

वार्षिक प्रतिवेदन
ANNUAL REPORT
2005-2006

अखिल भारतीय समन्वयित खुम्ब उन्नयन परियोजना
All India Co-ordinated Mushroom Improvement Project



राष्ट्रीय खुम्ब अनुसंधान केन्द्र
NATIONAL RESEARCH CENTRE FOR MUSHROOM

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

चम्बाघाट, सोलन — 173 213 (हि.प्र.), भारत
Chambaghat, Solan-173 213 (H.P.) India

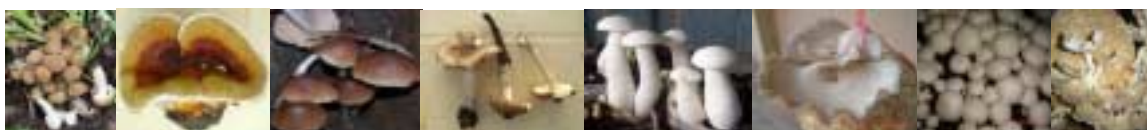
ANNUAL REPORT 2005-2006

All India Co-ordinated Mushroom Improvement Project

National Research Centre for Mushroom

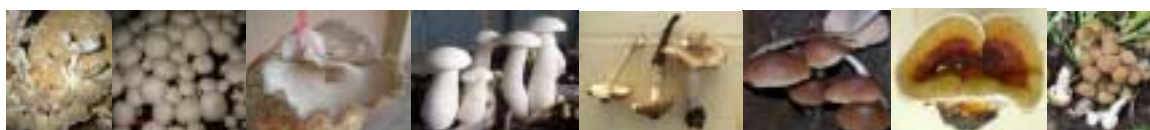
Solan - 173 213, India

- Compiled and Edited by* : Dr. O.P. Ahlawat, Sr. Scientist
Dr. Satish Kumar, Sr. Scientist
Er. T. Arumuganathan, Scientist
- Hindi Translation* : Dr. M.P. Sagar, Sr. Scientist
- Composed by* : Smt. Sunila Thakur (Steno Grade III)
- Published by* : **Dr. R.P. Tewari**
Project Co-ordinator, AICMIP
National Research Centre for Mushroom
(Indian Council of Agricultural Research)
Chambaghat, Solan - 173 213 (H.P.)
- Cover Photographs* : Research & Development activities at various
AICMIP Centres
- Printed at* : Yugantar Prakashan (P) Ltd., New Delhi-110064,
Ph: 011-28115949, 28116018



CONTENTS

Preface	v
सारांश	vii
Summary	xi
Introduction	1
Technical Programme of Work	3
Research Progress	12
Collection and Preservation of Fleshy Fungi	30
Survey and Surveillance of Diseases and Insect-Pests	34
Extension Activities	37
Publications	47
Personnelia	60
Budget	61

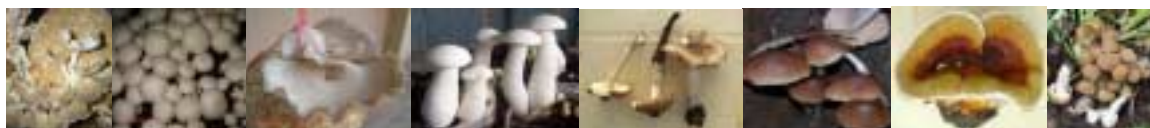


PREFACE

The report contained in this document pertains to the achievements made during the financial year 2005-06 by the ten Coordinating Centres and one Cooperating Centre working under the aegis of the All India Coordinated Mushroom Improvement Project (AICMIP) with the Headquarters 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 (Uttaranchal), 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 University of Horticulture and Forestry, Nauni, Solan (HP). All the Coordinating Centers along with Headquarters, NRCM, Solan conducted a total of 16 experiments following a common package of practices finalized and adopted at IXth Biennial Group Meeting of Workers of AICMIP held on 25-26 October, 2004 at NRCM, Solan.

During the year under report, attempts were made to bring out better strains of white button mushroom, paddy straw mushroom and milky mushroom, use of locally available agro-industrial wastes as casing materials, postharvest technology and cultivation 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, paddy straw, milky, shiitake and black-ear mushrooms by way of using different substrates, supplements and methods of bed preparation. Safer chemicals viz., EDTA-Di Sodium salt alone and in combination with KMS 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 and conservation, 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-3, CM-7, CM-1 and CM-15 of *Agaricus bisporus*, Vv-7 and Vv-6 of *Volvariella volvacea*, C.I-1 and C.I-6 of *Calocybe indica*. Casing mixture prepared from 2 year old recombined spent mushroom substrate alone and 1:1, v/v mixture of coir pith with FYM gave maximum yield of *A.bisporus*. The washing treatment with 200 ppm EDTA and 100 ppm EDTA + 0.02% KMS has also provided a safer alternate to higher concentration of KMS for increasing



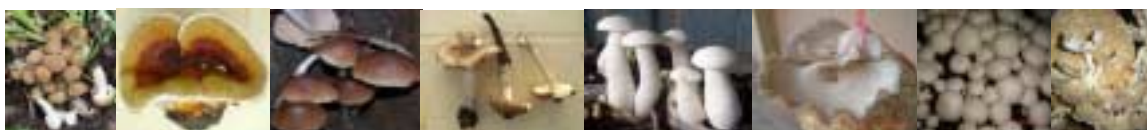
shelf-life of button mushroom. Packaging of button mushroom in 100 gauge PP bags has also increased the keeping quality of button mushroom.

In case of oyster mushroom, spray application of different chemicals have invariably increased the yield at different Centres. The superior yield of blue oyster (*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 postharvest management of oyster mushroom by using simple pre-drying chemical treatment followed by sun drying.

Use of different types of beds and different substrates has opened up the options of introducing tropical mushrooms like paddy straw and milky. The achievement made in obtaining consistently good yield of shiitake has also opened up new line for introducing this mushroom in the country. 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



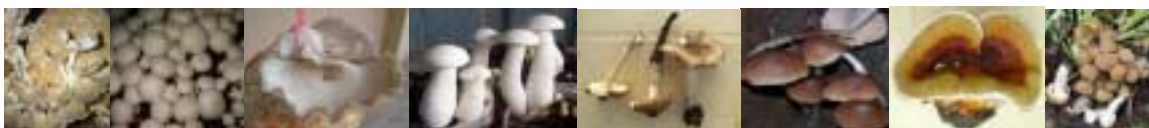
सारांश

वर्ष 2005-06 के दौरान मुख्यालय राष्ट्रीय खुम्ब अनुसंधान केन्द्र, सोलन(हि0प्र0), सहयोगी केन्द्र तथा विभिन्न राज्यों में स्थित सभी अखिल भारतीय समन्वयित मशरूम उन्नयन परियोजना केन्द्रों पर वर्ष 2004 में आयोजित द्विवर्षीय कार्यशाला में तय किये गये तकनीकी कार्यक्रम के अनुसार प्रयोग किये गये।

विभिन्न केन्द्रों पर श्वेत बटन मशरूम (*एगोरिकस बाइसपोरस*) के कुल चार बिन्दुओं— प्रजाति मूल्यांकन, केसिंग मिश्रण मूल्यांकन, कटाई उपरांत मशरूम का उपचार तथा पैकिंग मैटेरियल मूल्यांकन पर प्रयोग किये गये। श्वेत बटन मशरूम के प्रजातिय मूल्यांकन पहलू पर सात परियोजना केन्द्रों पर प्रयोग किये गये। इन प्रयोगों के दौरान पाया गया कि सी0एम0-7, सी0एम0-13 तथा सी0एम0-14 प्रजातियों ने पूणे केन्द्र पर सार्थकतापूर्वक अधिक उपज दी। जबकि लुधियाना केन्द्र पर सी0एम0-5, रायपुर केन्द्र पर सी0एम0-7, फैजाबाद केन्द्र पर सी0एम0-3, पंतनगर केन्द्र पर सी0एम0-3 एवं सी0एम0-5, कोयम्बटूर केन्द्र पर एस0-10 तथा सोलन मुख्यालय पर सी0एम0-11 तथा सी0एम0-12 प्रजातियों ने अन्य प्रजातियों की तुलना में अच्छी पैदावार दी। सभी केन्द्रों पर प्राप्त पैदावार पर आधारित औसतन पैदावार के अनुसार सी0एम0-3 व सी0एम0-7 प्रजातियों ने अन्य प्रजातियों की तुलना में अधिक पैदावार दी। सोलन केन्द्र पर सी0एम0-10, कोयम्बटूर व पंतनगर केन्द्रों पर सी0एम0-3, उदयपुर केन्द्र पर सी0एम0-6, रायपुर केन्द्र पर सी0एम0-7 तथा फैजाबाद केन्द्र पर सी0एम0-13 प्रजातियों का प्रथम तुड़ान में लिया गया समय सबसे कम पाया गया। विभिन्न प्रजातियों के फलनकाय का औसतन वजन 11.50 ग्राम से 16.40 ग्राम तक पाया गया।

विभिन्न केसिंग अवयवों के मूल्यांकन संबंधी प्रयोगों में पाया गया कि दो साल पुरानी कम्पोस्टिड स्पेंट कम्पोस्ट से निर्मित केसिंग मिट्टी द्वारा बहुत अधिक मशरूम की पैदावार मिली। इस केसिंग मिट्टी से लुधियाना केन्द्र पर 10.20 किलोग्राम, उदयपुर केन्द्र पर 15.31 किलोग्राम तथा सोलन केन्द्र पर 15.60 किलो ग्राम प्रति किंवटल कम्पोस्ट की दर से मशरूम की पैदावार प्राप्त हुई। जबकि क्वायरपिथ व गोबर की खाद को बराबर हिस्सों में मिलाकर तैयार की गई केसिंग मिट्टी को प्रयोग में लाया गया तो पूणे व लुधियाना केन्द्रों पर प्रति किंवटल कम्पोस्ट 14.56 किलोग्राम अधिकतम उपज पायी गई। तुड़ाई उपरांत श्वेत बटन मशरूम की गुणवत्ता बनाये रखने व अधिक समय तक भण्डारण करने के उद्देश्य से मशरूम को जब 100 पी0पी0एम0 सांद्रता के ई0डी0टी0ए0 घोल को 2 प्रतिशत पोटेसियम मेटाबाईसल्फाइट (के0एम0एस0) घोल के साथ मिलाकर तैयार किये गये घोल से धोया गया तो लगभग सभी केन्द्रों पर 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 कैंप का खुलना मानको को आधार मानकर किये पैकेजिंग के प्रयोग में कोयम्बटूर, पंतनगर व रायपुर केन्द्रों पर 100 गेज की पॉलीप्रोपाईलीन बैग में पैक की गई मशरूम उपरोक्त मानकों पर खरी उतरी।

आयस्टर (ढींगरी) मशरूम वर्ग में प्लूरोटस की पैदावार पर रसायनों का छिड़काव का प्रभाव प्लूरोटस फोस्फूलेटस व हाईपजीजाईगस अलमेरियस प्रजातियों की उत्पादन क्षमता का मूल्यांकन तथा मशरूम को



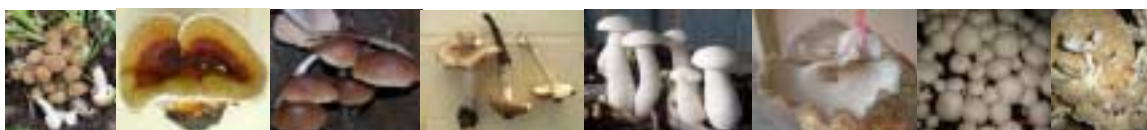
सुखाना बिन्दुओं पर तीन प्रयोग किये गये। रसायन छिड़काव का आयस्टर मशरूम की उपज वृद्धि पर प्रभाव जानने हेतु किये गये प्रयोगों में पाया गया कि कोयम्बटूर, फैजाबाद व रायपुर केन्द्रों पर *प्लूरोटस फ्लोरिडा* की फसल पर 0.1 एम0 सांद्रता के K_2HPO_4 के घोल का छिड़काव करने से उपज में वृद्धि पाई गई। जबकि सोलन, पंतनगर, बारापानी तथा बिल्लियानी केन्द्रों पर *प्लूरोटस फ्लोरिडा* की फसल पर 0.1 प्रतिशत सांद्रता का यूरिया के घोल के छिड़काव से अधिक उपज प्राप्त हुई। प्लूरोटस सजोर काजू की उपज पर भी रसायन छिड़काव का प्रभाव 9 केन्द्रों पर देखा गया। प्लूरोटस सजोर काजू की फसल पर 0.1 एम. सांद्रता के K_2HPO_4 घोल का छिड़काव करने से रांची, फैजाबाद, उदयपुर, बिल्लियानी व पंतनगर केन्द्रों पर उपज में बढ़ोत्तरी पाई गई। जबकि लुधियाना, रायपुर तथा पूर्ण केन्द्रों पर रसायन छिड़काव रहित फसल में उपज वृद्धि पाई गई।

प्लूरोटस फोस्फोलेटस व *हाईपजीजाईगस अल्मेरियस* प्रजातियों की उत्पादन क्षमता के मूल्यांकन हेतु 11 केन्द्रों पर अध्ययन किया गया। कोयम्बटूर केन्द्र पर *हाईपजीजाईगस अल्मेरियस* प्रजाति की जैव परिवर्तन क्षमता *प्लूरोटस फ्लोरिडा* (94%) की तुलना में बहुत ही ज्यादा (124%) पायी गई। पूर्ण, पंतनगर, रांची, लुधियाना व उदयपुर केन्द्रों पर *हाईपजीजाईगस अल्मेरियस* प्रजाति की उपज प्लूरोटस, प्लोरिडा व प्लूरोटस सजोर काजू की तुलना में अति अधिक उपज पाई गई। सुखाने के विभिन्न तरीकों का प्रभाव आयस्टर मशरूम की गुणवत्ता पर परखा गया। 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-3, Vv-6 व Vv-7 ने विभिन्न केन्द्रों पर अन्य प्रजातियों की तुलना में अधिकतम पैदावार दी। पराली मशरूम उत्पादन तकनीकी में सुधार हेतु किये गये अनुसंधान में पाया गया कि पराली से तैयार किये गये गोलाकार ठोस शैय्या से सबसे अधिक उपज (41.2 कि0ग्रा0/100 कि0ग्राम शुष्क माध्यम) मिली। इसके निकटतम पैदावार वर्गाकार ठोस शैय्या की रही।

दूधिया मशरूम प्रजाति मूल्यांकन अध्ययन सात केन्द्रों पर किये गये। अध्ययन के दौरान पाया गया कि प्रजाति सी0आई-06 ने कोयम्बटूर व रांची केन्द्रों पर सबसे अधिक पैदावार दी जबकि प्रजाति सी0आई0-1 ने फैजाबाद, पूर्ण और पंतनगर केन्द्रों पर, प्रजाति सी0आई0-3 ने लुधियाना केन्द्र पर तथा प्रजाति सी0आई0-08 ने उदयपुर केन्द्र 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 भुसा व पराली के विभिन्न अनुपातों में तैयार पोषाधार की तुलना में अधिकतम उपज प्राप्त हुई।

शिटाके मशरूम (लेन्टीनुला इडोडस) की उत्पादन तकनीकी का मानकीकरण करने हेतु किये गये प्रयोगों से ज्ञात हुआ कि पंतनगर व पूर्ण केन्द्रों पर बुरादे में 20 प्रतिशत की दर तथा कोयम्बटूर व उदयपुर केन्द्रों पर 10 प्रतिशत की दर गेहूं का चोकर मिलाने पर शिटाके मशरूम की सबसे अधिक उपज मिली। काले कनचपड़े (*ऑरिकुलेरिया पॉलीट्राईको*) मशरूम की उत्पादन तकनीकी मानकीकरण अध्ययनों में पाया गया कि उदयपुर तथा पंतनगर केन्द्रों पर गेहूं के भुसे में 10 प्रतिशत की दर से गेहूं का चोकर

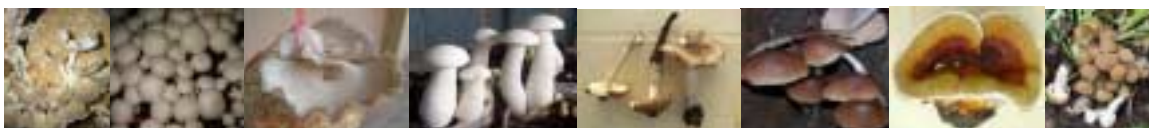


मिलाकर तैयार किये गये पोषाधार से अधिकतम उपज प्राप्त हुई। जबकि कोयम्बटूर केन्द्र पर पराली में 5 प्रतिशत की दर से गेहूं का चोकर मिलाकर तैयार किये गये पोषाधार से अधिकतम पैदावार मिली।

जंगली गूदे-दार कवकों को एकत्र करने, उन्हें पहचानने व संरक्षित करने के उद्देश्य से सभी परियोजना केन्द्रों पर सर्वेक्षण किये गये। जंगलों से कोयम्बटूर केन्द्र ने 20, फैजाबाद केन्द्र ने 4, पंतनगर केन्द्र ने 29, पूणे केन्द्र ने 18, रायपुर केन्द्र ने 26, रांची केन्द्र ने 4, उदयपुर केन्द्र ने 113, विल्लियानी केन्द्र ने 4 तथा सोलन केन्द्र ने 371 गुद्देदार 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 कीड़े-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* स्पीसीज, *अल्टर्नरिया अल्टर्नाटा*, *कोप्राईनस* स्पीसीज व *राईजोपस* स्पीसीज नामक बीमारियां फैजाबाद केन्द्र पर पाई गयीं। लुधियाना केन्द्र पर *ट्राईकोडर्मा* स्पीसीज, *कोप्राईनस* स्पीसीज, *पापुलास्पोरा बाईसीना* व *सेपिडोनियम* स्पीसीज 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 रोलफसाई*, *कोप्राईनस* स्पीसीज व यलो ब्लॉच बीमारियों का प्रकोप देखने को मिला। उदयपुर केन्द्र पर कोप्राईनस स्पीसीज तथा सोलन केन्द्र पर वेट बबल 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 गईं। किसानों व मशरूम उत्पादकों को पत्रों, फोन 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 12 प्रशिक्षण कार्यक्रम विभिन्न वर्ग के लिये आयोजित किये गये जिसमें 6 प्रशिक्षण शिविर वाह्य परिसर, 3 प्रायोजित और तीन नियमित कार्यक्रम थे। सोलन केन्द्र पर 'राष्ट्रीय मशरूम मेला' का भी आयोजन 10 सितम्बर, 2005 को किया गया जिसमें पिछले वर्षों की भांति इस वर्ष भी हिमाचल प्रदेश व उसके पड़ोसी राज्यों से लगभग 650 किसानों, मशरूम उत्पादकों व विस्तार कार्यकर्ताओं ने भाग लिया।

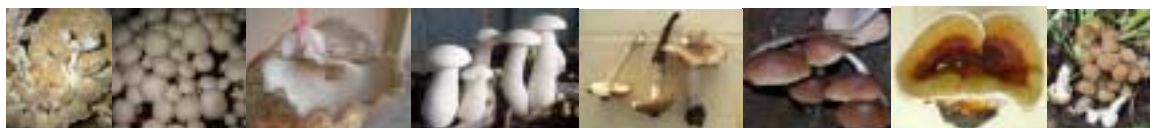


SUMMARY

During the year under report (2005-06), 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 at the IXth Biennial Group Meeting of the Workers of All India Coordinated Mushroom Improvement Project (AICMIP) held on 25th-26th October, 2004 at NRCM, Solan (HP).

Altogether 4 experiments were laid on white button mushroom, *Agaricus bisporus* at various Centres. In strain evaluation trial conducted at seven Centres, strains, CM-7, CM-13 and CM-14 gave significantly higher mushroom yield at Pune, while strain, CM-5 at Ludhiana, strain CM-7 at Raipur, strain CM-3 at Faizabad, strain CM-5 and CM-3 at Pantnagar, strain CM-10 at Coimbatore and strain CM-11 and CM-12 at Solan performed better than other strains. On overall average basis, calculated by summing up average yields obtained at different Centres, strain CM-3 and CM-7 gave superior yield than other strains. The time taken for the first harvest (days post-casing) was lowest in strain CM-7 at Raipur, CM-13 at Faizabad, CM-3 at Pantnagar and Coimbatore, CM-6 and CM-10 at Solan and Udaipur, respectively. Average fruiting body weight varied in the range of 11.50g to 16.40g in different strains. In casing materials evaluation trial, 2 years old recomposted spent compost gave superior yield of 10.20 kg, 15.31 kg and 15.60 kg/100 kg compost at Ludhiana, Udaipur and Solan, respectively, while coir pith in combination with FYM in 1:1, v/v ratio gave superior yield (14.56 kg) at Pune Centre. 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 whiteness, weight loss and veil opening on their storage both at refrigerated and ambient temperature conditions at Coimbatore, Pantnagar, Udaipur and Raipur Centres.

Three experiments were laid on oyster mushroom cultivation aspect, which includes 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 effect of chemical spray experiment, spray of 0.1M K_2HPO_4 significantly enhanced the yield of *P.florida* at Faizabad, Raipur and Coimbatore Centres. However, spray application of 0.1% Urea gave significantly higher yield at Barapani, Pantnagar, Vellayani and Solan. Effect of chemical spray treatments on the yield of *P.sajor-caju* was also conducted at 9 Centres. Enhanced yield of *P.sajor-caju* was obtained by spraying of 0.1M K_2HPO_4 on mushroom

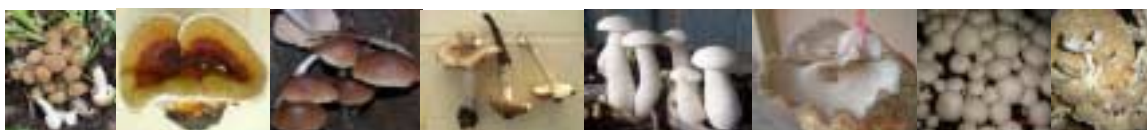


beds at Ranchi, Faizabad, Udaipur, Vellayani and Pantnagar Centers, while in control treatment at Ludhiana, Raipur and Pune. Experiments on evaluation of yield potential of *P.fossulatus* and *Hypsizygus ulmarius* was conducted at eleven different Centres. At Coimbatore Centre *H. ulmarius* gave very high biological efficiency of 124.0% in comparison to 94.0% in *P.florida*. Superior yield of *H.ulmarius* was also recorded at Pune, Pantnagar, Ranchi, Ludhiana and Udaipur Centres in comparison to *P.florida* and *P.sajor-caju*. *P.fossulatus* did not perform better than *P.florida* and *P. sajor caju* at any of the Centre. Effect of different drying methods on the quality of oyster mushroom revealed that chemical treatment along with sun drying and simple washing with sun drying gave better results with respect to 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 yield and refinement in their cultivation technologies. In the strain evaluation trial on *V.volvacea*, strains, Vv-06, Vv-07 and Vv-03 gave higher yield as compared to other strains at different Centres. Compact round bed prepared out of paddy straw gave highest mushroom yield of 41.2kg/100kg dry substrate at Coimbatore which was closely followed by compact square bed. Strain evaluation trial on milky mushroom was laid out at seven Centres. Strain C.I-06 gave highest yield at Coimbatore and Ranchi Centres, while strain C.I-01 at Faizabad, Pune and Pantnagar, strain C.I-03 at Ludhiana and C.I-08 at Udaipur Centre. Among different substrates evaluated, highest mushroom yield was obtained on wheat straw as compared to paddy straw and different ratios of wheat straw and paddy straw.

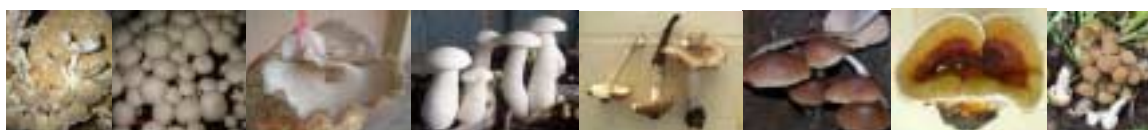
Experiments were also conducted on standardization of cultivation technology of shiitake (*L. edodes*) and black ear (*A. polytricha*) mushrooms. In case of shiitake, saw dust substrate supplemented with 20% of wheat bran gave superior yield at Pantnagar and Pune Centres, while supplement with 10% wheat bran gave superior yield at Udaipur and Coimbatore Centres. In case of black ear mushroom, 10% wheat bran supplemented wheat straw gave higher yield at Udaipur and Pantnagar, while 5% wheat bran supplemented paddy straw at Coimbatore.

Survey for collection, identification and preservation of wild fleshy fungi were conducted by various Centres. A total number of 20 fleshy fungi were collected at Coimbatore, four at Faizabad, 29 at Pantnagar, 18 at Pune, 26 at Raipur, 4 at Ranchi, 113 at Udaipur, 4 at Vellayani and 371 specimens at Solan Centres. 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. Survey and surveillance of diseases and insect-pests was also done by almost all the Centres. Among the common fungal pathogens/competitors, *Coprinus* sp.,



T.pseudokoningii were recorded at Coimbatore, *Penicillium* spp., *Trichoderma* spp., *Alternaria alternata*, *Coprinus* spp., and *Rhizopus* spp. at Faizabad, *Trichoderma* spp., *Coprinus* spp., *Papulaspora byssina* and *Sepedonium* spp. at Ludhiana, *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. at Udaipur and wet bubble at Solan. Among insect-pests, sciarid, cecid 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 through AIR's. Advisory services were also provided by replying letters, telephones, e-mails and on the spot guidance during farm visits. Almost all the Centres conducted training programmes of different durations for farmers, farm women, unemployed youths and the entrepreneurs of their areas. The Centres also supplied pure culture and spawn to mushroom growers. At headquarters, a total of 13 training programmes of 3 to 10 days duration were conducted out of which 6 were off-campus, 4 sponsored and rest 3 were under regular institutional activities.

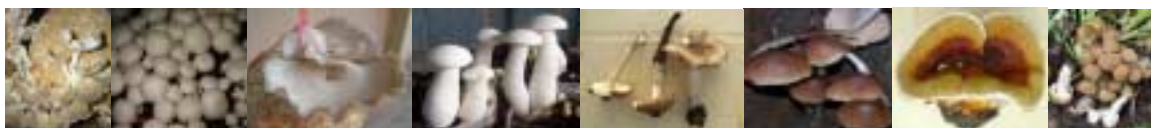


1. INTRODUCTION

The All India Coordinated Mushroom Improvement Project (AICMIP) 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 AICMIP started with six Centres at Punjab Agricultural University, Ludhiana (Punjab), G.B.Pant University of Agriculture and Technology, Pantnagar (Uttaranchal), 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 (MP) 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 AICMIP 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 (Uttaranchal)
- Mahatma Phule Agricultural University, Pune (Maharashtra).
- N.D.University of Agriculture and Technology, Faizabad (UP).
- Indira Gandhi Krishi Vishwa Vidyalaya, Raipur (MP).
- Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan).
- Kerala Agricultural University, 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 & Forestry, Nauni, Solan – Co-operating Centre.

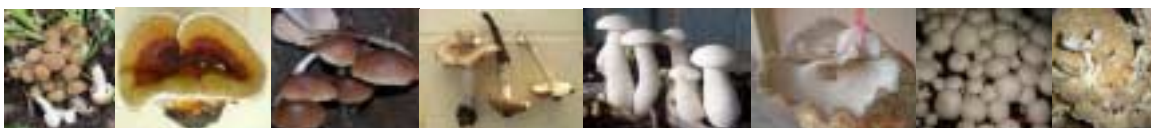
All the Co-ordinating Centres and HQrs. at NRCM, Solan work in co-ordination on common objectives and mandate. The technical programme for conducting participatory research at all the Centres and the HQrs. is



finalized in a biennial workshop organised at any of the Centres or HQrs. During the biennial workshop the progress reports for the previous years are presented and discussed to monitor the progress made in the project during the previous years and the technologies generated are assessed for release and their adoption at all India level. The last Group meeting of workers of AICMIP was held on 25th and 26th October, 2004 at National Research Centre for Mushroom, Solan (HP) under the Chairmanship of Dr. H.S. Sohi FNA and Ex-Director National Research Centre for Mushroom, Solan. During the meeting the progress of last two years was read out and technical programme for 2004-2006 was finalized. The objectives of the AICMIP are also identified during the workshop and presently AICMIP is working on the following objectives:

Objectives

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



2. TECHNICAL PROGRAMME OF WORK

I. CROP IMPROVEMENT

Expt.No.-1: Testing of different strains of *Agaricus bisporus*.

a) Participating Centres:

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

Ludhiana, Raipur, Faizabad (Long method compost using wheat straw)

Coimbatore (Long method compost using paddy straw)

b) Substrate:

i) Compost formula :

Wheat straw	-	1000 kg
Poultry manure	-	500 kg
Urea	-	16kg
Wheat bran	-	120 kg
Gypsum	-	30 kg

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

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

c) Strains :

i) CM-1, CM-3, CM-5, CM-6, CM-7, CM-10, CM-11, CM-12, CM-13, CM-14 and S-130 at Pune, Pantnagar and Solan.

ii) CM-3, CM-5, CM-10, S-130 and S-11 to be used at rest of the Centres by using long method of composting.

d) Methodology to be adopted:

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

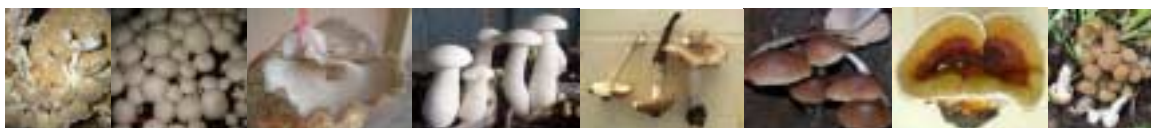
Compost will be ready in 18 days.

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)

Spawning rate: 0.7% of wet weight of compost.

ii) Long method compost to be prepared in single phase outdoors (without steam pasteurization) in 18-20 days (0,4,7,9,11,13,15,17 and spawn).

Ingredients to be used are wheat/ paddy straw-1000kg, wheat bran 150kg, Urea-18kg, Gypsum-35kg. 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), bulk density 80-90kg per m³ bed area @ (6"-7" depth).



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%
CO₂ - above = 10,000ppm.
 - ii) Case run.....do..... =
 - iii) Days taken to pin after ventilation
(Temp. = $15-17^\circ\text{C}$, RH 80-85%,
CO₂ - below 1500ppm)
 - iv) First harvest (after casing/No. of
days taken) =
 - v) Last harvest (Data for total
cropping days of 6 weeks only to be
recorded) =
 - vi) Disease/pest 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 randomised in cropping rooms in different tiers in RBD.
 - Watering should be restricted to wetting of casing material. Humidifier to be used for RH maintenance.
 - Use standard casing material recommended, i.e., spent compost/FYM (both 2 years old - well decomposed in a pit).
 - The casing material should be water leached for 8 hours before treatment with steam/chemicals.

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

- Harvest mushrooms in button form, 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 the quality of the fruitbody produced by a particular strain.
- Average fruitbody 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.
- Every effort should be made to strictly adhere to the above instructions for this experiment. This will facilitate generation of uniform data for assessment and final recommendation.

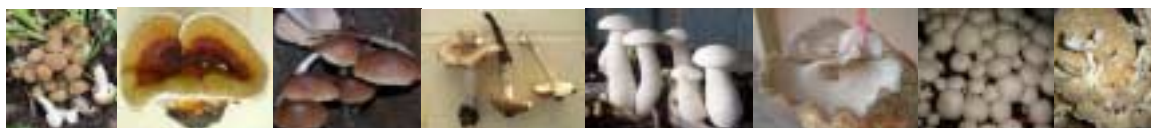
Expt.No.2: Strain evaluation of Milky Mushroom (*Calocybe indica*)

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
- iii) No. of replications - 8 for each strain.
- iv) Substrate treatment - Hot water treated (70°C for 30 minutes) paddy straw/wheat straw
- c) Strains - 9 strains C.I-1, C.I-2, C.I-3, C.I-4, C.I-5, C.I-6, C.I-7, C.I-8 and CI-9.
- d) Spawn rate - 5% wet wt. basis
- e) Observation to be recorded
 - Number, weight and size of the mushroom viz., Pileus diameter and stipe length are also to be observed

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.8 by using 5 bundles x 4 layers + 2 bundles opened at top.

- c) Strains** -All *Volvariella* strains except Vv-05 & Vv-03.

II. CROP PRODUCTION

1. Button Mushroom

Expt.No.4: To test the locally available agro-industrial wastes for feasibility as casing materials.

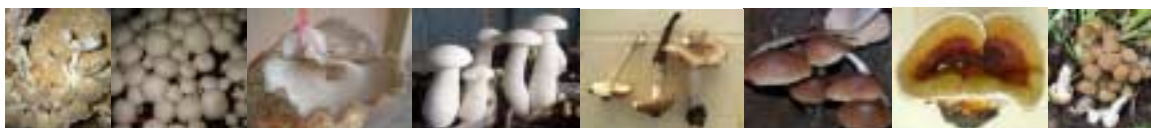
a) Participating Centres:

Solan, Ludhiana, Pune and Udaipur

b) Substrate treatment

- i) FYM+spent compost (1:1) (v/v)
 - ii) Spent compost (2 years old)
 - iii) Coirpith
 - iv) Coirpith+FYM (1:1) (v/v)
 - v) Coirpith + FYM (1:4) (v/v)
 - vi) Coirpith + spent compost (1:1) (v/v)
 - vii) Burnt rice husk + FYM (1:1) (v/v)
 - viii) Burnt rice husk +FYM (1:2) (v/v)
 - ix) FYM+Coirpith+burnt rice husk (4:1:1) (v/v)
 - x) FYM+garden soil (1:1) (v/v) – (control-1)
 - xi) FYM (control-2)
- c) No. of replications :** 10 of 10 kg compost/bag

d) Design : RBD



e) Brief Description of Methodology:

Cultivation method same as for Expt.1.

Data to be recorded:

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

2. Oyster Mushroom**Expt.No.5: Effect of chemical spray on yield of *Pleurotus* spp.****a) Participating Centres :**

All Centres

b) Species to be used :

P.florida, *P.sajor-caju*

c) Substrate treatment :

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

d) Containers : Polybags (60x30cm)**e) Substrate treatments****Spraying mushroom beds at pinning**

- i) with 0.1M Dipotassium hydrogen phosphate (K_2HPO_4)
- ii) with Urea 0.1%

* Second and third spray after 1st harvest and 15 days later respectively

f) No. of replications : 15 bags each of 1.0kg dry wt./treatment**g) 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 flush.
5. Contamination of beds (%).
6. Type of contamination
7. Daily bed temperature
8. Cropping room temperature (Max. and min.) and RH (%).

Expt. No.6: Evaluation of the yield potential of *Pleurotus fossulatus*.**a) Participating Centres :**

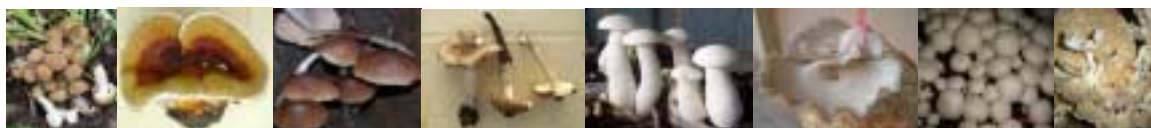
Solan, Udaipur, Coimbatore, Ludhiana, Raipur, Barapani, Faizabad, Ranchi, Pantnagar

b) Species to be used :

P.fossulatus and *P.florida* (low temperature strain)

c) Substrate treatment :

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

d) Containers : Polybags (60x30cm)

e) No. of replications : 15 bags each of 1.0 kg dry weight

Raipur, Vellayani, Solan and Barapani

f) Data to be recorded :

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

b) Substrate Treatments

1. Hollow bed (6" hollow dia)
2. Compact bed (Square)
3. Compact bed (Round)
4. Bundle method (hollow) (4 bundles x 5 layers + 2 bundles opened)
5. Bundle method (5 bundles x 4 layers + 2 bundles opened at top)

Replication : 5

Design : RBD

Expt. No.7: Evaluation of the yield potential of blue oyster mushroom (*Hypsizygus ulmarius*).

c) Supplementation :

2 % Horse gram powder

a) Participating Centres :

All Centres

d) Substrate treatment :

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

b) Species to be used :

- i) *Hypsizygus ulmarius*
- ii) *Pleurotus florida*
- iii) *P.sajor-caju*

e) Spawn rate : 1.5 % to dry weight of straw

c) All other details as per Experiment No.6

f) Harvesting at egg stage

3. Paddy straw mushroom

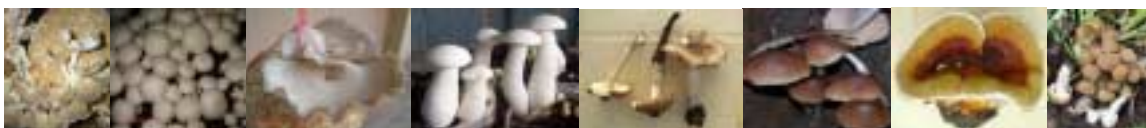
g) Observation to be recorded

Expt.No.8: Cultivation of Paddy Straw Mushroom (*Volvariella volvacea*)

1. Daily room temperature & 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

a) Participating Centres :

Coimbatore, Ludhiana, Faizabad,



7. Yield data (number and weight 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. The observations are to be tabulated and the AICMIP Co-ordinator will supply uniform data sheet.

4. Milky Mushroom

Expt. No.9: Cultivation of milky mushroom (*Calocybe indica*)

a) Participating Centres :

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

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:

CST hot water, solar pasteurization, Autoclaving

e) Spawn rate : 4%

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 : 90cm x 30cm

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 psi pressure)

j) Casing layer : 2 cm thick

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

k) Observation to be recorded :

As per Experiment No.2.

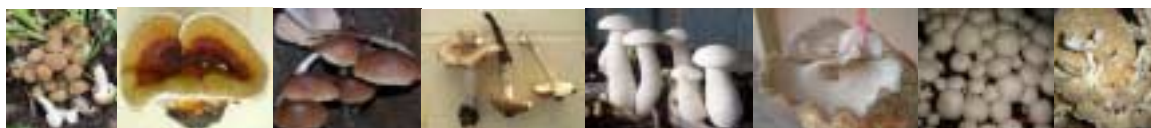
5. Shiitake Mushroom

Expt. No. 10: 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
- ii) Wheat straw

d) Supplement :

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

e) Method of substrate preparation : Autoclaving**f) Spawn rate :** 5%**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 saw dust
 ↓
 Add water (65%) for thorough wetting overnight
 ↓
 Add wheat bran and thoroughly mix
 ↓
 Fill in polypropylene bags 2kg each and put ring and cotton plug
 ↓
 Autoclave at 121°C for 1/2 hours
 ↓
 On cooling spawn aseptically @ 2% wet weight basis.

↓

Incubate at 24°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 minutes.

↓

Keep the block for fruiting at <20°C

6. Jew's Ear Mushroom**Expt.No.11: Cultivation of Black ear mushroom (*Auricularia polytricha*)****a) Participating Centres :**

Pantnagar, Coimbatore, Raipur, Ludhiana, Udaipur and Barapani.

b) Substrate :

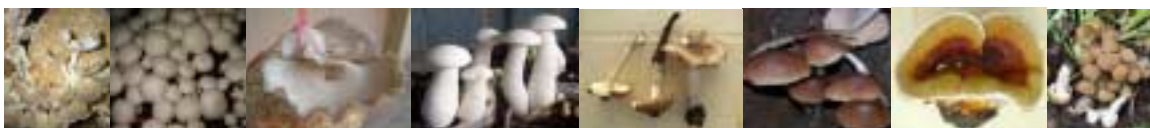
- i) Wheat straw
- ii) Paddy straw

c) Supplement :

Wheat bran 2, 5 and 10% dry weight basis.

d) Method of substrate preparation :

Autoclaving, hot water, solar pasteurization

e) Spawn rate : 2%**f) No. of replication :** 20 each (2kg/ bag)

g) Production technology to be followed

a)

Substrate preparation
↓
Wet the substrate for 20 h
↓
Supplement with wheat bran (if required as per treatments)
↓
Fill in autoclavable PP bags (30 x 60 cm) @ 2 kg (wet weight) per bag
↓
Autoclave at 15 Psi for 1 hour
↓
Cool the bags and spawn (preferably aseptically) @ 2 % wet weight basis
↓
Incubate at 25 to 28 °C
↓
After 3-4 weeks give vertical slits and maintain high RH (80-85%) in the cropping room

b) Design : RBD

c) Observations to be recorded:

1. Daily room temperature & RH
2. Substrate moisture at spawning
3. Days for spawn run
4. Days for pinhead formation
5. No. of fruit bodies
6. Average fruit body weight
7. Yield data (I, II, III week)
8. Biological efficiency
9. Incidence of pests, diseases and abiotic disorders as per proforma.

III. POST HARVEST TECHNOLOGY

Expt.No.12: 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

200 ppm EDTA

100 +0.02% KMS

500 ppm EDTA

Unwashed

d) Storage : 5°C, Ambient (only upto 48 h)

e) Observations to be recorded :

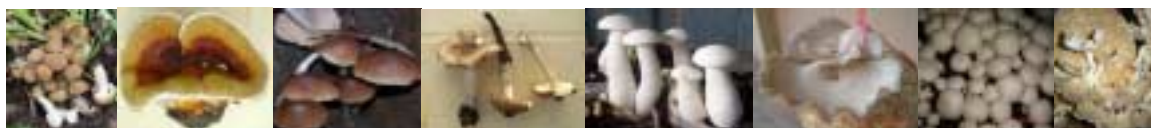
Whiteness only (either % reflectance or ++, +++, +++)

Before washing

After washing

After 24 h

After 48 h



Expt.No.13: Packaging for button mushroom (washed with 0.05% KMS)

a) Participating Centres:

All Centres doing experiments on button mushroom

b) Treatments:

- i) Uniform size, 75 gauge PP, 100 gauge PP, 125 gauge and 100 PE control
- ii) No holes: 10 allpin holes

c) Storage : Refrigerator, Ambient

d) Observation :

- 1. Weight loss
- 2. Whiteness (% reflectance or ++, +++,++++)
- 3. Veil opening (% mushrooms opened)

Expt. No.14: Drying of oyster mushroom

a) Participating Centres :

Raipur, Ludhiana, Udaipur, Coimbatore and Vellayani.

b) Strain/species :

Most popular in the region

c) Treatments :

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

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

Sun drying

Cabinet drying (60°C till 7% moisture)

d) Observation :

- 1. Weight gain/loss
- 2. Whiteness/yellowness
- 3. Brittleness
- 4. Keeping quality in pack of 100 gauge PP (3 months – rottage, insect attack, off-flavour)

Expt.No. 15: Wild germplasm collection, identification and conservation

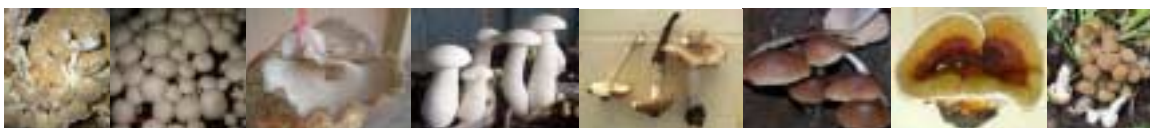
Data Recording :

As per the proforma supplied in proceedings of the VIIIth Biennial Workshop of AICMIP.

Expt. No. 16: Survey and Surveillance of diseases and insect pests in mushroom farms in different regions

Data Recording :

As per the proforma supplied in proceedings of the VIIIth Biennial Workshop of AICMIP.



3. RESEARCH PROGRESS

1. Crop Improvement

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

The trial was assigned to nine Centres including the Headquarter by using compost prepared both by long and short method of composting. At Coimbatore Centre highest yield (16.80kg) was recorded in strain CM-10 followed by strain CM-5. At Faizabad Centre highest yield of 12.78 kg/100kg compost was recorded in strain CM-3, followed by 11.82 kg in strain CM-5. At Ludhiana Centre strain CM-5 out-yielded other strains, while strains CM-7 and CM-13 at Pune, strains CM-1 and CM-5 Pantnagar and CM-7 at Raipur gave higher yield than other strains tested. At Barapani Centre highest yield of 16.2 kg was recorded in strain CM-13. At Headquarters, strain CM-12 gave highest yield (21.89kg) and it was followed by strain CM-11 and CM-13 (Table-1). In overall average basis strain CM-3 followed by strain CM-7 out performed others.

The time taken for first harvest (days post-casing) was lowest in strain CM-7 at Raipur, while it was lowest in strains CM-1 and CM-3 at Pantnagar Centre. On overall basis lowest time for first harvest was 13.6 days in strain CM-7 at Raipur in comparison to highest of 54.2 to 57.4 days at Barapani Centre. The average fruiting body weight was higher at

Faizabad and Raipur Centres, where it ranged between 11.44 to 27.5g in comparison to range of 9g to 11.80g at Ludhiana and Pantnagar Centres. At Solan Centre, the time taken for first harvest ranged between 18.7 to 19.8 days. The difference in time taken for first harvest was insignificant in different strains. The average fruiting body weight ranged between 11.50 g to 16.40g. On overall average basis the time taken for first harvest was lowest in strains CM-1, CM-7 and CM-15, while, average fruitbody weight did not show much variation in different strains (Table-2).

1.2 Testing of strains of milky mushroom, *Calocybe indica*

The trial was laid out at eight Centres by including 9 different strains. The mushroom yield obtained at different Centres varied in different strains. Strain, C.I-06 gave highest yield at Coimbatore and C.I-8 at Udaipur Centre, while strain C.I-1 at Faizabad and Pantnagar, strain C.I-03 at Ludhiana and C.I-07 at Ranchi Centre (Table-3). Highest biological efficiency of 118.89 per cent was obtained at Ranchi while lowest of 4.4% at Pune Centre.

1.3 Testing of strains of paddy straw mushroom, *Volvariella volvacea*

The trial was laid out at 5 different Centres and highest biological

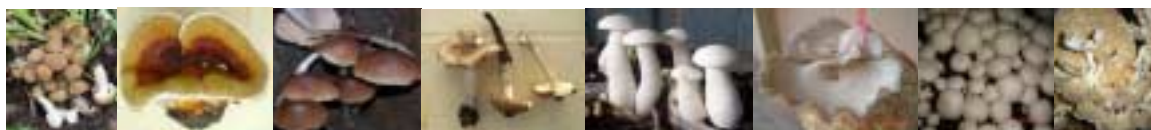
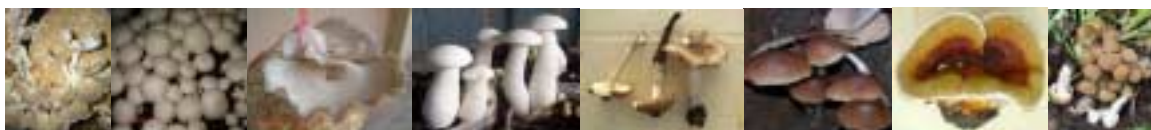
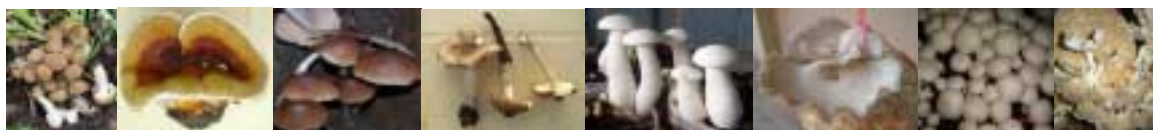


Table 1. Yielding potential of different strains of white button mushroom, *A.bisporus*

<i>A. bisporus</i> strain	Pune	Ludhiana	Raipur	Faizabad	Pantnagar	Coimbatore	Solan	Udaipur	Barapani	Av.
CM-1	13.44	-	-	-	15.33	-	16.34	-	-	15.04
CM-3	14.04	7.72	11.3	12.78	14.03	3.30	17.65	11.98	-	18.53
CM-5	10.18	8.20	-	11.82	14.67	12.88	18.79	13.96	-	12.93
CM-6	14.14	-	-	-	9.32	-	16.15	-	-	13.20
CM-7	18.10	-	11.8	-	12.37	-	20.95	-	-	15.80
CM-10	13.86	6.50	0.69	8.76	13.95	16.80	16.85	13.66	-	11.38
CM-11	12.68	-	1.18	-	11.87	-	21.75	-	-	11.87
CM-12	12.40	-	1.36	-	10.57	-	21.89	-	4.9	10.22
CM-13	16.66	-	1.05	11.55	11.65	-	18.81	-	12.5	12.04
CM-14	16.01	-	0.76	-	10.82	-	18.78	-	16.2	12.51
S-11	-	6.95	-	10.09	-	-	17.89	12.77	-	11.92
CM-15 control	13.91	-	-	-	13.06	-	18.11	-	-	15.03
CD	2.70	1.12	ND	0.81	1.02	ND	2.15	2.58	ND	

ND: Not determined



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

Strain	Pune		Ludhiana		Time taken for first harvest (days post-casing)/ fruiting body weight/ Centre				Pantnagar		Coimbatore		Solan		Udaipur		Barapani		Average	
	b	a	b	a	Faizabad	a	b	a	b	a	b	a	b	a	b	a	b	a	b	
CM-1	13	-	-	-	-	-	-	15	8.63	-	-	19.5	14.5	-	-	-	-	17.25	12.04	
CM-3	14	11.3	14.3	11.44	25	25.77	15	9.32	11	18.8	14.8	18	17.32	-	-	-	-	18.22	14.36	
CM-5	12	9.2	-	-	27	24.94	16	9.71	11.3	19.7	13.6	19	15.01	-	-	-	-	20.42	13.68	
CM-6	14	-	-	-	-	-	16	11.8	-	18.7	14.0	-	-	-	-	-	-	17.35	13.27	
CM-7	15	-	13.6	11.9	-	-	18	8.97	-	19.2	14.1	-	-	-	-	-	-	16.93	12.49	
CM-10	10	9.0	20.1	18.75	25	21.47	17	11.2	12	19.1	13.8	17	18.31	-	-	-	-	19.64	14.32	
CM-11	15	-	18.4	19.0	-	-	17	10.45	-	19.6	14.3	-	-	54.5	11.4	27.37	14.03	-	-	
CM_12	16	-	19.4	19.89	-	-	16	11.39	-	19.5	14.8	-	-	57.4	9.4	28.07	14.29	-	-	
CM-13	16	-	18.2	20.28	23	27.5	16	10.05	-	19.0	13.8	-	-	54.2	10.8	26.08	16.40	-	-	
CM-14	17	-	18.4	16.17	-	-	16	10.89	-	19.3	14.3	-	-	-	-	-	-	17.90	14.59	
S-11	-	-	-	-	32	20.59	-	-	-	19.8	13.5	22	13.15	-	-	-	-	24.60	15.75	
CM-15	11	-	-	-	-	-	15	9.71	-	19.6	13.8	-	-	-	-	-	-	17.30	11.50	

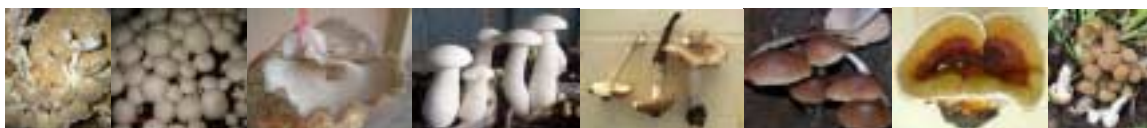
a = Time taken for first harvest (days post-casing)

b = Average fruiting body weight (g)

Table 3. Yielding potential of different strains of milky mushroom, *Calocybe indica*

Strain	Yield (kg/ 100Kg dry substrate) at different Centres																	
	Ludhiana		Faizabad		Udaipur		Ranchi		Pune		Pantnagar		Coimbatore		Average			
	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b		
C.I-1	47.2	47.6	43.93	19.53	20.0	55.0	61.42	45.37	25.7	13.3	59.62	16.35	16.8	42.8	39.23	34.28		
C.I-2	60.3	40.5	25.28	18.31	38.10	28.60	-	-	15.9	11.2	45.75	15.45	17.6	44.0	33.82	26.34		
C.I-3	65.5	44.6	38.06	23.95	33.47	55.77	37.03	75.37	15.5	12.7	39.75	17.13	16.2	42.0	35.07	38.79		
C.I-4	-	-	25.57	19.84	38.67	38.66	-	-	9.2	16.3	26.25	12.32	15.6	47.6	23.05	26.94		
C.I-5	40.2	59.5	29.84	21.64	39.33	39.33	-	-	4.4	12.5	27.56	13.74	17.0	48.0	26.39	32.45		
C.I-6	35.3	44.0	32.45	19.68	46.67	43.75	118.89	92.18	-	-	38.37	13.43	18.2	42.0	48.32	42.34		
C.I-7	25.8	49.3	37.75	22.10	15.00	60.00	83.93	56.62	-	-	50.31	15.10	16.4	43.4	38.20	41.08		
C.I-8	43.7	48.3	18.69	18.32	50.95	38.21	-	-	-	-	-	-	15.8	46.2	32.29	37.76		
C.I-9	40.0	54.9	19.44	16.62	39.67	66.11	-	-	-	-	-	-	17.2	46.0	29.07	45.83		
CD 0.05%	3.80	-	3.49	-	-	-	19.76	-	-	-	2.37	1.20	-	NS				

a) mushroom yield; b) average fruitbody weight (g)



efficiency in the range of 8.05 to 25.42 % was recorded at Coimbatore followed by Ludhiana Centre. Strain Vv-01 gave highest yield of 25.42 kg/100kg dry substrate at Coimbatore, while strain Vv-04 at Ludhiana, Vv-02 at Faizabad and Vv-07 at Ranchi Centre (Table-4). On overall average basis strains, Vv-03 and Vv-07 gave higher yield than other strains.

2. Crop Production

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

The experimental trail was laid out at four Centres including the Headquarter. Coirpith in combination with FYM in the ratio of 1:1 (v/v) gave

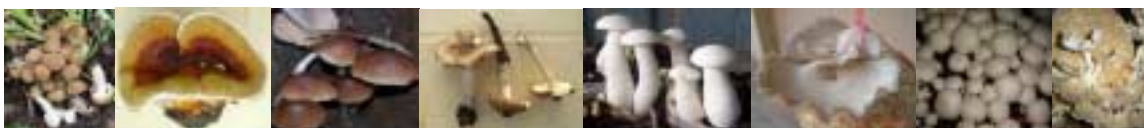
Table 4. Yielding potential of different strains of paddy straw mushroom, *Volvariella volvacea*

Strain	Yield (kg/100 kg of dry substrate) at different centres											
	Ludhiana		Barapani		Faizabad		Coimbatore		Ranchi		Average	
	a	b	a	b	a	b	a	b	a	b	a	b
Vv-1	0.7	5.0	0.19	1.5	-	-	25.42	20.5	3.3	50.0	7.40	19.25
Vv-2	13.1	6.2	0.14	4.0	3.87	12.5	21.20	20.0	-	-	9.58	10.67
Vv-3	15.0	6.2	-	-	3.15	12.1	20.80	20.0	-	-	12.98	12.77
Vv-4	15.5	3.4	0.14	4.0	0.97	12.7	9.82	18.2	2.7	8.54	5.83	9.37
Vv-5	7.7	3.6	-	-	1.71	11.5	8.05	17.5	-	-	5.82	10.87
Vv-6	-	-	10.8	10.9	1.23	12.6	-	-	11.29	12.76	7.77	12.09
Vv-7	11.8	6.8	6.69	6.4	-	-	-	-	13.88	9.16	10.79	7.45
CD					0.24	1.0						

a) average mushroom yield; b) average fruiting body weight (g).



Fig. 1. White button mushroom crop raised by using different casing materials at NRCM, Solan



highest mushroom yield of 14.56 kg/100kg compost, at Pune, whereas two year old spent mushroom compost performed better at Udaipur and Ludhiana Centres. At Solan Centre, coirpith and 2 year old spent compost gave yield at par with each other and superior than other treatments. The fruiting bodies obtained from two year old spent compost were of good weight and it ranged between 11.10g to 11.75g at different Centres (Table-5).

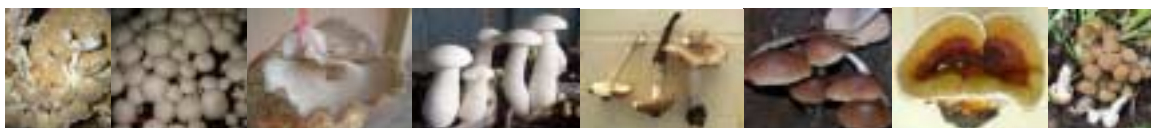
2.1.2 Physico-chemical properties of agro-industrial wastes evaluated as casing materials for white button mushroom, *A. bisporus*.

The experiment was laid out at 4 different Centres. The pH, water holding capacity and conductivity were recorded highest in coirpith and its combination with FYM at Ludhiana, Udaipur and Pune

Table 5. Effect of different casing materials on the yield and fruiting body weight of *A. bisporus*

Treatment	Mushroom yield (kg/100 kg compost) at different Centres						
	Pune a	Ludhiana a b		Udaipur a b		Solan a b	
Farm yard manure (FYM) + spent compost (SC) (1:1, v/v)	11.24	8.98	9.7	12.08	11.69	-	-
SC (2 years old)	11.75	10.20	11.7	15.31	11.75	15.66	11.10
Coirpith (CP)	14.31	6.08	7.2	13.63	11.77	15.72	11.10
CP+FYM (1:1, v/v)	14.56	9.74	10.6	9.63	14.33	-	-
CP+FYM (1:4, v/v)	14.20	8.76	9.1	9.40	13.58	-	-
CP+SC (1:1, v/v)	13.60	7.75	8.2	12.13	11.52	14.83	10.82
Burnt rice husk (BRH)+ FYM (1:1, v/v)	13.30	7.65	10.2	11.44	13.02	12.77	10.97
BRH+FYM (1:2, v/v)	14.08	7.85	9.7	10.32	17.76	-	-
FYM+CP+BRH (4:1:1, v/v)	13.80	7.05	9.7	11.36	15.62	-	-
FYM+Garden soil (1:1, v/v)	12.90	7.68	8.9	9.70	18.76	-	-
Control-I							
FYM control-II	12.27	7.80	10.5	10.74	18.77	12.81	11.20
CD (5%)	2.73	0.82	-	2.31	-	1.69	-

a = Total yield, b = Average fruitbody wt.



Centres, while the particle density was in lower range and the highest particle density was of casing material prepared with FYM+garden soil (1:1, v/v). The pH of better performing casing material (coirpith and 2 years old spent compost) differed with each other and it varied from 6.90 to 7.94. The conductivity varied between 0.45 mmho in burnt rice husk+coir pith to maximum of 3.77 in FYM+spent compost (1:1 v/v). Similarly the water holding capacity ranged between lowest of 35.67 to highest to 475 in coirpith. The particle density increased with increased proportion of FYM in the casing material (Table-6).

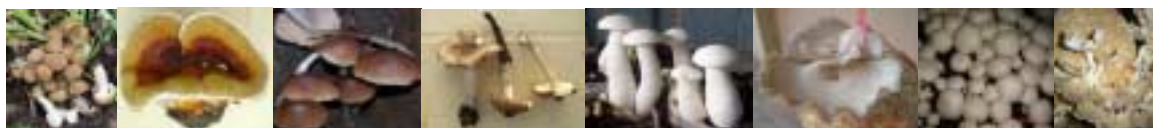
2.2.1 Effect of spray of different chemicals on yield of *Pleurotus florida* and *P. sajor-caju*

The experiment was conducted at 11 different Centres. Two chemicals viz; dipotassium hydrogen phosphate (K_2HPO_4) and Urea were applied @ 0.1M and 0.1%, respectively on mycelium colonized substrate bags of *P. florida* and *P. sajor-caju*. The spray of 0.1M K_2HPO_4 significantly enhanced the yield of *P. florida* at Raipur, Faizabad and Coimbatore Centres. At Ludhiana, Pune, Udaipur and Ranchi Centres, the control

Table 6. Quality parameters of casing materials at different Centres

Treatment	Centres											
	Ludhiana				Pune				Udaipur			
	pH	WHC	Cond.	Den.	pH	WHC	Cond.	Den.	pH	WHC	Cond.	Den.
FYM+SC (1:1)	7.05	95	0.52	0.85	7.0	75	0.58	0.61	7.66	43.87	3.77	0.605
SC (2 year old)	7.19	130	0.65	0.68	6.9	72	0.82	0.58	6.91	62.89	3.37	0.662
Coirpith (CP)	7.25	475	0.53	0.15	7.4	82	1.60	0.42	7.94	35.67	1.03	0.387
CP+FYM (1:1)	6.67	275	1.45	0.34	7.2	78	1.45	0.48	7.87	94.95	2.58	0.457
CP+FYM (1:4)	6.60	135	2.33	0.63	7.1	75	1.50	0.50	8.1	40.18	3.05	0.581
CP+SC (1:1)	6.61	215	1.54	0.49	7.3	75	1.58	0.45	7.27	52.66	2.64	0.304
BRH+FYM (1:1)	7.04	190	1.59	0.55	6.8	65	0.48	0.40	8.33	62.09	2.62	0.731
BRH+FYM (1:2)	7.50	185	2.45	0.54	6.7	67	0.45	0.41	8.35	67.21	2.84	0.628
FYM+CP+BRH (4:1:1)	7.65	175	1.95	0.60	6.9	70	0.90	0.45	8.05	75.25	2.64	0.325
FYM+Garden soil (1:1)	7.20	55	1.65	1.15	7.0	68	0.53	0.82	8.26	52.66	1.87	0.804
Control-I												
FYM Control-2	7.05	103	2.65	0.73	7.2	69	0.50	0.58	8.29	44.25	2.69	0.714

WHC-water holding capacity; FYM- farm yard manure; SC- spent compost; CP-coirpith; BRH- burnt rice husk



treatment gave significantly higher yield than chemical sprayed substrate bags (Table-7). The spray treatment with 0.1% Urea gave significantly higher yield at Barapani, Pantnagar, Vellayani and Solan. However, the overall average did not show much variations in yield.

The experiment with *P.sajor-caju* was conducted at 9 Centres. Enhanced yield of *P.sajor-caju* was obtained on spraying 0.1M K_2HPO_4 on mushroom beds at Faizabad, Ranchi, Pantnagar, Udaipur and Vellayani Centres, while the mushroom yield at Ludhiana, Raipur and Pune Centre was significantly less in chemical sprayed treatments in comparison to control

(Table-8). There were minor variations at average mushroom yield data calculated after summing up of yield obtained at different Centres.

2.2.2. Evaluation of yield potential of *Pleurotus fossulatus* and *Hypsizygus ulmarius*

The experiment was conducted at 11 different Centres including the Headquarter. Blue oyster mushroom, *Hypsizygus ulmarius* gave higher yield at Ranchi, Pune, Pantnagar, Vellayani, Ludhiana, Udaipur and Coimbatore Centres. At Ranchi Centre very high biological efficiency of 132.59.% was recorded in this mushroom in comparison to 101.65

Table 7. Effect of chemical spray on yield of *Pleurotus florida*

Treatment	Yield (kg/100kg dry substrate) at different Centres										
	Ludh- iana	Rai- pur	Faiz- abad	Bara- pani	Pune	Pant- nagar	Coimb- atore	Vella- yani	Udai- pur	Ran- chi	Solan
K_2HPO_4 (0.1M)	36.2	64.5	68.67	96.4	52.8	65.33	92	25.3	47.83	47.23	84.62
Urea (0.1%)	42.31	57.7	59.62	98.9	48.7	78.95	87	29.88	45.9	69.68	87.81
Control	49.3	55.8	65.39	97.3	55.2	60.00	84	24.25	58.06	80.38	73.0
CD (5%)	3.33	NS	3.24	ND	28.8	ND	28.42	ND	ND	89.57	16.3

ND- not determined

Table 8. Effect of chemicals spray on yield of *P. sajor-caju*

Treatment	Yield (kg/100kg dry substrate) at different Centres									
	Ludh- iana	Rai- pur	Faiz- abad	Ran- chi	Pant- nagar	Udai- pur	Vella- yani	Pune	Solan	Av.
K_2HPO_4 (0.1M)	32.5	82.1	74.86	96.88	74.01	81.01	23.0	50.5	61.0	63.96
Urea (0.1%)	38.6	93.5	69.35	42.6	68.1	29.13	22.0	47.8	66.4	53.05
Control	45.7	130.5	70.15	82.62	62.7	36.21	22.75	59.2	52.7	62.50
CD (5%)	2.2	ND	3.97	NS	ND	ND	ND	22.8	14.28	

ND- not determined

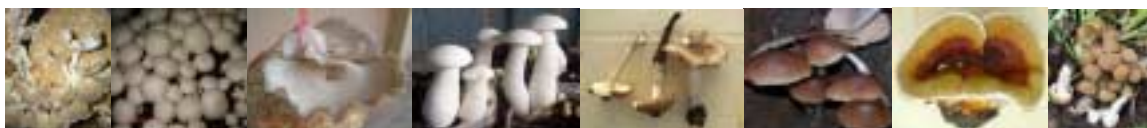




Fig. 2. Oyster mushroom crop on neemcake supplemented wheat straw substrate

and 75.90% in *P.florida* and *P.sajor-caju*, respectively. At Faizabad, Solan and Raipur, the control *Pleurotus* spp. (*P.florida* and *P.sajor-caju*) out-yielded the test species (Table-9).

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

The trial could only be laid out at three Centres. At Coimbatore Centre the compact round bed prepared out of paddy straw gave highest

Table 9. Evaluation of yield potential of *P.fossulatus* and *Hypsizygus ulmarius*

Centres	Biological efficiency (%)				CD (5%)
	<i>P. fossulatus</i>	<i>P. florida</i>	<i>H. ulmarius</i>	<i>P. sajor-caju</i>	
Pune	-	57.7	78.8	63.7	13.5
Raipur	-	44.45	55.25	76.95	13.57
Faizabad	3.51	64.71	60.25	68.52	3.94
Pantnagar	43.84	50.00	66.72	60.68	4.69
Ranchi	-	101.65	132.59	75.90	29.72
Coimbatore	-	94.0	124	-	11.54
Barapani	-	-	67	-	-
Vellayani	-	26.87	26.95	23.73	4.76
Ludhiana	-	25.8	49.3	45.7	1.7
Udaipur	-	48.89	67.03	34.63	26.32
Solan	39.5	41.40	29.31	48.39	19.39



Fig. 3.1. Fruiting body of *Hypsizygus ulmarius* on wheat straw at Raipur



Fig. 3.2. *Pleurotus sajor-caju* on wheat straw at Raipur

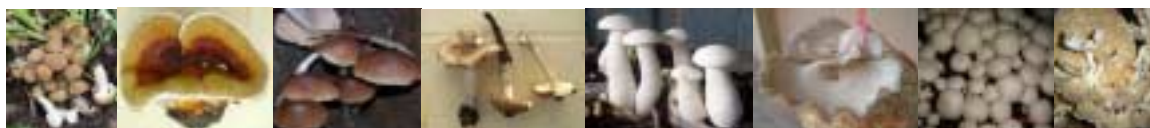




Fig. 3.3. *Pleurotus florida* grown on wheat straw at Raipur

mushroom yield of 41.2kg/100 dry substrate. It was closely followed by compact square bed. At Ludhiana again the highest mushroom yield was obtained on compact round bed and it was followed by hollow bed (Table-10). At Faizabad very poor yield was recorded. Average fruiting body weight was also highest (45.5gm) from compact round bed at all the Centres and it was followed by compact square bed.

Table 10. Cultivation of paddy straw mushroom

Type of Bed	Faizabad			Coimbatore			Ludhiana		
	a	b	c	a	b	c	a	b	c
Hollow bed (6" dia)	1.43	551	8.1	19.2	408	20.0	15.7	2010	7.8
Compact bed (square)	4.30	1438	9.3	30.3	512	36.0	15.0	2015	7.4
Compact bed (round)	2.60	888	9.2	41.2	730	45.5	16.2	1819	8.9
Bundle method (hollow – 4 bundles x 5 layers + 2 bundles opened at the top)	3.14	1039	9.5	13.0	340	16.2	14.1	1755	8.0
Bundle method (5 bundlesx4 layers+ 2 bundles opened at the top)	6.58	2226	9.6	10.4	476	17.5	14.8	1935	7.6
CD (5%)	0.57	156.3	0.7	-	-	-	0.4	55	-

a-Mushroom yield (kg/100kg dry substrate); b-No. of fruiting bodies (no. / 100 kg substrate);

c- Av. Wt. of fruiting bodies (g)

2.4 Evaluation of different substrates for cultivating of milky mushroom, *Calocybe indica*

The experimental trial was conducted at 7 Centres and at all the Centres highest mushroom yield was obtained in wheat straw as substrate except Pune Centre where paddy straw

and wheat straw 1:1 (v/v) mixture gave highest yield of 59.1 kg. The mushroom yield varied from lowest of 1.96kg/100kg dry substrate at Faizabad to highest of 59.1 kg at Pune Centre. The yield levels obtained at Pune, Udaipur and Pantnagar were comparable, while it was low at Faizabad Centres (Table-11).

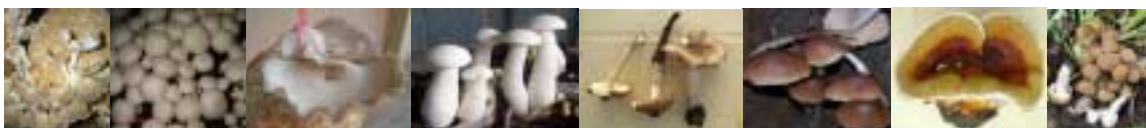


Table 11. Cultivation of *C.indica* on different substrates

Substrate	Yield (kg/100kg dry substrate) at different Centres					
	Pune	Ludhiana	Pantnagar	Faizabad	Vellayani	Udaipur
Wheat straw (WS)	45.0	53.4	48.25	23.35	-	52.8
Paddy Straw (PS)	31.3	-	20.55	-	38.94	-
WS+PS (1:1)	59.1	-	30.95	1.96	-	50.0
WS+PS (1:2)	32.1	-	26.75	-	-	51.2
WS+PS (2:1)	37.9	-	35.42	4.96	-	50.80
CD (5%)	7.08	-	2.07	4.96	-	-

**Fig. 4.1. Milky mushroom crop at Udaipur Centre****Fig. 4.2. Strainal evaluation trial on milky mushroom, *C. indica* at Vellayani**

2.5 Cultivation trial on black ear mushroom, *Auricularia polytricha*

The experiment was conducted at 3 Centres by using wheat straw and paddy straw as substrate and 2%, 5% and 10% supplementation of wheat bran. The 2% wheat bran supplemented wheat straw gave highest yield at Udaipur and Pantnagar, followed by wheat bran supplemented wheat straw both at Pantnagar and Udaipur Centres. Cultivation on paddy straw alone

resulted in slightly lower yield at Coimbatore Centre (Table-12).

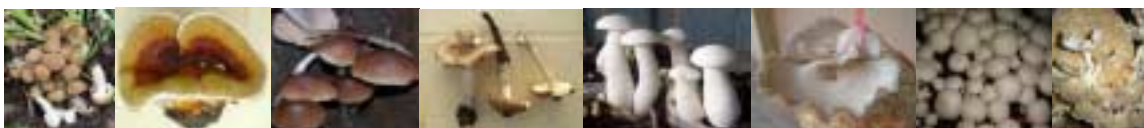
**Fig. 5. Black ear mushroom crop on mango wood chips**

Table 12. Evaluation of different substrates for the cultivation of *A. polytricha*

Substrate	Average yield (kg/100 kg substrate) at different Centres		
	Udaipur	Pantnagar	Coimbatore
WS alone	64.99	-	-
WS+WB (2%)	66.23	59.87	-
WS+WB (5%)	68.06	70.01	-
WS+WB (10%)	70.55	87.00	-
PS alone	61.42	-	36.00
PS+WB (2%)	64.24	58.09	43.02
PS+WB (5%)	65.57	62.00	44.25
PS+WB (10%)	66.40	76.03	42.53

WS – wheat straw, WB- wheat bran; PS – paddy straw

2.6 Cultivation trial on shiitake mushroom, *Lentinula edodes*

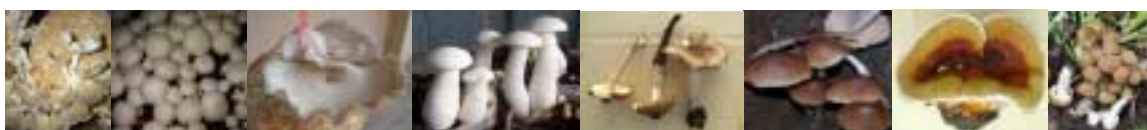
The experimental trial was conducted at 4 Centres only. Out of different substrates and supplements, the 10% wheat bran supplemented saw dust gave highest mushroom yield

at Udaipur and Coimbatore Centres. The paddy straw supplemented with different ratio of wheat bran gave comparatively good yield at Coimbatore Centre (Table-13). Average fruiting body weight (49.75 to 65.25g) was comparatively higher at Pantnagar than at Udaipur, Pune and Coimbatore Centres (14.5 to 22.04 g).

Table 13. Evaluation of different substrates for the cultivation of *Lentinula edodes*

Substrate	Average yield (g/2kg substrate) at different Centres							
	Pantnagar		Udaipur		Pune		Coimbatore	
	Yield	Av. Fruit-ing body wt. (g)	Yield	Av. Fruit-ing body wt. (g)	Yield	Av. Fruit-ing body wt. (g)	Yield	Av. Fruit-ing body wt. (g)
SD alone	-	-	-	-	-	-	183.5	18.4
SD+WB (5%)	298.5	49.75	1471.4	17.61	-	-	195.5	16.3
SD+WB (10%)	130.50	65.25	3493.5	24.6	34	17	272.0	16.0
SD+WB (20%)	445.23	52.38	3444.0	22.04	100	20	210.0	15.0
Paddy straw alone-	-	-	-	-	-	-	81.5	14.8
PS+WB (5%)	-	-	-	-	-	-	115.5	16.5
PS+WB (10%)	-	-	-	-	-	-	112.0	16.0
PS+WB (20%)	-	-	-	-	-	-	159.5	14.5

SD – saw dust, WB – wheat bran; WS – wheat straw, PS – paddy straw.



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

The experiment was conducted at 7 Centres with washing treatment of button mushroom fruiting bodies with 100, 150, 200 and 500ppm of EDTA, 100 ppm EDTA +0.02% KMS and unwashed mushroom as control. The combined washing treatment of 100ppm EDTA with 0.02% KMS gave highest whiteness just after washing and 48 hrs. of storage at 5°C at almost all the Centres. The second best treatment at Coimbatore, Raipur and Pantnagar was 500ppm EDTA, while 200 ppm EDTA at Faizabad, Ludhiana, Pune and Udaipur (Table-14).

The results were different after storing the mushrooms at ambient temperature conditions and washing with 200 ppm EDTA gave whiteness at par with that of washing with 100ppm EDTA + 0.02% KMS at Udaipur, Faizabad, Ludhiana, Pune and Raipur Centres. It was only the Pantnagar Centre, where better whiteness was retained in 500 ppm EDTA treatment than EDTA+KMS other EDTA washing treatments and the second best treatment and was recorded as 100 ppm EDTA+0.02% KMS (Table-15).

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 of 75, 100 and 125 gauge thickness and polythene of 100 gauge thickness. The packed mushrooms were stored both at ambient and refrigerated temperature conditions and the loss in whiteness, weight and opening of veil were recorded. At Coimbatore, Ludhiana, Pune and Udaipur Centres, the mushrooms packed in 100 gauge polypropylene gave better results with respect to whiteness, weight loss and veil opening on their storage both at refrigerated and ambient temperature conditions. At Faizabad and Raipur Centres better results were obtained on packaging mushroom in 125 gauge thick polypropylene, while at Pantnagar Centre no significant differences were recorded in either of the packaging treatment (Table-16). When the mushrooms were stored in different packaging materials without any hole, the 100 and 125 gauge polypropylene gave better results than other materials at Faizabad Centre (Table-17) whereas 75 and 125 gauge polypropylene gave better results at Pune Centre.

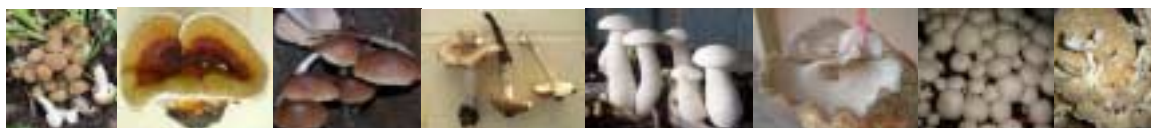


Table 14. Effect of washing treatment followed by storage at 5°C on whiteness of button mushroom, *A.bisporus*

Dipping treatment	Coimbatore				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	a	b	c	d
EDTA 100ppm	+	+	+	+	+++	++++	++++	+++	++	+++	++	++	++	-	+++	++	+++	+++	+++	+++	+	++	++	++	+++	+++	+++	+++
EDTA 150ppm	+	+	+	+	+++	++++	++++	+++	++	+++	++	++	++	-	+++	++	+++	+++	+++	+++	+	+	++	++	+++	+++	+++	+++
EDTA 200ppm	+	+	+	+	+++	++++	++++	+++	++	+++	+++	+++	++	-	+++	++	+++	+++	+++	+++	+	+	++	++	+++	+++	+++	+++
EDTA 100 ppm +0.02% KMS	+	+++	++	++	+++	++++	++++	+++	++	+++	+++	+++	++	-	++++	+++	+++	+++	+++	+++	+	+	+	+	+++	+++	+++	+++
EDTA 500 ppm	+	+++	+	+	+++	++++	++++	+++	++	+++	++	++	++	-	++++	++++	+++	+++	+++	+++	+	+	+	+	+++	+++	+++	+++
Unwashed	+	+	-	-	+++	+++	+++	+++	++	++	+	+	++	-	++	+	++	+++	++	+	+	+	++	++	+++	+++	+++	+++
Water washed	-	-	-	-	-	-	-	-	++	+++	++	++	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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

Table 15. Effect of washing treatment followed by storage at ambient temperature conditions on whiteness of button mushroom, *A. bisporus*

Dipping treatment	Coimbatore				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	a	b	c	d
EDTA 100ppm	+	+	+	-	+++	++++	++++	++	++	+++	++	++	++	-	+++	+	+++	+++	+++	+++	++	++	++	+++	+++	+++	+++	++
EDTA 150ppm	+	+	+	-	+++	++++	++++	++	++	+++	++	++	++	-	+++	+	+++	+++	+++	+++	++	++	++	+++	+++	+++	+++	++
EDTA 200ppm	+	+	+	-	+++	++++	++++	++	++	+++	+++	+++	++	-	+++	+	+++	+++	+++	+++	++	+	++	+++	+++	+++	+++	++
EDTA 100 ppm +0.02% KMS	+	+++	++	+	+++	++++	++++	+++	++	+++	+++	+++	++	-	+++	++	+++	+++	+++	+++	++	++	+++	+++	+++	+++	+++	++
EDTA 500 ppm/ kms	+	++	+	-	+++	++++	++++	++	++	++	++	++	++	-	++++	+++	+++	+++	+++	+++	++	++	++	+++	+++	+++	+++	++
Unwashed	+	+	-	-	+++	+++	+++	+	++	++	+	+	+	-	+	+	+++	+++	+++	++	++	++	+++	+++	+++	+++	++	+
Water washed	-	-	-	-	-	-	-	-	++	+++	++	++	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

a) before washing; b) after washing; c) after 24 hrs. of washing; d) after 48 hrs. of washing.

Table 16. 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	Coimbatore			Faizabad			Ludhiana			Pantnagar			Pune			Raipur			Udaipur		
	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c
75 gauge PP (R)	+	12.5	10	++++	3.8	0	++	1.3	1	++++	0	N	-	-	-	+	0.45	-	+	5.88	-
(A)	+	14	30	++	14.4	11	++	2	4	+++	0.35	N	-	-	-	++	0.43	-	+	6.66	-
100 gauge PP(R)	++	7.0	8	++++	4.2	0	++	0	-	++++	0	N	+++	+2.5	-	+	0.43	-	+++	0	-
(A)	++	8.5	25	+++	15.3	9	++	3.4	2	+++	0.30	N	+++	1	2	+	0.31	-	+++	11.11	-
125 gauge PP(R)	++	9.0	8	++++	3.5	0	+++	2.6	-	++++	0	N	-	-	-	+	0.15	-	+++	0	-
(A)	++	10.0	28	+++	14.8	10	+++	5.3	2	++++	0.25	N	-	-	-	++	0.32	-	+++	14.29	-
100 gauge PE(R)	++	7.5	10	++++	3.6	0	++	0	1	++++	0	N	++	5	-	+	0.17	-	+++	0	-
(A)	+=	10.0	30	+++	14.6	10	++	4.7	1	++++	0.32	N	+++	5	3	+	0.28	-	++	12.5	-

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

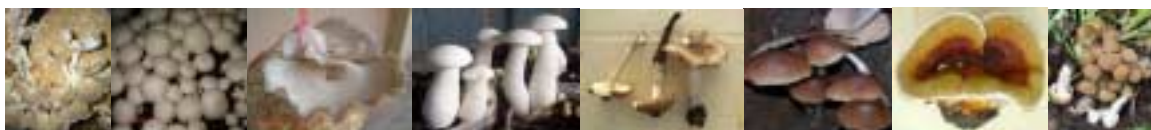


Table 17. Effect of different packaging treatments without hole on whiteness, weight loss and veil opening of button mushroom on storage for 48 hrs. at refrigerated and ambient temperature conditions

Treatment		Faizabad			Pune		
		a	b (%)	c (%)	a	b (%)	c (%)
75 gauze PP	(R)	++++	3.6	0	-	-	-
	(A)	++	11.6	14	-	-	-
100 gauze PP	(R)	++++	3.3	0	++	0.5	2
	(A)	+++	11.9	12	++	3	3
125 gauze PP	(R)	++++	3.5	0	-	-	-
	(A)	++	11.7	11	-	-	-
100 gauze PE	(R)	++++	3.3	0	+++	0.5	2
	(A)	+++	11.4	12	++	6	4

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, chemical treatment 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 recorded to be better in treatment involving blanching followed by sun-drying method at Coimbatore and Ludhiana Centres. However, at Udaipur and Raipur, the chemical treatment with sun drying and simple washing with sun-drying gave better results with respect to whiteness, brittleness and keeping quality after 3 months of storage (Table-18).



Fig. 6.1. Dried oyster mushroom by following different methods at Udaipur



Fig. 6.2. Value added product produced from mushrooms at Udaipur

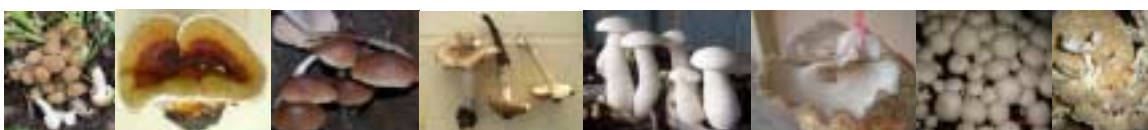


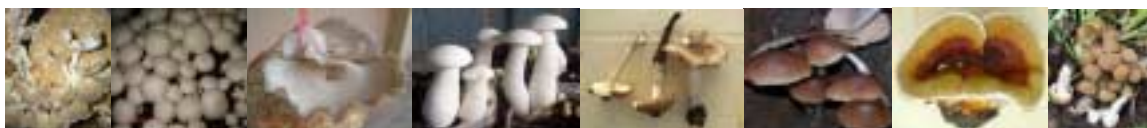
Table 18. Effect of different drying treatments on quality of dried oyster mushroom, *Pleurotus* spp.

Treatment	Coimbatore				Ludhiana				Raipur				Udaipur			
	a	b	c	d	a	b	c	d	a	b	c	d	a	b	c	d
Blanching and sun drying	++++	0.00	++	30.00	++++	++++	+++	-	Light brown	+	+	35.37	-	+++	88.0	
Chemical treatment and sun drying	+	0.00	+	0	++	++++	+++	-	Yellowish	++	+	39.56	+++	++	86.5	
Simple washing and sun drying	-	High	++	85.00	++	++++	++++	-	Light brown	++	+	29.87	+++	++	86.5	
Cabinet drying	+	Low	+	60.00	++++	++++	+++	-	Dark brown	+	+	31.28	-	++	85.5	

a)whiteness (++++ snow white, ++++ white, +++off white, + pale),

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

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



4. COLLECTION AND PRESERVATION OF FLESHY FUNGI

Coimbatore Centre

A total of 20 fleshy fungi were collected during the survey. Among them one each of *Agaricus*, *Calocybe*, *Ganoderma* and *Schizophyllum* were pure cultured.

Faizabad Centre

Surveys were conducted during rainy season in the forest areas of Faizabad and Sultanpur districts. A total of 34 samples were collected, out of which, 7 were *Volvariella* spp., 3 of *Termitomyces* spp., 3 of *Ganoderma* spp., 2 still unidentified and rest could not be cultured and identified.

Pantnagar Centre

Survey of wild fleshy fungi was conducted during the rainy season in the forest areas of Nainital, Bageshwar, Udham Singh Nagar, Pithoragarh and Dehradun districts of Uttaranchal. A total of twenty-nine specimens were collected out of which, 11 were identified tentatively. Some of the collections included *Geastrum* sp., *Boletus* sp., *Lepiota* sp., *Polyporus* sp., *Laetiporus*, *Cordyceps sinensis*, *Ganoderma* sp., *Coriolus* sp., *Ganoderma lucidum*, *Russula* sp., *Amanita* sp., *Hygrophorous* sp., *Hericium* sp., *Pleurotus* sp., *Termitomyces* sp., *Polyozellus* sp., *Auriculariya* sp., *Ramaria stricta*, *Armillaria* sp., *Collybia* sp., *Clavaria* sp., *Lactaria* sp. and *Suillus* sp.

Pune Centre

Surveys were conducted during the monsoon in different locations. The following fleshy fungi viz., *Podaxis pistillarius*, *Agaricus xanthodermis*, *Russula* spp., *Termitomyces* spp., *Ganoderma* spp., *Agaricus* spp., *Termitomyces* spp., *Lecocoprinus brebivesoni*, *Clitocybe* spp., *Ramaria* spp., *Clavaria* spp., *Letiopus* spp., *Polypore sulphurius*, *Agaricus augustus*, *Lepiota* and Earth star. Attempts have been made to isolate pure culture from them and 8 cultures were isolated and are purified.

Raipur Centre

Survey for wild mushroom flora was conducted during monsoon season in two districts of Chhattisgarh i.e. Raipur and Jagdalpur. Mushroom flora occurring in the vicinity of College of Agriculture was regularly

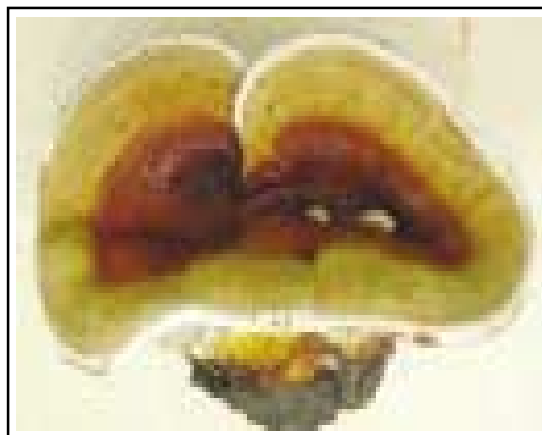


Fig. 7. Fruit body of *Ganoderma applanatum* collected naturally at Raipur

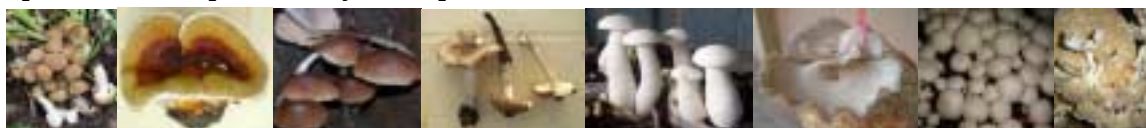




Fig. 8. *Hericium erynesius* on twig of mango tree collected naturally at Raipur



Fig. 9. *Termitomyces* spp. collected from termite mounds at Raipur

surveyed from June to August month. However, mushroom flora in Jagdalpur area was surveyed in the month of July and August. In all, 26 species of edible, inedible, medicinal and poisonous mushroom were collected from soil, termite mounds, wood logs, live plants, rotten leaves and market areas. The following fleshy fungi viz., *Auricularia* sp., *Amanita pantharina*, *Amanita vagnata*, *Amanita spissa*, *Collybia asema*, *Drosophila* sp., *Canthrellus* sp., *Coprinus* sp., *Ganoderma lucidum*, *Ganoderma applanatum*, *Lacrymaria velunita*, *Lepiota racodes*, *Polyporus ovinus*, *Pleurotus dryinus*, *Russula alutacea*, *Russula delica*, *Russula nigricans*, *Termitomyces* (Kanki phutu), *Termitomyces* (Bhimora phutu), *Termitomyces* (Bhadophutu), *Tuber* sp., *Mycena* sp., *Tricholoma* sp., *Boletus edulis* and *Pleurotus eous* were collected and identified.

Udaipur Centre

Total of 11 surveys were made in the month of July, August and September 2005. This year rain were started late in the last week of July only. Therefore, the collection were done only in August month in different district of Rajasthan such as Udaipur, Jodhpur, Sirohi, Pali, and Chittorgarh districts. The major area surveyed were Badgoan, Iaswal, Gogunda, Jhadol, Pai, Peepalvas, Undri, Nai, Sisarma, Locing, Khamnoor, Kelwara, Jarga, Jaswanthgarh, Saira, Malgarh, Pindwara, Sai, Malva Ka Chora, Pindwara, Falna, sadari, Pali and Jodhpur. Total of 113 different wild specimens were collected. Their data base, culture, spore prints were prepared. The specimens were preserved in dry form only. The most common occurring genera are *Agaricus* spp. *Calocybe* sp.,

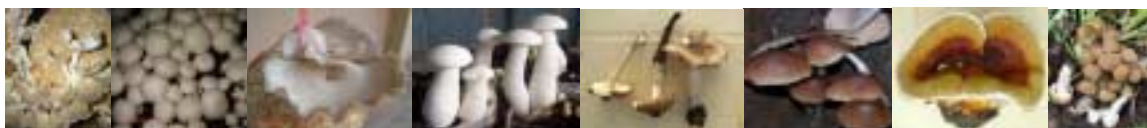




Fig. 10.1. *Pholiota squarrosoides* growing under natural conditions in Udaipur area

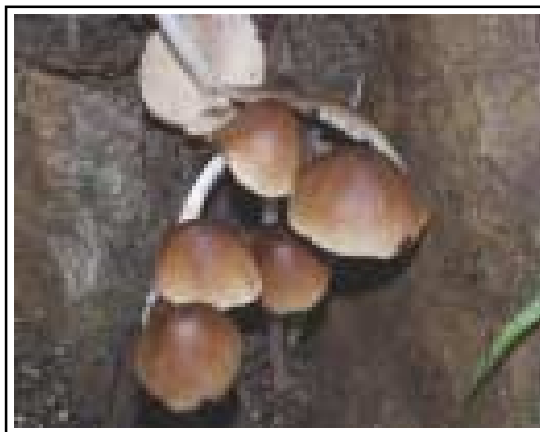


Fig. 10.2. *Collybia* sp. growing under natural conditions in Udaipur area

Auricularia, *Podaxis pistillaris*, *Lepiota* spp., *Volvariella* spp., *Pleurotus* spp., *Ganoderma* spp., *Schizophyllum commune*, *Geastrum* spp., *Pisolithus tintorius*, *Polypores*, *Mycena*, *Marasmius* spp., and *Phellorina* spp.

Some rare collection are *Melastiza chateri*, *Xylaria hypoxylon*, *Colocybe gambosa*, *Fuligo septica*, *Entoloma caesiocinctus*, *Hericius erinaceus*, *Sterum hirsutum*, *Polypores sulphureus*, *Ramaria fennica*, *Phellorina herculea* and *Microglossum viride*.

Vellayani Centre

The cultures of the ten strains of *Calocybe indica* were deposited in the National Mushroom Culture Bank at NRCM Solan for which accession numbers were obtained. The other isolates viz. *Pleurotus eous*, *Ganoderma lucidum* and *Schizophyllum commune* were

brought into pure culture and is being preserved in the laboratory of the AICRP- Vellayani Centre.

Solan Centre

Fungal forays were conducted in the forest areas of Himachal Pradesh namely Shilly, Fagu, Cheog, Baghi, Kufri, Narkanda, Ratnadi, Khada Pathar and Mashobra. Parts of the Haryana and Chandigarh were also visited for collection of wild specimens. In all 371 wild specimens were collected. All the specimens were examined and photographed under natural conditions. Spore prints along with dried specimens have been preserved in the Herbarium. Attempts were made to obtain tissue cultures from the fresh specimens on common mycological medium. The list of Agaricoid genera and their collections family wise are mentioned in Table 19. Some of the specimens have more than 2 to 3 collections from different areas.

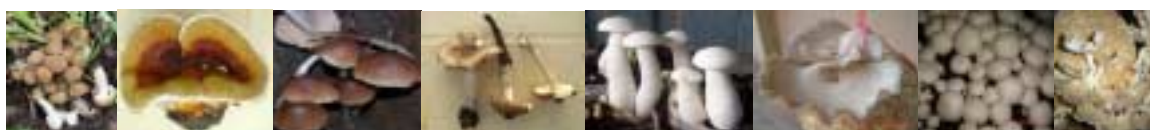
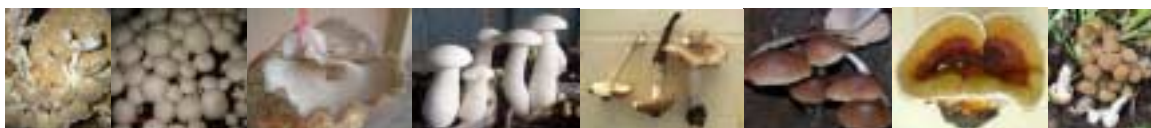


Table 19. List of Agaricoid specimens collected at Solan

S.No.	Family	Genera (No. of species collected)
1	Agaricaceae	<i>Chlorophyllum</i> (1), <i>Agaricus</i> (13), <i>Lepiota</i> (6), <i>Macrolepiota</i> (1), <i>Leucocoprinus</i> (1)
2	Amanitaceae	<i>Amanita</i> (18), <i>Limacella</i> (1)
3	Bolbitiaceae	<i>Descolea</i> (2), <i>Agrocybe</i> (2)
4	Boletaceae	<i>Boletus</i> (5), <i>Leccinum</i> (1), <i>Suillus</i> (1), <i>Strobilomyces</i> (1)
5	Coprinaceae	<i>Psathyrella</i> (4), <i>Paneolus</i> (1)
6	Cortinariaceae	<i>Cortinarius</i> (11), <i>Inocybe</i> (17), <i>Gymnopilus</i> (3), <i>Hebeloma</i> (1), <i>Galerina</i> (2)
7	Crepidotaceae	<i>Crepidotus</i> (3)
8	Entolomataceae	<i>Entoloma</i> (4)
9	Gomphidiaceae	<i>Gomphidius</i> (3)
10	Hygrophoraceae	<i>Hygrophorus</i> (4), <i>Camerophyllus</i> (1)
11	Paxillaceae	<i>Paxillus</i> (1)
12	Pluteaceae	<i>Pluteus</i> (2), <i>Volvariella</i> (1)
13	Polyporaceae	<i>Pleurotus</i> (8), <i>Polyporus</i> (8), <i>Lentinus</i> (6), <i>Panus</i> (1), <i>Panellus</i> (1)
14	Russulaceae	<i>Lactarius</i> (3), <i>Russula</i> (1)
15	Strophariaceae	<i>Psilocybe</i> (1), <i>Stropharia</i> (2), <i>Pleuroflammula</i> (1), <i>Nematoloma</i> (6), <i>Pholiota</i> (2)
16	Tricholomataceae	<i>Marasmius</i> (7), <i>Mycena</i> (5), <i>Oudemansiella</i> (1), <i>Tricholoma</i> (5), <i>Laccaria</i> (8), <i>Lyophyllum</i> (7), <i>Clitocybe</i> (5), <i>Lepista</i> (1), <i>Melanoleuca</i> (2), <i>Collybia</i> (6), <i>Armillaria</i> (3), <i>Leucopaxillus</i> (1)



5. SURVEY AND SURVEILLANCE OF DISEASES AND INSECT PESTS

Coimbatore Centre

During the survey of diseases and insect pests, *Coprinus* sp. infection was observed in oyster, milky and paddy straw mushroom beds from spawn running till harvest. Mould infection was found in paddy straw mushroom beds. In milky mushroom, the fungus *Trichoderma pseudokoningii* was observed and it caused gill spotting. Brownish necrotic lesions were recorded on the gills and the sporophore was totally rotten within a day.

Faizabad Centre

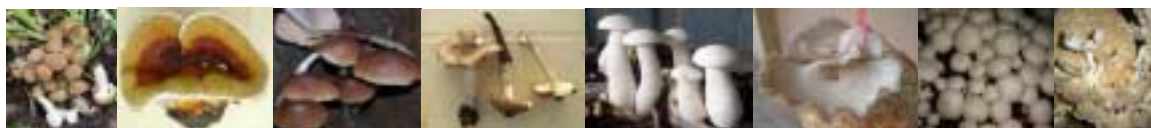
Survey for recording of the incidence of diseases and insect pests were carried out at farmer's units in the district Barabanki and Faizabad. Studies indicated that competitor moulds are the major constraints in the mushroom cultivation in this area. Few mycoparasitic nematodes and insects were also observed in or on substrate / fruiting bodies. Cultivation of button mushroom was most influenced by the fungi like *Trichoderma* spp., *Penicillium* spp., *Coprinus* spp. and *Alternaria alternata*; and presence of nematodes in manure was also confirmed. Cultivation of oyster mushroom was badly affected by *Trichoderma* spp., *Aspergillus* spp. and *Penicillium* spp., bacterial infection in beds was also observed. Paddy straw

and milky mushrooms were most affected by *Coprinus* spp., *Trichoderma* spp., *Penicillium* spp. and *Rhizopus* spp., and occurrence of insect phorids was also observed.

Pantnagar Centre

Marginal & small-scale mushroom farms located in the district U.S.Nagar and Nainital of Uttaranchal were surveyed periodically during crop season 2005-06. It was observed that green mould caused by *Trichoderma* spp. prevailed to the extent of 47.33% in marginal scale mushroom growing in hut conditions. Of the mushroom growing units surveyed, *Deihliomyces microsporus* and *Papulaspora byssina* were observed in 9.33% and 12.67% growing units, respectively in the month of February – March, 2006. *Verticillium fungicola* was observed in 6.49% out of 123 marginal & small growing units visited.

Infestation of sciarid and phorid flies was observed in 14.67% and 6.50% beds, respectively in last stage of the crop in most of the mushroom huts. During the month of March / April mushroom beetles were observed 16.38% in the cropping rooms (huts) of *Pleurotus* spp. Browning of the pin heads and Rose comb were also observed in 21.67% and 0.06% beds, respectively.



Pune Centre

Survey and surveillance of pests and diseases was carried out in the College of Agriculture, Pune campus and a total of 300 beds of button mushroom were observed in different experiments out of which 5 were found contaminated. Among the insects, mainly sciarid fly (10/bed) are recorded. The green mould disease incidence was up to 10%. In oyster mushroom experimental trials, total 60 beds were inspected, of which 10 were found contaminated. The incidence of sciarid flies was recorded @ 15/bed and 20% beds were recorded to be infected with green mould disease. In milky mushrooms total of 35 beds were inspected in the trials in which 5% beds were found to be infected with green mould disease.

During survey of private button mushroom farms, a total of 2500 beds were surveyed, of which 10 beds were found contaminated. The 10 number of Sciarid flies were observed per bed. The most common disease noticed was green mould up to 10%. A total 200 beds of oyster mushrooms were surveyed on private farms of which 23 beds were found to be contaminated. The 10 number of Sciarid flies were observed per bed. The beds of oyster mushroom were found to be contaminated up to 15 % due to green mould disease.

Raipur Centre

The work on survey and surveillance of various diseases and

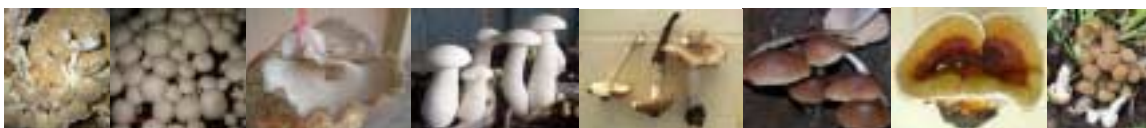


Fig. 11. Fruit body of *A. bisporus* infested with *Trichoderma* spp. at Raipur

insect pests of oyster mushroom was carried out in five mushroom farms at Bilaspur, Raipur and Durg districts



Fig. 12. Oyster mushroom bed contaminated with *Trichoderma* in layer method of spawning



during winter season. In all the cases, bags were contaminated with *Trichoderma* sp., *Sclerotium rolfsii*, *Coprinus* sp., patchy growth, yellow blotch and two farms showed the infestation of phorid and cecid fly in traces. In other farm, no infection of insect pests was observed.

Udaipur Centre

Different mushroom farms located at Udaipur, Bikaner, Nokha, Gusaisar and Jasrasar were visited for survey and surveillance of diseases and insect pests. Total of 25 mushroom farms were visited for occurrence of diseases and insect pests in Udaipur region, whereas 6 farms of button mushroom were visited in Bikaner district. It was observed that in tribal area no disease and insect pests were found. Further, only at 2-3 farms in Goran village infection of *Coprinus* spp. and green mould were observed in traces only.

In winter season, 20 farms of button mushroom were visited around Udaipur and Bikaner districts. In Udaipur district *Coprinus comatus* and dipterian fly were observed in 1-2 farms. The incidence was very low, while at Bikaner, browning, dipterian and house fly were observed. More over in district of Bikaner problem of casing material was observed.

Vellayani Centre

A survey was conducted on the incidence of mushroom pests in the region during the early months of summer 2005-2006 at five locations.

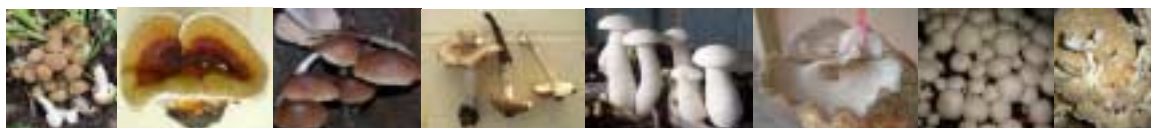
Two growing houses were examined in each location where both oyster and milky mushrooms were grown. Commonly found pests were mushroom flies namely, phorids, sciarids and cecids. Mild to medium level infestation and about 5 to 20% damages were noticed. No diseases could be noticed in any of the localities. The use of blue and yellow light traps in growing houses and keeping hygienic in and around the growing houses were recommended to tackle the pest problems in this region.

Ludhiana Centre

Survey and surveillance of pests and diseases was carried at PAU campus in 5 various strains (CM-3, CM-5, CM-10, S-11, U-3) of button mushroom grown on long method of compost. The incidence of *Trichoderma* spp., *Coprinus* spp., *Papulaspora byssina* and *Sepedonium* spp. were recorded on the compost bags. Among the abiotic disorder incidence of stroma, open veil and scales were observed in 2-3% bags. Among the insect pests, 5 % incidence of sciarid fly and phorid fly was observed.

Solan Centre

Surveys of different mushroom farms revealed the widespread incidence of wet bubble, brown plaster mould, ink caps at Kurukshetra, Sonapat and other adjoining areas of Sonapat (Haryana) and Chambaghat, Vaknaghat, Deothi and adjoining areas of Solan. Sciarid flies, mites and springtails were common in most of the farms visited.



6. EXTENSION ACTIVITIES

Coimbatore Centre

During the year 2005-2006 regular “one day training programmes” on mushroom cultivation were continued as usual on 5th of every month. Put together 275 such programmes have been conducted and more than twenty thousand people have been trained on oyster mushroom and milky mushroom production so far. The Centre has also participated in two exhibitions.

Faizabad Centre

In order to promote mushroom cultivation in Eastern Uttar Pradesh concerted efforts were made through trainings, demonstrations, advisory services, participation in Kisan Mela and by supplying ready spawn to growers for cultivation of mushroom.

a. Training

1. *Vocational training for rural youth:* Under this training programme organized by KVKs working under NDUAT, Kumarganj, the Centre participated in three trainings and trained 60 trainees. In future, efforts will be made to cover all 15 KVKs.
2. *Off-campus training programmes:* Three such training programmes were organized at village Somntha ka Purva and Kumarganj and at

Cantonment, Faizabad with the participation of 57 trainees.

3. *On-campus training programmes:*
 - a. One hundred and twenty-four graduates were trained in cultivation technology of different edible mushrooms.
 - b. Small groups of 2-5 growers have been visiting mushroom unit and getting one day training. Thus during the period under report 87 growers were trained on-campus. Efforts are being made to organize more training programmes with higher strength.

b. Kisan Mela

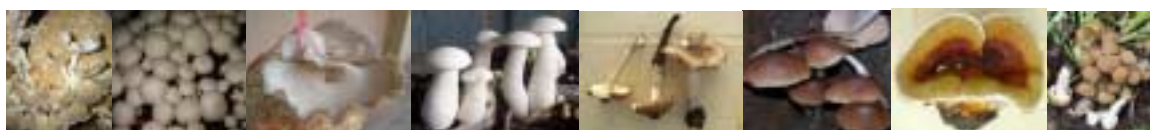
Participated and exhibited mushroom cultivation technology in Kharif (19-20 November, 2005) and Rabi (24-25 February, 2006) season Kisan Mela & Agriculture Exhibitions organized by NDUAT, Kumarganj with the registration of 4871 farmers.

c. Spawn supply

In total 450 kg mushroom spawn was prepared, 175 kg was supplied to farmers and rest was used in various experiments.

d. Front-line Demonstrations

Ten each for oyster and milky mushroom were laid down at village



level in Faizabad and Sultanpur districts. One demonstration of button mushroom was conducted at Cantonment, Faizabad.

e. Visits

During the year 86 school children with their teachers, 327 mushroom growers / consumers, QRT members with Director, NRCM, Solan and authorities of NDUAT, Kumarganj

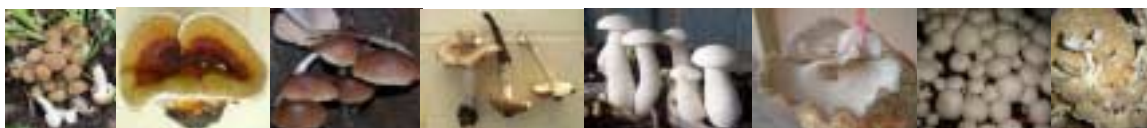
viz. Vice-chancellor, Director of Research, Dean College of Agriculture and Registrar visited the mushroom unit.

Ludhiana Centre

The various training programmes organized by the Centre are presented in the following Table-20. In addition, 14 lectures cum demonstration programmes were conducted in

Table 20. List of training programmes organised by Ludhiana Centre

S.No.	Training course	Duration	No. of participants
1	Mushroom training lecture on tropical mushroom cultivation and processing for ADO's from Punjab at PAU, Ludhiana	19.04.05 – 21.04.05	22
2	Capsule training course by WWICS at PAU, Ludhiana	11.05.05	40
3	Mushroom training course at PAU, Ludhiana	12.09.05 – 16.09.05	23
4	Mushroom training course at PAU, Ludhiana	26.09.05 – 30.09.05	35
5	Mushroom training course for Military Personnels of Khasa at Amritsar	5.10.05	50
6	Mushroom training course at KVK, Langroya	7.10.05	15
7	Capsule training course of mushroom cultivation for WWICS at Mohali	24.10.05	55
8	Mushroom training course for young farmers for generating self employment	21.11.05 & 28.11.05	42
9	Mushroom training course for farm workers from KVK, Bathinda	5.12.05	2
10	Farming system approaches on PAMETI at PAU campus, Ludhiana	12.12.05	13
11	Entrepreneurship development programme in agricultural business (Mushroom cultivation for ASI, KVK)	8.02.06	19



various places of Punjab viz. Gurdaspur, Ballawal, Rauni, Ludhiana and Bhatinda. The Centre also participated in 3 Kisan Melas at Gurdaspur, Ballawal, Rauni, Ludhiana and Bhatinda. A TV talk on cultivation of summer varieties of mushrooms was delivered on DDK, Jalandar on 22.05.05.

Pantnagar Centre

a. Training

Five training programmes on different aspects of mushroom cultivation were organized and a total of 96 participants from Almora, Lucknow, Pauri, Himachal Pradesh, Uttar Pradesh and Uttaranchal got trained at the Centre.

b. Spawn supply

Two thousand eight hundred forty kilogram (2840 kg) of mushroom spawn, 28 bottles of master spawn and 62 culture tubes of different species / strains were supplied to the growers and spawn producers in the year 2005-06.

c. Compost supply

The Centre has supplied 984.48 Quintal compost alongwith spawn and casing soil (196.9 quintal) to farmers from April, 2005 to February, 2006. Besides, 18.67 MT compost prepared and used at Mushroom Research & Training Centre(MRTC).

d. Field days and Front Line Demonstration

During the year under report, mushroom field days were organized at growers farm and front line demonstrations (FLD) of Dhingri and milky mushroom were laid down in Nainital, U.S.Nagar and Almora Districts of Uttaranchal.

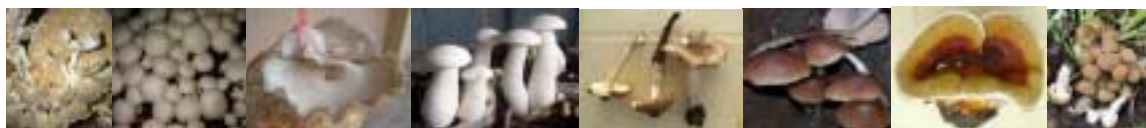
Pune Centre



Fig. 13. Mrs. Kapre established her own market for oyster mushroom in Pune city



Fig. 14. Prof. T.K. Narute, Mycologist delivering lecture on mushroom cultivation to the students of Khalasa college Mumbai



Raipur Centre

Besides the research activities, this Centre is also working on transfer of mushroom growing technology to the rural as well as urban people through organizing training/kisan mela/kisan divas, live demonstrations cum training programmes for extension workers, sale of mushroom spawn, mushroom pickle, publicity through research articles, popular articles, folder, bulletins and coverage of the news in local news papers, weekly magazines, monthly magazines, All

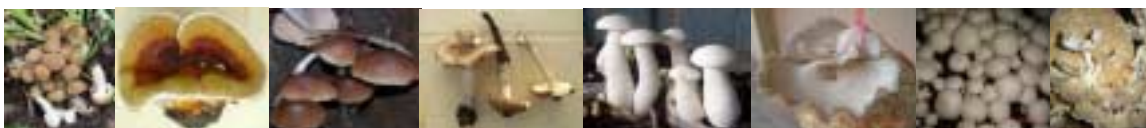
India Radio and Raipur Doordarshan, Sahara TV, E TV, etc. The Table-21 shows the various training programmes, national workshops and ICAR short course organized by the Raipur Centre during the year under report.

a. Extension material developed

1. Oyster Mushroom utpadan takniki
2. Safed dudhia mushroom utpadan takniki
3. Para mushroom utpadan takniki

Table 21. Training programmes /National Workshop/ICAR Short Course organized by Raipur Centre

S. No.	Training	From	To	Sponsoring agency	Trainees from	No. of participants
1.	Mushroom processing technology	14.6.05	16.6.05	DBT	Dondekhurd	20 women
2.	Mushroom processing technology	20.6.05	22.6.05	DBT	Tarra	23 women
3.	Mushroom spawn production technology	18.7.05	21.7.05	DBT	Tarra and Dondekhurd	14 women
4.	Training on mushroom production technology	1.8.05	11.8.05	University	Government Science College	7 students
5.	Mushroom production technology	19.9.05	21.9.05	DBT	Tarra	40 women
6.	Mushroom production technology	23.11.05	25.11.05	DBT	Dondekhurd	20 women
7.	Mushroom production technology	6.12.05	15.12.05	University	Government Science College	7 students
8.	National workshop "Awareness Creation on Biodiversity and Conservation of Mushroom"	1.12.05	2.12.05	NBA, Chennai	All over India	150
9.	ICAR Short course	9.1.06	18.1.06	ICAR, New Delhi	All over India	21



b. TV / Radio Talk

1. Thakur MP (2004). A radio talk on 'Mushroom ki kheti' was broadcasted by All India Radio on 9th May, 2004.
2. Shukla CS (2005). A T.V. talk on 'Milky mushroom ka utpadan Main samansyaen' was telecasted by Doordarshan Kendra, Raipur under 'Bhuiya Ke Goth' on 22nd August, 2005.
3. Shukla CS (2005). A documentary film on "Mushroom ki kheti kaisen kare evam samasyen" was telecasted by Doordarshan Kendra, Raipur on 25th March 2005
4. Shukla CS (2005). A T.V. talk on 'Oyster mushroom ka utpadan Main samasyen' was telecasted by E TV, M. P. under Annadata programme on 12 February, 2006.
5. Shukla CS (2005). A T.V. talk on 'Mushroom spawn kaise banayen' was telecasted by E TV, M. P. under Annadata programme on 20 March, 2006.
6. Shukla CS (2005). A Radio talk on 'Mushroom ka utpadan Kaqse karen' was telecasted by AIR Ambikapur, under Choupal on 27th January, 2006.

c. Participation in Kisan Mela / Exhibition/ NSS Camp

1. Participated in 4-day Western Region Krishi Exhibition Cum

Kisan Mela being organised by IGAU and Department of Agriculture at College of Agriculture Campus, IGAU, Raipur on 14-17th March 2005. Mushroom exhibits related to production, protection and preparation of recipies were displayed. A video CD on 'Mushroom Production Technology' was displayed during the whole day.

2. Participated in Rajyotsava 2005 being organised by Govt of Chhattisgarh at Pt. RSU Campus Raipur from 1-7th November 2005 and mushroom production technology was demonstrated through coloured charts.

d. Video CD on Mushroom

1. A video CD on "Oyster Mushroom Production Technology" was prepared.

Ranchi Centre

1. Efforts were made for popularization of mushroom cultivation in Eastern India through availability of quality spawn to farmers of Jharkand, Bihar, Uttar Pradesh, West Bengal, and Chhattisgarh. A total of 3324.8 kg of spawn were made available to the farmers.
2. The following training programmes have been conducted. The details are given in the Table-22 below.

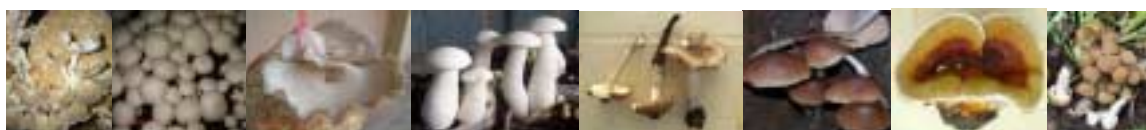


Table 22. List of training programmes organised by Ranchi Centre

S. No.	Name of training course	Sponsoring agency	Duration	Total no. of trainees
1	Production of Mushroom	Deptt. of Soil Conservation, Ranchi	3.6.2005 – 7.6.2005	25
2	Production of Mushroom	Deptt. of Soil Conservation, Ranchi	10.6.2005 – 14.6.2005	24
3	Production of Mushroom	Deptt. of Soil Conservation, Ranchi	17.6.2005 – 21.6.2005	20
4	Production of Mushroom	Horticulture & Agro Forestry Research Programme, Ranchi	9.8.2005	32
5	Production Technology of Mushroom	World Vision, Khunti, Ranchi	16.9.2005	19

3. Literature on Milky mushroom in Hindi was published and distributed to interested growers. **Udaipur Centre**

Table 23. Training programme held from March 2005 to March 2006 at Udaipur Centre

S. No.	Date	Topics	No. of Trainees	Sponsors
1	04.03.05	Mushroom cultivation	30 (BPL farmers)	Katholic church
2	05.03.05	Mushroom cultivation	600 Tribals	MPUAT, Udaipur
3	15.03.05	Mushroom cultivation	15 mentally retarded children	Praish NGO
4	28.03.05	Mushroom cultivation	25 Women	DEE
5	31.05.05	Mushroom cultivation	1 Entrepreneur	Paid
6	12.08.05	Mushroom cultivation	32 Farmers	VRS employees of Hindustan Zinc
7	18.01.06	Mushroom cultivation	50 Women	CSS Govt. of Rajasthan
8	21.01.06	Button mushroom cultivation	73 Women	CSS Govt. of Rajasthan
9	6.02.06	Mushroom cultivation	21 Farmers	Self help group
10	16.02.06	Mushroom cultivation	35 Farmers	Agri. Deptt.
11	9.03.06	Mushroom cultivation	50 Farmers	Agri. Deptt.
12	10.03.06	Mushroom cultivation	70 Farmers	Agri Deptt., Barmer

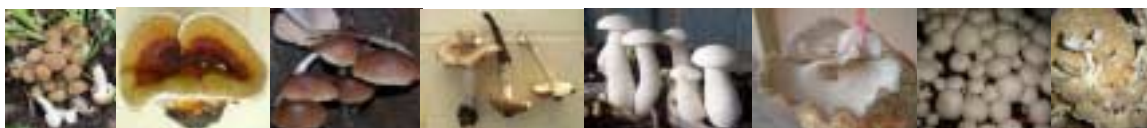




Fig. 15.1. Trainees filling substrate bags at Udaipur



Fig. 15.3. Dr. Anila Doshi explaining mushroom cultivation technology to women trainees



Fig. 15.2. Mushroom grower harvesting button mushroom



Fig. 15.4. Dr. Anila Doshi explaining compost preparation technologies to visitors

Vellayani Centre

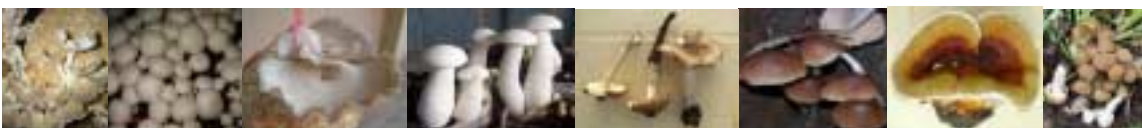
1. One batch of VHSC students was given training on tropical mushrooms
2. The Centre participated in three day Mushroom Grower's Meet organized by TBGRI at Trivandrum.
3. Conducted training programme on mushroom cultivation for 3 batches of total 90 individuals

4. Participated in one exhibition at Trivandrum.
5. Supplied about 6000 bags spawn to the growers.
6. Participated in the Mushroom Mela organized by RBGRI at Thiruvananthapuram.

Solan Centre

a. Mushroom Mela- 2005

The ninth one day Mushroom Mela was organised on 10th September, 2005



– the day on which Solan was declared as Mushroom City of India. It was inaugurated by Dr. Jagmohan Singh, Vice Chancellor Dr. Y.S. Parmar University of Hort. and Forestry, Solan (H.P.) in the presence of Ex-Director, NRCM, Dr.H.S. Sohi and other dignitaries.

It was attended by about 650 farmers, farm women, mushroom growers, researchers, extension workers and businessmen from various states viz; Himachal Pradesh, Haryana, Punjab, Uttar Pradesh, Bihar, Maharashtra, Rajasthan, Delhi, Sikkim, Kerala and Uttranchal.

An exhibition on improved mushroom cultivation technologies and other related aspects was organised in which twelve Govt. organisations, ICAR Institutes/ University, Govt. financial organisation, compost and spawn producers, mushroom product manufacturers, seed, pesticides and chemicals suppliers and NGOs displayed their valuable information/ technologies/products and provided their services to the participants of Mushroom Mela.

In order to make the participants aware about various improved technologies/practices of mushroom cultivation, farm visit of the Centre, s growing unit was conducted and improved technologies were demonstrated to the participants of Mushroom Mela.

During the afternoon session, a Kisan Goshthi was held to solve the problems in mushroom cultivation faced by mushroom growers from all over the country. On the occasion, the Centre also awarded a progressive mushroom grower -Mr. Vikash Banal, R/O village Samlach, Solan(H.P) for adopting innovative practices in mushroom cultivation at larger scale.

b. Training Programmes Conducted

During the year under report, the Centre organised a total number of 13 on&off-campus training programmes for farmers, entrepreneurs & Agril/ Hort Officers. A list of training programmes organised at the Centre is presented in Table-24

c. Popularization of milky mushroom in H.P.

Keeping in mind the need of diversification in mushroom cultivation, milky mushroom crop was raised at the Centre during the period April to July, 2005. Substrate was prepared through pasteurization techniques. This crop was shown to the visitors at the Centre. Milky mushroom cultivation has already been adopted by farmers and mushroom growers of Hamirpur, Bilaspur, Mandi, and Una districts of H.P. as climate of these districts is conducive for milky mushroom cultivation. Farmers of Solan district were also motivated to grow milky mushroom during summer season.

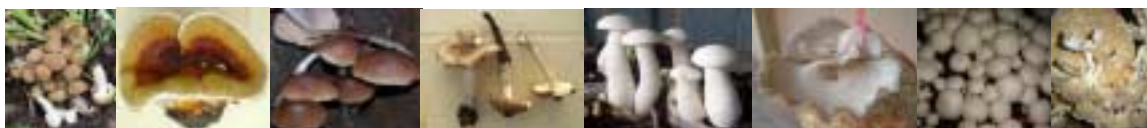
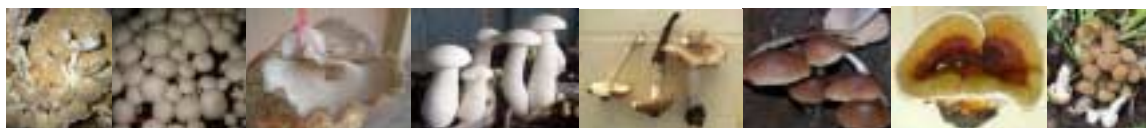


Table 24. Training programmes conducted during the year April,2005-March,2006

S. No.	Name of Training Programm	Sponsored by	No. of Trainees	CD & CC
1.	Seven days training on mushroom production for farm women of Shimla (H.P.) w.e.f. 4 th to 11 th April, 2005.	Dept. of Agril., Shimla	48	Dr. B.Vijay Dr. M.P.Sagar
2.	Three days off campus training programme on mushroom production technology for mushroom growers/farmers & officers of Jorhat (Assam), at AAU, Jorhat, w.e.f. 8 th – 10 th June, 2005	MM-I Scheme	31	Dr. B.Vijay Dr. M.P.Sagar
3.	Seven days training on mushroom production for farmers w.e.f. 3 rd to 9 th August, 2005.	NRCM, Solan	55	Dr B. Vijay Dr. M.P.Sagar
4.	Seven days training on mushroom production for farmers of Kinnaur (H.P.) and Jammu (J&K) sponsored by DDP, Pooh (H.P.) and SASD, Jammu w.e.f. 15 th to 21 st November, 2005.	Desert Dev. Proj. Pooh. & SASD, Jammu	28+5	Dr. B.Vijay Dr. M.P.Sagar
5.	Ten days training programme on mushroom production technology for Entrepreneurs sponsored by HP-STEP, Shimla w.e.f. 20 th – 28 th Dec.,05 & 7 th Jan, 2006.	HP-STEP, Shimla	18	Dr R.C. Upadh- yay Dr. M.P. Sagar
6.	Seven days training programme on msuhroom production technology for Agril & Hort. officers of NEH region, w.e.f. 17 th to 23 rd January, 2006.	MM-I Scheme	7	Dr. B.Vijay Dr. M.P.Sagar
7.	Three days off campus training programme on mushroom production technology for progressive farmers & officers of Imphal(Manipur), w.e.f. 20 th to 22 nd Dec.,2005	MM-I Scheme	40	Dr. B.Vijay Dr. M.P.Sagar
8.	Three days off campus training programme on mushroom production technology for mushroom growers/farmers & officers of Guwhati (Assam), at Guwhati, w.e.f.18 th to 20 th Feb, 2006	MM-I Scheme	40	Dr. B.Vijay Dr. M.P.Sagar
9.	Three days off campus training programme on mushroom production technology for mushroom growers/farmers at Gangtoke (Sikkim), w.e.f. 22 nd to 24 th Feb, 2006	MM-I Scheme	89	Dr. B.Vijay Dr. M.P.Sagar
10.	Three days off campus training programme on mushroom production technology for mushroom growers/farmers at Agartala (Tripura), w.e.f. 4 th to 6 th April, 2006	MM-I Scheme	50	Dr. B.Vijay Dr. M.P.Sagar

On-farm trials were also conducted at three farmer's farm in a near by village- Top Ki Ber. As a result, one farmer adopted mushroom cultivation

and took two crops of button mushroom during the current year after one milky mushroom crop.

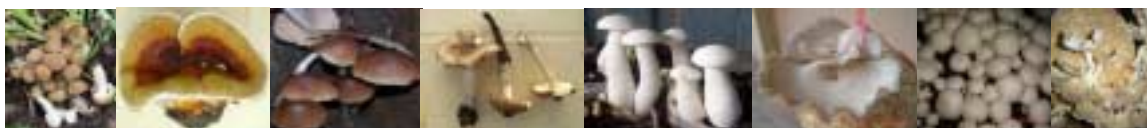


d. Participation in National/ State level Kisan Melas and Exhibition

In order to create awareness about mushroom cultivation, the Centre participated in the National & State level exhibitions in India.

e. Preparation of extension literature

Three multicoloured folders viz. cultivation of milky mushroom, cultivation of paddy straw mushroom, and round the year cultivation of mushrooms were prepared and got printed in hindi for distribution among mushroom growers.



7. PUBLICATIONS

Coimbatore Centre

1. Radhajeyalakshmi R, Krishnamoorthy AS, Sandoskumar R, Karthikeyan M and Velazhahan R (2006). Exploitation of bioactive secondary metabolites from basidiomycetss of medicinal importance for phytoremediation, GTCAM, International Conference on Medicine, March 16-18, pp-62.
 2. Radhajeyalakshmi R, Krishnamoorthy AS, Mathiyazhagan S, Nagarajan R, Amutha G, Ramiah M and Velazhahan R (2006). Molecular characterization of *Volvariella volvacea*. Acc. No-DQ420165 (GeneBank).
 3. 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*, March 2006, pp: 1-17
- Proceedings of “Global Conference – II” on “Plant Health: Global Wealth” jointly organized by the Indian Society of Mycology and Plant Pathology, Udaipur and M.P.U.A.T., Udaipur at M.P.University of Agriculture & Technology, Udaipur during 25th to 29th November, 2005.
2. Meteorological Constraints and Opportunities in Edible Mushroom Cultivation. Proceedings of “Global Conference – II” on “Plant Health: Global Wealth” jointly organized by the Indian Society of Mycology and Plant Pathology, Udaipur and M.P.U.A.T., Udaipur at M.P.University of Agriculture & Technology, Udaipur during 25th to 29th November, 2005.
 3. Isolation of mycoflora from the compost and casing soil of white button mushroom. *Ann. Pl. Prot. Sci.* (paper communicated)

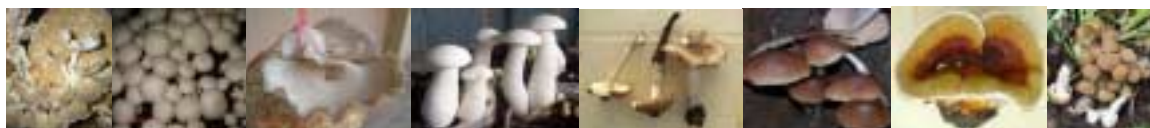
B. Popular article

1. Oyster mushroom ki kheti. *Krishi Vigyan Sandesh*. 2(4): 16-17.
2. Puwal mushroom ki kheti. *Poorvanchal Kheti*. 15(11): 27-28.
3. Mushroom spawn evam spawn utpadan. *Poorvanchal Kheti*. 16(3): 27-28.

Faizabad Centre

A. Research Paper

1. Wild Edible Fungal Flora of Eastern Uttar Pradesh.

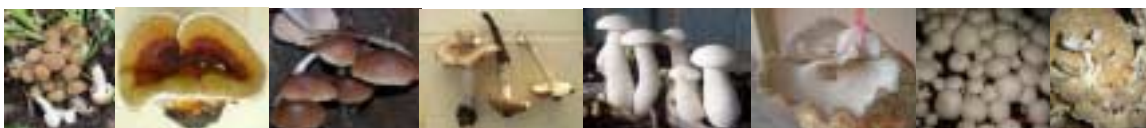


4. Midani chhetron men mushroom utpadan: Mausam pradatt awsar evam kathinaeyan. *Chhatrak* (communicated).
5. A poem on mushrooms. *Krishi Vigyan Sandesh*. 2(4): 15 (2005).

Pantnagar Centre

A. Research Paper/Abstract

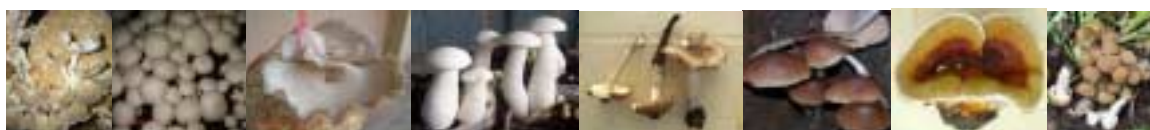
1. Singh Mandvi & Singh RP (2005). Management of mushroom pathogens through botanicals. *Indian Phytopath.* 58(2) : 189-193.
2. Kushwaha KPS (2005). Effect of different treatments and supplements on yield of *Pleurotus* species. *Progressive Horticulture*. 37 (1) : 220-222.
3. Kushwaha KPS, Bhatt P, Mishra KK and Singh RP (2005). Yield performance of *Auricularia polytricha*; a medicinal mushroom on different substrate. Abstracts of National consultative workshop on Medicinal and Aromatic Plants organized by G.B.Pant Univ. of Agric. & Tech., Pantnagar, pp. 14-15.
4. Dwivedi RR, Bhatt P and Kushwaha KPS (2005). Successful cultivation of *Lentinula edodes*: a medicinal mushroom on wheat straw. Abstract of National consultative workshop on Medicinal and Aromatic Plants organized by G.B.Pant Univ. of Agric. & Tech., Pantnagar, pp. 84-85.
5. Mishra KK and Singh RP (2005). Performance of *Ganoderma lucidum* (local): the mushroom of immortality. Abstract of National consultative workshop on Medicinal and Aromatic Plants organized by G.B.Pant Univ. of Agric. & Tech., Pantnagar. pp. 16-17.
6. Khan MR, Mishra KK and Kushwaha KPS (2005). Evaluation of locally available agricultural wastes for production of oyster mushroom in Uttarancal. In: Second Global Conference on Plant Health – Global Health on November 25-29, 2005, Udaipur. pp.85.
7. Bhatt Pratibha, Verma RC and Kushwaha KPS (2005). Evaluation of substrate for cultivation of a medicinal mushroom – *Lentinula edodes*. In: Second Global Conference on Plant Health - Global Health on November 25-29, 2005, Udaipur. pp.84-85.
8. Mishra KK, Kavidayal CS and Kushwaha KPS (2005). Commercial exploitation of medically important mushroom – *Ganoderma lucidum*. In: Second Global Conference on Plant Health – Global Health on November 25-29, 2005, Udaipur. pp.86.



9. Bhatt P, Kushwaha KPS and Singh RP (2006). Effect of washing treatment on the quality of button mushroom *Agaricus bisporus*. In: 58th Annual Meeting of Indian Phytopathological Society on Jan.31-Feb 02, 2006. pp 139.
10. Kushwaha KPS and Singh RP (2006). Cultivation of *Hypsizygus ulmarius* (blue oyster mushroom) using wheat straw. In: 58th Annual Meeting of Indian Phytopathological Society on Jan.31-Feb 02, 2006. pp 139-140.
11. Mishra KK and Singh RP (2006). Genetic variability among isolates of *Ganoderma lucidum*. In: National Symposium organised by Indian Phytopathological Society on Jan.31-Feb 02, 2006 at Univ. of North Bengal, Siliguri. pp 66.
12. Verma RC and Singh RP (2006). Morphological variation among the single spore isolates of *Agaricus bisporus*. In: National Symposium organised by Indian Phytopathological Society on Jan.31-Feb 02, 2006 at Univ. of North Bengal, Siliguri. pp 66 - 67.
13. Khan MR, Verma RC, Kushwaha KPS and Singh RP (2006). Effect of chemical treatment on different agro-wastes for production of *Pleurotus sajor-caju*. In: National Symposium organised by Indian Phytopathological Society on Jan.31-Feb 02, 2006 at Univ. of North Bengal, Siliguri. pp 138.
14. Kavidayal CS, Mishra KK and Singh RP (2006). Quantification of sugar content in *Ganoderma lucidum* isolates. In: National Symposium organised by Indian Phytopathological Society on Jan.31-Feb 02, 2006 at Univ. of North Bengal, Siliguri. pp 138-139.
15. Joshi HC and Kushwaha KPS (2006). Interspecies hybridization for yield and quality of oyster mushroom (*Pleurotus* spp.). In: National Symposium organised by Indian Phytopathological Society on Jan.31-Feb 02, 2006 at Univ. of North Bengal, Siliguri. pp 140.

B. Popular article

1. Mishra KK and Singh RP (2005). Fungal Biodiversity and food security. *Agrobios News letter*. 3(9): 12-13.
2. Mishra KK and Singh RP (2005). Beware of poisonous mushroom – *Amanita*. *Indian Farmer's Digest*. 38(2): 40-41.
3. Mishra KK and Singh RP (2006). Status and prospectus of edible and medicinal mushroom. *Indian Farmer's Digest*. 39(3): p-5.
4. Kushwaha KPS, Bhatt Pratibha and Singh RP (2006). Fungal diseases of Button mushroom and their management. *Indian Farmer's Digest*. 39(3) : p-12.

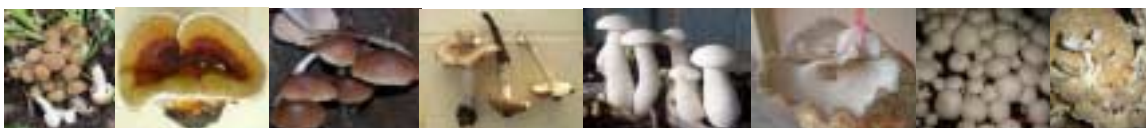


5. Bhatt Pratibha, Kushwaha KPS and Singh RP (2006). Mushroom and their recipes. *Indian Farmer's Digest*. 39(3): p-15.

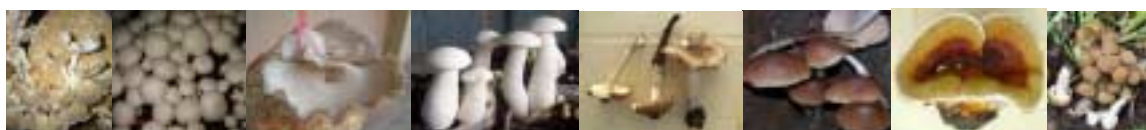
Raipur Centre

A. Research Paper

1. Bhanwar RR and Thakur MP (2004). Effect of biofertilisers with microorganisms on vegetative growth and yield of oyster mushroom (*Pleurotus* spp.) using extract of medicinal and weed plants and their influence on growth and yield of oyster mushroom. *J. Mycol. Pl. Pathol.* 34(2): 960-964.
2. Bhanwar RR and Thakur MP (2004). Management of competitors using extract of medicinal and weed plants and their influence on growth and yield of oyster mushroom. *J. Mycol. Pl. Pathol.* 34(2): 954-956.
3. Kotasthane A S, Thakur M P and Shukla CS (2006). Development in isolation, purification and maintenance of mushroom. In: Compendium of lectures of ICAR Short Course on "Emerging areas in Mushroom Diversity, Production and Post Harvest Developments". (eds . M. P. Thakur, C. S. Shukla, R. R. Saxena and Vijay Yadav), Dept. of Plant Pathology, IGAU, Raipur. pp. 211-222.
4. Sanger RB, Thakur MP and Shukla CS (2006). Recent advances in production technology of oyster mushroom. In: Compendium of lectures of ICAR Short Course on "Emerging areas in Mushroom Diversity, Production and Post Harvest Developments". (eds . M. P. Thakur, C. S. Shukla, R. R. Saxena and Vijay Yadav), Dept. of Plant Pathology, IGAU, Raipur. pp. 89-99.
5. Saxena RR and Thakur MP (2006). Use of computer in planning, monitoring and management of mushroom crop. In: Compendium of lectures of ICAR Short Course on "Emerging areas in Mushroom Diversity, Production and Post Harvest Developments". (eds . M. P. Thakur, C. S. Shukla, R. R. Saxena and Vijay Yadav), Dept. of Plant Pathology, IGAU, Raipur. pp. 163-180.
6. Thakur M P and Yadav V (2006). Modern techniques of cultivating paddy straw mushroom at a commercial scale. In: Compendium of lectures of ICAR Short Course on "Emerging areas in Mushroom Diversity, Production and Post Harvest Developments". (eds . M. P. Thakur, C. S. Shukla, R. R. Saxena and Vijay Yadav), Dept. of Plant Pathology, IGAU, Raipur. pp. 10-25.



7. Thakur MP and Yadav V (2006). Recent advances in cultivation technology of Reishi mushroom (*Ganoderma lucidum*). In: Compendium of lectures of ICAR Short Course on "Emerging areas in Mushroom Diversity, Production and Post Harvest Developments". (eds . M. P. Thakur, C. S. Shukla, R. R. Saxena and Vijay Yadav), Dept. of Plant Pathology, IGAU, Raipur. pp. 125-133.
 8. Thakur MP, Shukla CS and Yadav VK (2006). Present status and prospects of tropical mushroom production in India. In: Proceedings of Seminar on Resource Management for Agricultural Development in Northern Hills of Chhattisgarh at RMD College of Agriculture and Research Station, IGAU, Ambikapur from 26-27th January, 2006. Pp. 75-77.
 9. Shukla CS (2006). Advances in production technology of milky mushroom. In: Compendium of lectures of ICAR Short Course on "Emerging areas in Mushroom Diversity, Production and Post Harvest Developments" held at Department of Plant Pathology, Indira Gandhi Agricultural University, Raipur from January 9-18th, 2006. Published by Yugbodh Digital Print, Raipur. p 26-32.
 10. Shukla CS and Awadhiya GK (2006). Use of locally available substrate for cultivation of Mushroom. In: Compendium of lectures of ICAR Short Course on "Emerging areas in Mushroom Diversity, Production and Post Harvest Developments" held at Department of Plant Pathology, Indira Gandhi Agricultural University, Raipur from January 9-18th, 2006. Published by Yugbodh Digital Print, Raipur. p. 207-210.
- B. Research Papers Presented in International Conference**
1. Thakur MP, Shukla CS, Gupta SB and Thrimurthy VS (2005). Effect of Biofertilisers (Effective Microorganisms) on the vegetative growth and yield of oyster mushroom (*Pleurotus* spp.). In: International Conference on Plant Genomics and Biotechnology: Challenges and Opportunities held at Indira Gandhi Agricultural University, Raipur from 26-28th October, 2005. p. 61.
 2. Sharma D, Thakur MP and Shukla CS (2005). Collection, identification and nutritive values of *Ganoderma lucidum* (Reishi mushroom) collected from Chhattisgarh.). In: International Conference on Plant Genomics and Biotechnology: Challenges and Opportunities held at Indira Gandhi Agricultural University,



Raipur from 26-28th October, 2005. p 229.

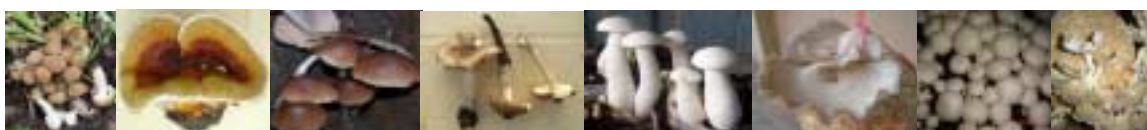
3. Shukla CS, Thakur MP, Thrimurthy VS and Geda A (2005). Growth yield and nutritive variation in isolates of *C. indica*. In: International Conference on Plant Genomics and Biotechnology: Challenges and Opportunities held at Indira Gandhi Agricultural University, Raipur from 26-28th October, 2005. p.232.

C. Research Papers Presented in National Conference

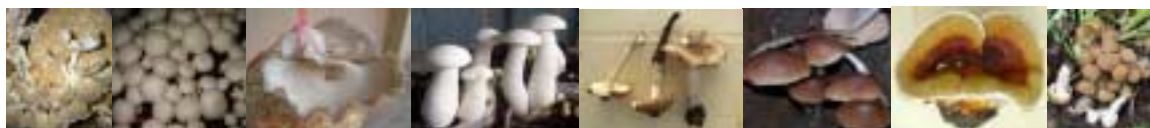
1. Thakur M P, Shukla CS and Yadav VK (2005). Mushroom wealth of Chhattisgarh: Potential and Exploitation. In: National Workshop on "Awareness Creation on Mushroom Biodiversity and Their Conservation" held at Department of Plant Pathology, Indira Gandhi Agricultural University, Raipur from December 1-2, 2005. Souvenir cum Abstract, pp. 3-4.
2. Sharma D, Thakur MP, Shukla CS and Yadav VK (2005). Diversity of Reishi mushroom in Chhattisgarh: Potential and prospects in health management. In: National Workshop on "Awareness Creation on Mushroom Biodiversity and Their Conservation" held at Department of Plant Pathology, Indira Gandhi

Agricultural University, Raipur from December 1-2, 2005. Souvenir cum Abstract, pp. 9-10.

3. Thakur T, Swamy SL, Mishra A and Thakur MP (2005). Monitoring and mapping of mushroom diversity of dry tropical forest system using satellite remote sensing & GIS techniques. In: National Workshop on "Awareness Creation on Mushroom Biodiversity and Their Conservation" held at Department of Plant Pathology, Indira Gandhi Agricultural University, Raipur from December 1-2, 2005. Souvenir cum Abstract, p. 11.
4. Shukla CS and Thakur MP (2005). Transfer of mushroom technology in Chhattisgarh: Accomplishments and constraints. In: National Workshop on "Awareness Creation on Mushroom Biodiversity and Their Conservation" held at Department of Plant Pathology, Indira Gandhi Agricultural University, Raipur from December 1-2, 2005. Souvenir cum Abstract, p. 16.
5. Sil BK and Thakur MP (2005). Mushroom spent substrate as a suitable substrate for cattle feed. In: National Workshop on "Awareness Creation on Mushroom Biodiversity and Their Conservation" held at Department of Plant Pathology, Indira Gandhi Agricultural University, Raipur



- from December 1-2, 2005. Souvenir cum Abstract, p.20.
6. Bhanwar RR and Thakur MP (2005). Effect of biofertiliser and effective microorganisms on yield contributing characters of local strains of *Pleurotus* sp. (Oyster mushroom). In: National Workshop on "Awareness Creation on Mushroom Biodiversity and Their Conservation" held at Department of Plant Pathology, Indira Gandhi Agricultural University, Raipur from December 1-2, 2005. Souvenir cum Abstract, p.21.
 7. Dewangan UK, Thakur MP, Shukla CS and Geda AK (2005). Changes in biochemical constituents in substrates during spawn run and fruitbody formation of shiitake mushroom (*Lentinula edodes*). In: National Workshop on "Awareness Creation on Mushroom Biodiversity and Their Conservation" held at Department of Plant Pathology, Indira Gandhi Agricultural University, Raipur from December 1-2, 2005. Souvenir cum Abstract, pp.21-22.
 8. Yadav VK, Thakur MP, and Shukla CS (2005). Ethnobotanical studies on different mushrooms to prevent various physiological disorders/illness. In: National Workshop on "Awareness Creation on Mushroom Biodiversity and their Conservation" held at Department of Plant Pathology, Indira Gandhi Agricultural University, Raipur from December 1-2, 2005. Souvenir cum Abstract, p.24.
 9. Oudhiya P and Thakur MP (2005). Unique traditional knowledge about medicinal mushrooms in Indian states, Chhattisgarh. In: National Workshop on "Awareness Creation on Mushroom Biodiversity and Their Conservation" held at Department of Plant Pathology, Indira Gandhi Agricultural University, Raipur from December 1-2, 2005. Souvenir cum Abstract, pp.38-39.
 10. Thakur MP, Shukla CS and Yadav VK (2006). Present status and prospects of tropical mushroom production in India. In: Seminar on Resource Management for Agricultural Development in Northern Hills of Chhattisgarh at RMD College of Agriculture and Research Station, IGAU, Ambikapur from 26-27th January, 2006. Proceeding, pp. 75-77.
 11. Thakur MP, Shukla CS and Yadav VK (2006). Biodiversity and conservation of mushroom in Chhattisgarh region. In: Brain Storming Session on Status and future strategies on R&D of mushroom in India at National Research Centre for Mushroom, Solan (H.P.) from 18-19th March, 2006.



12. Thakur MP, Shukla CS and Yadav VK (2006). Transfer of mushroom production technology to the growers of Chhattisgarh. In: Brain Storming Session on Status and future strategies on R&D of mushroom in India at National Research Centre for Mushroom, Solan (H.P.) from 18-19th March, 2006.

D. Souvenir/ Reports/Compendium/ Recommendation

1. Thakur MP, Shukla CS and Yadav VK (2005). Souvenir cum Abstract. National Workshop on "Awareness Creation on Mushroom Biodiversity and Their Conservation" held at Department of Plant Pathology, Indira Gandhi Agricultural University, Raipur from December 1-2, 2005. p. 35.
2. Thakur MP, Shukla CS, Saxena RR and Yadav VK (2006). Compendium of lectures of ICAR Short Course on "Emerging areas in Mushroom Diversity, Production and Post Harvest Developments" held at Department of Plant Pathology, Indira Gandhi Agricultural University, Raipur from January 9-18th, 2006. Published by Yugbodh Digital Print, Raipur. p. 235.

E. Bulletin

1. Thakur MP, Shukla CS and Yadav VK (2006). Oyster Mushroom Utpadan Karyamala. Extension

Bulletin.1 Published by Technical Cell, IGAU, Raipur. p. 18.

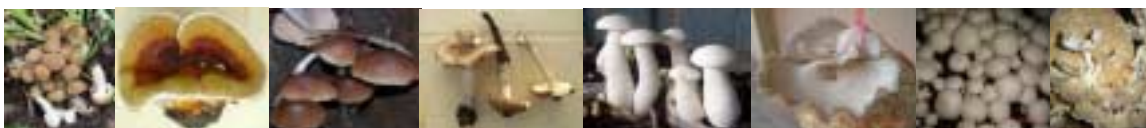
F. Popular article

1. Thakur MP (2005). Oyster mushroom kee vibhinna prajatiyan. Krishak Shrinkhla. 2 (12): 31-34.
2. Shukla CS, Thakur MP and Yadav VK (2006). Chhattisgarh main mushroom utpadan ke badalte charan: Adhiktam labh lene hetu Ranneeti. Krishi Smarika-2006(Western Region Exhibition cum Krishi Mela).pp 76-78.
3. Yadav V K, Thakur MP and Shukla CS (2005). Ghar main ugayen paustic mushroom. Chhattisgarh Kheti. October-December.2005,21-22.

Udaipur Centre

A. Research Paper

- 1 Sharma Manish, Shah Rakesh and Doshi Anila (2005). Nutritional requirements of casing soil bacteria of white button mushroom *Agaricus bisporus*. *J. Mycol Pl. Pathol.*, 35 (1) : 84-86.
- 2 Doshi Anila, Sharma Manish and Munot Jayshri (2005). Cellulose utilizing ability of different wild and cultivated mushrooms. Abstract of paper presented in Second Global Conference on Nov. 25-29th, 2005 held at RCA, Udaipur.



- 3 Doshi Anila , Sharma Manish and Rawal Pokhar (2005). Cultivation of blue oyster mushroom *Hypsizygus ulmarius* in Rajasthan. Abstract of paper presented in Second Global Conference on Nov. 25-29th , 2005 held at RCA, Udaipur.
- 4 Khajuria Rakesh, Sharma FL and Doshi Anila (2005). Technological knowledge of mushroom entrepreneurs in Jammu and Kashmir. Abstract of paper presented in Second Global Conference on Nov. 25-29th , 2005 held at RCA, Udaipur.
- 5 Doshi Anila and Sharma Manish (2005). Biodiversity and conservation of mushroom in Rajasthan, India. Invited lecture delivered at Raipur (C.G.) in National Work Shop on Awareness Creation on Biodiversity and Conservation of Mushroom on 4-6th December 2005.
- 6 Doshi Anila, Sharma Manish and Rawal Pokhar (2006). Post harvest preservation of oyster mushroom *Pleurotus sajor-caju* and *Pleurotus florida* . Abstract of paper presented in National Seminar on Biodiversity, Conservation, Cultivation, Processing and Marketing of Medicinal and Aromatic Plants held on 8-10th March, 2006 MPUAT, Udaipur.
- 7 Doshi Anila and Choudhary SN (2006). Mushroom Utpadan. ATIEC, MPUAT, 1-25.

Vellyani Centre

A. Research Paper

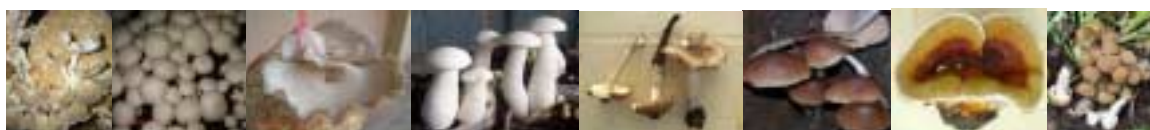
1. Pramod R, Balakrishnan B and Das Lulu (2005). Gamma irradiation- a promising tool for strain improvement in *Volvariella volvacea*. Mushroom Research 14(1):33-36.

B. Review Paper

1. Balakrishnan B and Das Lulu (2006) Production Technologies and constraints in oyster mushroom-paper presented in the "Brain storming session on status and future strategies on R&D of mushroom in India" at NRCM, Solan on 18-19th March, 2006.
2. Balakrishnan B (2005). "Construction of mushroom houses" Paper presented in regional language in the Mushroom Growers Meet organized at Thiruvananthapuram by T.B.G.R.I., Palode, during May 16-18, 2005.

C. Booklet

1. Balakrishnan B (2006). Ningalkum koon valartham. Krishivijnana manjari -5; PP.20. published by the "Indian Agricultural Association" Reg. No. Q.65/03, I.A.A. Bhavan University.P.O.,Thiruvananthapuram.

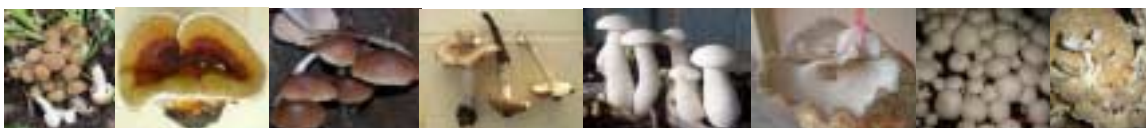


2. Balakrishnan B (2006). Koon Krishi. Published as a "Kerala Gandhi Smaraka Nidhi Publication" in connection with the District level Agriculture/Horticulture seminar conducted on 10-11 November 2005 with the financial support from National Horticulture Board.

Solan Centre

A. Research Paper

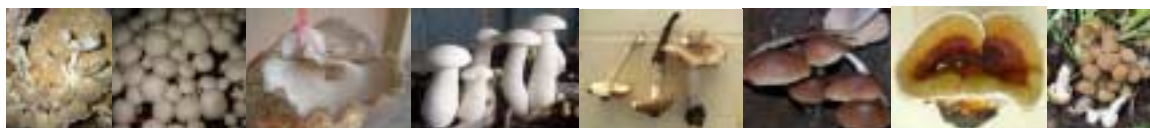
1. Ahlawat OP, Sagar MP, Dev Raj, Indu Rani C, Gupta Pardeep and Vijay B (2005). Effect of spent mushroom substrate on yield and quality of capsicum (*Capsicum annuum*). *Indian Journal of Horticulture* (communicated).
2. Arumuganathan T, Rai RD and Hemakar Anil Kumar (2005). Effect of blanching time, concentration of sugar syrup and citric acid concentration on the quality of mushroom *murabba* (preserve). *Beverage and food world*. **32(11)**: 84-85.
3. Arumuganathan T, Hemakar Anil Kumar and Rai RD (2005). Studies on development of value added products from fresh white button mushroom, *Agaricus bisporus*. *Mushroom Research*. **14(2)**: 84-87.
4. Dev Raj, Indu Rani C, Sagar MP, Gupta Pardeep, Ahlawat OP and Vijay B (2005). Effect of spent mushroom substrate recomposted by different methods and of different age on vegetative growth, yield and yield of tomato (*Lycopersicon esculentum* Mill.). *Vegetable Science*. (communicated).
5. Dev Raj, Gupta Pardeep, Ahlawat OP and Rai RD (2005). Effect of pretreatments on the quality characteristics of the dehydrated paddy straw mushroom (*Volvariella volvacea* Bull.). *Indian Journal of Mushrooms* **22(1&2)**: 24-28.
6. 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* (communicated)
7. Dhar BL and Arumuganathan T (2005). Low cost seasonal mushroom growing houses. *Mushroom International*. **100**: 7-10.
8. Sagar MP and Vijay B (2005). Impact of integration of extension methods on adoption of mushroom cultivation. *Indian Res J Extn Edu*, **5(2&3)** 64:66.
9. Sagar MP and Vijay B (2006) Assessment and fulfillment of training needs of entrepreneurs in mushroom cultivation. *SAARC Journal of Agriculture* (communicated)



10. Sharma VP (2005). *Trichoderma*, the most common mould associated with mushroom cultivation. *Plant Disease Research* 20: 72-73.
11. Semwal KC, Bhatt RP and Upadhyay RC (2005). The genus *Amanita* from Garhwal Himalaya, India. *Mushroom Research*, 12(2): 50-55.
4. Arumuganathan T, and Rai RD (2005). Machinery, equipments and instrument in mushroom production and processing. *Frontiers in Mushroom Biotechnology*. (Eds. R.D.Rai, R.C.Upadhyay and S.R.Sharma); pp:343-359.
5. Rai RD and Arumuganathan T (2005). Nutritive value of mushrooms. *Frontiers in Mushroom Biotechnology*. (Eds. R.D.Rai, R.C.Upadhyay and S.R.Sharma); pp:27-36.
6. Rai RD and Arumuganathan T (2005). Post harvest handling of the fresh mushrooms. *Frontiers in Mushroom Biotechnology*. (Eds. R.D.Rai, R.C.Upadhyay and S.R.Sharma); pp:365-375.
7. Sagar MP (2005). Transfer of technology strategies for mushroom production In: *Frontiers in Mushroom Biotechnology* (R.D. Rai, R.C. Upadhyay and S.R. Sharma). Pp. 400-410. National Research Centre for Mushroom (HP), India.
8. Sagar MP (2005). Sources of information for various inputs and guidance on mushroom cultivation In: *Frontiers in Mushroom Biotechnology* (R.D. Rai, R.C. Upadhyay and S.R. Sharma). Pp. 411-425. National Research Centre for Mushroom (HP), India.

B. Book/ Book Chapter

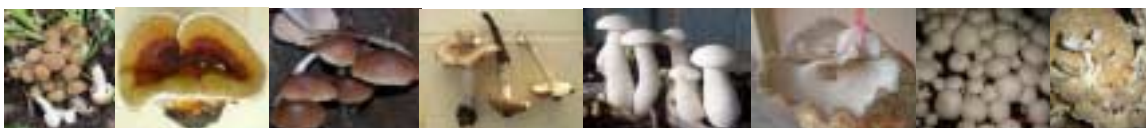
1. Ahlawat OP, Indu Rani C and Sagar MP (2005). Spent mushroom substrate-properties and recycling for beneficial purposes. In: *Frontiers in Mushroom Biotechnology* (R.D. Rai, R.C. Upadhyay and S.R. Sharma). Pp. 314-334. National Research Centre for Mushroom, Solan (HP), India.
2. Ahlawat OP and Kumar S 2005. Traditional and modern cultivation technologies for the paddy mushroom (*Volveriella* spp.) In: *Frontiers in mushroom biotechnology* (RD Rai, RC Upadhyay and SR Sharma eds) : 157-164. National Research Centre for Mushroom, Solan (HP), India.
3. Arumuganathan T, Dhar BL and Rai RD (2005). Low-cost structures for the seasonal production of mushrooms. *Frontiers in Mushroom Biotechnology*. (Eds. R.D.Rai, R.C.Upadhyay and S.R.Sharma); pp:294-300.



9. Sharma SR and Kumar S (2005). Diseases of Mushroom and their management. In Challenging Problems in Horticulture and Forest Pathology (RC Sharma & JN Sharma eds) Indus Pub. Co. New Delhi : 246-286
10. Sharma VP and Suman BC (2006). Diseases and Pests of Mushrooms. Agribios (India) 212p
11. Sharma VP, Sharma SR and Kumar Satish (2005). Insects and Mite Pests in the cultivation of Edible Mushrooms and their Management. In: Frontiers in Mushroom Biotechnology (RD Rai, RC Upadhyay and SR Sharma, eds) pp244-258. NRCM, Solan (HP), India.
12. Vijay B (2005). Formulations for white button mushroom. In: Frontiers of Mushroom Biotechnology (RD Rai, RC Updhyay and SR Sharma eds.) pp80-87. NRCM, Solan (HP), India.
13. Vijay B (2005). Recent advances for compost preparation for white button mushroom . In: Frontiers of Mushroom Biotechnology (RD Rai, RC Updhyay and SR Sharma eds.) pp88-107. NRCM, Solan (HP), India.
14. Vijay B (2005). Thermophilic fungi and their significance in compost preparation. In: Frontiers of Mushroom Biotechnology (RD Rai, RC Updhyay and SR Sharma eds.) pp108-116. NRCM, Solan (HP), India.
15. Vijay B (2005). Economics of modern and seasonal production of mushrooms. In: Frontiers of Mushroom Biotechnology (RD Rai, RC Updhyay and SR Sharma eds.) pp301-313. NRCM, Solan (HP), India.
16. Gautam Y (2005). Application of electronics in mushroom production system. In: "Frontiers in Mushroom Biotechnology" (eds. RD Rai et al) pp 335-342. National Research Centre for Mushroom, Solan (HP), India.
17. Gautam Y (2005). Mushroom informatics on the NET- its importance in research, production and trade. In " Frontiers in Mushroom Biotechnology" (eds. RD Rai et al) pp 360-364. National Research Centre for Mushroom, Solan (HP), India.

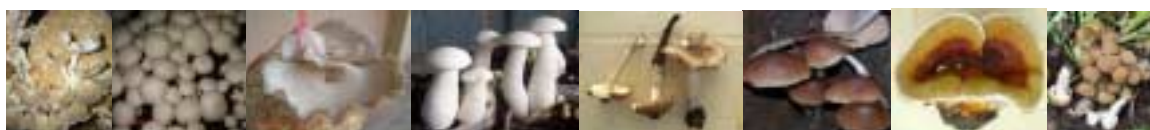
C. Technical Bulletin

1. Dhar BL and Arumuanathan T (2005). Farm Design for White Button Mushroom Cultivation. *NRCM-Technical Bulletin No.6*. (Revised 2005) : pp32.
2. Dhar BL and Tewari RP (2005). Cultivation Technology of High Temperature Tolerant White Button Mushroom *Agaricus bitorquis*. *NRCM, Tech. Bulletin No.8* (Revised 2005); pp29.



D. Popular/ Technical article

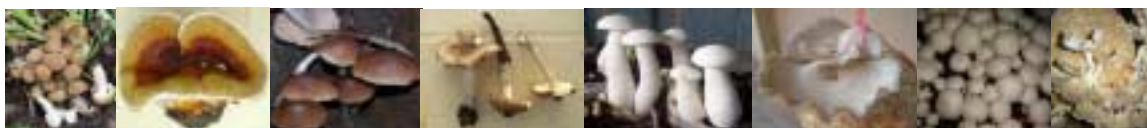
1. Y Gautam and Kumar S (2006). Internet Application for Mushroom Research and Development. *Indian J Mush* XXII (1&2): 31-36.
2. Kumar S and Sharma SR (2006). Persistence of pesticide residue in edible mushrooms- present status and future perspective . *Indian J Mush* XXII (1&2): 10-17.
3. Sagar MP and Verma RN (2005). Mushroom Utpadan Vevsai me Safalta-Ek Kahani, Kisan ki Jubani, *Unnat Krishi* 44(3), May-June.
4. Sagar MP (2006). Mushroom Utpadan Dwara Mahilaon ka Sashaktikaran. *Unnat Krishi*, March-April.
5. Sharma VP, Kumar Satish and Sharma SR (2006). Hygiene: Key to the successful mushroom cultivation. *Indian J Mush*. XXIII. (1&2): 41-46.



PERSONNELIA

Staff position at various AICMIP Centres during 2005-06

Post	Coimbatore	Ludhiana	Faizabad	Pantnagar	Pune	Raipur	Udaipur	Thrissur
Mycologist	Dr. P. Lakshmanan	Dr. (Mrs.) S. Dhanda (Mycologist)	Dr. S.K.S. Chauhan	Dr. R. P. Singh Joint Director	Dr. T.K. Narute	Dr. M.P. Thakur	Dr. Anila Doshi	Dr. B. Balakrishnan
Asstt. Mycologist	Dr. R. Radhajeaya lakshmi	Dr. H.S. Sodhi (Mycologist)	Dr. P.K. Shukla	Dr. K.P.S. Kushwaha Assoc. Director	Dr. S.S. Wange	Dr. C.S. Shukla	Dr. Pokar Rawal	Dr. Lulu Das
Technical Assistant	Th. M. Nagendran	Sh. Jagmail Singh	Sh. G.P. Gautam	Ms. Pratibha Bhatt (Contractual)	Sh. V.K. Bhalerao	Vacant	Vacant	Sh. D. Siva prasad (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. H. Kaur	Sh. S.G. Yadav	Sh. Vishnu Ray	Sh. S.C. Kashid	Sh. R.K. Panday	Sh. Nathu Singh	—
Beldar	Th. P. Selvaraj	Sh. Ram Kumar	Sh. G. Prasad	Sh. Deo Kumar	Sh. Y.S. Bhawe	Sh. A.R. Sahu	Sh. Kishan Singh	—



BUDGET

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. Charges	7.00	7.00	7.37	7.38	9.00	6.21	9.30	9.30	8.00	7.00	6.00	4.62	7.00	6.80	8.00	7.65	—	—	—	—	—	—
T.A.	0.10	0.10	0.10	0.10	0.10	0.08	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.06	0.06	—
Recurring contingencies including FLD	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.60	0.60	0.90	0.90	0.90	0.90	0.60	0.60	0.60	0.60	0.60	—
Non-Rec.																						
a) Equipments	—	—	—	—	—	—	—	—	—	—	—	0.04	—	—	—	0.17	—	—	—	—	—	—
b) Vehicle	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
c) Works	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	8.00	8.00	8.37	8.38	10.00	7.19	10.30	10.30	8.00	9.00	6.70	5.32	8.00	7.80	9.00	8.65	0.70	0.70	0.70	0.66	0.70	—

a- sanctioned amount

b- actual expenditure

