom production technology for farmers of Sikkim State w.e.f. 26 th Feb. to 5 th March, 2007.	MM-I Scheme	28
12.	Three days off campus training programme on mushroom production technology for progressive farmers and officers of Aizwal (Mizoram), w.e.f. 5 th to 7 th March, 2007	MM-I Scheme	40
13.	Three days off campus training programme on mushroom production technology for mushroom growers/farmers and officers of Guwhati (Assam), at Guwhati, w.e.f. 20 th to 22 nd Feb, 2007	MM-I Scheme	40
14.	Three days off campus training programme on mushroom production technology for mushroom growers/farmers at Agartala (Tripura), w.e.f. 23 rd to 25 th Feb, 2007	MM-I Scheme	65



7. PUBLICATIONS

COIMBATORE CENTRE

1. Lakshmanan P, Jagadeesan A, Sudha A, Rajesh M, Prabakara S and Arun Prasad (2006). Potentiality of new mushroom fungus *Lentinus connatus* Berk. for the production of biomanure from sugarcane trash (*Saccharum officinarum* L.) and its impact on the management of groundnut root rot diseases. *Archives of Phytopathology and Plant Protection*: 1-17.

FAIZABAD CENTRE

A. Research paper

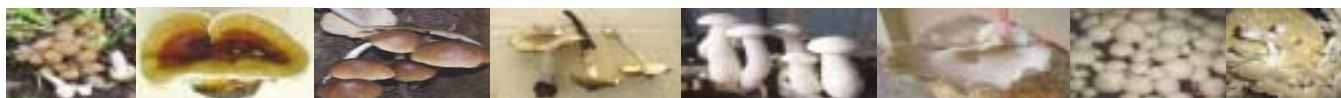
1. Shukla PK (2007). Effect of thickness of casing soil on crop duration and yield of milky mushroom (*Calocybe indica*). *Indian Phytopathology* (Accepted).
2. Shukla PK (2007). Effect of soil and manure ratio of casing soil on crop duration and yield of milky mushroom (*Calocybe indica*). *Journal of Mycology and Plant Pathology* (Communicated).
3. Mishra RS, Singh RV and Shukla PK (2007). Isolation of mycoflora from compost and casing soil of white button mushroom. *Journal of Mycology and Plant Pathology* (Communicated).
4. Mishra RS and Shukla PK (2007). Effect of weather variables on the extent of contamination in Oyster mushroom spawn. *Annals of Plant Protection Sciences* (Accepted).

B. Popular article

1. Mishra RS and Shukla PK (2006). Mushroom ke hanikarak kavak ka niyantran. *Poorvanchal Kheti* 16(7): 23-24.
2. Shukla PK, Singh SP and Pandey MK (2007). Mausam ka mushroom utpadan par prabhav. *Poorvanchal Kheti* 17(3): 13-15.
3. Shukla PK and Awasthi LP (2007). Techniques in Mushroom Cultivation – Teaching Manual.
4. Shukla PK and Singh SP (2007). Dudhiya Mushroom Utpadan – Extension folder.

C. Papers in Conferences/ Symposia

1. Shukla PK and Singh TB (2006). Studies on the post harvest shelf life of milky mushroom (*Calocybe indica*). Proceedings of International Conference on “Post Harvest Technology and Value Addition in Cereals, Pulses and Oilseeds” held during 27-30th November, 2006 at C.S. Azad University of Agriculture and Technology, Kanpur.
2. Shukla PK, Chauhan SKS, Singh SP and Singh TB (2006). Effect of washing treatment on the post harvest storage of button mushroom (*Agaricus bisporus*). Proceedings of International Conference on “Post Harvest Technology and Value Addition in Cereals, Pulses and



Oilseeds” held during 27-30th November, 2006 at C.S. Azad University of Agriculture and Technology, Kanpur.

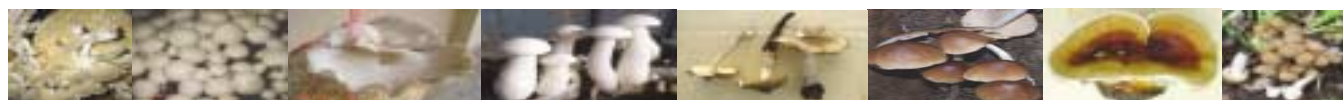
Society of India and National Research Centre for Mushroom, Solan during 10th to 11th February, 2007, p. 156.

3. Shukla PK, Singh SP and Singh TB (2006). Effect of soil and manure ratio of casing soil on crop duration and yield of milky mushroom (*Calocybe indica*). National Symposium on “Biodiversity and Biotechnology: Research and Development Needs in Edible Mushrooms and Crop Diseases Management” jointly organized by the Indian Society of Mycology and Plant Pathology, Udaipur and G.B.P.U.A.T., Pantnagar at G.B. Pant University of Agriculture and Technology, Pantnagar during 9th to 11th November, 2006, p. 7.
4. Shukla PK, Jha AK, Chauhan SKS and Singh TB (2006). Effect of amount of casing soil on crop duration and yield of milky mushroom (*Calocybe indica*). National Symposium on “Biodiversity and Biotechnology: Research and Development Needs in Edible Mushrooms and Crop Diseases Management” jointly organized by the Indian Society of Mycology and Plant Pathology, Udaipur and G.B.P.U.A.T., Pantnagar at G.B. Pant University of Agriculture and Technology, Pantnagar during 9th to 11th November, 2006, p. 7-8.
5. Shukla PK and Jha AK (2007). Effect of different casing materials on productivity of milky mushroom (*Calocybe indica*). Proceedings of International Conference on “Mushroom Biology and Biotechnology” jointly organized by the Mushroom

PANTNAGAR CENTRE

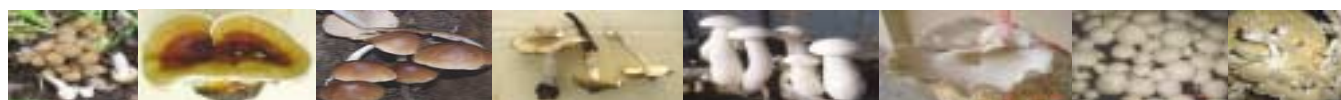
A. Research paper

1. Mishra KK and Singh RP (2006). Exploitation of indigenous *Ganoderma lucidum* for yield on different substrates. *J. Mycol. Pl. Path.* 36(2): 130-133.
2. Kushwaha KPS, Bhatt Pratibha and Singh RP (2006). Evaluation of different substrate for yield performance of *Auricularia polytricha*; a medicinal mushroom. *Int. J. Agri. Sci.* 2(2): 389-391.
3. Bhatt P, Kushwaha KPS and Singh RP (2006). Physico-chemical properties of different casing mixtures and its effect on yield of *Agaricus bisporus*. *Mushroom Research* 15(1): 29-32.
4. Kushwaha KPS, Verma RC and Singh RP (2006). Yield performance of different strains of *Agaricus bisporus* (Lange) Imbach. *Int. J. Pl. Sci.* 1(2): 264-265.
5. Bhatt P, Verma RC, Kushwaha KPS and Singh RP (2007). Cultivation of medicinally important edible mushroom: *Auricularia polytricha*. *Indian Farmer Digest* 40 (1): 33-34.
6. Singh RP, Mishra KK, Verma RC, Tandon S and Dubey A (2007). Anti-oxidative properties of *Ganoderma lucidum* and *Cordyceps sinensis*. *Mushroom Research* (Accepted).



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1. Mishra KK and Singh RP (2006). Genetic variability among isolates of *Ganoderma lucidum*. National Symposium of Indian Phytopathological Society during Jan. 31-Feb. 02, 2006, Univ. of North Bengal, Siliguri. p. 66.
2. Singh RP, Mishra KK and Singh Mandvi (2006). Biodiversity and utilization of medicinal mushrooms. National Symposium, *ISMPP*, during Nov. 09-11, 2006. Deptt. of Plant Pathology, GBPUAT, Pantnagar. pp. 50-53.
3. Verma RC, Mishra KK and Singh RP (2006). Effect of chemical treatments on yield of *Calocybe indica*. National Symposium on Biodiversity and Biotechnology: Research and Development Needs in Edible Mushrooms and Crop Diseases Management organized by Indian Society of Mycology and Plant Pathology held on Nov. 09-11, 2006 at G.B.P U.A. &T., Pantnagar. p. 66.
4. Verma RC, Mishra KK and Singh RP (2006). Yield performance of *Pleurotus sajor-caju* using different grains spawn. National Symposium on Biodiversity and Biotechnology: Research and Development Needs in Edible Mushrooms and Crop Diseases Management organized by Indian Society of Mycology and Plant Pathology held on Nov. 09-11, 2006 at G.B.P U.A. &T., Pantnagar. p. 67.
5. Chaudhary Aditi and Dwivedi RR (2006). Screening of parents and hybrids of oyster mushroom for yield. National Symposium, *ISMPP*, during Nov. 09-11, 2006. Deptt. of Plant Pathology, GBPUAT, Pantnagar. p. 36.
6. Khan MR, Verma RC, Kushwaha KPS and Singh RP (2006). Effect of chemical treatments on different agro-wastes for production of *Pleurotus sajor-caju*. In: National symposium on Emerging Plant Diseases, their Diagnosis and Management organized by Indian Phytopathological Society held during Jan. 31- Feb. 3, 2006 at Department of Botany (UGC-SAP), University of North Bengal, Siliguri (WB), India. p. 138.
7. Arora RK, Verma RC, Mishra KK and Singh RP (2007). Strainal evaluation of *Calocybe indica*. International Conference on "Mushroom Biology and Biotechnology" jointly organized by the Mushroom Society of India and National Research Centre for Mushroom, Solan during 10th to 11th February 2007, p. 70.
8. Arora RK, Verma RC, Mishra KK and Singh RP (2007). Evaluation of substrate for yield of *Calocybe indica*. International Conference on "Mushroom Biology and Biotechnology" jointly organized by the Mushroom Society of India and National Research Centre for Mushroom, Solan during 10th to 11th February 2007, p. 137.
9. Chaudhary Aditi, Dwivedi RR and Singh RP (2007). Evolution and evaluation of hybrids of oyster mushroom. International Conference on "Mushroom Biology and Biotechnology" jointly organized by the Mushroom Society of India and National Research Centre for Mushroom, Solan during 10th to 11th February 2007, p. 150.



10. Rawat Shilpi, Chaudhary Aditi, Verma RC, Mishra KK and Singh RP (2007). Yield performance of *Calocybe indica* in different districts of Uttarakhand. International Conference on "Mushroom Biology and Biotechnology" jointly organized by the Mushroom Society of India and National Research Centre for Mushroom, Solan during 10th to 11th February 2007, p. 151.
11. Singh RP, Verma RC, Mishra KK, Arora RK and Singh Mandvi (2007). Medicinal mushrooms of Uttarakhand with particular reference to *Ganoderma*, *Auricularia* and *Cordyceps sinensis*. International Conference on "Mushroom Biology and Biotechnology" jointly organized by the Mushroom Society of India and National Research Centre for Mushroom, Solan during 10th to 11th February 2007, p. 122-123.
12. Singh RP, Verma RC and Mishra KK (2007). Status and prospects of mushroom cultivation in Uttarakhand. International Conference on "Mushroom Biology and Biotechnology" jointly organized by the Mushroom Society of India and National Research Centre for Mushroom, Solan during 10th to 11th February 2007, p. 181.
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3. Thakur MP, Shukla CS and Yadav VK (2006). Research Achievements of Mushroom Project. In: Souvenir of two days Xth Biennial Workshop of All India Coordinated Mushroom Improvement Project held at Department of Plant Pathology, Indira Gandhi Agricultural University, Raipur from October, 26-27, 2006.p. 14-25.

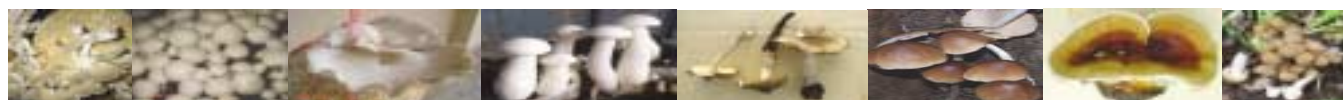
B. Papers in Conferences/ Symposia

1. Thakur MP, Yadav VK, Chandravanshi SS and Sharma D (2006). Medicinal Mushrooms: A boon to quality human health. National Seminar on Medicinal Aromatic, Spices Plants: Perspective and Potential at TCB College of Agriculture, IGKV, Bilaspur from Dec. 18-19, 2006, p. 144-146.
2. Awadhiya GK, Dantre RK, Chandravanshi SS and Thakur MP (2006). Seed mycoflora of Chickpea and their management by some of medicinal plant extracts. National Seminar on Medicinal Aromatic, Spices Plants: Perspective and Potential at TCB College of Agriculture, IGKV, Bilaspur from Dec. 18-19, 2006, p. 121.
3. Thakur MP, Yadav VK and Chadravanshi SS (2006). Invited paper on "Mushroom

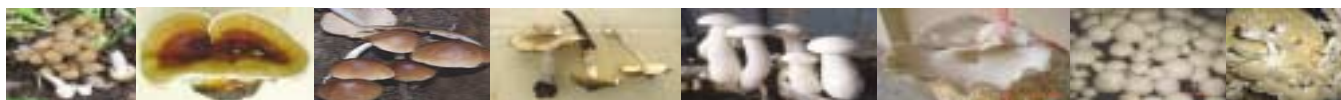
RAIPUR CENTRE

A. Research paper

1. Thakur MP, Shukla CS and Yadav VK (2006). Biodiversity, conservation and utilization of edible mushrooms in Chhattisgarh region. *J. Mycol. Pl. Pathol.* 36(3): 445.



- diversity and its conservation in National Seminar on “Biodiversity and its Conservation” at Deptt. of Botany, Kamla Nehru College, Korba from 18-19th Nov., 2006, p. 12-13.
4. Thakur MP, Shukla CS and Yadav VK (2006). Invited paper on “Biodiversity conservation and utilization of edible mushrooms. National symposium on” Biodiversity and Biotechnology: Research and Development Needs in Edible Mushrooms and Crop Diseases Management at Deptt. of Plant Pathology G.B. Pant University of Agril. and Technology, Pantnagar from 9-11 Nov., 2006. p. 44-46.
 5. Yadav VK, Sharma ND and Thakur MP (2006). A new rust on *Lagescea mollis*. Paper presented in National symposium on” Biodiversity and Biotechnology: Research and Development Needs in Edible Mushrooms and Crop Diseases Management at Deptt. of Plant Pathology G.B. Pant University of Agril. and Technology, Pantnagar from 9-11 Nov., 2006. p. 67-68.
 6. Thakur MP, Shukla CS, Yadav VK and Chandravanshi SS (2006). Invited talk on “ Transfer of Mushroom technology: A case study of Chhattisgarh in International Conference on Mushroom Biology and Biotechnology at National Research Centre for Mushroom, Solan (H.P.) from 10-11th Feb. 2007.
 7. Lakpale N, Khare N and Thakur MP (2006). Urid ke bhabhutia rog ke prati nirrodhak srot par adhayayan in State level Krishi Shodh Patra Poster Pradarshini awam Sangosthi at IGKV, Raipur on September 14, 2006. p. 76.
 8. Thakur MP, Yadav VK and Chandravanshi SS (2006). Mushroom utpadan takniki ka labharthiyon par prabhav in State level Krishi Shodh Patra Poster Pradarshini awam Sangosthi at IGKV, Raipur on September 14, 2006. p. 74.
- C. Technical Bulletin, Folder and Souvenir**
1. Thakur MP, Chandravanshi SS and Shukla CS (2007). Mushroom – Paustic awam ousdhiya guno ka khajana, Directorate of Research, IGKV, Raipur, p. 17.
 2. Shukla CS and Thakur MP (2007). Mushroom Utpadan, published by Sanchar Bhavan, Directorate of Extension, IGKV, Raipur, p. 35.
 3. Thakur MP, Yadav VK and Chandravanshi SS (2006). Oyster Mushroom: Utpadan Kaise Karen. Extension Folder, published by Technical Cell, IGKV, Raipur. p. 6.
 4. Thakur MP, Yadav VK and Chandravanshi SS (2006). Mushroom prasanskaran kaise Karen. Extension Folder, published by Technical Cell, IGKV, Raipur. p. 4.
 5. Thakur MP, Yadav VK and Chandravanshi SS (2006). Souvenir of two days Xth Biennial Workshop of All India Coordinated Mushroom Improvement Project held at Department of Plant Pathology, Indira Gandhi Agricultural University, Raipur from October, 26-27, 2006. p. 37.



UDAIPUR CENTRE

A. Research paper

1. Singh SK, Doshi Anila, Yadav MC and Shwet Kamal (2006). Molecular characterization of specialty mushroom of Western Rajasthan, India. *Current Science* 91(9): 1225- 1230.
2. Singh Upendra, Jain SK, Doshi Anila and Verma RC (2007). Tray drying of Button Mushroom (*Agaricus bisporus*). *Beverage and Food World* March : 20-22.

VELLAYANI CENTRE

A. Papers in Conferences/ Symposia

1. Lulu Das (2006). Mushroom cultivation in KAU. Paper presented in the International training at Wageningen, Netherlands from 29th May-23rd June, 2006.

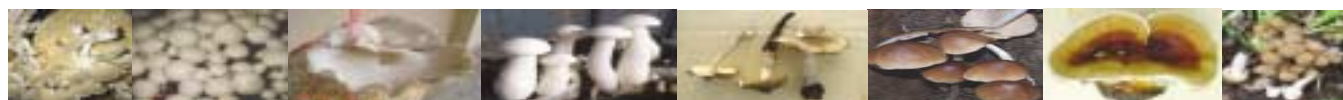
B. Popular article

1. Lulu Das and Balakrishnan B (2006). Coirpith composting. Published by Farm Information Bureau, Trivandrum.
2. Lulu Das and Balakrishnan B (2006). Milky Mushroom. Paper submitted to FIB, Trivandrum.
3. Balakrishnan B (2006). Ningalkum Koon Valartham. Krishnavigyan manjari. published by Indian Agricultural Association, Trivandrum. 5: 20.
4. Balakrishnan B (2006). Koon Krishni. Published by Kerala Gandhi Smaraka Nidhi.

SOLAN CENTRE

A. Research paper

1. Ahlawat OP, Dev Raj, Sagar MP, Gupta Pardeep and Vijay B (2006). Effect of recomposted spent mushroom substrate on yield and quality of cauliflower (*Brassica oleracea* L. var. *botrytis*). *Mushroom Research* 15(2): 149-152.
2. Dhar BL, Ahlawat OP, Gupta Pardeep and Dev Raj (2006). Casing layer as related to mushroom yield and quality in *Agaricus bisporus* in India. *Mushroom Research* 15(2): 111-117.
3. Sagar MP and Vijay B (2006). Impact of Mushroom Cultivation Training on Horticulture Officers. *Indian Res. J. Ext. Edu.* 6(1&2): 45-47.
4. Semwal KC, Bhatt RP and Upadhyay RC (2006). *Amanita avellaneosquamosa* (Imai), a new record of the genus *Amanita* for India. *Mushroom Research* 15(1) :7-9 .
5. Sharma SR, Satish Kumar and Sharma VP (2006). Physiological requirement for cultivation of Malaysian strain of shiitake, *Lentinula edodes*. *J. Mycol. Pl. Pathol.* 36:149-152.
6. Sharma VP, Sharma SR and Satish Kumar (2006). Comparative studies on substrate treatment methods for cultivation of *Calocybe indica*. *J. Mycol. Pl. Pathol.* 36:145-148.
7. Sharma VP and Satish Kumar (2006). Effect of crop residue supplements to substrate on the productivity of black poplar mushroom, *Agrocybe aegerita*. *J. Mycol. Pl. Pathol.* 36:189-192.



8. Sharma VP, Satish Kumar and Ranjna Kumari (2006). Symptomatology and management of cobweb disease of oyster mushroom. *Mushroom Research* 15: 55-58.
9. Sharma VP, Satish Kumar and Sonali Mahajan (2006). Yield loss and management of *Oedocephalum* during cultivation of *Calocybe indica*. *Annals of Plant Protection Sciences* 14(2): 306-309.
10. Vijay B (2006). Indoor composting for button mushroom cultivation. *Mushroom Research* 15(1): 23-27.

B. Book/ Book Chapter

1. Dhar BL and Kaul TN (2007). *Biology and Cultivation of Edible Mushroom*. Westille Publisher House, New Delhi. pp 240.
2. Sharma VP and Suman BC (2006). *Khumb Ki Kheti*. Agribios, Jodhpur (India) pp 103

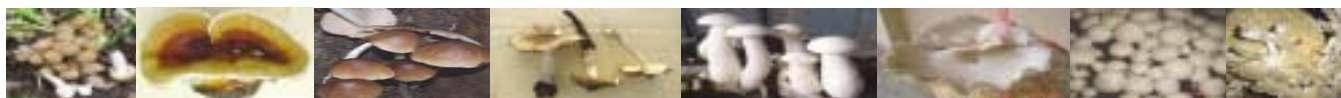
C. Technical Bulletin

1. Ahlawat OP and Sagar MP (2006). Management of Spent Mushroom Substrate (SMS). National Research Centre for Mushroom, Solan (HP), India. p. 37.
2. Ahlawat OP and Tewari RP (2006). Cultivation Technology of Paddy Straw Mushroom (*Volvariella volvacea*).

National Research Centre for Mushroom, Solan (HP), India. p. 30.

D. Popular/ Technical Article

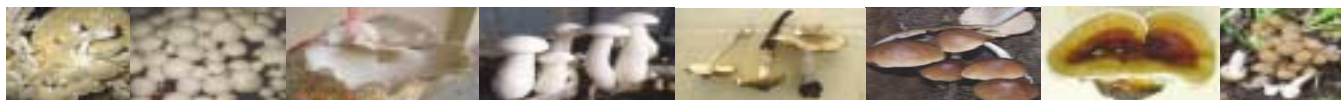
1. Ahlawat OP and Sagar MP (2006). Paira (prali) mushroom ki kheti (folder in Hindi). NRCM, Solan (HP) (released during Kisan Mela – 2006).
2. Ahlawat OP and Sagar MP (2006). Recycling of Spent Mushroom Substrate to Use as Organic Manure (folder in English). NRCM, Solan (HP) (released during Xth Biennial Workshop of AICMIP held on 26-27 October, 2006 at IGAU, Raipur).
3. Dhar BL and Arumuganathan T (2006). Kam mulya ka khumb utpadan kaksh. Khumb Kissan Mela, 10 September, 2006 ke avsar par prakashit vishesh pustika. NRCM, Solan. p: 1-8.
4. Gautam Y (2006). The Million Dollar email. On <http://www.home.rica.net/alphae/fighter1.html>.
5. Sharma VP and Satish Kumar (2006). Kumb ki Kheti ke dauran aavashyak savdhaniyan. *Indian J. Mush.* XXIII: 37-39.
6. Sharma VP, Satish Kumar and Singh SK (2006). *Trichoderma* causing green mould in mushrooms and its management - A Review. *Mushroom Research* 15(2): 93-102.



PERSONNELIA

Staff position at various AICMIP Centres during 2006-07

Post	Coimbatore	Ludhiana	Faizabad	Pantnagar	Pune	Raipur	Udaipur	Thrissur
Mycologist	Dr.G. Chandrasekar	Dr. (Mrs.) S. Dhanda (Mycologist)	Dr.S.P. Singh	Dr. R.P. Singh Joint Director	Dr.S.G. Sawashe	Dr.M.P. Thakur	Dr. Anila Doshi	Dr.B. Balakrishnan
Asstt. Mycologist	Dr.R.Radhajeya Lakshmi	Dr. H.S. Sodhi (Mycologist)	Dr. P.K.Shukla	Dr.K.K. Mishra Assoc. Director	Dr.S.S. Wange	Dr. S.S. Chand-ravanshi	Dr. Pokhar Rawal	Dr. (Mrs.) Lulu Das
Technical Assistant	Th.M.Nagendran	Sh. Jagmail Singh	Sh.G.P. Gautam	Mr. Rupesh Arora (Contractual)	Sh. V.K.Bhalerao	Vacant	Vacant	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	Vacant	—
Lab. Asstt.	Th.M. Munusamy	—	—	—	—	—	—	—
Typist cum Clerk	—	Mrs. Harvinder Kaur	Sh.S.G. Yadav	Sh. Vishnu Ray	Sh.S.C. Kashid	Sh. R.K. Pandey	Sh. Nathu Singh	—
Beldar	Th. P.Selvaraj	Sh. Ram Kumar	Sh. L. Prasad	Sh. Deo Kumar	Sh. Y.S. Bhave	Sh. A.R. Sahu	Sh. Kishan Singh	—



BUDGET / EXPENDITURE 2006-07

Head	Udaipur		Faizabad		Coimbatore		Ludhiana		Pantnagar		Thrissur		Pune		Raipur		Ranchi		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.	6.60	8.00	8.00	8.00	8.00	12.98	12.98	8.00	8.00	4.00	2.94	8.98	8.98	6.94	6.94	-	-	-	-	-	-	-	
Charges																							
T.A.	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.05	0.05	0.10	0.10	0.10	0.10	0.11	0.11	0.10	0.10	0.05	0.05	0.05	
Recur-	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.45	0.45	0.90	0.90	0.90	0.90	0.91	0.91	0.50	0.50	0.45	0.45	0.45	
ring																							
contingencies																							
including FLD																							
NON-REC.																							
a) Equip-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
ments																							
b) Vehicle-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
c) Works -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total	7.60	7.60	9.00	9.00	9.00	8.76	13.98	13.98	9.00	9.00	4.50	3.44	9.98	9.98	7.94	7.94	1.02	1.02	0.60	0.60	0.50	0.50	

a- sanctioned amount
b- actual expenditure

