वार्षिक प्रतिवेदन
ANNUAL REPORT
2010

खुम्ब अनुसंधान निदेशालय
DIRECTORATE OF MUSHROOM RESEARCH
(भारतीय कृषि अनुसंधान परिषद्)
(Indian Council of Agricultural Research)
चम्बाघाट, सोलन – 173 213 (हि.प्र.), भारत
Chambaghat, Solan - 173 213 (H.P.), India

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Back Cover Page : (*Left to Right*)

Phellorinia sp. in natural habitat in Rajasthan

Lentinus sajor-caju under cultivation on saw dust

Phellorinia at sale in local market at Jaisalmar

Dr Manjit Singh, Director, DMR, Solan, visiting a canning unit at Village Aterna in Haryana

Dr M.M. Anwer, Director, NRC seed spices, Ajmer visiting the exhibition stalls after inauguration of mushroom mela-2010

Prof. A. K. Bakshi, Chairman QRT and other members visiting mushroom growing facilities of DMR, Solan

Sh Mahantesh Shirur, Scientist conducting visit of scientists and officials of Bangladesh

Dr H.P. Singh, DDG (Hort.) releasing publications during mushroom mela 2010

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PREFACE

Mushroom cultivation is gaining momentum in the country due to the improved productivity of various mushrooms as well as appreciable increase in the number of seasonal and hi tech mushroom farms. In the coming years the share of currently popular button mushroom is likely to decrease further with increase in cultivation of more and more specialty mushrooms under seasonal conditions. With the increase in production there is likelihood of the establishment of an organized mushroom marketing, both for domestic and export sector. Mushroom growing activity will help in complete recycling of the agrowastes for the production of highly nutritious food and manure.

Survey and collection is an important activity of this Directorate and during the year National Mushroom Repository of this Directorate has been enriched by addition of 54 specimens. Various strains of button mushroom collected from different sources were evaluated for yield and other desirable traits to select strains to include in breeding programme. Genetic diversity in button, oyster, paddy straw mushroom and specialty mushrooms was studied. Diversification is key to give boost to mushroom cultivation in India. Locally available mushrooms should be brought under cultivation so that they can be easily adopted for cultivation by masses without any fear of marketing. A new mushroom *Lentinus sajor- caju* collected from Andeman and Nicobar was cultivated successfully at 30^0C. Large number of *Phellorinia*, the most abundantly occurring mushroom in Indian Thar desert, was collected from Rajasthan. Detailed physiological and molecular studies on this muhroom were undertaken at the Directorate - an information required before attempting its cultivation. Shiitake strains were evaluated and promising high temperature strains were identified. Prolific sclerotia producing strains of *Morchella* were identified and physiological studies on most sought after medicinal mushroom *Cordyceps* were undertaken.

Directorate is working to develop spawn standards and studies revealed that spawn to spawn multiplication results in decrease in yield. The cost of some basic ingredients like wheat straw is increasing sharply. Therefore, Directorate is exploring some low cost materials like soybean straw which in combination with wheat straw is giving satisfactory results. Materials like cotton ginning mill waste are being explored for enhancing yields of paddy straw mushroom. Survey of different mushroom farms revealed that brown plaster mould, yellow mould and wet bubble were the most prevalent diseases in button mushroom.

Nine training courses were organized at the Directorate and one day Mushroom Mela was also organized at the Directorate and two regional mushroom mela and consumption fairs were held at Aterna and Gannaur in Haryana to address the problems faced by mushroom growers and to promote mushroom consumption among common public. India is blessed with varied agro-climatic conditions, huge agricultural wastes and plenty of labour making it suitable for cultivation of variety of temperate and tropical mushrooms. The Directorate is committed to improve the cultivation technology of cultivated mushrooms and explore the cultivation technology of new and locally available mushrooms to give boost to diversification.

The Directorate is indebted to ICAR for financial support and Division of Horticulture for technical guidance. The editorial committee members of this annual report deserve appreciation for their sincere efforts in reflecting the significant achievements of Directorate.

(Manjit Singh)
Director

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कार्य सारांश

खुम्ब अनुसंधान निदेशालय ने वर्ष 2010–11 में अनुसंधान, विस्तार एवं मानव संसाधन विकास के क्षेत्रों में महत्वपूर्ण प्रगति की है। वर्ष के दौरान निदेशालय द्वारा फसल उन्नयन, फसल उत्पादन, फसल संरक्षण, विस्तार, शिक्षण एवं प्रशिक्षण तथा प्रकाशनों के क्षेत्रों में की गई प्रगति का संक्षिप्त विवरण यहां प्रस्तुत किया गया है।

फसल उन्नयन

क) जैव संपदा संग्रहण एवं चरित्रण

जंगली खुम्बों को एकत्र करने के लिये हिमाचल प्रदेश, झारखण्ड, त्रिपुरा एवं राजस्थान के जंगलों में खोज की गयी। कुल 111 जंगली खुम्बों के नमूने एकत्र किये गये तथा उनमें से 108 की पहचान जाति स्तर तक की गई। सभी एकत्रित नमूनों को निदेशालय के संग्रहण में संरक्षित किया गया है।

सभी नमूनों का परीक्षण उनके आकारिकी के आधार पर किया गया तथा उनके फोटोग्राफ भी लिये गये। एकत्रित खुम्बों में से 54 नमूनों के शुद्ध संवर्धन टिशु कल्चर तकनीक के द्वारा किये गये तथा खुम्ब अनुसंधान निदेशालय के जीन बैंक में जमा कराये गये। एकत्र किये खुम्बों के कुछ नमूनों जैसे कि *अमैनिटा हनानैन्सिस, आर्मिलेरिया मेला, डिक्टियोफोरा इन्डसियाटा, लैक्टेरियस सैन्गुईपनस, लै0 सीबिकुलेटस, लेन्टिनस स्कवैरासुलस* (त्रिपुरा में खायी जाने वाली), *लिमासेला फर्नेसिया, मारास्मिमस कोहेरेन्स, माइक्रोलेपियोटा, परमिक्सटा, मिलैनोल्युका ब्रैमिपस, सैथिरेला कौन्डोलिना, स्पैरोसिसि क्रिस्पा* इत्यादि की पहचान प्रजाति स्तर तक की गई। इन खोजों से कुछ नमूने जैसे कि *ह्यूमिडिकुटिस, ल्यूकोएगैरिकस, ल्युकोपैकिसलस, माइक्रोम्फैलिया, ओटिडिया, साईजोस्टोना, ट्यूलोस्टोमा* तथा *वेसिलम* इत्यादि भारत में पहली बार एकत्र किये गये ।

ख) अनुवांशिक सुधार

i) *एगेरिकस बाईस्पोरस*

जंगलों, भारतीय कृषि अनुसंधान संस्थान तथा खुम्ब अनुसंधान निदेशालय के संवर्धन संग्रहण से लगभग 100 से भी अधिक बटन खुम्ब की प्रजातियां प्राप्त की गई जिनमें से 29 प्रजातियों को पैदावार एवं गुणवत्ता मूल्यांकन हेतु उपजाया गया। इन प्रजातियों में ए–17, डेल्टा तथा एस–130 प्रजातियों ने क्रमशः अच्छा प्रदर्शन किया। सभी प्रजातियों के स्पोर प्रिंट लिये गये तथा स्पोर के अंकुरण के सर्वोत्तम माध्यम की भी पहचान की गई। कुल 294 एकल बीजाणु संवर्धन विभिन्न प्रजातियों जैसे कि एस–11, यू–3, ए–4, ए–6, ए–16, ए–17, ए–2, ए–15, ए–94, एन.सी.एस.–101, एस–465 तथा एस.–130 से प्राप्त किये गये। इनमें से 132 एकल बीजाणु संवर्धनों को उत्पादकता एवं गुणवत्ता के मूल्यांकन के लिये उपजाया गया। 64 उर्वर एकल बीजाणु संवर्धनों में से 34 को उत्पादकता एवं गुणवत्ता के आधार पर बड़े स्तर पर मूल्यांकन के लिये चयनित किया गया।

यू–3 प्रजाति के 22 तथा ए–94 के दो एकल बीजाणु संवर्धन गैर–उपजाऊ पाये गये। इन गैर–उपजाऊ समकेन्द्रक एकल बीजाणु संवर्धनों का उनके पैतृक प्रजातियों के साथ डी.एन.ए. (आर.

ए.पी.डी., आर.एफ.एल.पी, आई.एस.एस.आर. आदि) तथा प्रोटीन (एच.डी.एस. पेज) के आधार पर विश्लेषण किया गया ताकि गैर–उपजाऊ समकेन्द्रक एकल बीजाणु संवर्धनों की पहचान करने हेतु किसी चिन्ह की पहचान की जा सके। समकेन्द्रक एकल बीजाणु संवर्धनों को आपस में निषेचित किया गया ताकि संकर बनाया जा सके एवं *एगेरिकस बाईस्पोरस* प्रजाति में संभोग प्रकार की भी पहचान की जा सके।

64 उर्वर एकल बीजाणु संवर्धनों की कम्पोस्ट में नीचे की ओर वृद्धि की दर का भी अध्ययन किया गया और पाया गया कि नीचे की ओर वृद्धि की दर एवं पैदावार में एक सकारात्मक सह–संबंध है जिनका सांख्यिकीय मान 0.75 पाया गया तथा R^2=0.52 पाया गया।

ii) *प्लूरोटस* प्रजाति

प्लूरोटस इरिन्जाई तथा *पी0 फासुलेटस* जातियों की छह प्रजातियों की पैदावार का मूल्यांकन किया गया। *पी0 इरिन्जाई* की प्रजाति–3 की पैदावार क्षमता अन्य प्रजातियों के मुकाबले अच्छी पाई गई। साथ ही साथ *पी0 फ्लोरिडा* एवं *पी0 साजोर–काजू* की दस प्रजातियों की पैदावार का भी मूल्यांकन किया गया। इसके अलावा 19 जंगली *प्लूरोटस* प्रजातियों की उत्पादकता का मूल्यांकन किया गया जिसमें सर्वाधिक उत्पादकता X–586 एवं X–1021 में पायी गई।

iii) *वॉल्वेरियेला* प्रजाति

पुआल खुम्ब की छह प्रजातियों, वी.वी.–01, बी. बी.एच.–01, बी.बी.एस.आर,–002, बी.बी.एस. आर,–003, बी.बी.एस.आर,–007 एवं डब्ल्यू. डब्ल्यू–08 एवं दो एकल बीजाणु संवर्धनों (ओ.ई. –55–08 एवं ओ.ई.–55–30) का अध्ययन किया गया। ए.एफ.एल.पी. तकनीक द्वारा की गई वंशावली अध्ययन में वी.वी.–01 बाकि सभी प्रजातियों से भिन्न पायी गई तथा इसके बाद डब्ल्यू. डब्ल्यू.–08 एवं दोनों एकल बीजाणु संवर्धन भी अनुवांशिक तौर पर अलग पाये गये। बाकि की चार प्रजातियां एक ही समूह में आई जो कि ये दर्शाती है कि ये सभी प्रजातियॉ एक ही उत्पत्ति की है। इन परिणामों का आई.टी.एस.–आर.एफ.एल.पी. के परिणामों के साथ भी तुलना की गई। इंट्रौन की संख्या तथा स्थिति के आधार पर यह पाया गया कि *वॉल्वेरियेला* खुम्ब *प्लूरोटस* की तुलना में *कोपराईनस सिनेरेटा* के ज्यादा करीब है। आई.टी.एस. अनुक्रमों एवं लैक्केज जीन के अनुक्रमों के विश्लेषण में काफी भिन्नता देखी गई जिससे *वॉल्वेरियेला* की नई प्रजाति की पहचान की संभावना है।

फसल उत्पादन

क) बटन खुम्ब

बटन खुम्ब उत्पादन के लिये खाद बनाने हेतु सोयाबीन के पुआल के मूल्यांकन पर कई प्रयोग किये गये। इन प्रयोगों से यह पाया गया कि अकेले सोयाबीन की पुआल से अच्छी खाद नहीं बन पाती है जो कि कम उत्पादकता द्वारा परिलक्षित होती है। जबकि गेहूं के पुआल के साथ सोयाबीन के पुआल को मिलाने से लम्बी विधि द्वारा अच्छी खाद का निर्माण होता है। एक दूसरे प्रयोग में जैविक खुम्ब उत्पादन हेतु खाद का सूत्रीकरण सफलतापूर्वक किया गया।

कुल 19 केसिंग मिट्टियों तथा उनके मिश्रणों का मूल्यांकन किया गया जिसमें गोबर की खाद

एवं प्रयुक्त खुम्ब पोषाधार (धान की पुआल का) के मिश्रण में सर्वाधिक उत्पादकता प्राप्त हुई।

ख) प्रयुक्त मशरूम कम्पोस्ट का उपयोग

वर्मीवाश एवं वर्मी–कम्पोस्ट दोनों का रसायनिक एवं जैविक चरित्र चित्रण किया गया तथा जब वर्मी–कम्पोस्ट वाश को 100 मि0ली0/बैग खुम्ब कवक जाल फैलाव के समय बैग में मिलाया गया तो काफी अच्छे परिणाम प्राप्त हुए एवं खुम्ब की पैदावार में भी वृद्धि दर्ज की गई। इसके अलावा जब वर्मीवाश भी 100 मि0ली0/3 कि0ग्रा0 केसिंग में मिलाया गया तो अच्छे परिणाम प्राप्त हुए।

प्रयुक्त खुम्ब कंपोस्ट का मिट्टी की संरचना एवं गुणवता पर भी अच्छा असर देखा गया। हालांकि यह भी देखा गया कि यह असर मिट्टी की गहराई के साथ कम होता जाता है। साथ ही साथ मिट्टी में पोषक तत्वों एवं जैविक पदार्थें की वृद्धि भी दर्ज की गई।

ग) ढींगरी खुम्ब

प्लूरोटस जामोर वार रोसियस के उत्पादन हेतु नारियल उद्योग प्रतिफल मुख्यतः रैचिस एवं इनफ्लोरेसेंस का प्रयोग किया गया तथा यह पाया गया कि नारियल के रैचिस पर ढींगरी की अच्छी उपज प्राप्त हो सकती है।

एक कम लागत ढींगरी खुम्ब उत्पादन कक्ष एवं कंपोस्टिंग यार्ड प्रर्दशन हेतु बनवाया गया है।

घ) पुआल खुम्ब

पुआल खुम्ब के उत्पादन हेतु कॉटन जिनिंग मिल वेस्ट तथा धान के पुआल का कंपोस्टिड पोषाधार बनाया गया तथा उन पोषाधारों पर विभिन्न प्रजातियों के उत्पादन पर प्रयोग किये गये। इस अध्ययन में प्रजाति बी.बी.एस.आर.–07, बी.बी.एस. आर.–02 एवं बी.बी.एच.–01 की उत्पादकता सर्वाधिक पायी गई।

ड.) विशिष्ट खुम्ब

अंडमान एवं निकोबार से एकत्रित *लेन्टाईनस* की प्रजाति के अध्ययन से पता चला कि उपयुक्त माध्यम माल्टअगर, पीएच 7.0 एवं अनुकूल तापमान 25 डिग्री सै0 है। पीसीआर प्रबर्धन एवं अनुक्रम विश्लेषण से यह पता चला कि प्रजाति की 91 प्रतिशत समानता *लेन्टाईनस टाईग्रीनस* के साथ है। कायिकी एवं आकारिकी के आधार पर इसे *लेन्टाईनस साजोर–काजू* के रूप में पहचाना गया। इस खुम्ब का सफलतापूर्वक उत्पादन लकड़ी के बुरादे पर 28–30^0 सै0 पर किया गया। खुम्ब कलिकाएं बनने में लगभग 72 दिन लगे तथा अगले 3–4 दिन में कलिकायें परिपक्व फलनकायो में परिवर्धित हो गई। दूसरी फसल आने में लगभग 20 दिन का समय लगा तथा फलनकायो का औसत भार लगभग 17.0 ग्राम पाया गया।

राजस्थान में 12 स्थानों (एन. 26–27^0, ई 76–77^0 तथा एम.एस.एल. 105–235 मीटर) से *फेलोरिनिया* खुम्ब के कुल 84 नमूने एकत्रित किये गये। खुम्ब के कवक जाल फैलाव के लिये माल्ट अगर माध्यम सर्वोत्तम पाया गया तथा वृद्धि दर 2–5 मि0मी0 प्रति दिन पाई गई। खुम्ब के लिये अनुकूल तापमान 40^0 सेल्यिसम एवं पी.एच. 7–7.5 पाया गया।

कुल 29 संवर्धनों को जब पी0सी0आर द्वारा प्रबर्धित किया गया तो आई0टी0एस0 के 800 बीपी के खण्ड प्राप्त हुए। न्युक्लियोटाईड अनुक्रमों के तुलनात्मक विश्लेषण से इन नमूनों की 90 प्रतिशत

समानता *फेलोरिनिया हरकुलिया* के साथ मिली। इन नमूनों में अनुवांशिक विविधता का विश्लेषण –12 आर.ए.पी.डी. प्राईमरों तथा 8 प्रतिबंध किण्वकों द्वारा किया गया। वंशावली विश्लेषण के आधार पर इन संवर्धनों को 10 समूहों में विभक्त किया गया तथा इस अध्ययन से यह भी निर्देश मिला कि इन नमूनों में कम से कम *फेलोरिनिया* की तीन प्रजातियां पहचानी जा सकती है।

शिटाके खुम्ब की 23 प्रजातियों की रैखिक वृद्धि गेंहू के पुआल पर मुल्यांकित की गई। सभी प्रजातियों की वृद्धि गेहूं के पुआल पर अच्छी पायी गई जबकि ओई–9, ओई–24, ओई–45 एवं ओई–388 की वृद्धि दर सबसे ज्यादा दर्ज की गई। लगभग सभी प्रजातियों के लिए अनुकूल पीएच0 7.0 पाया गया जबकि प्रजाति ओई–2, ओई–23, ओई–45 एवं ओई–388 के लिए यह 6.0 पाया गया। सभी प्रजातियों के लिए अनुकूलतम तापमान 25 डिग्री सै0 पाया गया जबकि ओई–17 के लिए यह 20 डिग्री सै0 पाया गया।

शिटाके खुम्ब की 23 प्रजातियों के उत्पादन पर प्रयोग किये गए तथा यह पाया गया कि ओई–16, ओई–28 एंव ओई–388 प्रजातियां अधिक तापमान पर उगाई जा सकती है। इनके अलावा ओई–22, ओई–23, ओई–8 एवं एलई0–2 भी कुछ अधिक तापमान पर उगाई जा सकती है। साथ ही साथ शिटाके खुम्ब के लिए खाद का सुत्रीकरण गेहूं के पुआल, अमोनियम नाईट्रेट, मक्के के गुल्ले, कपास के बीज की खली, जिपसम, कैल्सियम कार्बोनेट एवं पोटाशियम नाईट्रेट के प्रयोग द्वारा की गई तथा इनमें से गेहूं के पुआल, कैल्शियम कार्बोनेट तथा जिप्सम के मिश्रण से बनी खाद द्वारा अच्छे परिणाम प्राप्त हुए।

वर्षपर्यन्त गुच्छी खुम्ब के कुल 14 नमूने अगस्त एवं सितम्बर माह में एकत्रित किए गए। आठ प्रजातियों के शुद्ध संवर्धन निदेशालय के कल्चर बैंक से स्कलेरोशिया बनाने हेतु लिये गये। कुल आठ मे से ओई–198, ओई–232 एवं ओई–260 प्रजातियों में सबसे ज्यादा स्केलरोशिया का निर्माण हुआ। स्केलेरोशिया के अंकुरण एवं गुच्छी के फलनकायो को बनाने हेतु विभिन्न प्रयोग किये गये परन्तु कोई सफलता प्राप्त नहीं हुई। गुच्छी के फलनकाय के निर्माण हेतु विभिन्न पोषाधारों का भी मुल्यांकन किया गया जैसे कि सेब की खली, सड़ी हुई नाशपाती, गेंहूं का पुआल, लकड़ी के टुकड़े एवं जूट बैग। सभी पोषाधारों में गुच्छी के कवक जाल का फैलाव दर्ज किया गया। गुच्छी को कृत्रिम तौर पर उपजाने के लिए सेब, नाशपाती एवं पलम के पौधे लगाये गए है तथा उन्हें गुच्छी के संवर्धन द्वारा निवेशित किया गया है।

एगेरिकस बाईस्पोरस की प्रजाति एस–11 के बीज को छहः पीढ़ी तक बीज से बीज बनाया गया ताकि यह सुनिश्चित किया जा सके कि बीज से बीज बनाने पर उत्पादकता में कितनी गिरावट आती है। यह देखा गया कि बीज से बीज बनाने पर हर पीढ़ी में उत्पादकता कम होती जाती है तथा छहः पीढ़ी तक जाने पर लगभग 33 प्रतिशत तक कम उत्पादकता दर्ज की गई।

कॉर्डिसेप्स साईनेन्सिस एक महत्वपूर्ण औषधीय खुम्ब है एवं इस पर किए गये अध्ययनों से यह पता चला कि माध्यम रिचर्ड अगर, तापमान 25 डिग्री सै0 एवं पीएच0 6 इसके लिए अनुकूलतम है। इसके लिए सर्वोत्तम कार्बन स्रोत स्टार्च एवं माल्टोस पाये गए जबकि एस्पाराजीन एवं कैल्शियम नाईट्रेट सर्वश्रेष्ठ नाईट्रोजन स्रोत के रूप में पहचाने गए।

इस खुम्ब के विभिन्न किण्वकों की परख भी की गई तथा काईटीनेस (79.51 यू/मिली0/घण्टा), जाईलानेस (68.56 यू/मिली0/घण्टा) एवं पेक्टिनेस (45.25 यू/मिली0/घण्टा) आदि किण्वक काफी मात्रा में पाये गए। इस खुम्ब में औषधीय गुण मुख्यतः इसके एन्टी–आक्सीडेन्ट गुण के कारण होते है। अतः इसका परीक्षण विभिन्न तकनीको जैसे कि रिडयूसिंग गुण (91.03 प्रतिशत) एवं डी0पी0पी0एच0 रैडीकल स्कैवेन्जिग गुण (47.03 प्रतिशत) द्वारा किया गया।

फसल संरक्षण

वर्ष के दौरान हरियाणा राज्य के कुल 232, हिमाचल प्रदेश में 12 एवं पंजाब के एक फार्म का बीमारियों एवं कीटों के संक्रमण को दर्ज करने के लिए सर्वेक्षण किया गया। फार्मों पर ब्राउन प्लास्टर फंफूद, पीला फंफूद एवं गीला बुलबुला का संक्रमण काफी मात्रा में पाया गया। कुछ फार्मों में हरी फंफूद एवं फाल्स ट्रफल फंफूद भी पाए गए।

गीला बुलबुला फंफूद एवं पीला फफूंद (*सेपिडोनियम*) की पहचान हेतु आण्विक स्तर पर प्राईमर बनाए एवं प्ररीक्षण किए गए। इसमें से *माईकोगॉन* की पहचान के लिए एक प्राईमर बहुत ही प्रभावशाली पाया गया एवं 750 बीपी के सिर्फ एक डीएनए खण्ड का प्रतिवर्धन हुआ। *सेपिडोनियम* की पहचान के लिए दो प्राईमरों ने बहुत अच्छें परिणाम दिए।

किसानों के फार्म पर इन बीमारियों के संक्रमण को रोकने एवं उपचार करने हेतु प्रयोग किए गए जिसमें खाद को वैविस्टिन एवं फार्मोलिन से उपचारित करके उसमें बीजाई की गई। यह प्रयोग हरियाणा के सोनीपत जिले में आठ फार्मों पर लगाया गया और अच्छे परिणाम प्राप्त हुए।

एक अन्य प्रयोग जिसमें खुम्ब कीटों के नियंत्रण के लिए विभिन्न प्रकाश का अध्ययन किया गया, यह पता चला कि पीला प्रकाश फोरिड मक्खियों को आकर्षित करने एवं पकड़ने में काफी उपयोगी है। पीले प्रकाश को ऑयस्टर मशरूम को नुकसान करने वाले बीटल को भी पकड़ने में प्रभावी पाया गया।

पश्च फसल तकनीकी

खुम्ब में शुष्कीकरण एवं मूल्यवर्धन दो बहुत ही महत्वपूर्ण पश्च फसल तकनीकियां है जिसके द्वारा खुम्ब को लम्बे समय के लिए संरक्षित किया जा सकता है। इसी सोच के साथ, बटन खुम्ब की पश्च शुष्कीकरण विशेषताओं का अध्ययन एक फलुडाईज्ड बेड ड्रायर में किया गया। इस अध्ययन में 55^0 सैल्सियस तापमान एवं 2.5 एम/एस हवा की गति द्वारा रंग, कुटुकरापन, खुशबु इत्यादि में सर्वोत्तम परिणाम प्राप्त हुए। इसके अलावा ढींगरी खुम्ब को धूप में सुखाने के लिए भी विभिन्न प्रयोग किए गए तथा यह पाया गया कि अधिकतम गुणवत्ता (7 प्रतिशत आर्द्रता) $28–30^0$ सैल्सियस तापमान तथा 45–52 प्रतिशत आर्द्रता में 18–22 घंटे के सुखाने से प्राप्त हुई।

कुछ अन्य प्रयोगों में खुम्ब में कुछ मूल्यवर्धिति उत्पाद विकसित किए गए जिसमें ताजे व सुखी हुई ढींगरी खुम्ब का प्रयोग किया गया। ढींगरी खुम्ब के अच्छी गुणवत्ता वाले बिस्कुट, अचार, सूप पाउडर, जैम, पैटीज, पकौंड़े इत्यादि बनाने की तकनीक भी सफलतापूर्वक मानकीकृत की गई।

इन सभी उत्पादों में मशरूम बिस्कुट, अचार, जैम, पकौड़े एवं सूप पाउडर सबसे ज्यादा पसंद किए गए।

तकनीकी हस्तांतरण

वर्ष 2010 में, इस निदेशालय ने नौ प्रशिक्षण शिविर परिसर में एवं परिसर के बाहर किसानों, महिलाओं, उद्यमियों एवं कृषि विज्ञान केन्द्रों के अधिकारियों एवं वैज्ञानिकों के लिए आयोजित किया। इन प्रशिक्षणों में कुल 364 प्रशिक्षणार्थियों को प्रशिक्षण दिया गया। एक दस दिन का प्रशिक्षण बंगला देश से आये हुए अधिकारियों एवं वैज्ञानिकों को भी दिया गया। इन प्रतिनिधियों को खुम्ब अनुसंधान निदेशालय एवं इसकी कार्यशैली के बारे में तथा भारत में प्रयुक्त उन्नत खुम्ब उत्पादन तकनीकों के बारे में भी बताया गया।

हर वर्ष की भांति इस वर्ष भी राष्ट्रीय खुम्ब मेला 10 सितम्बर, 2010 को इस निदेशालय के प्रांगण में मनाया गया जिसमें देश के विभिन्न क्षेत्रों से लगभग 550 किसानों, महिलाओं, अनुसंधानकर्ताओं तथा उद्यमियों ने भाग लिया। इस मेले में लगभग 20 राज्यों का प्रतिनिधित्व हुआ। मेले में उन्नत खुम्ब उत्पादन तकनीकों पर एक प्रर्दशनी भी लगाई गई जिसके उपरांत एक किसान गोष्ठी का आयोजन भी किया गया। इस मेले के दौरान कुल सात प्रगतिशील किसानों को सम्मानित एवं पुरस्कृत किया गया। इसके अलावा भारत के उतर पूर्वी राज्यों से आए प्रगतिशील खुम्ब उत्पादकों को भी प्रशस्ति पत्र प्रदान किए गए।

भारत में मशरूम से जुड़ी भ्रान्तियों को खत्म करने एवं इसके स्वास्थ्य लाभ के बारे में जानकारी फैलाने हेतु निदेशालय द्वारा पांच भिन्न राज्यों में राज्य एवं राष्ट्रीय स्तर के मेलों में प्रदर्शनी लगाई गई एवं खुम्ब के बारे में साहित्य मुफत बांटे गए।

इसी वर्ष दो क्षेत्रीय खुम्ब मेले अटेरना व गन्नौर, हरियाणा में आयोजित किए गए। इन मेलों में माध्यम से खुम्ब उत्पादकों की समस्याओं का समाधान करने तथा खुम्ब के प्रयोग को जनसाधारण में बढ़ावा देने हेतु प्रयास किए गए।

निदेशालय द्वारा खुम्ब उत्पादन के विभिन्न पहलुओं पर पत्राचार द्वारा सलाह की सुविधा भी खुम्ब उत्पादकों के लिए दी जाती है। औसतन 6 प्रश्न रोजाना पुछे जाते हैं तथा निदेशालय के विशेषज्ञों द्वारा इनका उत्तर दिया जाता है। विभिन्न राज्यों से किसानों के समूह इस निदेशालय का अध्ययन भ्रमण करने आते हैं तथा निदेशालय द्वारा उन्हें खुम्ब उत्पादन की विधि एवं निदेशालय द्वारा प्रदत सेवाओं के बारे में बताया जाता है।

खुम्ब के प्रचार एवं प्रसार के लिए निदेशालय द्वारा 9 दूरदर्शन कार्यक्रम भी शिमला दूरदर्शन केन्द्र की मद्द से प्रसारित किए गए। केन्द्र के निदेशक महोदय का साक्षात्कार दूरदर्शन के दिल्ली केन्द्र द्वारा प्रसारित किया गया।

प्रकाशन

वर्ष 2010 में इस निदेशालय द्वारा कुल 18 अनुसंधान पत्र राष्ट्रीय एवं अन्तर्राष्ट्रीय शोध पत्रिकाओं में प्रकाशित किए गए। इसके अलावा 2 पुस्तकें, 11 पुस्तकों में अध्याय एवं एक तकनीकी विस्तार पत्र भी प्रकाशित किए गए।

EXECUTIVE SUMMARY

The Directorate of Mushroom Research has made significant progress in research, transfer of technology and human resource development. The achievements of Directorate of Mushroom Research during 2010 in Crop Improvement, Crop Production, Crop Protection, Transfer of Technology, Education and Training and Publications are summarized here.

CROP IMPROVEMENT

(a) Germplasm Collection and characterization

Fungal forays were undertaken in the forest areas of Himachal Pradesh, Jharkhand, Tripura and Rajasthan. A total of 111 specimens were collected and 108 specimens identified upto genus level. All the specimens have been preserved in the Herbarium of DMR, Solan.

All the specimens were examined for their macroscopic features in the field along with their field photographs. Pure tissue cultures of 54 specimens were obtained and deposited in the Gene Bank of DMR, Solan. Some collections namely, *Amanita hunanensis*, *Armillaria mellae, Dictyophora indusiata, Lactarius sanguifluus, L. scrobiculatus, Lentinus squarrosulus* (edible in Tripura), *Limacella furnaceae*, *Marasmius cohaerens, Macrolepiota permixta, Melanoleuca bravipes, Psathyrella condolina, Sparaciss crispa Amanita* species were identified upto species level. Some of the new genera recorded for the first time include *Humidicutis*, *Leucoagaricus, Leucopaxillus, Micromphalea, Otidea, Schizostoma, Tulostoma* and *Vascellum.*

(b) Genetic Improvement

i) *Agaricus bisporus*

Procured more than 100 strains of *Agaricus bisporus* from wild and culture collection of IARI and DMR. A total of 29 strains were put under cultivation trials and A-17 followed by Delta and S-130 performed best. Spore prints were obtained from fruit body for all the strains and media were standardized for maximum spore germination. Isolation of 294 single spore isolates from different parents i.e. S-11, U-3, A-4, A-6, A-16, A-17, A-2, A-15, A-94, NCS-101, S-465 and S-130 was achieved. A total of 132 isolated spores were subjected to fruiting trial. Out of 64 fruiting single spore isolates 34 have been selected for large-scale cultivation trails on the basis of the high yield and quality of fruit body.A total of 22 non-fruiting single spore isolates from U-3 strains and 2 from A-94 could be identified. The homokaryons along with parental strains are under DNA (using RAPD, RFLP and ISSR) and intra- and extra-cellular protein analysis (SDS PAGE) to correlate the data with fruiting trial and identify a marker for homokaryon identification without going for lengthy fruiting tests. The non-fruiting isolates have been crossed intra- and inter-strainal level for hybrid formations and mating type determination. The crosses are under spawn preparation for their confirmation of hybridization and mating type identification. All the 64 single spore isolates (SSIs) were assessed for their downward linear growth in compost that has been correlated with the yield. A positive correlation of 0.75 could be calculated with a R^2 value of 0.52. The spawn of newly developed 162 SSIs are under preparation for fruiting trials.

ii) *Pleurotus* species

Six strains of *P. eryngii* and *P. fossulatus* were compared for yield evaluation. *P. eryngii* strain-3 gave better productivity than other strains. Ten different strains of *P. florida* and *P. sajor caju* were compared for yield evaluation. Nineteen wild *Pleurotus* spp were compared for yield potential. Strain X-586 and X-1021 gave maximum production.

iii) *Volvariella volvacea*

Six strains of paddy straw mushroom (*V. volvacea*) viz., Vv-01, BBH-01, BBSR-002, BBSR-003, BBSR-007 and WW-08 and two single spore isolates (OE-55-08 and OE-55-30) were used for different studies. Phylogenetic study using AFLP technique revealed that strain Vv-01 was quite distinct, followed by WW-08, two SSIs (OE-55-08 and OE-55-30), while rest 4 strains basically

from same origin formed single group. These findings were further corroborated by the ITS sequences and ITS-RFLP of these strains. The study on presence of number of introns and their positioning revealed that *V. volvacea* is closer to *Coprinus cinerea* than *Pleurotus ostreatus*, which actually has been projected in earlier studies. The study on ITS sequences and laccase gene sequencing has also revealed that strain Vv-01 as heterozygotic, while rest other strains as homozygotic. The study on morphological and molecular characterization of newly received strains from different regions of the country has revealed variability in different strains, indicating either wrong identification of the strains or presence of be new species of *Volvariella,* which will only be clarified after ITS sequencing.

CROP PRODUCTION

(a) Button mushroom

Experiments were conducted for utilization of soybean straw for compost production for button mushroom. Soybean straw as such was not useful as the same produced low yield. However, its combination with wheat straw produced satisfactory yield under long method of composting. In an another trial a formulation for organic button mushroom production was standardized.

Out of the 19 different casing materials and their combinations tried as casing substrates, a combination of FYM and paddy straw SMS gave the highest yield.

(b) Utilization of spent mushroom substrate

The impact of SMS composting on soil was significant. The composting influence was more on the surface and with increasing depth the extent of influence was reduced. The soil fertility in terms of nutrient and organic matter content increased significantly on the site of SMS composting.

The vermiwash and vermicompost was characterized for both chemical and biological properties. The mixing of vermicompost wash @ 100 ml per bag at spawn running was the best followed by vermiwash @100 ml per 3 kg casing material in increasing the button mushroom yield.

(c) Oyster mushroom

Coconut industry wastes mainly rachis and inflorescence were used for cultivation of *Pleurotus djamor* var. *roseus*. Coconut rachis was found superior over inflorescence.

(d) Paddy straw mushroom

The cultivation trials using composted substrate prepared from cotton ginning mill waste and paddy straw has revealed BBSR-007, BBSR-002 and BBH-01 as the high yielding strains.

(e) Specialty mushrooms

Pure culture of *Lentinus* collected from Andeman and Nicobar was prepared**.** Optimum conditions for the mycelial growth in Malt Extract Medium was 25ºC temperature and pH 7.0. PCR amplification of ITS region showed 91 per cent identity with *Lentinus tigrinus*. On the basis of other morphological characteristics the species was identified as *L. sajor-caju*. This mushroom was successfully cultivated on sawdust at 28-30ºC. Primordia start developing after 72 days of spawning, which fully developed in the next 3-4 days. The next flush appeared after 20 days. The average weight of the fresh fruit body was 17g.

Eighty-four samples of *Phellorinia* were collected from 12 sites ranging from N 26-27º, E 76-77º and MSL105-235m elevation. Malt Extract Medium was found to be the best to support the growth of *Phellorinia*. The growth rate varied between 2-5 mm/day. Optimum temperature for the mycelial growth was observed to be 40ºC. and optimum pH was 7.0-7.5.

PCR amplification of ITS region of 29 selected cultures yielded an ITS fragment of approximately 800 bp length. Nucleotide sequence comparisons showed 90 percent identity with *Phellorinia herculea.* Genetic variability among these cultures was studied using 12 RAPD primers and 8 restriction enzymes. Phylogenetic analysis divided these 29 cultures into 10 groups. DNA sequencing of these cultures revealed the presence at least 3 different *Phellorinia* species.

Wheat straw was evaluated for the linear growth of 23 strains (OE-2, OE-8, OE-9, OE-8, OE-13, OE-16, OE-17, OE-20, OE-21, OE-22, OE-23, OE-24, OE-26, OE-27, OE-38, OE-45, OE-329, OE-388, X-1121 and Le-6, Le-7, Le-8, Le- 9) of shiitake. All the strains were able to grow on wheat straw and OE-9, OE-24, OE-45, OE-388 were the fastest growing strains. Optimum pH for most of the strains was 7.0, however, OE-2, OE-23, OE-45 and OE-388 showed better growth at pH 6.0. Optimum temperature for all the strains was 25ºC except OE-17, which grew best at 20ºC.

Cultivation trial on 23 strains of shiitake on wheat straw and sawdust revealed that OE – 16, OE-38, OE-388 strains were the most promising high temperature tolerant strains. Other high temperature strains were OE-22, OE-23, OE-8 and Le-7.

Different compost formulations using wheat straw, ammonium nitrate, corncobs, cotton seed cake, gypsum, calcium carbonate and potassium nitrate were prepared for cultivating shiitake. One formulation consisting of wheat straw, calcium carbonate and gypsum gave satisfactory results.

During the year 14 samples of *Morchella* were collected from three different sites of Solan (Deoli Ki Sher, Deonghat, Kuthar) in the month of August and September.

Eight strains procured from DMR culture bank were evaluated for sclerotia formation. Three strains (OE-198, OE-232 and OE-260) produced sclerotia abundantly.

Old apple pomace supported the fastest growth of all the eight strains of *Morchella.* Different formulations consisting of apple pomace, pear, wheat straw, wood chips and jute bags were tried. All the formulations were successfully colonized by *Morchella* spawn.

Saplings of apple, pear and plum were procured and have been planted in the pots inoculated with *Morchella* spawn for further studies.

Morchella usually grows on higher altitudes, hilly landform with cool microclimate (western aspect, below trees and weeds) whereas *Phellorinia* spp prefers plains with warm climatic conditions. *Morchella* likes clay loam soil with rich organic matter, nitrogen and potassium but sandy soil with poor nutrients is the ideal choice for *Phellorinia* spp. Both mushrooms prefer alkaline soil conditions among which *Phellorinia* is fond of strong alkalinity

Spawn of S-11 strain of *Agaricus bisporus* was multiplied up to six generation from the original master spawn. The production decreased gradually. After multiplication up to six generation there was 33% reduction in yield.

In *Cordyceps sinensis* best growth supporting medium (Richards synthetic agar) was selected for studying the effect of different temperature regimes and pH. Best radial growth was recorded at 25^0C at pH 6.0 followed by pH 7.0. Among the different carbon sources tested, starch proved to be the best carbon source followed by maltose. While among the different nitrogen sources tested, asparagine proved to be the best nitrogen source followed by calcium nitrate. Among different enzyme profile studied, maximum activity of chitinase (79.51 Unit/ml/h) was recorded followed by xylanase (68.56 Unit/ml/h) and pectinase (45.25 Unit/ml/h).

Antioxidant assay of mycelial extract of *C. sinensis* revealed 46.39% inhibition while reducing activity and scavenging effect on DPPH radicle were 91.03% and 47.03%, respectively.

CROP PROTECTION

During the year 232 farms in Haryana, 12 farms in Himachal Pradesh and 1 in Punjab were visited to record the incidence of diseases and competitor moulds. Brown plaster mould, yellow mould and wet bubble were the most prevalent problems. Olive green mould and false truffle were also recorded in few farms.

Specific primers designed to target *Mycogone* and *Sepedonium* were tested against the pure cultures. One primer was found very specific to *Mycogone* that produced a band of 750bp. Two primers gave satisfactory results against *Sepedonium.*

On farm trial for the control of yellow mould using bavistin and formaldehyde was laid at two villages of Sonepat at eight farms. The trial was successful at six places.

In order to study the effect of different coloured lights for trapping phorid flies, LED light was used during the cultivation of oyster mushroom when temperature range was 19-21^{0}C. Yellow light proved highly effective for trapping the phorid flies followed by green light. Yellow light also proved effective for trapping beetles damaging oyster mushroom.

POST HARVEST TECHNOLOGY

Characteristics of button mushroom in fluidized bed dryer was studied and the best quality of dried mushroom slices were obtained at 55^{0}C and 2.5 m/s drying air velocity in terms of physical parameters viz., colour, crispy structure, flavour and comparatively less shrinkage. Also, various sun-drying trials of *Pleurotus* spp. species in steel tray was carried out. The best quality sun dried oyster mushroom with final moisture content 7% (d.b.) was obtained at temperature of 28-32ºC and relative humidity at 45-52% within 18-22 hours of sun drying.

A good quality crunchy oyster mushroom biscuits, pickle, mushroom soup, jam and mushroom patties were successfully prepared and evaluated. As far as the overall acceptability was concerned, mushroom biscuits topped in the list, followed by mushroom pickle, mushroom jam, mushroom patties and mushroom soup.

TRANSFER OF TECHNOLOGY

During 2010, the Directorate organized nine On and Off campus training programmes for farmers, farmwomen, entrepreneurs, officers and scientists of KVKs. A total of 364 trainees got benefited in all these trainings during 2010. A training for the officials and scientists of Bangladesh on a 10 day study visit to DMR, Solan was organised. The delegates were exposed about the activities of DMR and advances in mushroom cultivation technology in India.

One day Mushroom Mela was organized on 10th September, 2010 as regular activity of the Directorate. It was attended by about 550 farmers, farmwomen, mushroom growers, researchers, extension workers and businessmen from 20 states. An exhibition on improved mushroom cultivation technologies and a kisan goshthi was organized during the Mushroom Mela. During the Mushroom Mela, the Directorate awarded seven (7) progressive/ innovative mushroom growers for adopting innovative practices in mushroom and a certificate of appreciation was awarded to nine progressive mushroom growers from North East region.

In order to create awareness about mushroom cultivation and its health benefits the Directorate participated in five different state and national level exhibitions and fairs by establishing a stall and by distributing the free literature.

Two regional Mushroom Mela and consumption fairs were held at Aterna and Gannaur villages in Haryana on 16th-17th Jan., 2010 to address the problems faced by mushroom growers and to promote mushroom consumption among common public.

Advisory services through postal extension letters on various aspects of mushroom cultivation, training and marketing were provided. Queries on mushroom cultivation, training were replied through telephone and e-mail. On an average 6 queries per day were received either by phone/mail/letters. The farmer groups from different states and students of various colleges visiting the institute were briefed regularly about the various facilities and services rendered by DMR, Solan

Nine (09) Phone-in and field based programmes were telecast on Doordarshan Kendra from Shimla on Krishi Darshan. Another programme/ interview of Director DMR, Solan was aired by Delhi Doordarshan.

PUBLICATIONS

During the year, the scientists of the DMR published 18 research papers in refereed national and international journals, 2 books, 11 book chapters and 1 technical folder.

INTRODUCTION

In India every year more than 600 million ton of agrowastes forest wastes, agro-industrial and animal wastes are generated. Among the different agricultural and horticultural products mushroom are considered the highest protein producers per unit area and time due to utilization of vertical space and short life cycle. Since mushroom cultivation is done under controlled conditions the water requirement is less than any other crop grown in the field and has all the potentials of being a major crop in coming days. Current mushroom production in India is over 1 lac tonnes, of which 85 per cent is contributed by button mushroom only. The demand for quality food and novel products especially in urban areas is increasing with the change in life style and income. The present century is going to be a century of functional food. With the ever increasing population and shrinking land holding, secondary agricultural vocations are going to occupy a prominent place to fill the void of quality food requirements.

Integrating mushroom cultivation in the existing farming system will not only increase the income of the farmers but will also promote proper recycling of agrowastes, thereby improving soil health and promoting organic agriculture. Some of the mushrooms are very easy to cultivate and can be adopted by small farmers or urban and peri-urban population.

Directorate of Mushroom Research is located in Solan, H.P. There is no regional station of the Directorate but for the multi-locational testing of technology under varied agro-climatic conditions, an All India Coordinated Research Project on Mushroom (AICRPM) has been sanctioned and established with its Headquarter at Directorate of Mushroom Research, Solan (HP). The Director, DMR also functions as the Project Coordinator of the project.

Achievements

National Mushroom Repository of this Directorate has been enriched by addition of 111 specimens. New genera recorded for the first time include *Humidicutis, Leucoagaricus, Leucopaxillus, Micromphalea, Otidea, Schizostoma, Tulostoma* and *Vascellum*. Evalution of various strains of button mushroom revealed that A-17 followed by Delta and S-130 are the best. Genetic diversity studies on *Volvariella volvacea* strains revealed that Vv-01 and WW-08 strains are quite distinct than other strains.The study on ITS sequences and laccase gene sequencing has also revealed that strain Vv-01 as heterozygotic, while rest other strains as homozygotic.

Pure soybean straw was not suitable for button mushroom compost; however, when mixed with wheat straw it can be used successfully for making compost in long method of composting. The cultivation trials of paddy straw mushroom using composted substrate prepared from cotton ginning mill waste and paddy straw, revealed BBSR-007, BBSR-002 and BBH-01 as the high yielding strains. The impact of SMS composting on soil was significant and it was more on the surface. Eighty-four samples of *Phellorinia* were collected from 12 sites in Rajasthan. Nucleotide sequence comparisons of 29 selected cultures showed 90 per cent identity with *Phellorinia herculea*. A new mushroom *Lentinus sajor-caju* collected from Andeman and Nicobar was successfully cultivated on sawdust at 28-30°C. Evaluation trial of 22 strains of shiitake revealed that OE –16, OE-

38, OE-388 strains are the most promising high temperature tolerant strains. Three strains (OE-198, OE-232 and OE-260) of *Morchella* were observed to be prolific sclerotia producer. Physiological studies on *Cordyceps* revealed best radial growth at 25^{0}C at 6.0 pH. Starch was the best carbon and asparagine was the best nitrogen source. Studies on spawn degeneration indicated that spawn to spawn multiplication results in decreased yield.

During the year 245 farms in Haryana, Himachal Pradesh and Punjab were visited to record the incidence of diseases and competitor moulds. Brown plaster mould, yellow mould and wet bubble were the most prevalent problems. Specific primers were designed to target *Mycogone* and *Sepedonium*. On farm trial for the control of yellow mould using bavistin and formaldehyde was largely successful. Yellow light proved highly effective for trapping the phorid flies followed by green light.

One day Mushroom Mela was also organized which was attended by large number of farmers from 20 States. Two regional mushroom Mela and consumption fairs were held at Aterla and Gannaur villages in Haryana. Nine Phone-in and field based programmes were telecast on Doordarshan Kendra from Shimla on Krishi Darshan. A total of 364 trainees got benefited in nine trainings programmes during 2010.

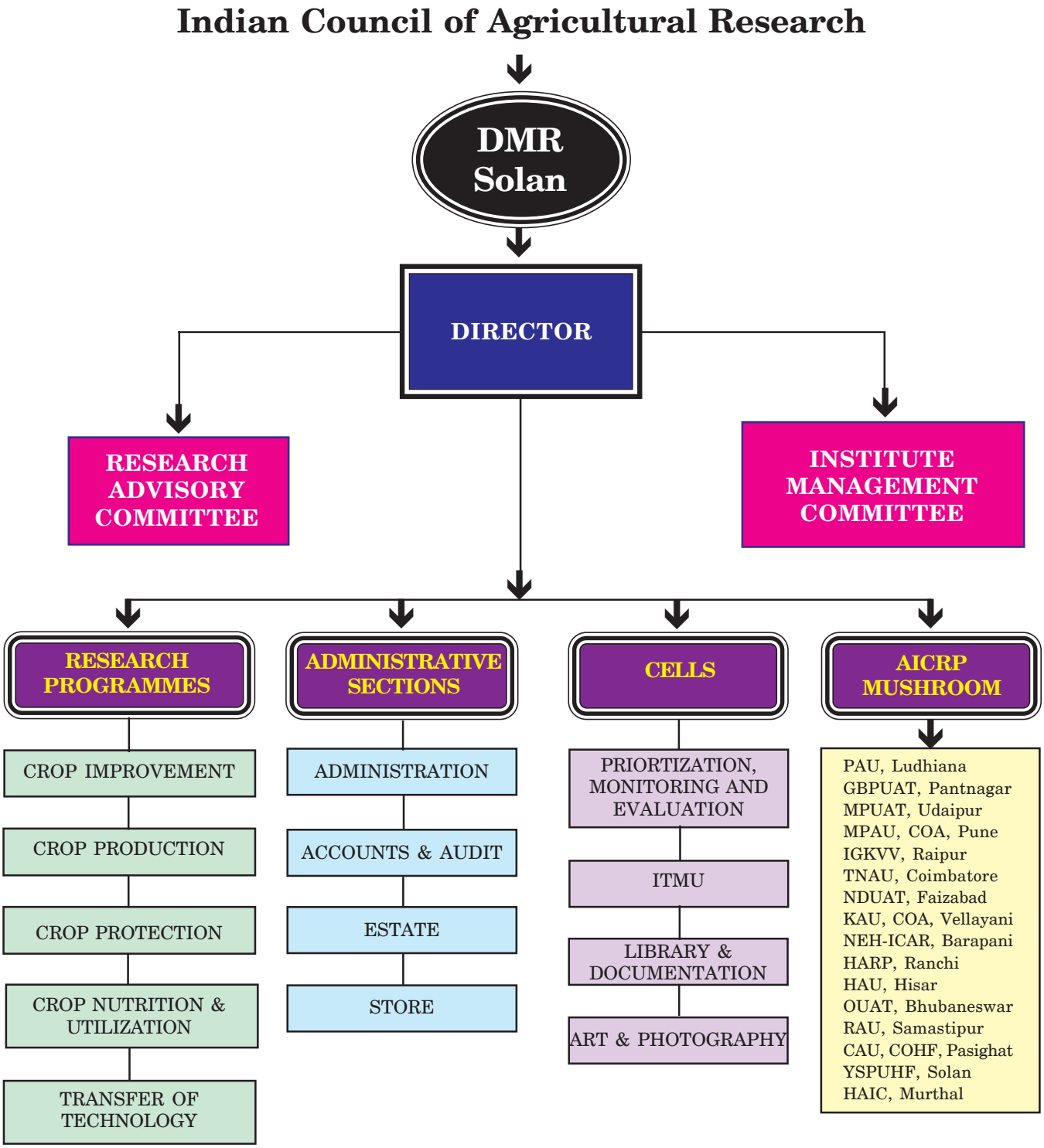
Staff and Finance

The Directorate has a sanctioned strength of 16 scientists + 1 Director, 14 Technical, 16 administrative and 11 supporting staff. The staff in position on 31.12.2010 was 10 scientists, 14 technical, and 16 administrative and 9 supporting staff. The annual budget of the Directorate for the year 2010-2011 was Rs.250.00 Lakh (Plan) which was fully utilized and Rs. 260.00 Lakh (Non Plan) out of which 258.10 lakh was utilized. The Directorate earned Rs.15.60 Lakhs as revenue during the year by sale of literature, mushroom cultures, spawn, fresh mushrooms, pickles, consultancy, training and other services.

Facilities

- Thirteen environmental controlled cropping rooms.
- One poly house
- Two low cost specialty mushroom growing sheds
- Modern composting units comprising of 4 indoor bunkers, 4 bulk chambers, covered outdoor composting platform and related structures.
- Five well equipped laboratories with all sophisticated equipments.
- Excellent Library facilities with access to world literature on mushrooms through internet, CeRA, periodicals on mushroom and its related disciplines from all over the world, reference services and CD-ROM search service. It has presently number of accessions including 1691 books and 2500 back volumes of journals. It subscribes eight foreign journals and thirty-two Indian journals.

ORGANOGRAM


Indian Council of Agricultural Research
DMR Solan
DIRECTOR
RESEARCH ADVISORY COMMITTEE
INSTITUTE MANAGEMENT COMMITTEE
RESEARCH PROGRAMMES
CROP IMPROVEMENT
CROP PRODUCTION
CROP PROTECTION
CROP NUTRITION & UTILIZATION
TRANSFER OF TECHNOLOGY
ADMINISTRATIVE SECTIONS
ADMINISTRATION
ACCOUNTS & AUDIT
ESTATE
STORE
CELLS
PRIORTIZATION, MONITORING AND EVALUATION
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AICRP MUSHROOM
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MPUAT, Udaipur
MPAU, COA, Pune
IGKVV, Raipur
TNAU, Coimbatore
NDUAT, Faizabad
KAU, COA, Vellayani
NEH-ICAR, Barapani
HARP, Ranchi
HAU, Hisar
OUAT, Bhubaneswar
RAU, Samastipur
CAU, COHF, Pasighat
YSPUHF, Solan
HAIC, Murthal

1. RESEARCH ACHIEVEMENTS

A. CROP IMPROVEMENT

1. Mushroom Genetic Resources

i) Survey, collection and identification of wild fleshy fungi

Fungal forays were undertaken in the forest areas of Himachal Pradesh, Jharkhand, Tripura and Rajasthan. A total of 111 specimens were collected and 108 specimens were identified upto genus level. All the specimens have been preserved in the Herbarium of DMR, Solan. All the specimens were examined for their macroscopic features and photographed in the field. There was one specimen belonging to Ascomycetous and rest basidiomycetous fungi. The no of specimems in each family were as follows: Agaricaceae(18), Albatrelaceae (2), Amanitceae (4), Auriculariaceae (5), Boletaceae (4), Cantharellaceae (2), Coprinaceae (2), Cortinariaceae (5), Hygrophoracea*e* (1), Ganodermataceae (3), Inocybeceae (4), Lactariaceae (4), Leucopaxillaceae (1), Lentinaceae (4), Lyophyllaceae(7), Marasmiaceae (5), Mycenaceae (3), Phallaceae (1), Phelloriniaceae (1), Pleurotaceae (1), Pluteaceae (3), Polyporaceae (6), Psathyrellaceae (4), Russulaceae (3), Sclerodermataceae (2), Strophariaceae (6), Sparacissdaceae (1), Tricholomataceae (4), three unidentified and secotoid form of *Amanita* species

Pure tissue cultures of 54 specimens were obtained and deposited in the Gene Bank of DMR, Solan. Some collections have been identified upto species level i.e. *Amanita hunanensis*, *Armillaria mellae, Dictyophora indusiata, Lactarius sanguifluus, L. scrobiculatus, Lentinus squarrosulus* (edible in Tripura), *Limacella furnaceae*, *Marasmius cohaerens, Macrolepiota permixta, Melanoleuca bravipes, Psathyrella condolina, Sparassis crispa* and an interesting gastroid form of *Amanita* species. Some of the new genera recorded for the first time include *Humidicutis*, *Leucoagaricus, Leucopaxillus, Micromphalea, Otidea, Schizostoma, Tulostoma* and *Vascellum*. The detailed anatomical description of an important specimen is as below:

a. *Limacella* species (Fig. 1)

Macroscopic characters:- Pileus 20 cm wide , depressed to cyathiforme and finally plane, copuccine buff (9E-5) to peach blow (10B-5) in colour, covered with small, felted, fibrillose, Tawny (10D-10) to windson tan (13H-12) patches , margin irregular and splitting in the mature specimen, margin roll reflexed, surface moist and non hygrophanous. Lamellae adnexed, crowded, pinkish white in colour, lanceolate to normal, edge cerrate to dentate, lemellulae sub truncate of ½, 1/3, ¼, 1/5 lengths. Stipe 22 X

Fig. 1. *Limacella* species

2.5 cm, distinctly bulbous, enlarge at both ends, off white above the annulus, than popcorn, (9J-3) and at the base peach blow (10B-5), tubular enlarged at both ends, 2.7 cm at the top, 1.8 in the middle and 3 cm at the base, surface covered with brownish scales, slimy, sticky, pruinose. Annulus superior, single, not movable, wooly, broad, thick, yellowish hanging, creamish in colour. Odour strong, unpleasant, taste mild.

Microscopic characters:-Basidiospores:- [20/1/11] (5.4-)6.3-9(-9.9) X (4.95-) 5.85-8.55(-9.45) µm, L'=7.5 µm, Q'= µm, globose to subglobose, thin walled , inamyloid, light yellow colour in 3 % KOH, hyaline, granulated, apiculate, spore deposit white.

Basidia:- 34.2-45 X 10.8-12.6 µm, sub clavate to cylindric, 2.4 spored, sterigmata 4.5-7.2 µm long, basal septa with clamp, slightly thick walled , granulated, light yellow colour in 3 % KOH, cystidia none.

Pseudoparaphysis:- 80.6-40.5 X 10.35-13.5 µm, cylindrical, clavate to broadly clavate, hyaline, thin walled, colourless.

Gull trama:- Irregular, 2.7-14.4 µm wide, mixed with inflated cells, 17.1-24.3 µm wide, narrow to broad, thin, slightly thick walled, clamped, branched, septate, yellowish colour in 3 % KOH, hyaline.

Subhymenium:- Arranged in 2-3 chains of cellular, globose to subglobose cells, 9-24.3 µm wide.

Pileus surface :- 2.7-16.2 µm wide branched, septate, thin to thick walled. Narrow to broad, clamped, mixed with filamentous hyphae, hyaline, light yellow colour in 3 % KOH, inflated cells, 14.4-20.7 µm wide.

Stipe cuticle:- 2.7-31.5 µm wide branched, septate, narrow to broad, thin to thick walled, hyaline, clamped, light yellow colour in 3% KOH, inflated cells 17.1-27.9 µm wide, cylindrical hyphae.

(Survey, collection and identification of fleshy fungi - DMR-1)

2. Genetic Improvement

i) *Agaricus bisporus*

Procured more than 100 strains of *Agaricus bisporus* from culture collection of IARI and DMR. A total of 29 strains were put under cultivation trials and A-17 followed by Delta and S-130 performed the best. Spore prints were obtained from fruit bodies for all the strains and media composition was standardized for maximum spore germination. Germinated and isolated 294 single spore isolates from different parents i.e. S-11, U-3, A-4, A-6, A-16, A-17, A-2, A-15, A-94, NCS-101, S-465 and S-130. A total of 132 isolated spores were subjected to fruiting trial.Out of 64 fruiting single spore isolates 34 were selected for large-scale cultivation trails on the basis of the high yield and quality of fruit body (Fig.2). A total of 22 non-fruiting single spore isolates from U-3 strains and 2 from A-94 could be identified. The homokaryons along with parental strains are under DNA (using RAPD, RFLP and ISSR) and intra- and extra-cellular protein analysis (SDS PAGE) to correlate the data with fruiting and identify marker for homokaryon identification without going for lengthy fruiting tests.The non-fruiting isolates were crossed intra- and inter-strainal level for hybrid formations and mating type determination (Fig.3&4). All the 64 SSIs were assessed for their downward linear growth in compost and data were correlated with the yield data. A positive correlation of 0.75 could be calculated with a R^2 value of 0.52.

(Genetic Improvement of button, Pleurotus and Volvariella mushrooms - DMR-2)

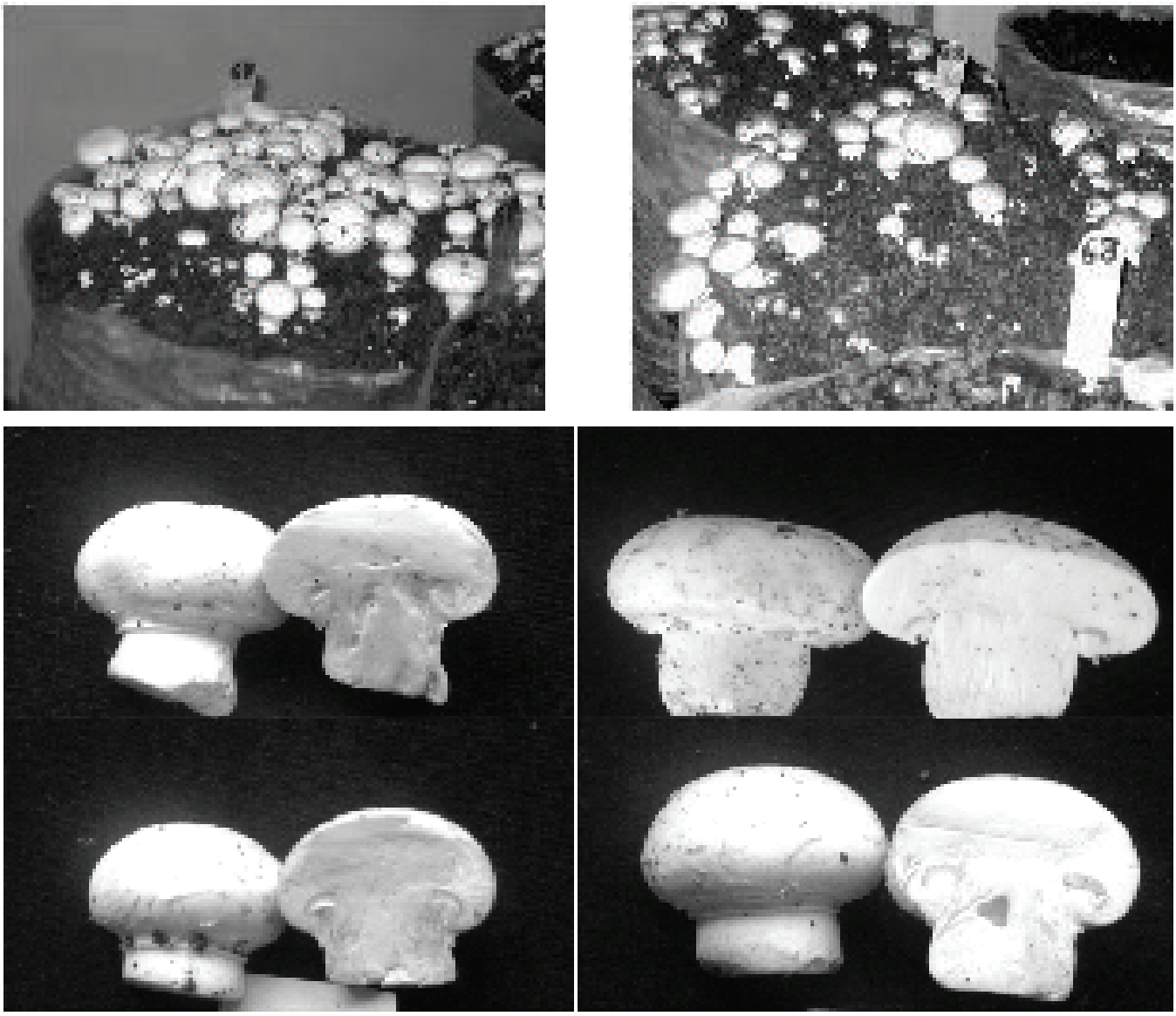


Fig. 2. Quality fruit bodies of some of the selected single spore isolates

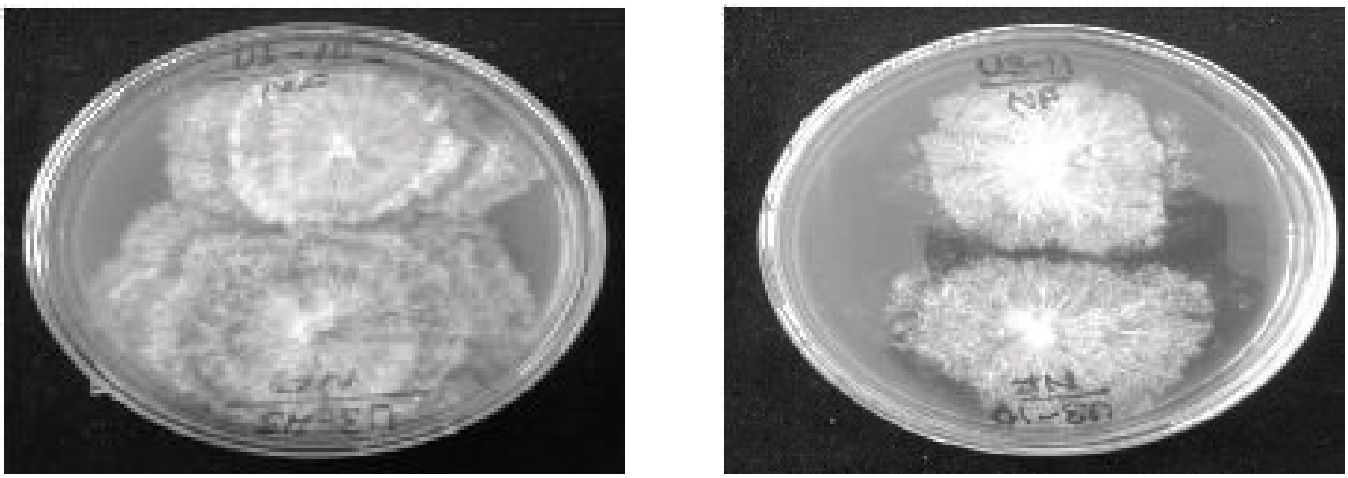


Fig. 3. Mating type determination in *Agaricus bisporus*

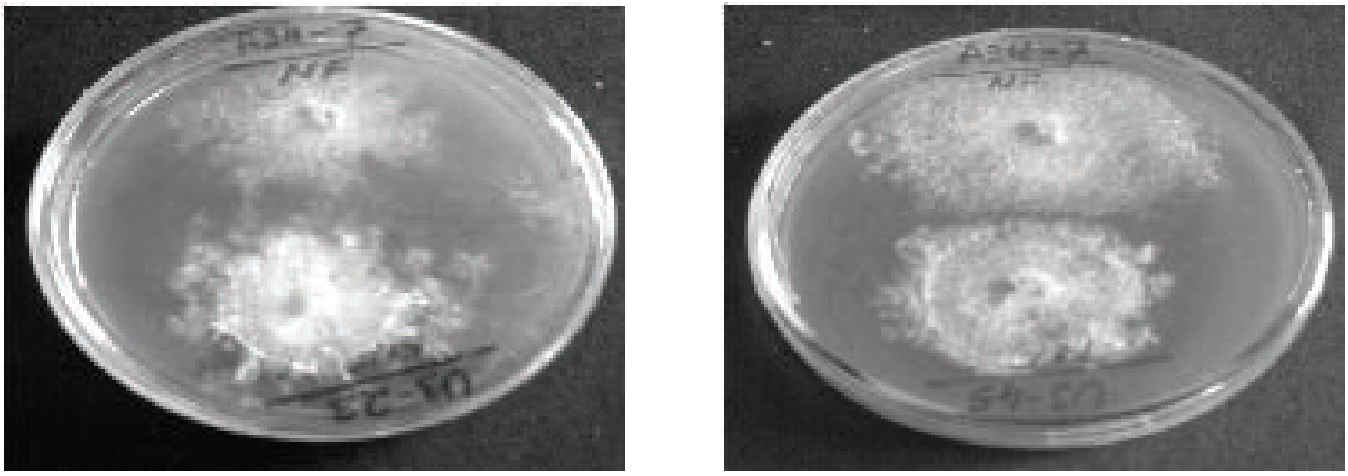


Fig. 4. Hybridization Experiments in *Agaricus bisporus*

Table 1. Yields of promising SSIs (in four week) of various strains

SSIs	Yield (kg/100 kg compost)
U-3-57	17.50
U-3-5	17.75
U-3-54	15.75
U-3-39	15.96
Control (U-3)	14.69
S-11-13	14.25
Control (S-11)	12.87
A-94-22	20.06
A-94-12	21.06
A-94-15	19.50
Control (A-94)	12.75
A-6-1	21.12
A-6-5	18.62
Control (A-6)	12.31

ii) *Pleurotus*

Comparative evaluation of hybrid strains of *P. sajor-caju* and *P. florida* on pasteurized wheat straw

Five high yielding strains of *P. sajor-caju* and *P. florida* were evaluated for their yield performance and data are presented in Table 2.

Strain P-7 gave maximum production on paddy straw followed by P-3 and P-1, while strain P-1 gave maximum production on wheat straw followed by strain P-3 and P-8. Strain P-3 gave better yield in wheat and paddy straw both.

Table 2. Yield of *P. sajor-caju* and *P. florida* strains on pasteurized wheat straw and paddy straw

S.No.	Strain	Paddy straw (BE %)	Wheat straw (BE %)
1.	Strain P-1	55.4	76.0
2.	Strain P-2	30.7	19.0
3.	Strain P-3	56.6	60.2
4.	Strain P-4	49.0	37.4
5.	Strain P-5	50.5	32.5
6.	Strain P-6	43.6	48.6
7.	Strain P-7	58.0	48.0
8.	Strain P-8	43.8	54.0
9.	Strain P-9	38.8	23.5
10.	Strain P-10	44.0	29.3

Evaluation of wild *Pleurotus* spp strains for yield on pasteurized wheat straw.

Nineteen different strains of *Pleurotus* were evaluated on pasteurized wheat straw during Sept-Oct months. Fifteen strains gave successful mycelial growth and fruiting. Highest yield was obtained in strain X-586 (97 % BE) followed by

strain X-1021 (94% BE). Both the varieties had light creamish yellow basidiocarp, strain X-597 which had light brown colored fruit body similar to *P. sajor-caju* also gave 85-75 % BE. All these varieties were selected for large scale cultivation. The yield data are presented in the Table 3.

(Genetic Improvement of button, Pleurotus and Volvariella mushrooms - DMR-2)

Table 3. Yield of wild *Pleurotus* spp. cultivated on pasteurized wheat straw

S. No.	Strain	BE %	Pileus colour
1.	X-347	76.75	Pink
2.	X-584	82.25	Creamish
3.	X-462	70.25	Light pink
4.	X-586	97.00	Light yellowish
5.	X-1021	94.00	Light yellow
6.	X-1025	79.50	Light brown
7.	X-1054	67.50	Light yellow
8.	X-1066	67.50	Not examined
9.	X-1135	84.00	Light yellow
10.	X-468	48.75	Creamish
11.	X-498	55.50	Creamish
12.	X-577	85.75	Grayish brown
13.	X-936	69.00	Light brown
14.	X-914	81.25	Light brown
15.	X-505	66.50	Pinkish white
16.	X-915	No spawn run	--
17.	X-660	No spawn run	--
18.	X-583	No spawn run	--
19.	X-688	No spawn run	--

iii) *Volvariella volvacea*

Genetic diversity

i) Amplified Fragment Length Polymorphism (AFLP) : The AFLP of 8 strains of *V. volvacea* was carried out by using 12 AFLP primers and amplification of specific bands using PCR. Clear-cut polymorphism was revealed at 8-16 different places with different primers. The pooled data was subjected to phylogenetic tree development to study the similarity coefficient between studied strains (Fig. 5).

ii) ITS-RFLP of 5.8S rDNA : Eight strains of *V. volvacea* were studied first by amplification of the ITS region of 5.8S rDNA using PCR and there after the amplicons were got sequenced. The amplicons were also subjected to restriction digestion using 16 different restriction endonucleases (Hae III, Hha I, Rsa I, Hinf I, Hpa II, Alu I, Taq I, Nde II, TRu 9I, Hsp 92II, Ava II, Ava I, Hae II, Nde I, Pst I and Tsol). The use of restriction endonucleases revealed polymorphism in strain Vv-1 and WW-08, which have quite diverse origin, while the rest of the strains did not exhibit much polymorphism (Fig. 6). The phylogenetic tree constructed out of ITS-RFLP profile also confirms the distinctness of Vv-01 and WW-08 from other strains and formed separate group (Fig. 7). It was also confirmed by ITS sequences of different strains.

iii) Sequencing of the ITS region of 5.8S rDNA: The sequences revealed strain Vv-01 as the heterokaryon. Strains, BBH-01, BBSR-002, BBSR-003, BBSR-007, OE-55-08 and OE-55-30 did not exhibit much variations in their ITS sequences of 5.8S rDNA. Strain WW-08 showed a big deletion in its ITS region and such strains also have record in NCBI data base.

iv) Laccase gene sequences

a) Studies on gene sequences of different Laccase of *V. volvacea*: The 6 different laccases of *V. volvacea* (Laccase-1, 2, 3, 4, 5 and 6) were studied first by developing the couples of primers against the mRNA

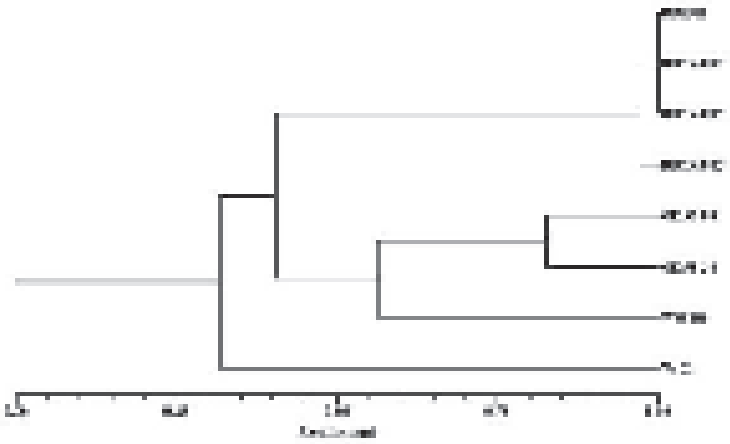


Fig. 5. AFLP phylogenetic tree of 8 different strains of *V.volvacea*

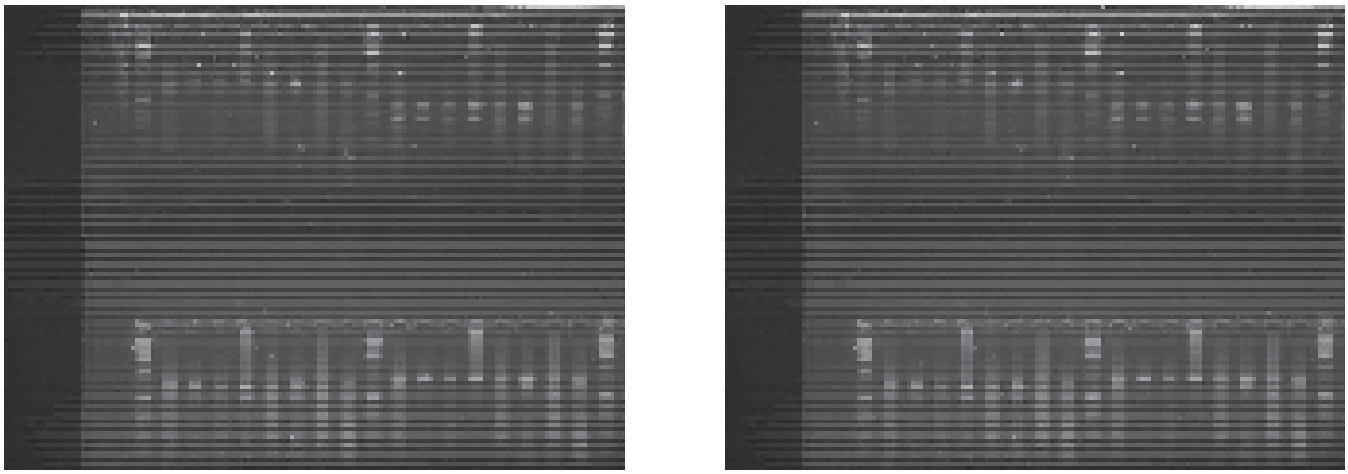


Fig. 6. ITS-RFLP profile of 8 strains of *V. volvacea*

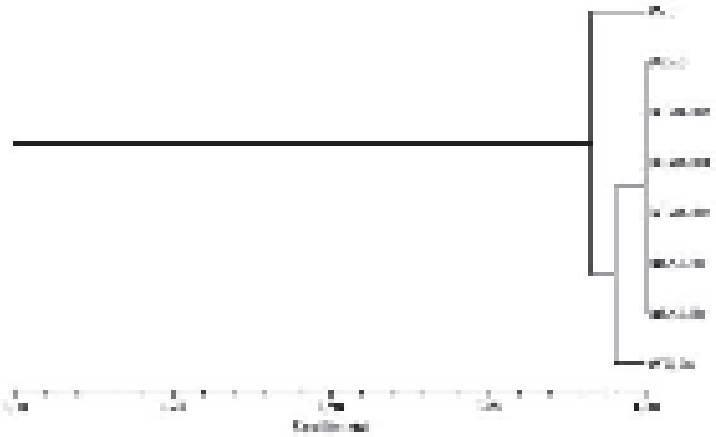


Fig. 7. ITS-RFLP phylogenetic tree of 8 different strains of *V. volvacea*

Table 4. Sequences of couple of primers used for amplification of different genes of different laccases of *Volvariella volvacea*

Sr. No.	Laccase	Primer name	Sequence (5´ to 3´)
1	Laccase 1	Vv1FL1	CCGATGAAGTTGGGACATTC
		Vv4RL1	TCGCAATCACAATCACAGTTC
2	Laccase 2	Vv1FL2	CCTTGCTCAACACCCTTACC
		Vv4RL2	GCCAGAGACTGGGTTAGACG
3	Laccase 2 (revised)	Vv12FL2	CTGCTGCACAACAGAGCTTC
		Vv42RL2	AATACCAGAGGACGCGAGAC
4	Laccase 3	Vv1FL3	TGCGAGCGTAACTCAATGTC
		Vv4RL3	GCAAAGCTCATCCCAAGAAG
5	Laccase 4	Vv1FL4	ATATCTGCTCGGCCATCTTG
		Vv4RL4	GACAGAGCTGCTTCCATTCC
6	Laccase 5	Vv1FL5	CAGTGCAATTTTGGTCAACG
		Vv4RL5	AAGTGTCCGATCCACTGTCC
7	Laccase 6	Vv1FL6	TGGAACAGCCTCTCACACAC
		Vv4RL6	ATTCGACACCAGGTCTGAGG
8	Laccase 6 (revised)	Vv01FL6	CAACACCCTCACTGTCGTTC
		Vv35RL6	CACAAAGGTCATCCCACTCC
9	Laccase 4 (revised)	Vv15FL4	TCATTCTGGGGGTTATCCTG
		Vv45RL4	TAGAAGCGGGTTTCTCCTTG
		Vv05FL4	CTCGTCGCGGGTAAAATATC
10	Laccase 3 (for remaining portion)	Vv2FL3	AGCCCGTTGACAACTACTGG
		Vv3RL3	GGGACGGCATTTTCTATGAG
		Vv2RL3	AGTTGTCAACGGGCTGATTG
		Vv3FL3	TTGATTGGGATATGCTGCAC
11	Laccase 1 (for remaining portion)	Vv18FL1	GGCTGATTTCGATCTCTTGC
		Vv2FL1	CCGTTATCAATAGGCCAACG
		Vv18RL1	AATCAGCCTCATGCGATACC
		Vv2RL1	TTGATAACGGAATGCGTCAG
		Vv3RL1	CCTAGGGTCTTGCTCGAGTTC
		Vv08FL1	TTGAGCTCGCATACGTTGAC
		Vv45RL1	TCTGAAGCGGGGATAGAAAA

sequences available in nucleotides sequences database of NCBI (Table 4). In the preliminary study limited success was achieved. However, upon manipulation of the primer annealing temperatures and redesigning new couples of primers the sequences of laccase-1 and laccase-3 genes were amplified and sent for sequencing.

b) Studies on presence of introns, annotation and completion of complete sequence of laccase-1 and laccase-3: The received sequences were cleaned and studied for the presence of number of introns along with their positions and annotation with respect to amino acid sequence. The complete sequences of laccase-3 gene and protein of heterozygotic strain Vv-01 and homozygotic strain BBSR-003 were submitted to NCBI data bank with accession No. lcc3.sqn lcc3 HQ687205 dated 08-12-2010 and lcc3.sqn lcc3 JF313903 dated 11-02-2011, respectively.

(Genetic Improvement of button, Pleurotus and Volvariella mushrooms - DMR-2)

B. CROP PRODUCTION

1. Button Mushroom

Native mycoflora associated with soybean straw

Soybean straw was explored for button mushroom compost. Before planning the formulations and its usage for compost production the native flora (mesophilic and thermophilic) of soybean straw was studied using dilution plate technique. Since this straw was harbouring too many spores of *Aspergillus* sp., mycoflora study was done with water washed samples also. Mycoflora was isolated at 25, 42, 47 and 52^{0}C. Data obtained are presented in Table 1. A total of 11 different mesophiic and thermophlic fungi were isolated from this material. Unwashed sample harboured more colonies than washed sample. Prominent mesophilic fungi isolated were *A. fumigatus, Mucor* sp., *Sepedonium* sp. Common thermphilic fungi were *Scytalidium thermophilum, Humicola insolens, H. grisea* and *Thermoascus crustaceus.*

Suitability of soybean straw for the growth of *Agaricus bisporus* under *in-vitro* conditions after its degradation by thermophilic fungi

Above experiment was planned with a view to see the suitability of this material for the growth of *A. bisporus* when fermented under *in vitro* conditions with the help of thermophilic fungi and with ready compost. Soybean straw after its thorough wetting (moisture 68%) was filled in PP bags weighing one kg each. These bags were then divided in two lots. One lot was inoculated with thermophilic fungi spawn (*S. thermophilum, H. insolens, H. grisea*), their consortium, with mature compost of Soya straw as well as wheat straw compost. @ 2% wet weight of the wetted straw. Another treatments of this set are presented in Table –2. Other lot was pasteurized in the autoclave at 10 Ib per sq. inch for 15 minutes and inoculated as above. These bags were then kept in BOD incubators and incubated at 45^{0}C for 3-7 days (Table 2). One control was kept at room temperature. After 3-7 days, these bags were taken out of the incubator and observation on growth of thermophilic fungi was recorded (Table 3). Excellent to very good growth of *S. thermphilum, H. grisea* and *H. insolens* was observed in both the sets in respective treatments. In other treatments growth was rated as good to poor. Soybean straw as such showed almost nil growth. Final weight of these was than again measured and highest loss in weight was observed in case of *S. thermophilum* followed by inoculation with mature compos. Negligible loss in weight was observed in uninoculated bags. These bags were than inoculated with *A.*

Table 1. Native Mycoflora of Soybean Straw

Temperature (^{0}C)	Washed Straw	Unwashed Straw
25	*Aspergillus* sp, *Mucor* sp, *Sepedonium* sp., *Fusarium* sp.	*Aspergillus* sp., *Mucor* sp., *T. viride* . *Sepedonium* sp., *Papulospora* sp.,
42	*Aspergillus* sp., *Mucor* sp., *Thermoascus crustaceus.*	*Aspergillus* sp. (Yellow colony), *Sepedonium* sp., *T. Crustaceus*
47	*Mucor* sp. *Aspergillus* sp., *T. crustaceus, S. thermophilum*	*A. fumigatus, Sepedomium* sp., *H. grisea, S. thermophilim*
52	*Mucor* sp., *Aspergillus* sp., *Sepedonium* sp., *H. insolens, S.thermophilum*	*Humicola grisea, Aspergillus* sp., *Scytalidium thermophilum, Sepedonium* sp.

Table 2. Treatments of *in vitro* experiment

S. no.	Treatments/ inoculation for soybean straw	Temp / Duration of Incubation	
		Unpasteurized	Pasteurized
1	Soybean straw + St	45^{0}C / 5 Days	45^{0}C / 5 Days
2	Soybean straw + Hi	45^{0}C / 5 Days	45^{0}C / 5 Days
3	Soybean straw + Hg	45^{0}C / 5 Days	45^{0}C / 5 Days
4	Soybean straw + Hg + Hi + St	45^{0}C / 5 Days	45^{0}C / 5 Days
5	Soybean straw + Mature compost	45^{0}C / 5 Days	45^{0}C / 5 Days
6	Soybean straw + Soybean compost	45^{0}C / 5 Days	45^{0}C / 5 Days
7	Soybean straw as such	45^{0}C / 3 Days	45^{0}C / 3 Days
8	Soybean straw as such	45^{0}C / 5 Days	45^{0}C / 5 Days
9	Soybean straw as such	45^{0}C / 7 Days	45^{0}C / 7 Days
10	Soybean straw (Control as such)	25^{0}C / 5 Days	25^{0}C / 5 Days
11	Soybean straw (Control as such)	25^{0}C / 5 Days	25^{0}C / 5 Days

St (*S. thermophium*), Hi (*H. insolens*), Hg (*H. grisea*) Inoculation rate @ 2%, 1 kg compost in bag, +++ Excellent, ++ very good, + good, - no growth

bisporus spawn (strain U-3) and kept in the growing room for the spawn run. Observation on the spawn run was recorded after 15 days and the data so obtained are presented in Table 4.

Surprisingly unpasteurized set supported better spawn run compared to pasteurized set. Few treatments showed green mould infestation. These bags were cased afterwards however, no fruit bodies could be obtained in any of the treatments though fungal inoculated treatments

Table 3. Growth of thermophilic fungi in the bags

S. No	Treatments/ Inoculation	Growth of thermophilic fungi	
		Unpasteurized	Pasteurized
1	Soybean straw + S.T.	+++	+++
2	Soybean straw + H.I.	++	++
3	Soybean straw + H.G.	+++	++
4	Soybean straw + H.G. + H.I. + S.T.	++	++
5	Soybean straw + Mature compost	+	+
6	Soybean straw + Soybean compost	+	+
7	Soybean straw (3 Days)	-	-
8	Soybean straw (5 Days)	-	+
9	Soybean straw (7 Days)	+	+
10	Soybean straw (Control)	-	+
11	Soybean straw (Control as such)	-	+

supported very good pinning but these did not mature into fruit bodies.

Suitabilty of soybean straw for button mushroom compost

By long method

The formulation consisted of Soybean Straw (500 kg), chicken manure (170 kg), wheat bran (50 kg), urea (2kg) and gypsum (40 kg). The cold N percentage in the formulation was 1.45. Compost was prepared in 28 days time when it was free from ammonia. Compost pile showed an average pH of 9.11 between the turnings. Usual native

Table 4. Condition of spawn run (*A. bisporus* (U-3) in different treatments

S. No	Treatments/ Inoculation	*Agaricus* spawn run (After 2 weeks)	
		Unpasteurized	Pasteurized
1	Soybean straw + S.T.	++++	+++
2	Soybean straw + H.I.	++++	+++
3	Soybean straw + H.G.	++++ (Green mould)	+++
4	Soybean straw + H.G. + H.I. + S.T.	+++	+++
5	Soybean straw + Mature compost	++++	+++
6	Soybean straw + Soybean compost	++++	+++
7	Soybean straw (3 Days)	++++	++
8	Soybean straw (5 Days)	++++	++
9	Soybean straw (7 Days)	++ (Green mould)	++ (Green mould)
10	Soybean straw (Control)	+++ Green mould	++
11	Soybean (Control as such)	++	++

mesophilic and thermophilic flora was isolated at different turnings. pH at spawning was 8.91 which was brought down to 7.59 by 20 % acetic acid spray (@ 6ml./ kg compost). However, next day pH again rose to 8.1 and again a spray of acetic acid was given and spawning done. Fairly good spawn run was observed in the bags, however later suddenly *Coprinus* appeared in almost all the bags leading to failure of fruit bodies production.

By Short method

In short method three compost piles were prepared using under mentioned ingredients (Table 5).

Table 5. Ingredients used in short method of composting

Pile 1 (kg)	Pile 2 (kg)	Pile 3 (kg)
Wheat straw (600)	Paddy straw (600)	Soybean straw (600)
Wheat bran (50)	Wheat bran (50)	Wheat bran (50)
Chicken manure (300)	Chicken manure (300)	Chicken manure (300)
Urea (9)	Urea (9)	Urea (5)
Gypsum (50)	Gypsum (50)	Gypsum (50)
N% 1.50	1.56	1.61

Compost from the above ingredients was prepared by short method. However, during phase-II temp. did not go beyond 40^0C in soybean compost consequently it could not be conditioned and pasteurized. pH of three composts after termination of the phase –II was, wheat straw-7.63, paddy straw- 8.30, soya straw- 8.75. No spawn run could take place in paddy and soya straw composts leading to failure of the experiment. Further, soya straw compost showed the infestation of *Coprinus* sp. However, wheat straw compost yielded 8.7 kg mushroom/100 kg compost.

Long method compost production using soybean straw at low N level

Since no success was met to produce quality compost using soybean straw with optimum initial N level (1.5-1.75%) and as these failures were attributed to no spawn run or to heavy infestation of *Coprinus* sp., it was thought prudent to prepare compost with very low N%. In this case composting was attempted with under mentioned formulation having around 1% cold N level. Ingriedients used were soybean straw (100 kg), wheat bran (20 kg) and gypsum (20 kg).

Compost was ready and free from ammonia in 16 days time. It was later

spawned with *A. bisporus* spawn (strain U-3) and cropping done. A total of 384 kg of compost was produced with 100kg of base material having 72% moisture level. Excellent spawn run was observed in all the bags in 12 days time. An average yield of 6.81 kg mushrooms /100kg compost was obtained in the experiment in 30 days of cropping. Still yield obtained are low and further modification are required for compost production using this material.

Utilization of soybean straw alone and in combination with wheat straw for compost production

In this particular experiment three compost piles were prepared with under mentioned ingredients/ formulations (Table 6). Compost was prepared by long method in 20 days time following 0, +4, +6, +8, +10, +12, +14, +16, +18 followed by spawning schedule. Excellent spawn run was observed in all the piles.

Table 6. Showing formulations taken in the study

Pile 1 (kg)	Pile 2 (kg)	Pile 3 (kg)
Soya straw (200)	Wheat straw + Soya straw (200)	Wheat straw (200)
Wheat bran (20)	Wheat bran (20)	Wheat bran (20)
Urea (1.5)	Urea (2.5)	Urea (3.5)
Gypsum (30)	Gypsum (30)	Gypsum (30)
N 1.25%	1.22%	1.18%

Evaluation of different casing materials

Six different casing materials viz., Farm Yard Manure (FYM), Paddy Straw Mushroom Spent Substrate, Button Mushroom Spent Substrate, Pine Needles, Coir Pith, Sandy Soil and Forest Soil were used separately and in combinations along with amendment with calcium carbonate to evaluate their role in button mushroom yield. The casing materials were pasteurized at 65 ± 2ºC for 6-8 hours before their application as casing material. Standard cultural practices were adopted for button mushroom cultivation. Yield data was recoded for 1 month cropping period from the date of start of first harvest and the highest mushroom yield (14.56 kg/q compost) was recorded with Farm Yard Manure in combination with Paddy Straw Mushroom Spent Substrate mixed in 2: 1(v/v), followed

Table 7. Effect of different casing materials on yield of white button mushroom

Casing treatment	Mushroom yield (kg/100 kg compost)	Fruiting body weight (g)
FYM + PN (2:1, v/v)	08.40	14.48
FYM + PSM-SMS (2:1, v/v)	14.56	15.27
FYM + CC @ 1.0%	10.02	14.75
FYM	12.71	14.68
SMS + PN (2:1, v/v)	12.03	14.86
SMS + PSM-SMS (2:1, v/v)	08.91	15.89
SMS + CC @ 1.0%	06.72	15.17
SMS	09.94	14.91
CP + PN (2:1, v/v)	03.66	15.00
CP + PSM-SMS (2:1, v/v)	03.78	15.20
CP + CC @ 1.0%	04.94	14.42
CP	02.43	15.31
SS + PM (2:1, v/v)	06.03	14.26
SS + PSM-SMS (2:1, v/v)	10.16	14.56
SS + CC @ 1.0%	04.29	13.45
SS	00.94	12.93
PSM-SMS + CC @ 1.0%	11.51	14.98
PSM-SMS	07.98	14.37
Forest soil	13.49	15.22

FYM=Farm yard manure, PN=Pine needles, SMS=Spent mushroom substrate of button, PSM-SMS=Paddy straw mushroom-SMS, CC=Calcium carbonate, CP=Coir pith

by Forest Soil. Fruiting body weight did not vary much in different casing treatments and was in the range of 12.93 to 15.27 g. The highest yielding casing materials also supported highest average weight of fruiting body (Table 7).

Organic button mushroom (*A. bisporus*) cultivation: The trial on organic button mushroom cultivation was conducted in the month of February to April by using wheat straw-1000 kg, poultry manure-600 kg, brewer's grain-400 kg (wet), wheat bran-150 kg, cotton seed cake-60 kg, neem cake-50 kg and gypsum-45 kg with an initial nitrogen of 1.65% and final moisture of 62%. Spawn run was achieved with in 14 days, while first harvest was made after about 16 days of casing (16.12 ± 0.20). Cropping period of 4 weeks yielded 18.80 kg mushrooms/100 kg of compost. Average fruiting body weight varied from highest of 20.96 g during first flush to lowest of 17.09 g in third flush. (Table 8).

Vermiwash and vermicompost wash characterization: The earthworm species *Eisenia foetida* was utilized for the preparation of vermiwash. In this, one-kilogram of earthworm devoid of casts was released in to the beaker containing 500 ml of lukewarm sterile distilled water. This was agitated for two minutes to facilitate release of mucus and other body fluids from earthworm. Then the supernatant water was drained out. Again the same process was repeated with 500 ml of lukewarm sterile distilled water. Vermicompost wash was collected from the mini-tank based vermicomposting unit. The vermiwash and vermicompost obtained was characterized for its chemical as well as biological properties. The results obtained was presented in Table 9.

Vermiwash casing experiment: The influence of vermiwash and vermicompost on the button mushroom yield was assessed. In this trial, 100 ml of vermiwash and vermicompost wash was mixed in both spawn run compost and casing material. The significant difference was found among the treatments imposed. The vermicompost wash in spawn run produced the maximum mushroom yield of 1012 g per bag, which was followed by vermiwash in casing soil (946.22 g/bag). The control produced the lowest yield of 653.3 g per bag (Table 10). The yield obtained from the experiment was below the expected average.

Utilization of Spent Mushroom Substrate

Three pits were made at a size of 5x5x5 feet at DMR, Chambaghat. The initial soil were collected at different depth of the pit and analyzed. Thereafter fresh SMS obtained from U3 stains of button mushroom was put inside up to surface level during mid June. To assess the leaching influence, the compost pit was opened on second fortnight of

Table 8. Mushroom yield and yielding attributes of organically raised button mushroom crop

Yielding attribute	First harvest (days post-casing)	Weekly yielding pattern				Total
		1st	2nd	3rd	4th	
Mushroom yield (kg/100 kg compost)	16.12 ± 0.195	5.2	5.8	4.5	3.4	18.8
Number of fruiting bodies/100 kg compost		248.0	332.0	261.0	182.0	1023.0
Average fruiting body weight (g)		20.9	17.3	17.1	18.6	18.4

Table 9. Chemical and biological properties of vermiwash and vermicompost wash

Parameters	Vermiwash	Vermicompost wash
pH	7.6	7.2
EC (dS m^{-1})	0.1	2.5
OC %	0.0	0.2
N %	Traces	0.1
P (ppm)	46.1	91.6
K (ppm)	58.2	72.4
Bacteria (cfu)	8.0	64.0
Fungi (cfu)	13.0	39.0
Actinomycetes (cfu)	4.0	12.0

October and soil samples were collected from different depths. The soil colour of the site was from yellowish brown to black and soluble salt content increased considerably (0.47 to 1.72 dS m^{-1}) making soil more saline (Table 11). The soil reaction changed from acidic to neutral. The mineral nutrients content both phosphorous and potassium also increased from the initial level. The depth wise study indicated that the leachates influence was beyond 75 cm depth in which first 30 cm was most affected.

(Improvement in cultivation technology of white button mushroom & effective utilization of spent substrate - DMR-3)

Table 11. Impact of SMS composting on onsite soil

Depth (cm)	pH	EC (dS m^{-1})	P (kg/ha)	K (kg/ha)
Initial	5.8	0.5	4.6	113.9
0	6.7	1.7	10.7	214.1
15	6.2	1.3	7.0	190.5
30	6.5	0.9	5.1	148.4
50	6.1	1.2	5.6	144.0
75	6.1	1.1	4.2	141.1

Table 10. Effect of vermiwash and vermicompost wash on button mushroom yield

Treatments	Yield/ bag	No. of fruit bodies/ bag
Control	635.3	46.5
Vermiwash in spawn run mix	703.4	50.0
Vermicompost wash in spawn run	1012.0	60.6
Vermiwash in casing soil	946.2	54.7
Vermicompost wash in casing soil	808.0	42.2
SEd	28.6	2.9
CD (0.05%)	60.7	6.2

2. Oyster mushroom

Use of coconut industry wastes for growing oyster mushroom

Wastes from coconut trees such as coconut rachis and coconut inflorescence were treated in four different ways: - soaked in hot water (70°C for 15 min); chemical treated in the solution of carbendazim and formaldehyde (50ppm + 500ppm) for 14 h, autoclaved after soaking in water at 22 psi for 2 hours and simple water soaked as control. The substrate was spawned with *Pleurotus djamor* var. *roseus.* The yield data are shown in Table 12.

Table 12. Yield of *P. djamor* var. *roseus* on coconut wastes

S. No.	Substrate treatment	BE (%) (Coconut rachis)	BE (%) (Coconut inflorescence)
1.	Simple water treatment	10	14
2.	Hot water treatment	42	26
3.	Chemical Treatment	40	24
4.	Autoclave	42	18

Evaluation of *P. eryngii* and *P. fossulatus* strains on wheat straw, paddy straw and corn cobs on autoclaved and pasturised substrates.

Crushed corn cobs, chopped wheat straw and paddy straw were soaked for twelve hours in water and then autoclaved at 22 psi for one hour and spawned with six different strains of *P. eryngii* and *P. fossulatus*. It was observe that corn cobs gave earliest fruiting than wheat and paddy straw (8 days earlier). The yield data are shown in Table 13.

P. fossulatus had creamish fruit bodies while, the colour of basidiocarps of *P. eryngii* was grayish. The pileus size was larger in *P. fossulatus* than *P. eryngii*. Among all the strains *P. fossulatus* (Strain II) gave maximum biological efficiency on corn cobs while *P. eryngii* (Strain III) gave the highest BE on paddy straw (48.6%).

Tunnel pasteurization of substrate for cultivation of *Pleurotus* spp.

Wheat straw after soaking in water were mixed with 1 % of lime and used for making compost pile. The height of the pile was 120 cm and breadth was 100-110 cm. The pile was given turning on alternate days for two times and then filled in the compost tunnel. The temperature of the pile and air was equilibrated by introducing fresh air and then the substrate pasteurized at 58-62ºC for four hours. The temperature was lowered to 44-48ºC and maintained for 36 h. It was cooled and inoculated. There was no contaminated bag out of six hundred bags.

(Cultivation technology of oyster mushroom - DMR-4)

3. Paddy straw mushroom

Strainal evaluation of paddy straw mushroom

(a) On composted paddy straw + cotton ginning mill based substrate

To evaluate 6 different strains for their mushroom yield potential and quality of fruiting body, the substrate prepared from 1: 1 w/w ratio of paddy straw and cotton ginning mill waste was used. Compost was prepared by 4 days outdoor + 4 days indoor method (pasteurization + conditioning). Spawning was done @ 1.5% of the dry substrate and there was insignificant difference in time taken for first harvest and it was in the range of 12.2 to 12.4 days in different strains (Table 14). Highest mushroom yield in two flushes was in strain, BBSR-007 (19.80 kg/q dry substrate), followed by BBH-01 and BBSR-002. The number of fruiting bodies harvested/q dry

Table 13. Evaluation of *P. eryngii* and *P. fossulatus* strains on wheat straw, paddy straw and corn cobs

S.No.	Strain	Corn cobs (BE %)	Wheat straw (BE %)	Paddy straw (BE %)
1.	*P. eryngii* strain I	32.0	28.9	34.0
2.	*P. eryngii* Strain II	37.2	34.0	47.5
3.	*P. eryngii* Strain III	33.3	45.4	48.6
4.	*P. fossulatus* Strain I	26.6	34.0	18.3
5.	*P. fossulatus* Strain II	40.0	57.0	54.3
6.	*P. fossulatus* Strain III	44.0	38.5	27.0

Table 14. Mushroom yield in different strains of paddy straw mushroom (*V.volvacea*) on composted substrate prepared from cotton ginning mill and paddy straw

Strain	First harvest (day post-spawning)	Mushroom yield (kg/q dry compost)			No. of fruiting bodies/ q dry substrate			Average fruiting body wt. (g)		
		1st flush	2nd flush	Total	1st flush	2nd flush	Total	1st flush	2nd flush	Total
BBH-01	12.4	17.66	1.46	19.12	1446	158	1604	12.21	9.24	11.92
BBH-05	12.2	10.18	2.03	12.21	808	218	1026	12.60	9.31	11.90
BBSR-002	12.2	16.02	2.40	18.42	1284	286	1570	12.48	8.39	11.73
BBSR-003	12.4	13.43	2.26	15.69	942	252	1194	14.26	8.97	13.14
BBSR-007	12.4	16.66	3.14	19.80	1102	286	1388	15.12	10.98	14.27
OE-55-08	12.2	14.64	2.41	17.05	1516	242	1758	9.65	9.96	9.70
CD 0.05%	3.212	298.00	2.05							

substrate was highest in strain OE-55-08. Heaviest fruiting bodies were harvested from strain BBSR-007 (14.27 g), while lowest in SSI, OE-55-08 (9.70 g).

The repeat trial was conducted by using same 6 strains plus one additional strain again by using composted substrate prepared from paddy straw and cotton ginning mill waste. The highest mushroom yield was recorded in strain BBSR-003 (21.50 kg/q dry substrate), followed by strain BBSR-007 (17.83 kg/q dry substrate). Fruiting body number harvested from 100 kg dry substrate was highest in strain BBSR-003, followed by BBH-01 (Table 15). The fruiting body weight was maximum in strain, BBSR-007 (13.51 g), closely followed by strain, BBSR-003 (13.33 g). Fruiting body weight was quite low in strains, OE-272, BBH-01 and SSI, OE-55-08 (9.35 to 9.58 g).

Table 15. Mushroom yield in different strains of paddy straw mushroom (*V.volvacea*) on composted substrate prepared from cotton ginning mill and paddy straw

Strain	Mushroom yield (kg/q dry compost)	No. of fruiting bodies/q dry substrate	Average fruiting body wt. (g)
BBH-01	14.82	1573	9.42
BBH-05	12.72	966	13.17
BBSR-002	14.72	1127	13.06
BBSR-003	21.50	1613	13.33
BBSR-007	17.83	1320	13.51
OE-272	12.03	1287	9.35
OE-55-08	13.31	1390	9.58
CD 0.05%	2.83	244	

(b) On pasteurized paddy straw bundles

The trial was conducted by using 10 pasteurized paddy straw bundles (45 cm x 10 cm) for each bed and the bed was prepared by preparing 3 layers of straw with 3 pasteurized bundles for one layer in criss cross fashion. Shortest time for first harvest was taken in strain, Vv-01 (12.44 days), while the highest (Table 16) in strain Vv-11 (13.83 days). The highest mushroom yield was recorded in strain Vv-13 (18.95 kg/q dry straw), which was closely followed by strains Vv-09 and Vv-12.

(Integrative use of cultivation technologies for enhancing yield and quality of paddy straw mushroom V.Volvacea. - DMR-5)

Table 16. Mushroom yield in different strains of paddy straw mushroom (*V. volvacea*) on pasteurized paddy straw substrate

Strain	First harvest (day post spawning)	Mushroom yield (kg/q dry compost)	No. of fruiting bodies/ q dry substrate	Average fruiting body wt. (g)
Vv-01	12.44	15.67	1339	11.89
Vv-09	12.50	18.85	1960	9.62
Vv-11	13.83	7.88	483	16.30
Vv-12	12.66	18.58	1516	12.20
Vv-13	13.11	18.95	1528	12.40
CD 0.05%	1.54	2.30	196	

4. Specialty Mushrooms

Identification and cultivation of new *Lentinus* sp. from Andeman and Nicobar

Fruit bodies of *Lentinus* were collected from Andeman and Nicobar**.** Pure culture was prepared by tissue culture after the sterilization of fruit body with alcohol. Small tissue from the cap portion was transferred to sterile Malt-Extract-Agar (MEA) culture slants. These slants are then incubated at 25°C ± 2°C for 2 weeks to obtain pure culture.

Mushroom spawn was prepared on wheat grains by following standard procedure of spawn production. Mother spawn bottles became ready to be used for inoculating commercial spawn bags after 16 days. The commercial spawn became ready in 14 days.

DNA Sequencing

The PCR-amplified ITS region containing ITS-1, 5.8S rDNA and ITS-2 was got sequenced from Delhi University. Nucleotide sequence comparisons were performed using Blast network and compared with database of the National Centre for Biotechnology Information (NCBI). Investigations of nucleotide sequence comparisons using BLAST network services against NCBI, USA data bases for molecular identification of showed 97 per cent identity with *Lentinus tigrinus*. The morphological studies indicated it to be *Lentinus sajor-caju*.

Cultivation

Cultivation was carried out on mixed saw dust collected from broad leave trees. Fifty kg saw dust was soaked in 70 litre of water for 18 hours. Next day 150g sodium bicarbonate, 500g calcium carbonate and 2 kg wheat bran was mixed. After through mixing 2 kg wet substrate was filled in a polypropylene bag. The bags were sterilized in autoclave at 22 Ibs for 2 h. On cooling the bags were inoculated with 50 g spawn per bag in laminar flow. The inoculated bags were incubated in copping room at 25 -26°C temperatures. The bags were fully colonized after 30 days. Thereafter the polythene was removed and bags were sprayed with water twice, RH 80-85% and temperature 25 -26°C were maintained. Light was also provided for 4 hours daily. No fruiting was formed even after 60 days after opening the bags. Thereafter the blocks were shifted to another room where 28-30°C temperature and RH 80-85% were maintained. Light was also provided for 4hours daily. Primordia start developing after 12 days, which fully develop in the next 3-4 days (Fig. 1). The next flush appeared after 20 days. The average weight of the fresh fruit body was 17g.

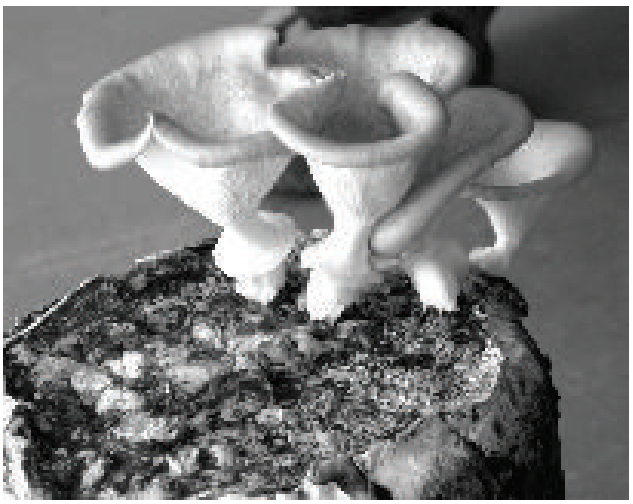


Fig. 1. ***Lentinus sajor-caju***

Studies on *Phellorinia*

Survey and collection of *Phellorinia*

Eighty-four samples of *Phellorinia* were collected from 12 sites (Figs. 2, 3, 4, 5 & 6) ranging from N 26-27^0, E 76-77^0 and MSL105-235m elevation (Table 17). *Phellorinia* prefers arid climatic conditions and coarse textured soils. The soils of *Phellorinia* site were sandy in texture (Fig. 7), very poor in organic matter (0.041%), strongly alkaline (pH-9.3) and very low in electrical conductivity. The soil fertility status was also very poor in terms of macronutrients (NPK) status.

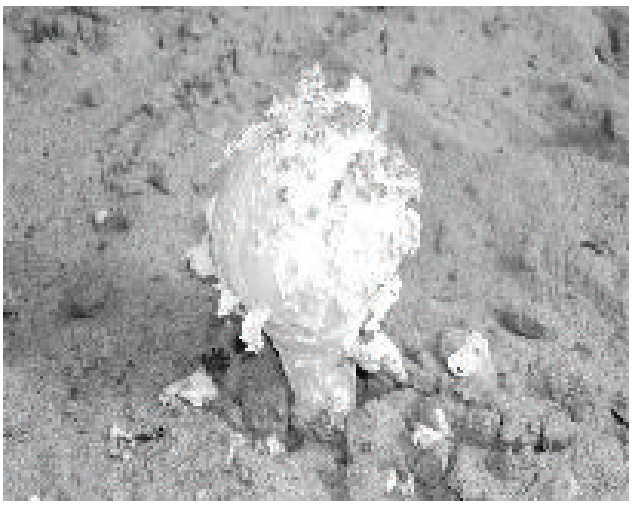


Fig. 2. ***Phellorinia*** **sp.**

Fig. 3. ***Phellorinia*** **sp.**

Fig. 4. ***Phellorinia*** **sale in Jaisalmer market**

Fig. 5. ***Phellorinia*** **collection by local people**

Fig. 6. *Phellorinia* sp.

Fig. 7. Dr Z. Kavia watching *Phellorinia* fruit body growing in field

Table 17. Location and various morphological features of *Phellorinia* collected from different places in Rajasthan

Sr. No	Location	Long. - Lat.	No. of app.	Cap dia	Stipe dia	Wt. (g)	Moisture
1	Village Dirae, The. Shergarh (El= 252m)	26° 28.386 N 72° 39.870 E	15	4.5	1.6	11.4-	57.42
2	Road side boy(50Km (El= 195m)	27° 00.2842 N 71° 21.226 E	14	4.0	1.7	12.0-49	69.15
3	Road side (50Km before (El= 208m)	27° 00.2902 N 71° 21.208 E	3	2.7	1.1	11.2-24.8	70.15
4	Jaisalmer Res.Station (El= 231m)	26° 55.4032 N 70° 58.319 E	4	3.7	1.5	9.0-53.1	72.96
5	Jaisalmer Res.Station (El= 231m)	26° 55.401 N 70° 58.319 E	1	2.7	0.7	5.38	72.41
6	Jaisalmer Market (El= 230m)	26° 55.398 N 70° 55.218 E	17	4.5	3.1	19.4-53.9	69.35
7	Road side boy (El= 195m)	27° 00.294 N 71° 27.202 E	24	4.2	2.1	16.0-80.5	70.69
8	Tanote (El= 135m)	27° 32.053 N 70° 27.365 E	2	2.6	2.2	3.7-53.7	79.00
9	Near Tanote (El= 155m)	27° 38.7632 N 70° 27.488 E	1	2.7	1.7	13.3	40.88
10	609 point (El= 105m)	27° 48.5292 N 70° 20.359 E	1	2.7	1.7	7.19	32.31
11	Phog, Jaisalmer		1	3.7	1.5	17.6	75.34
12	Bhagu ka gaoun, Jaisalmer		1	4.0	1.4	12.56	44.70

Growth rate and growth type of various isolates of *Phellorinia*

Pure cultures of all the samples were raised. Colony characteristics and growth rate was studied. The growth rate varied between 2-5 mm/day. The growth was mainly cottony type to very fine cottony type. Malt Extract Medium was found to be the best to support the growth of *Phellorinia* (Table 18). Optimum temperature for the mycelial growth was observed to be 40ºC (Table 19) and optimum pH was 7.0-7.5 (Table 20).

Table 18. Evaluation of different media for the growth of *Phellorinia* (in mm)

S.No	Medium	10 Days	15 Days	25 Days
1	Malt extractAgar	22.6	48.3	90.0
2	Asthane and Hawker'smedium	16.5	19.0	24.0
3	Brown's medium	15.0	19.0	23.5
4	Czapek Dox AgarMedium	18.3	46.0	66.7
5	Dextrose Nitrate Agar	16.5	21.0	62.0
6	Elliot's Agar	15.0	18.0	22.5
7	Malt ExtractPeptone Dextrose	17.0	35.6	52.7
8	Malt Rose Bengal Streptocyclin Agar	18.0	20.0	48.0
9	Walkman's Agar	15.0	18.0	23.8
10	Sabauraud's medium	15.0	32.0	47.5
11	Glucose Peptone Agar medium	18.3	40.3	65.0
12	Jaffer's medium	8.0	15.0	20.0
13	Potato DextroseAgar	21.7	43.3	78.3

Table 19. Evaluation of different temperature for the growth of *Phellorinia* (in mm)

Temp.	After 5Days	10 Days	15 Days	20 Days	25 Days
10 °C	0.0	0.0	0.0	0.0	0.0
15 °C	0.0	0.0	0.0	0.0	0.0
20 °C	0.0	0.0	0.0	11.7	15.4
25 °C	0.0	21.0	30.0	34.0	38.0
30 °C	0.0	16.5	25.0	35.0	40.0
35 °C	18.0	23.0	41.6	52.0	55.7
40 °C	21.3	30.7	52.3	62.0	69.0
45 °C	21.3	36.5	60.0	63.0	67.0

Table 20. Evaluation of different pH for the growth of *Phellorinia* (in mm)

pH	Myceial growth (mm) after days		
	10 Days	15 Days	25 Days
5.0	16.00	28.00	42.70
6.0	21.00	32.30	45.00
6.5	21.00	40.00	66.50
7.0	27.70	54.30	74.30
7.5	27.70	51.00	81.70
8.0	22.60	42.00	68.00
8.5	21.00	36.50	64.00
9.0	19.30	43.30	70.30
10.0	17.70	40.70	57.50

Molecular chracterization

PCR amplification of ITS region of 29 selected cultures yielded an ITS fragment of approximately 800 bp length (Fig. 8). Nucleotide sequence comparisons showed 90 percent identity with *Phellorinia herculea*. Genetic variability among these cultures was studied using 12 RAPD primers (Fig. 9) and 8 restriction enzymes. Phylogenetic analysis divided these 29 cultures into 10 groups. DNA sequencing of these cultures revealed

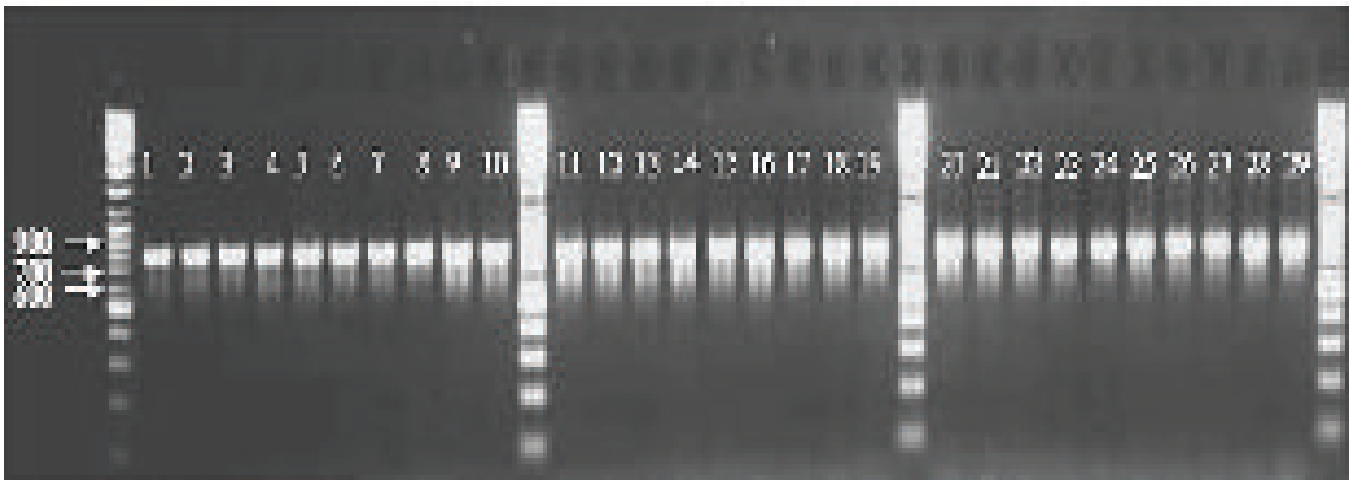


Fig. 8. ITS profile of 29 isolates of *Phellorinia*

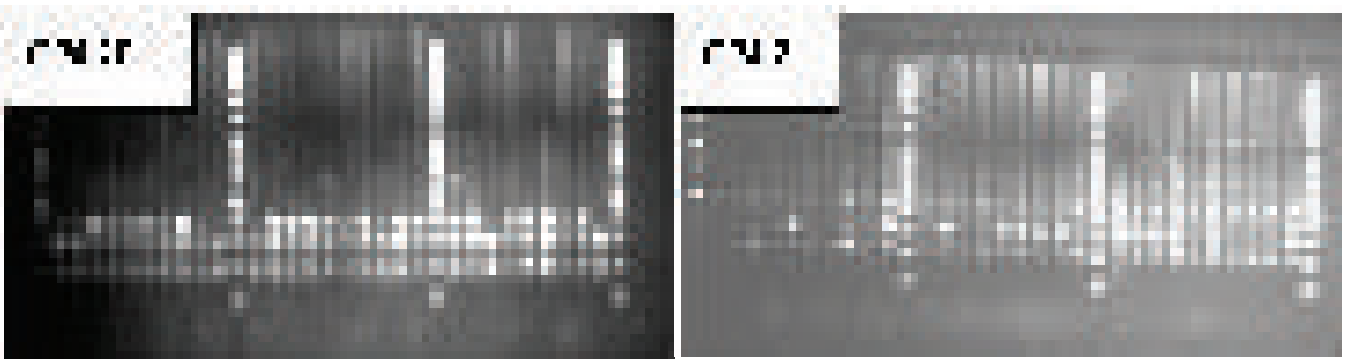


Fig. 9. RAPD Profile of various isolates of *Phellorinia*

the presence at least 3 different *Phellorinia* species.

Growth of various strains of shiitake at different temperatures

Evaluation of 23 strains of shiitake at various temperatures revealed that 25^{0}C is the best temperature for the growth of most of the strains except OE-17. However, temperature 20^{0}C also supported almost equally good growth of all the strains of shiitake (Table 21).

Optimum pH was 7.0, however, OE-2, OE-23, OE-45 and OE-388 grew best on pH 6.0 (Table 22).

Table 21. Growth of various strains of shiitake at different temperatures

Strains	Av. mycelial diametric growth of various strains of shiitake at different temperatures (^{0}C) after 15-day			
	15	20	25	30
OE-27	55.0	79.0	90.0	47.0
OE-13	61.6	90.0	90.0	40.4
Le-6	54.0	90.0	90.0	71.0
OE-142	67.0	90.0	90.0	80.0
OE-45	65.0	90.0	90.0	71.6
OE-2	62.3	90.0	90.0	90.0
OE-28	80.0	90.0	90.0	80.0
Le-9	80.0	90.0	90.0	54.0
OE-16	80.0	90.0	90.0	74.6
OE-9	65.0	90.0	90.0	90.0
OE-21	60.3	90.0	90.0	60.0
OE-388	67.3	90.0	90.0	52.5
OE-38	60.0	90.0	90.0	73.3
OE-23	73.3	90.0	90.0	81.6
Le-8	63.3	86.6	90.0	48.3
Le-7	58.3	90.0	90.0	25.0
X-1121	80.0	90.0	90.0	77.6
OE-17	80.0	90.0	86.6	35.6
Le-10	70.0	90.0	90.0	60.0
OE-22	80.0	-	-	-
OE-24	78.3	90.0	90.0	25.0
OE-329	88.3	90.0	90.0	35.0
OE-8	69.0	85.0	85.5	39.7

Table 22. Growth of various strains of shiitake at different pH

Strains	Av. mycelial diametric growth of various strains of shiitake at different temperatures (^{0}C) after 10-day				
	5.0	6.0	7.0	8.0	9.0
OE-27	69.6	66.6	73.3	72.3	54.0
OE-13	70.6	60.6	69.3	51.0	42.8
Le-6	79.3	76.3	75.3	62.3	53.0
OE-142	70.0	75.0	74.4	68.5	63.0
OE-45	59.3	78.6	76.3	74.0	50.0
OE-2	82.6	80.0	73.3	74.0	68.0
OE-28	90.0	90.0	90.0	74.0	62.0
Le-9	73.6	68.3	70.0	68.3	56.6
OE-16	90.0	76.3	83.6	73.3	59.6
OE-9	80.0	69.0	77.0	68.3	58.6
OE-21	80.0	77.5	80.0	73.5	65.0
OE-388	82.0	83.6	81.3	75.0	52.0
OE-38	79.5	79.0	79.0	66.0	62.5
OE-23	80.0	80.0	77.6	71.0	69.0
Le-8	85.0	77.6	80.0	67.3	51.0
Le-7	80.0	70.0	75.0	64.0	41.4
X-1121	88.3	87.3	82.0	74.3	62.5
OE-17	80.0	90.0	88.3	73.6	67.0
Le-10	69.0	69.5	70.6	63.0	43.5
OE-22	48.0	72.0	59.0	62.0	55.0
OE-24	77.6	70.0	75.0	61.3	47.5
OE-329	90.0	73.0	73.6	62.6	57.0
OE-8	85.3	83.6	83.0	75.0	13.5

Studies on *Morchella*

Surveys were conducted for the site evaluation and wild collection of *Morchella* (July 2010). The natural site conditions were assessed and soil samples collected from these sites were characterized. *Morchella* was collected from agricultural field bunds of Chambaghat village, Solan District, Himachal Pradesh. The fruit bodies collected after the heavy southwest monsoon rainfall. The fruit bodies were found under the pear tree and associated with different agricultural weeds. The slope of the field bund was more than 30 per cent and aspect is towards western side. The soil was (Table 23 & 24) clay loam with relatively higher organic carbon (0.64%), slightly alkaline reaction (7.82) and low soluble salts (EC<1 dS m^{-1}). In case of fertility status, the nitrogen level was medium (280-450 kg/ha), phosphorus was low (< 11 kg/ha) and potassium was high (> 280 kg/ha).

Table 23. Soil conditions of *M. esculenta* and *Phellorinia*

Parameter	*M. esculenta*	*Phellorinia* spp.
Texture	Clay laom	Sandy
OC (%)	0.64	0.04
pH	7.82	9.30
EC (dS m^{-1})	0.76	0.03
Available N (kg/ha)	364.50	56.30
Available P (kg/ha)	6.82	2.40
Available K (kg/ha)	486.40	60.80

Table 24. Site conditions of *M. esculenta* and *Phellorinia* spp.

Parameter	*M. esculenta*	*Phellorinia* spp.
Latitude	30^0 55′ 37"	26^0 28′ 386"
Longitude	77^0 05′ 27"	72^0 39′ 870"
Slope (%)	> 33%	< 3%
Aspect	Western	All aspects
Topography	Undulating	Plains
Landform	Hills	Sandy plain
Microclimate	Cool, moist	Warm, dry
Altitude	1350 m above MSL	250 m above MSL
Plant association	Pear tree, weeds	Bajra field bunds

Linear growth of *Morchella* spp on apple pomace

Linear growth of different *Morchella* spp on forest waste (89%), old apple pomace (1%) and fresh apple pomace (10%) revealed that three strains namely OE-198, OE-232 and OE-260 (Table 25) produced 130 mm growth after 20 days of incubation. Whereas two strains namely OE-252 and OE-254 failed to grow on this substrate.

Table 25. Linear growth of *Morchella* spp. on apple pomace

Strain	Av. linear growth of *Morchella* (mm) after days				
	4^{th} day	8^{th} day	12^{th} day	16^{th} day	20^{th} day
OE-188	-	19	37	60	95
OE-198	33	85	97	120	130
OE-216	10	20	25	50	75
OE-232	30	52	60	110	130
OE-252	-	-	-	-	-
OE-254	-	-	-	-	-
OE-260	20	45	80	120	130

In pure old apple pomace too two strains OE-198 and OE-232 resulted in 130mm growth after 20 days. Two strains namely OE-252 and OE-254 failed to grow on this substrate (Table 26).

Table 26. Linear growth of different *Morchella* spp on old apple pomace

Strain	Av linear growth of *Morchella* strains (mm) after days				
	4th day	8th day	12th day	16th day	20th day
OE-188	-	-	-	-	20
OE-198	24	63	108	123	130
OE-216	-	-	-	-	-
OE-232	30	53	60	110	130
OE-252	-	-	-	-	-
OE-254	-	-	-	-	-
OE-260	20	35	52	75	90

Formulations attempted for cultivation of *Morchella* sp.

The following formulation was tried for the fructification of *Morchella.*

I. Wheat straw= 40 kg
Wood chips= 40 kg
Apple pomace=10 kg

II. Wheat straw= 50 kg
Wood chips=25 kg
Mature dry pear=50 kg

Composting was done for 74 days for I and II. After-wetting turning was given after every 3 days. Two kg substrate was filled in each bag and autoclaved at 22 psi for 2 h.

Each bag was inoculated in a laminar flow @1% spawn. The bags were incubated at 25^{0}C. Spawn run got completed in all the formulations in 30-50 days.

Cordyceps sinenesis

Physiological studies and cultivation trials of *C. sinensis*

Best growth supporting medium (Richards synthetic agar) was selected for studying the effect of different temperature regimes. Best radial growth was recorded at 25^{0}C (Table 27).

Table 27. Average growth of *Cordyceps sinensis* at different temperatures

Temperature (^{0}C)	Av. Growth (mm)
10	0.00
15	40.00
20	53.66
25	62.00

Among the different pH tested best growth was recorded at pH 6.0 followed by pH 7.0 (Table 28).

Table 28. Growth of *C. sinensis* at different pH regimes

pH	Av. Growth (mm)
5.0	75.4
6.0	81.2
7.0	79.0
8.0	76.4
9.0	73.2

Among the different carbon sources tested, starch proved to be the best carbon source followed by maltose (Table 29).

Table 29. Evaluation of different carbon sources for growth of *C. sinensis*

Carbon source	Av. mycelial wt. (g)
D-mannitol	0.2387
Maltose	0.3789
Starch	0.6254
Sorbitol	0.2897
Lactose	0.2285
Sucrose	0.2246

Among the different nitrogen sources tested, asparagine proved to be the best nitrogen source followed by calcium nitrate (Table 30).

Table 30. Evaluation of different nitrogen sources for growth of *C. sinensis*

Nitrogen source	Av. mycelial wt. (g)
Aspartic acid	0.132
Sodium nitrate	0.128
Ammonium nitrate	0.088
Asparagine	0.235
Calcium nitrate	0.173
Potassium nitrate	0.096

Studies on enzyme profile of *C. sinensis*

Among the different enzyme profile studied, maximum activity of chitinase was recorded followed by xylanase and pectinase (Fig. 10).

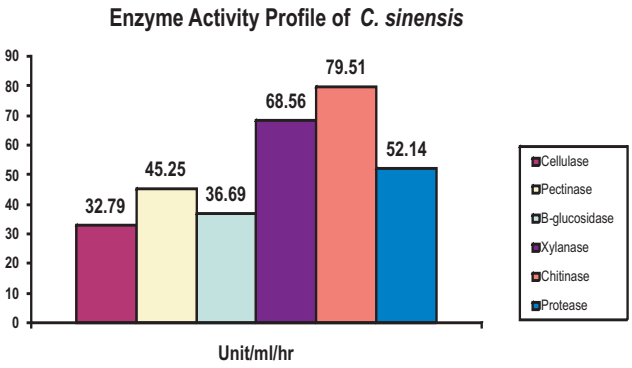


Fig. 10. Enzyme profile of *C. sinensis*

Physiological studies on *Hypoxilon*

Fungi in the genus *Hypoxilon* generally cause a white rot of hardwood slash. However, some species are known to cause severe cankering of stressed hardwoods. Cankering caused by this fungus contributes to the premature death of trees stressed by drought, construction damage, or other problems. Rapidly rotting tissue leads to structural weakening, which causes serious hazard to people or property in high-use areas. Weakened trees are most often attacked by *Hypoxilon* spp. The fungal spores enter wounds, germinate, and grow into the cambium, severely cankering and often girdling the tree very quickly. Concurrently, white rot of the sapwood under the canker begins. Fruiting structures eventually cover the cankered area and rupture the bark. Spores are produced at a rapid rate and are wind borne to new hosts. Recently on February 23rd 2010 a huge mass of honey bee colony was found floating dead inside the well of a farmer in Pulippara, Aanadu, Trivandrum district of Kerala as intimated by AICRPM, Vellayani. On examination of the honey bee cadaver filamentous structures 2.7 cm in length were noted entangling the cephalo thoracic region. The body of the infected bees was very stiff with fungal growth inside the viscera replacing the host tissues. The fruiting bodies which sprouted out of the dead honey bees had yellowish cord like strands with thickened small apex. The cord like strands were branched in several specimens. Since the fungus was parasitizing honey bees and on the basis of its morphological characters it was thought to be the some species of *Cordyceps*. Pure culture of the fungus was obtained from AICRPM Centre, Kerala. Detailed physiological studies and molecular characterization was carried out which revealed it as *Hypoxilon.*

Evaluation of different media: Fourteen different media viz. Luria agar, Czapak dox agar, beef extract, dextrose mannitol agar, dextrose starch agar, Sabourand's dextrose agar, potato dextrose agar, Richards synthetic agar, dextrose agar, dextrose peptone agar, nutrient agar, starch casein agar, potato malt agar and Brown's medium were used for the present study (Table 31). Among the different media tested,best growth was recorded on Richards synthetic agar medium followed by

Czapakdox agar medium. Least growth was recorded on Beef extract medium.

Table 31. Evaluation of different media for the growth of *Hypoxilon*

Medium	Av. dia. growth (mm)
Luria agar	28.4
Czapakdox agar	70.0
Beef extract	15.0
Dextrose mannitol agar	39.0
Dextrose starch agar	27.4
Sabourand's dextrose agar	60.8
Potato dextrose agar	51.6
Richards synthetic agar	90.0
Dextrose agar	43.8
Nutrient agar	51.6
Starch casein agar	40.4
Potato malt agar	40.0
Brown's medium	61.6

Evaluation of different broths: Ten different broths viz. Luria broth, Czapdox broth, dextrose mannitol broth, dextrose starch broth, sabourands broth, potato dextrose broth, Richard's synthetic broth, dextrose agar broth, dextrose peptone broth, nutrient broth and beef extract broth were used for present study (Table 32). Among the different broths tested, best growth was recorded on Dextrose mannitol agar followed by Potato dextrose agar. Least growth was recorded on Potato dextrose agar.

Table 32. Evaluation of different media for the growth of *Hypoxilon*

Broth	Av. mycelial wt. (g)
Luria agar	0.107
Czapakdox agar	0.245
Dextrose mannitol agar	0.610
Dextrose starch agar	0.562
Sabourand's dextrose agar	0.067
Potato dextrose agar	0.052
Richards synthetic agar	0.296
Dextrose agar	0.396
nutrient broth	0.057
Beef extract	0.262

Effect of temperature: To find out optimum temperature regime for maximum mycelial growth on best suited solid medium, inoculated petri plates were incubated at 10, 15, 20, 25 and 30^{0}C in separate incubators. Among the different temperatures tested best growth was recorded at 30^{0}C. No growth was recorded at 10^{0}C (Table 33).

Table 33. Effect of temperature for the growth of *Hypoxilon*

Temperature (^{0}C)	Av.dia. growth (mm)
10	0.0
15	23.0
20	80.0
25	80.0
30	86.2

Effect of pH: To assess the effect of different pH levels on the growth of the fungus, best solid medium was adjusted at different pH levels viz. 6.0, 7.0, 8.0 and 9.0. The pH was adjusted with help of N/10 NaOH and N/10 Hcl. Inoculated petri plates were incubated for 10 days at optimum temperature (Table 34). Among the different pH tested, best growth was recorded at 6.0 pH No growth was recorded at 9.0 pH.

(Developing cultivation technologies for Indigenous edible mushrooms, Lentinula, Calocybe indica, Morchella, Cordyceps and Phellorina - DMR-6)

Table 34. Effect of pH for the growth of *Hypoxilon*

pH	Av.dia. growth (mm)
6.0	47.5
7.0	36.2
8.0	25.8
9.0	0.0

C. CROP PROTECTION

Survey and surveillance of diseases and pests: Survey of different farms in Sonepat, Panipat, Rohtak, Kurukshetra and Yamunanagar revealed wide spread incidence of brown plaster mould. However it never results in serious losses. Yellow mould that generally causes serious losses, was present in are few farms. The average size of huts was 33' x 60' accomodating about 10 tonne compost. Wet bubble was also present in few farms (Table 1).

Table 1. Incidence of various diseases and moulds

Village	No.of farms	No of huts	Incidence of			
			Yellow mould	Wet bubble	Brown plaster mould	Green mould
Rajmajra, Sbd	3	6	-	-	+	1
Khubru, Sonepat	17	182	-	-	+	-
Aaheermajra	2	15	-	2	+	-
Ghumard	1	12	-	-	+	-
Aterna	14	114	10	2	+	-
Manauli	1	12	2	-	+	1
Shaershah	6	186	-	-	+	-
Tjiggipur, Delhi	2	14	-	-	+	-
Gannaur, Sonepat	4	89	12	2	+	4
Bhapra	5	55	2	-	+	-
Puthar	17	17	-	-	+	-
Aasan, Rohtak	2	2	-	-	+	-
Mokhara, Rohtak	12	64	-	-	+	-
Rohak	1	10	-	-	+	-
Kakroi, Sonepat	11	25	10	-	+	-
Badana	7	8	1	-	+	4
Harsanakalan	13	24	2	1	+	
Baianpur	14	167	-	2	+	2
Rohat	15	21			+	
*Shehmalpur, Panipat	30	107	-	8	+	-
Samalakha	1	2	-	-	+	-
Taharpur	2	7	-	2	+	-
Malikpur,Kurukshetra	12	18	-	4	+	-
Kainthla	1	1	-	-	+	-
Bhorsaida	2	10	-	-	+	
Jyotisar	4	5				-
**Mundakhera	6	15	-	-	+	-
Samaspudera	5	6	-	2	+	-
Haripur	7	13	-	-	+	-
Bhukri, Yamunanagar	4	6	-	2	+	-
Alhar, Radaur	12	26	-	2	+	-

*** False truffle at one farm, ** Olive green mould at two farms, + = Present, - = Absent**

Interaction studies between different strains of *Agaricus bisporus* and *Sepedonium. Chrysospermum*

Interaction studies on ten most commonly cultivated white button mushrooms were undertaken with *Sepedonium, Chrysospermum* in dual culture. All the strains showed almost same growth in dual culture studies (Table 2).

Table 2. Interaction studies between different strains of *Agaricus bisporus* and *Sepedonium, chrysospermum*

Strain	Av. mycelial growth after 15 days	
	A. bisporus	*S. chrysospermum*
A-102	24 (26)	37(38)
A-103	25(28)	37(38)
A-104	25(28)	37(38)
Delta	20(22)	36(36)
S-11	27(28)	36(36)
A-15	22(23)	36(36)
A-17	22(23)	37(38)
XB-13	24(25)	37(38)
MS-56	24(25)	37(38)
U-3	20(22)	36(36)

Figures in parentheses represent growth in control

On Farm trial for the management of yellow mould using bavistin and formalin

On farm trial for the control of yellow mould was laid at two villages of Sonepat Aterna and Gannaur. 50g bavistin and 1.5 litre of formalin were added per ton of compost at last turning. After adding both the chemicals the compost was kept covered for 48 hours to avoid the escape of formaldehyde fumes. Thereafter the compost was spawned in normal way. Data on the occurrence of yellow mould was recorded after two months of spawning (Table 3).

Table 3. Performance of on farm trial

Name of farmer and location	Status of yellow mould after 2 months
Dinesh, Village Aterna, Sonepat	1% incidence
Surinder, Village Aterna, Sonepat	No yellow mould
Anand, Village Aterna, Sonepat	No yellow mould
Rajinder, Village Aterna, Sonepat	No yellow mould
Krishan, Village Aterna, Sonepat	No yellow mould
Kewal, Village Aterna, Sonepat	No yellow mould
Balraj, Village Gannaur, Sonepat	25% incidence of yellow mould
Kulraj, Village Gannaur, Sonepat	No yellow mould

Evaluation of different coloured lights for trapping mushroom flies

In order to study the effect of different coloured lights for trapping phorid flies, LED light was used during the cultivation of oyster mushroom when temperature range was 19-21^{0}C. Yellow light proved highly effective for trapping the phorid flies followed by green light. Yellow light also proved effective for trapping beetles damaging oyster mushroom Table 4.

(Integrated Pest and Disease Management in Mushrooms - DMR-8)

Table 4. Effect of different coloured lights for trapping insect-pests

Colour	Temperature (^{0}C)	No. of flies trapped
Red	21	45
Yellow	21	146*
Blue	20	60
Green	19	96
Violet	20	86
Pink	20	58

* beetles were also trapped

D. POST HARVEST TECHNOLOGY

1. Drying of mushrooms

i) *Fluidized bed drying of button mushroom*

Drying kinetics of white button mushroom (*Agaricus bisporus*) slices in fluidized bed dryer at three different drying air temperatures of 45, 55 and 65°C with constant drying air velocity of 2.5 m s^{-1} was studied. The thin layer drying process of white button mushroom slices occurred in falling rate period. Increased in drying air temperature (45, 55 and 65°C) decreased the drying time (8.5, 6.5 and 6 h), respectively for drying of white button mushroom slices in fluidized bed dryer (Fig. 1). The 55°C was found optimum temperature which gave the best quality of dried mushroom slices in terms of physical parameters viz., colour, crispy texture, flavour and comparatively less shrinkage than the other two selected temperatures (Fig. 2). To study the drying behavior of mushroom slices in the fluidized bed dryer seven thin layer-drying models, commonly used for perishable fruits/ vegetables, were tested. Among the mathematical models investigated, logarithmic model fitted best to moisture ratio data with higher R^2 and least c^2, *MBE*, *RMSE* values in fluidized bed drying process of white button mushroom slices (Table 1). The effective moisture diffusivity ranged from 9.21×10^{-8} to 1.50×10^{-7} $m^2 s^{-1}$, with higher values for high temperature (Table 2) and the minimum average activation energy of 36.39 kJ mol^{-1} was required for drying i.e. to detach water molecules of white button mushroom slices.

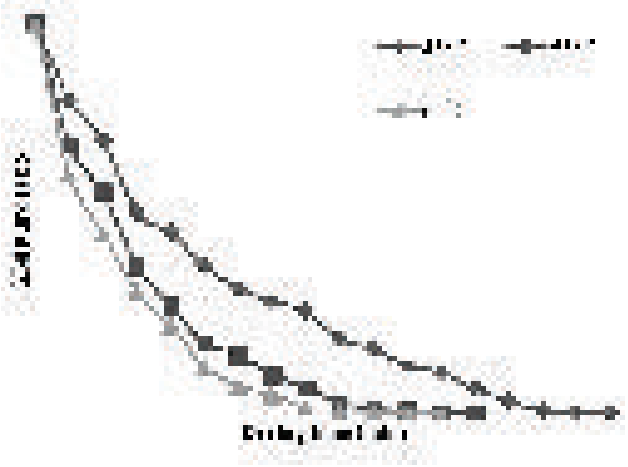


Fig. 1. Variation in moisture ratio of white button mushroom with drying time during fluidized bed drying

Fig. 2. Fresh slices of button mushroom before and after drying at 55°C air temperature in fluidized bed dryer

Table 1. Statistical parameters for different thin layer drying models

Sr. No.	Name of model	Temp (°C)	R^2	χ^2	*RMSE*	*MBE*
1	Newton	45	0.9914	0.0007	0.0263	-0.0048
		55	0.9963	0.0003	0.0179	-0.0042
		65	0.9953	0.0004	0.0200	-0.0037
2	Wang and Singh	45	0.9688	0.0028	0.0503	-0.0120
		55	0.9633	0.0037	0.0565	-0.0138
		65	0.9388	0.0061	0.0721	-0.0186
3	Page	45	0.3492	0.0594	0.2297	0.0000
		55	0.9965	0.0004	0.0173	-0.0035
		65	0.9955	0.0004	0.0195	-0.0045
4	Henderson and Pabis	45	0.9915	0.0008	0.0262	-0.0043
		55	0.9963	0.0004	0.0179	-0.0042
		65	0.9955	0.0004	0.0195	-0.0028
5	Logarithmic	45	0.9939	0.0006	0.0222	-5E-10
		55	0.9973	0.0003	0.0154	-3E-12
		65	0.9959	0.0005	0.0187	-7E-10
6	Two terms	45	0.9916	0.0009	0.0261	-0.0046
		55	0.9963	0.0004	0.0179	-0.0042
		65	0.9955	0.0005	0.0195	-0.0028
7	Two terms exp	45	0.9916	0.0008	0.0261	-0.0046
		55	0.9963	0.0004	0.0180	-0.0043
		65	0.9964	0.0004	0.0174	-0.0046

RMSE= Root Mean Standard Error, MBE= Mean Biased Error

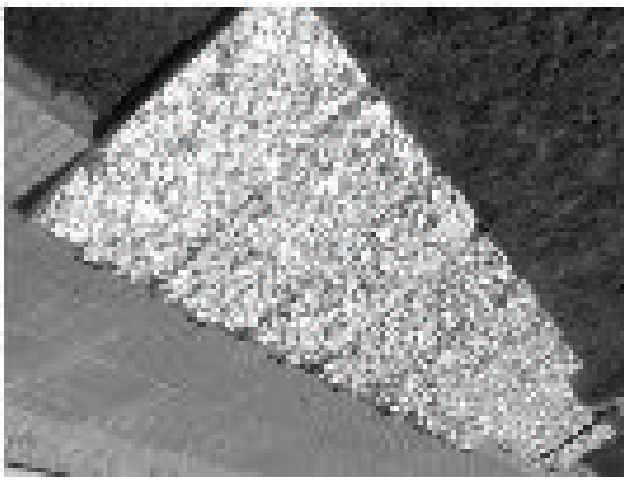
Table 2. Moisture diffusivity equations and effective moisture diffusivity, *Deff* ($m^2 s^{-1}$), values for drying of white button mushroom at different temperatures

Drying temp (°C)	Moisture Diffusivity equation	R^2	Effective Moisture Diffusivity ($m^2 s^{-1}$)
45	y = -0.009x + 0.425	0.905	9.21E-08
55	y = -0.013x + 0.239	0.986	1.35E-07
65	y = -0.014x + 0.076	0.987	1.50E-07

Where y= *lnMR* ratios, x= drying time in minutes

ii) Sun drying of oyster mushroom

Various sun drying trails of *Pleurotus* spp. on steel tray were carried out during the summer i.e. March-July 2010 at DMR, Solan. The best quality sun dried oyster mushroom with final moisture content 7% (d.b.) was obtained at temperature of 28-32°C and relative humidity at 45-52% within 18-22 hours of sun drying (Fig.3.) This optimum conditions i.e. temperature (28-32°C) and RH (45-52%) were found in April-June in Solan. Thus, April to June is the best season for sun drying of *Pleurotus* spp. in Solan.



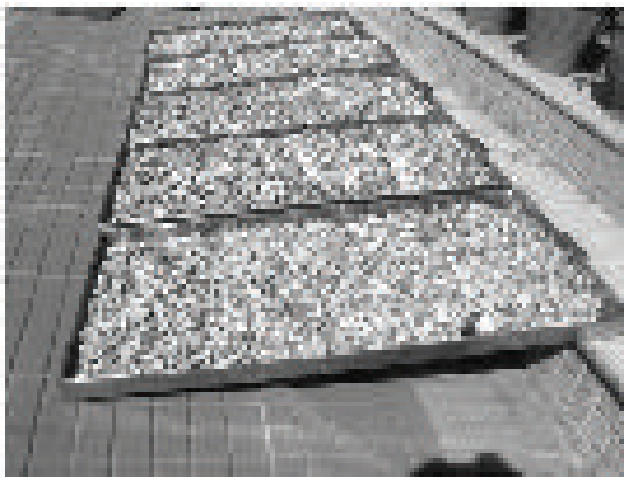


Fig. 3. Sun drying of oyster mushroom

2. Value additions of oyster mushrooms

Processing of oyster mushroom in the form of development of some novel value-added products was under taken from the fresh/dried oyster mushrooms. These include preparation of biscuits, pickle, mushroom soup, mushroom jam, mushroom patties and *pakoda*. The preparation of these products results in not only value addition but also provides additional income to the mushroom growers and protein rich nutritious food to the consumers. The details of mushroom biscuits and patties are described below.

i) Mushroom biscuits

Delicious and crunchy mushroom biscuits were prepared by using the oyster mushroom powder and various ingredients viz., maida, sugar, ghee (bakery fats), mushroom powder, coconut powder, backing soda, ammonium bichromate and milk powder (Table 3). For making biscuits entire ingredients were finely ground using electric mixture and cleaned with the help of fine sieve separately. The ingredients viz., ghee and sugar were well mixed for 5-7 minutes using dough kneeder to make the mixture homogenous. These ingredients were added to dough kneeder for dry mixing of 20-25 minutes. Thereafter, 500 ml water was added to kneeder to make dough cohesive and homogenous and continued for next 10-15 minutes. After that dough was kept for 10 minutes under the wet cloths to make it cool. Thereafter, thin sheets of dough (1.25 cm thick) were made and cut into different shapes of biscuits using different steel dies. These raw cut biscuits were kept in the steel trays in systematic manner and then these trays were baked in hot oven (180°C). After 20 minutes, baking trays were removed from the hot oven and after cooling the biscuits were ready to packaging and serve (Fig.4).

Table 3. Ingredients of oyster mushroom biscuits (6 kg biscuits)

Ingredients	Quantity
Maida	3.0 kg
Sugar powder	1.2 kg
Bakery ghee	300.0 g
Oyster mushroom powder	300.0 g
Coconut powder	500.0 g
Backing powder	300.0 g
Ammonium bichromate	2.0 g
Milk powder	200.0 g
Water	500.0 g

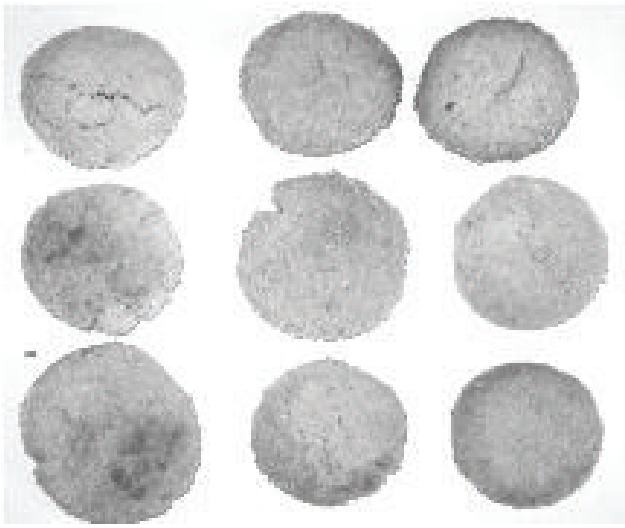


Fig. 4. Oyster mushroom biscuits

ii) Mushroom patties

Various ingredients viz. maida flour, ghee, refined oil; carom seed (*ajwain*) and salt were mixed properly along with water (Table 4). After homogeneous mixing of all ingredients dough was spread into thin sheets and folded . Similar procedure (spreading and folding) was repeated for seven times with 10 minutes time interval. Thereafter, dough sheet cut into small pieces and fried mushrooms were filled into it for making patties. Small amount of milk powder was used to avoid stickiness of dough pieces during handling. Raw pieces are kept in hot oven (180°C) for 10 minutes for making crunchy, crispy patties.

(Modified Atmosphere Packaging for safe storage of Mushrooms - DMR-7)

Table 4. Ingredients of oyster mushroom patties (100 pieces)

Ingredients	Quantity
Maida	2.0 kg
Water	1.0 litre
Salt	50.0 g
Refined oil	200.0 g
Carom seed (*ajwain*)	20.0 g
Ghee	1.0 kg
Fried mushroom with spices	1.0 kg
Milk powder	50.0 g

E. TRANSFER OF TECHNOLOGY

1. Training programmes conducted

During 2010, the Directorate organized nine On and Off campus training programmes for farmers, farmwomen, entrepreneurs, officers and scientists of KVKs.

2. Mushroom Mela-2010

One day Mushroom Mela was organized on 10th September, 2010 as regular activity of the center. It was inaugurated by Dr H. P. Singh Hon'ble Deputy Director General (Horticulture). Dr M. M. Anwer, Director, NRC seed spices, Ajmer was the guest of Honour. It was attended by about 550 farmers, farmwomen, mushroom growers, researchers, extension workers and businessmen from various states viz, Himachal Pradesh, Haryana, Punjab, Uttar Pradesh, Maharashtra, Madhya Pradesh, Chattisgarh, Bihar, Jharkhand, Delhi, Uttarkhand, Assam, Gujarat, Tamilnadu and Orissa. The mela was attended by representatives from more than 20 states of India. Dr. H.P. Singh, DDG (Hort.) released publications (Fig. 1) and falicitated progressive mushroom growers (Fig. 2).

Fig. 2. Dr H.P. Singh DDG (Hort) felicitating Sh Rajbir Singh as a progressive grower during mushroom mela- 2010

An exhibition on improved mushroom cultivation technologies and other related aspects were organized in which various Govt. Organisation, ICAR Institutes/ Universities, Govt. financial organization, compost and spawn producers, mushroom product manufacturer, seed and pesticides and chemical producers and NGOs displayed their valuable information/ technologies/products and provided their services to the participants of the Mushroom Mela. The Exhibition was inaugurated by the guest of honour Dr M. M. Anwer (Fig. 3).

Fig. 1. Dr H.P. Singh DDG (Hort) releasing publications during mushroom mela-2010

Fig. 3. Dr M.M. Anwer, Director, NRC seed spices, Ajmer visiting the exhibition stalls during mushroom mela-2010

To create awareness to the participants, various improved technologies/practices of mushroom cultivation, farm visit of the growing units of the Directorate was conducted and demonstrations on improved technologies were given in front of participants of Mushroom Mela.

In the afternoon session of Mushroom Mela, a Kisan Goshthi was held to answer the problems in mushroom cultivation faced by mushroom growers. The problems raised by mushroom growers and farmers were replied by panel of experts in a very systematic manner.

During the Mushroom Mela, the Directorate awarded seven progressive/ innovative mushroom growers for adopting innovative practices in mushroom cultivation on larger scale and mobilizing other farmers to adopt mushroom cultivation as source of income. In view of the large number of nominations from North-Eastern states of India, certificates of appreciation were given to all the participants to encourage more growers from N-E region.

3. Participation in national/state level exhibitions

To create awareness about mushroom cultivation and its health benefits the center has participated in many state and national level exhibitions and fairs by establishing a stall and by distributing the free literature of the Directorate.

DMR participated and put up a stall at Horti-Expo, 2010 during the National conference on Production of Quality seeds and Planting Material- Health Management in Horticultural Crops at New Delhi (11-14 March 2010). Dr S. Aiyappan, Secretary, DARE and DG (ICAR), New Delhi, Dr. H. P. Singh DDG (Horticulture) ICAR, New Delhi, Directors of all the Horticulture research institutes were present in the event.

Participated and put up a stall of DMR, Solan at IIHR Bangalore during the Horticulture - Industry interface on 10-11th November, 2010. Dr S. Aiyappan, Secretary, DARE and DG (ICAR), New Delhi, Dr. H. P. Singh DDG (Horticulture) ICAR, New Delhi, Directors of different Horticultural research institutes were present in the event.

Participated and put up a stall of DMR, Solan at National Conference on KVKs held at Udaipur w.e.f 21-24 December, 2010. Her Excellency Dr Pratibha Devi Singh Patil, President of India inaugurated the conference and the exhibtion. Sh. Shivaraj Patil Governor of Punjab and Rajasthan, Sh. Ashok Gehlot, Chief Minister of Rajasthan, Sh. Sharad Pawar Union Minister of Agriculture, Prof C. P. Joshi, Union Minister of Rural Development, Prof K. V. Thomas Union Minister of state of Agriculture, Sh. Harji Ram Burdak, Agriculture Minister, Govt of Rajasthan, Sh. Murari Lal Meena State Minister of Technical Education, Govt of Rajasthan, Dr S. Aiyappan, Secretary, DARE and DG (ICAR), New Delhi, Dr. K. D. Kokate, DDG (Agricultural Extension) ICAR, New Delhi, Dr S. S. Chahal, Vice Chancellor, MPUA&T, Udaipur, Rajasthan, Zonal Project Directors and Coordinators of all the KVKs and many other dignitaries and scientists were present in the event.

4. Promotion of Mushroom Cultivation and Consumption

Two regional mushroom mela and consumption fairs were held at Aterna and Gannaur villages of Haryana during January, 2010 to address the problems faced by mushroom growers and to promote mushroom consumption among common public. A regional mushroom mela and the

mushroom consumption fair was held at Aterna village in the farm house of progressive mushroom grower Mr Kanwal singh Chauhan on 16th January, 2010. Dr. U. Srivastava ADG (Horticulture II) was the chief guest and Dr S. Rajan ADG (Horticulture I) was guest of honour in the mela. More than 200 farmers, farm women, youth and more than 30 officials from different departments and financial institutions participated in the mela. A kisan goshthi was held on the occasion to facilitate on the spot solution to the problems of mushroom growers. Director, DMR, Solan, Scientists from DMR, Solan, KVKs, officials from Department of Agriculture, Horticulture, State Bank of India and NHB participated in the Goshthi to answer to the queries of farmers.

Another regional mushroom mela and consumption fair was organized at Gannaur village of Sonepat district of Haryana on 17th January, 2010. Dr. K. S. Khokhar, Honourable Vice Chancellor, CCS HAU, Hisar, Haryana was chief guest of the function (Fig. 4), Dr Manjit Singh, Director, DMR presided over the function. Over 300 farmers and mushroom growers attended the mela. A Kisan Goshthi was held in the presence of Scientists from DMR, Solan, HAU, Hisar, HAIC, Murthal, KVK, Panipat officials from NABARD, Dept. of Horticulture, NHB, Punjab National Bank. The farmers problems were addressed on the spot in the Kisan goshthi.

Fig. 4. Dr K. S. Khokhar, Hon'ble Vice Chancellor, CCS HAU, Hissar, Haryana addressing participants in Kishan Goshthi at Gannaur, Sonipat

To bring awareness about the mushrooms among common people, several posters were displayed to show the health benefits of mushroom, variety of value added products from different types of mushrooms, cultivation technologies of different mushrooms, spawn production technology etc in both the melas. A registration kit containing all the complementary literature of DMR, Solan, a writing pad and a pen was given to all the people attending the mela. All the priced publications of DMR including the mushroom recipes were kept for sale in the stall on both the melas. Mushroom biscuits and mushroom pickle were kept for sale for the visitors. A mushroom dish was served in the lunch for all the people attending the mela. Both the events were widely covered by Doordarshan national network, various local electronic and press media.

5. Foreign consultancy

Training for the officials and scientists of Bangladesh on a 10 day study visit to DMR, Solan. The delegates were exposed about the activities of DMR (Fig. 5) and advances in

Fig. 5. Sh Mahantesh Shirur, Scientist conducting visit of scientists and officials of Bangladesh

mushroom cultivation technology in India. Dr Nameq Rashid citizen of Iraq residing in United Kingdom attended the entrepreneurs training on mushroom cultivation technology held during April, 2010.

6. Advisory service to farmers/ Mushroom growers/ Businessman/ unemployed youths

Advisory services through postal extension letters on various aspects of mushroom cultivation, training and marketing were provided. Queries on mushroom cultivation, training were replied through telephone and e-mail. On an average 6 queries per day were received either by phone/ mail/ letters and were replied. The farmer groups from different states and students of various colleges visiting the institute were briefed regularly about the various facilities and services rendered by DMR, Solan

Nine Phone-in and field based programmes were telecast on Doordarshan Kendra from Shimla on Krishi Darshan. Another programme/ interview of Director DMR, Solan was aired by Delhi Doordarshan.

2. TRAINING COURSES ORGANISED

Table 1. Training courses organized at the Directorate in 2010

S. No.	Training	Date	Sponsoring agency	No. of benefaceries	Course Director & Course Co-ordinator
1	Training on Mushroom Cultivation Technology for Entrepreneurs	22nd April-1st May, 2010	ICAR	44	Dr. B. Vijay, Principal Scientist & Sh. Mahantesh Shirur, Scientist
2	Off-campus training on Mushroom Production Technology for farmers at KVK, Daula Kuan Dt: Sirmour (H.P)	14-15th June, 2010	ICAR	90	Dr. B. Vijay, Principal Scientist & Sh. Mahantesh Shirur, Scientist
3	Farmers Training on Mushroom Cultivation Technology-I	24-30th June, 2010	ICAR	46	Dr. B. Vijay, Principal Scientist & Sh. Mahantesh Shirur, Scientist
4	Training on Mushroom Cultivation Technology for the SMS/ Scientists of KVK	20-26th August, 2010	ICAR	07	Dr. V.P.Sharma, Principal Scientist & Sh. Mahantesh Shirur, Scientist
5	Training on Mushroom Cultivation Technology for the farmers and officials from North- East Region at DMR, Solan	9-11th Sept., 2010	Mini Mission Scheme for N-E states	06	Dr. B. Vijay, Principal Scientist & Sh. Mahantesh Shirur, Scientist
6	Training on Mushroom Cultivation Technology-II	14-20th Sept., 2010	ICAR	53	Dr. B. Vijay, Principal Scientist & Sh. Sunil Verma Technical Officer
7	Training on Mushroom Cultivation Technology for the SMS/ Scientists of KVK of Zone -I	28th Sept- 2nd Oct., 2010	ICAR	07	Dr. Shwet Kamal, Senior Scientist & Dr Goraksha. C. Wakchaure, Scientist
8	Training for the farmers and Horticulture officials of Tripura under TMNE-I at Agartala	6-8th Oct., 2010	Mini Mission Scheme for N-E states	42	Dr. B. Vijay, Principal Scientist & Sh. Mahantesh Shirur, Scientist
9	Refresher Training for the Officials and Extension functionaries of H. P State Dept. of Horticulture	25-30th Oct., 2010	Directorate of Horticulture, Shimla	32	Dr. B. Vijay, Principal Scientist & Sh. Mahantesh Shirur, Scientist

Fig. 1. Trainees learning to prepare mushroom during a training course

Fig. 2. Discussion among scientists of DMR and KVK, during a training programme

Summer Training of Students

Ten students completed their Summer Projects (3-6 months) under the guidance of different scientist at this Directorate. Mr. Shalender Parihar and Mr. Rahul Sharma worked under Dr. R.C. Upadhyay. Mr. Vishal Dhiman worked under Dr. B. Vijay. Ms. Kanika Thakur, Ms. Ruchika Thakur and Ms. Nisha Sharma got the guidance of Dr. V.P. Sharma. Mr. Sumit Prakash Kaundal worked under Dr. O.P. Ahlawat. Ms. Mahak Sharif and Ms. Nidhi Pawar worked under Dr. Satish Kumar whereas Dr. Aditya Saran got the guidance of Dr. Shwet Kamal.

3. AICRPM CENTRES

The All India Coordinated Research Project on Mushroom (AICRPM) came into existence during VIth Five-Year Plan on 01.04.1983 with its Headquarters at Directorate of Mushroom Research, Solan (HP). The Director of DMR, Solan (HP) also functions as the Project Coordinator of the project. Initially the AICRPM started with six Centres at Punjab Agricultural University, Ludhiana (Punjab), G.B.Pant University of Agriculture and Technology, Pantnagar (UP), 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 Coordinating 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, 14 Coordinating and two co-operating Centres are working under AICRPM programme with its Headquarters at DMR, 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 (Uttranchal)
- Mahatma Phule Agricultural University, COA, 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, COA, Vellayani (Kerala).
- ICAR Research Complex for NEH Region, Barapani (Meghalya).
- Horticulture and Agroforestry Research Programme (ICAR Research Complex for Eastern Region), Ranchi (Jharkhand).
- CCS Haryana Agricultural University, Hisar.
- Orissa University of Agriculture & Technology, Bhubaneswar.
- Rajendra Agricultural University, Samastipur (Bihar).
- Central Agricultural University, COHF, Pasighat, Arunachal Pradesh.
- Dr.Y.S.Parmar University of Horticulture & Forestry, Nauni, Solan – Co-operating Centre.
- HAIC Agro R&D Centre, Murthal (Sonepat), Haryana – Co-operating Centre.

4. PUBLICATIONS

A. Research Papers

1. Ahlawat, O.P., Gupta, Pardeep, Shwet, Kamal and Dhar, B.L. 2010. Variability in intra-specific and monosporous Isolates of *Volvariella volvacea* based on enzyme activity, ITS and RAPD. *Indian J. Microbiology,* 50(2): 192-198.

2. Ahlawat, O.P. and Vijay, B. 2011. Potential of thermophlic bacteria as microbial inoculantants for commercial scale white button mushroom (*Agaricus bisporus*) compost production. *J. Scientific and Industrial Research*, 69: 948-955.

3. Arumuganathan, T. Amnikantan, M.R. Indurani,C. Rai, R.D. and Kamal, S. 2010. Texture and quality parameters of oyster mushroom as influenced by drying methods. *Int. Agrophys*, 24: 339-342.

4. Kumari, Deepika, Upadhyay, R.C. and Reddy, M. S. 2010. *Cantharellus pseudoformosus,* a new species associated with *Cedrus deodara* from India. *Mycoscience,:* 5-9.

5. Kumari, Deepika, Upadhyay, R.C. and Reddy, M. S. 2010. New records of *Cantharellaceae* for India. *Mush. Res.,* 18(2): 47-50.

6. Kumar, S., Sharma, V.P. and Rai, R.D. 2009. *Lasioderma serricorne*- pest of dried *Ganoderma* spp. *Mush. Res*., 18 (2): 91-92.

7. Kumar, S., Sharma, S.R. and Sharma, V.P. 2009. Persistence and effect of processing on residues of malathion and decamethrin in white button mushroom , *Agaricus bisporus. Indian J. Mushroom,* Vol. XXVII (No 1&2): 19-24.

8. Manikandan, K. Subramaniyan,V. and Sankar, M. 2010. Studies on sustainable groundnut farming in semi arid sand dune ecosystem. *Indian Journal of Environment and Ecoplanning*, 17 (1-2): 33-38.

9. Manikandan, K. and Subramaniyan,V. 2010. Integrated Nutrient Management for sustainable groundnut cultivation in the soil. *Asian J. Soil Sci*., 5 (1) : 134-137.

10. Sharma, V.P., Kumar, S, and Anjali. 2009. Impact of neem pesticides for the management of mycoparasites. *Indian J. Mushroom,* XXVII (No 1&2): 38-40.

11. Sharma, V.P., Kumar, S. and Sharma, S.R. 2010. Yield loss and management of Cinamon mould (*Chromelosporium fulva*) during cultivation of *Calocybe indica. J. Mycol. Pl. Pathol.,* 40 (1): 99-102.

12. Sharma, V.P. and Kumar, S. 2010. Effect of substrate and cold water treatment on the productivity of shiitake. *Mush. Res*., 19(1): 22-26.

13. Sharma, V.P., Kumar, Satish and Gautam, Vanita. 2010. Molecular characterization of bacterial isolates causing brown blotch of cultivated mushrooms. *Mush. Res.,* 19 (2): 102-105.

14. Singh, A, Sharma, V.P., Kumar, S. Varshney, A. and Singh, R. 2010. Prevalence of competitor and parasitic moulds during milky and white

button mushroom cultivation in Haryana. *Mush. Res.*, 19(1): 45-49.

15. Singh, A., Sharma, V.P., Kumar, Satish and Varshney, A. 2010.Effect of supplementation, casing material and substrate preparation method on *Calocybe indica* production. *Mush. Res.,* 19 (2): 86-89.

16. Tripathi, A., Upadhyay, R.C. and Singh, S.K. 2010. Variability in phenol tolerance by coremia forming *Pleurotus* spp.on solid medium. *Mush. Res.,* 19(1): 9-15.

17. Tripathi, A., Upadhyay, R.C. and Singh, S.K. 2010. Biodegradation of chlorophenols by white rot fungi. *Flora and Fauna,* 16(2): 157-165.

18. Wakchaure, G.C., Shirur, M., Manikandan, K. and Rana, L. 2010. Development and evaluation of oyster mushroom value added products. *Mush. Res.,* 19(1): 40-44.

Book Chapters

1. Ahlawat, O.P. 2011. Crop Management of White Button Mushroom (*Agaricus bisporus*) In: Compendium on Mushroom Cultivation Technology, Directorate of Mushroom Research, Solan (HP), India. , pp. 89-99.

2. Ahlawat, O.P. 2011. Growth Regulators/ Hormones for Yield Enhancement in Mushrooms , Compendium on Mushroom Cultivation Technology, Directorate of Mushroom Research, Solan (HP), India pp. 105-108.

3. Ahlawat, O.P. 2011. Cultivation of Paddy Straw Mushroom (*Volvariella volvacea*). In: Compendium on Mushroom Cultivation Technology, Directorate of Mushroom Research, Solan (HP), India pp. 145-156.

4. Ahlawat, O.P. 2011. Recycling of Spent Mushroom Substrate. In: Compendium on Mushroom Cultivation Technology, Directorate of Mushroom Research, Solan (HP), India. pp. 203-210.

5. Kamal, S., Prasad, R. and Verma, A. 2010. Soil Microbial Diversity in Relation to Heavy Metals. In: Soil Heavy Metals (Irena Sherameti and Ajit Varma eds) Springer-Verlag, Germany

6. Kamal, S. 2010. Quality Traits in Cultivated Mushrooms and Consumer Acceptability. In: *Mushrooms: Cultivation, Marketing and Consumption*. (Manjit Singh, B. Vijay, S. Kamal and G.C. Wakchaure eds.), DMR Solan: 105-112.

7. Manikandan, K. 2010. Nutritional and Medicinal values of Mushrooms. In: Compendium on Mushroom Cultivation Technology, Directorate of Mushroom Research, Solan (HP), India

8. Sharma, V.P. 2010. Production technology of specialty (*Flammulina, Agrocybe, Stropharia*) Mushrooms. In: *Advances in Mushroom Biology and Biotechnology* (V.P. Sharma, Satish Kumar and G.C. Wakchaure eds.), DMR, Solan: 153-162.

9. Sharma, V.P. 2010. Competitor moulds and fungal diseases of

mushrooms. In: *Advances in Mushroom Biology and Biotechnology* (V.P. Sharma, Satish Kumar and G.C. Wakchaure eds.), DMR, Solan: 163-185.

10. Sharma, V.P. 2010. Bacterial diseases and abiotic disorders of mushrooms. In: *Advances in Mushroom Biology and Biotechnology* (V.P. Sharma, Satish Kumar and G.C. Wakchaure eds.), DMR, Solan: 186-197.

11. Upadhyay, R.C. and Manjit Singh. 2010. Production of edible mushrooms. In: Mycota – Industrial Applications-X, (Karl Esser ed.), Springer Publication pp 79-97.

Books

1. Sharma, V.P. Satish Kumar and G.C. Wakchaure. 2010. *Advances in mushroom biology and bio-technology*. Directorate of Mushroom Reasearch, Solan Pp 341.

2. Suman, B.C., Kumar Satish and V.P. Sharma. 2010. *Khumb ki Kheti*. published by Indian Mushroom Growers Association, Solan pp 93.

Folder

1. Ahlawat, O.P. 2010. Paira Mushroom (*Volvariella volvacea*) Ki Utpadan Taknik.

Reports

1. Ahlawat, O.P. and Kumar, Satish. 2009. Compiled and edited AICRP Annual Report 2008-09, DMR, Solan (HP) Pp.1-65.

2. Sharma, V.P., Kumar, Satish and Verma, Shailja. 2009. Compiled and edited DMR's Annual Report 2009. DMR, Solan , p 82.

Popular articles

1. Kumar, Satish and Sharma,V.P. 2010. *Khum Ki Makhiyon ka Niyantran*. *Indian J. Mush.*, XXVIII: 70-71

Abstract:

1. Ahlawat, O.P., Manikandan, K. and Vijay, B. 2010. Spent mushroom substrate: a valuable organic manure for vegetable and fruit crops, In: Swadesh Prem Jagriti Sangosthi – 2010 (National Conference on Horticultural Bio-Diversity for Livelihood, Economic Development and Health Care) from 29th to 31st May, 2010 at University of Horticultural Science, Bagalkot, Karnataka, p 58.

2. Kamal, Shwet and Singh, Manjit. 2010. Biotechnology in Mushrooms. In: Diversification for sustaining profitability in mushroom production. Held at Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan on 26-27th Nov., 2010.

3. Kamal, Shwet and Singh, Manjit. 2010. Molecular Markers in Mushroom Breeding. National Symposium on "Biotechnological Perspective of Plants, Microbes and their Interactions" at University Department of Botany, B R A Bihar University, Muzaffarpur under the aegis on January 15-17, 2011.

4. Kumari, Deepika, Upadhyay, R. C. and Reddy, M.S. 2010. Nutritional components and anti oxidant activity of eighteen different wild *Cantharellus* mushrooms collected from North-

Western Himalaya. "National Conference on Emerging trends in Biopharmaceuticals : Relevance to human health & 4thAnnual convention of Association of Biotechnology and Pharmacy" at Thapar University, Patiala, 11th to 13 th Nov., 2010.

5. Kumari, Deepika, Upadhyay, R. C. and Reddy, M.S. 2010. Nutritional components and antioxidant activity of different species of wild edible mushroom *Cantharellus* collected from North-Western Himalaya, India. Paper presented in the National Conference on "Fungal Biology and Applications" on 21st and 22nd March 2011 at Punjabi University, Patiala: 84.

6. Kumar, S, Singh, M. and Sharma V.P. 2010. Present status of *Cordyceps sinensis* in India. In: International Conference on *Codyceps,* Xining, China, June 8-10, 2010.

7. Kumar, S. and Sharma, V.P. 2010. Persistence of commonly used pesticides in different mushrooms. In: National symposium on Perspectives and Challenges of Integrated Pest Management for Sustainable Agriculture held at UHF, Nauni from Nov., 19-21, 2010 Abstracts : 177.

8. Kumar, S. and Sharma, V.P. 2010. Present status and future strategies for the management of insect-pests of mushrooms. *Ibid* : 36.

9. Kumar, S. and Sharma, V.P. 2010. Physiological studies and enzyme profile of *Cordyceps sinensis*. In: Diversification for sustaining profitability in mushroom production, held at Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan on 26-27th Nov., 2010: 44.

10. Kumar, S. and Sharma, V.P. 2010. Physiological studies and enzyme profile of *Cordyceps sinensis*. *Ibid*: 44.

11. Sharma, V.P., Kumar, S., Singh, R. and Lata, Hem. 2010. Medicinal Mushrooms: Pharmacological values and cultivation. *Ibid* : 53.

12. Singh, R., Sharma, V.P. and Kumar, S. 2010. Evaluation of different lignocellulotic waste for mycelial growth of *Morchella* sp. *Ibid*: 42.

13. Sharma, V.P. and Kumar, S. 2010. Cultivation of shiitake mushroom on wheat straw. In: National Conference on Horticultural Bio- Diversity for Livelihood, Economic Development and health Care, 29-31 May, 2010, UHS, Bangalore, Abstracts : 103.

14. Wakchaure, G.C. and Kumar, S. 2010. Mushroom production and marketing: Global and national Scenario. In: Diversification for sustaining profitability in mushroom production. Held at Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan on 26-27th Nov., 2010: 54.

5. APPROVED ONGOING RESEARCH PROJECTS

On-going Research Projects of DMR

Institute Code	Title	*Researchers*		Period
DMR-1	Survey, collection and identification of fleshy fungi	Dr. R.C. Upadhyay Dr.O.P. Ahlawat Dr. Satish Kumar	Principal Investigator Co-PI Co-PI	January, 1998 till date.
DMR-2	Genetic Improvement of *button*, *Pleurotus* and *Volvariella* mushrooms.	Dr. Manjit Singh Dr. R.C. Upadhyay Dr. O.P. Ahlawat Dr. Shwet Kamal Dr. K. Manikandan	PI (*Agaricus*) PI (*Pleurotus*) PI (*Volvariella*) Co-PI Co-PI	April, 2010 to March, 2013.
DMR-3	Improvement in cultivation technology of white button mushroom & effective utilization of spent substrate.	Dr. B. Vijay Dr. O.P. Ahlawat Dr. K. Manikandan	Principal Investigator Co-PI Co-PI	April, 2010 to March, 2013
DMR-4	Cultivation technology of oyster mushroom	Dr. R.C. Upadhyay Dr.V. P. Sharma	Principal Investigator Co-PI	Januay, 2007 to December, 2011. NCM-38 with title change only.
DMR-5	Integrative use of cultivation technologies for enhancing yield and quality of paddy straw mushroom *V.Volvacea*.	Dr. O.P. Ahlawat Dr. V.P. Sharma Dr. Satish Kumar	Principal Investigator Co-PI Co-PI	Januay, 2007 to December, 2011. NCM-40 with title change only.
DMR-6	Developing cultivation technologies for Indigenous edible mushrooms, *Lentinula*, *Calocybe indica*, *Morchella*, *Cordyceps* and *Phellorina*.	Dr. V.P. Sharma Dr. Manjit Singh Dr. Satish Kumar Dr. Shwet Kamal Dr. K. Manikandan	Principal Investigator Co-PI Co-PI Co-PI Co-PI	April, 2010 to March, 2015
DMR-7	Modified Atmosphere Packaging for safe storage of Mushrooms	Dr. Goraksha C. Wakchaure Dr. B. Vijay	Principal Investigator Co-PI	February, 2010 to June, 2014.
DMR-8	Integrated Pest and Disease Management in Mushrooms	Dr. Satish Kumar Dr. V.P. Sharma	Principal Investigator Co-PI	April, 2010 to October, 2012

Externally Funded Projects

Title of the Project	PI of the Project	Duration	Funding Agency
Agrowaste Management, Bioremediation and Microbes in Post Harvest Processing i) Refinement in indoor compost technology for white button mushroom using thermophilic organisms.	Dr. B. Vijay	01.08.2006 to 31.07.2011	ICAR (AMAAS)
Microbial diversity and Identification i) Strengthening, authentication and exploitation of mushroom biodiversity at the National Mushroom Repository for human welfare.	Dr. R.C. Upadhyay	01.08.2006 to 31.07.2011	ICAR (AMAAS)
Screening and evaluation of ascomycetous and basidiomycetous macro-fungi of Uttarakhand and Himachal Pradesh for new drug discovery and ligninolytic enzymes.	Dr. R.C. Upadhyay	01.02.2009 to 31.01.2011	CSIR, HRDG, New Delhi.

Consultancy Provided by the Scientists DMR

The Consultancy to the following organizations was given during the period under report.

Consultancy in the form of preparation of Techno Economic Feasibility Report **(TEFR)** and advise on mushroom cultivation during the year 2010-11 was provided to the following persons/units.

i. Sh. Hem Raj Kashyap S/o Sh. B.R. Kashyap, Vill. Bastla, P.O. Bhogri, Tehsil-Kaushali, Distt. Solan (H.P.) 173233.

ii. Sh. Baldev Kumar S/o Sh. Sh. Puran Chand, Vill. & P.I. Banjri, Tehsil-Kandaghat, Solan (H.P.).

iii. Sh. Jwala Prasad S/o Sh. Nand Lal, Vill. Makdi(Markand), Distt. Jhukhala, Tehsil-Sadar, Distt. Bilaspur (H.P.).

iv. Sh. Sukhdev Singh S/o Sh. Sunder Singh, Vill. Lanaksar, Distt. Sarso, Tehsil-Pachad, Distt. Sirmour (H.P.).

v. Sh. Kuldeep Bhardwaj, 51/1, Ward No.9, Vishnu Kutter, Poanta Sahib, Distt. Sirmour (H.P.)

vi. Sh. Manoj Kumar S/o Sh. Munshi Singh, Vill. & P.O. Derma, Distt. Navada, Bihar-805110.

vii. Sh. Dila Ram S/o Sh. Devi Ram, Vill. Neori, P.O. Kashlog, Tehsil Arki, Distt. Solan (H.P.).

viii. Sh. Vivek Rawat S/o Sh. Rajinder Singh, Mall Godown Road, In Front of IFFCO Tuhi Ram Colony, P.O. Palwal, Distt. Palwal, Haryana-121102.

ix. Sh. Digmber Singh S/o Sh. Yashweer Singh, C/o Sh. Vivek Rawat, Mall Godown Road, In Front of IFFCO Tuhi Ram Colony, P.O. Palwal, Distt. Palwal, Haryana-121102.

x. Sh. Dinesh Prasad, Village Datia, Post & District Khunti, Jharkhand – 835210.

xi. Sh. Vikram Maheshwari, D-121, Kabir Marg, Bani Park, Jaipur – 302016 (Rajasthan).

xii. Sh. Nitin Shantaram Chavunke, Chavunke Mushroom, At Kirtangli, Post Vdangli, Taluka-Sinnar, Distt. Nashik (Maharashtra).

xiii. Smt. Nisha Rani, House No.1047, Sector-4, Panchkula, Haryana.

xiv. Sh. Gurjoot Singh Walia S/o Sh. Jasbir Singh Walia, 37, Hira Nagar, Patiala (Pb.) – 147001

xv. Sh. Baldev Singh Bhandari, Village Jame-Ki-Ser, P.O. Upron, Tehsil Pachhad, Distt. Sirmour (HP)

xvi. Sh. Arpan Gupta S/o Sh. Anil Gupta, 314, Mahesh Nagar, Ambala Cantt – 133001 (Haryana)

xvii. President, Nari Saman Shakti Samiti, Shri Sai Niwas Maheli, Shimla – 171001 (HP)

xviii. Mrs. Sharda Suri W/o Sh. Mahesh Suri, Suri Star Cottage, Shilly Road, Solan

xix. Mr. Amit Chamola S/o Sh. Ishwar Dutt Sharma, Vill. Kuthar, Tehsil-Kasauli, Distt. Solan (H.P.)

xx. Sh. Sukhdev Singh Vill. Lanaksar, Distt. Sarso, Tehsil-Pachad, Distt. Sirmour (H.P.)

xxi. M/s. Krishna Associates, 27, Industrial Area, Gurdaspur (Punjab).

xxii. Sh. Sanjeev Sharma, H.No.1199, Sector-28 B, Chandigarh.

6. COMMITTEE MEETINGS

a) Institute Management Committee: No meeting of IMC was held during 2010.

1.	Dr. Manjit Singh, Director, DMR, Chambaghat, Solan (H.P.).	Chairman
2.	Dr. Umesh Srivastava, Asstt.Director General(Hor.II), ICAR, Krishi Anusandhan Bhavan-II, Pusa, New Delhi-110012.	Member
3.	Dr. D.K. Arora, Director, National Bureau of Agriculturally Important Microorganisms (NBAIM), Kusmaur, MAU Nath Banjan (U.P.).	Member
4.	Dr. Gurdev Singh Shama, Director of Horticulture, Deptt. of Horticulture, Govt. of Himachal Pradesh, Shimla-2 (H.P.).	Member
5.	Dr. Ajay Yadav, Incharge, HAIC Agro Research & Development Centre, Murthal (Haryana).	Member
6.	Director of Research, Dr. Y.S. Parmar University of Hort. & Forestry, Nauni, Solan(H.P.).	Member
7.	Sh. Vikas Benal, Vikas Mushroom, Vill. Shamlaich, P.O. Barog, Tehsil & Distt. Solan (H.P.).	Member
8.	Sh. Ram Dass Shinde, Tirupati Balaji Mushroom, Vill. Someshwarnagar(Nimbut), Tal. Baramati, Distt. Pune-412306(Maharashtra).	Member
9.	Dr. P.S Naik, Project Coordinator & Principal Scientist, CPRI, Shimla(H.P.).	Member
10.	Dr. Meera Pandey, Principal Scientist, IIHR, Bangalore, Karnataka.	Member
11.	Dr. V.P. Sharma, Principal Scientist, DMR, Chambaghat, Solan(H.P.).	Member
12.	Finance & Accounts Officer, Central Potato Research Institute, Shimla (H.P.).	Member
13.	Administrative Officer, DMR, Chambaghat, Solan(H.P.).	Member Secretary

(b) Research Advisory committee: One meeting was held on 31st July, 2010.

1.	Dr. S.M. Paul Khurana Director Amity University Haryana, E-1101, Park View City II Sohna Road, Gurgaon – 49 (Haryana)	-	Chairman
2.	Dr. P.C. Trivedi Vice Chancellor, Gorakhpur University, Gorakhpur (U.P.)	-	Member
3.	Dr. Umesh Srivastava Asstt. Director General (Hort.II) Indian Council of Agricultural Research Krishi Anusandhan Bhavan-II, Pusa New Delhi – 110 012	-	Member

4.	Dr. D.R. Sharma Dean Shoolini Institute of Life Sciences & Business Management Solan (H.P.) - 173212	-	Member
5.	Dr. R.P. Singh F/61, Alliance Kingston Estate, Rudarpur – 263153 (Uttarakhand)	-	Member
6.	Dr. J.C. Tarafdar ICAR National Fellow CAZRI, Jodhpur (Rajasthan)	-	Member
7.	Dr. Manjit Singh Director Directorate of Mushroom Research Chambaghat, Solan (H.P.)	-	Member
8.	Sh. Vikas Banal Vikas Mushroom Farm Vill. Shamlaich Solan (H.P.)	-	Member
9.	Sh. Ram Dass Shinde, Tirupati Balaji Mushroom, Vill. Someshwar Nagar (Nimbut), Tal. Baramati, Distt. Pune – 412306 (Maharastra)	-	Member
10.	Dr. R.C. Uapdhyay, Principal Scientist, Directorate of Mushroom Research, Chambaghat, Solan (H.P.) – 173213	-	Member Secretary

(c) Quinquennial Review Team

1.	Prof. A.K. Bakshi, Vice Chancellor, Sardar Vallabh Bhai Patel University of Agriculture & Technology, Modipuram, Meerut – 250110 (U.P.).	-	Chairman
2.	Dr. R. P. Singh, F/61, Alliance Kingston Estate, Rudarpur – 263153 (Uttarakhand)	-	Member

3.	Dr. R.N. Verma, Former Director (NRC on Mushroom), "Ashirvad", Rabindra Nagar Phase-II, Tagore Hill Road, Morabad University PO, Ranchi - 834 008, Jharkhand. Phone:0651-2250321	-	Member
4.	Dr. Adwaita Kumar Patra, Retired Professor OUA&T, M.B.47, Badagad, Brit Colony, Bhubaneswar – 751018. Cell:09439175743	-	Member
5.	Dr. S. Edison, Former Director, CTCRI, Trivandrum, Sreenidhi, T.C. No.13/550, Kesavadesapuram, Pottam, P.O. Thiruvananthapuram-695004 (Kerala)	-	Member
6.	Dr. B. Vijay, Principal Scientist, Directorate of Mushroom Research, Chambaghat, Solan (H.P.) – 173213.	-	Member Secretary

Fig. 1. Prof. A.K. Bakshi, Chairman, QRT interacting with scientists of AICRP and DMR

Fig. 2. Prof. A.K. Bakshi, Chairman and other QRT members visiting mushroom growing facilities of DMR

(d) Institute Research Council (IRC)

Two meetings of Institute Research Committee (IRC) were held on 19.04.2010, 12.05.2010, and attended by all the Scientists under the Chairmanship of Dr. Manjit Singh, Director, DMR, Solan.

(e) Core Committee

1.	Dr. Manjit Singh	-	Chairman
2.	Sh. K.K. Sood	-	AO
3.	Sh. Jiwan Lal	-	AFACO
4.	Sh. Rishi Ram	-	AAO
5.	Sh. R.K. Bhatnagar	-	Asstt.
6.	Sh. Rajinder Sharma	-	Asstt.
7.	Sh. Bhim Singh	-	Asstt.
8.	Sh. Dharam Dass	-	LDC

During the year six meetings were held on 20.01.2010, 25.03.2010, 24.05.2010, 21.08.2010, 27.09.2010 and 20.11.2010.

(f) Institute Joint Staff Council (IJSC)

Office Side

1. Dr.B. Vijay, Principal Scientist
2. Dr.V.P. Sharma, Principal Scientist
3. Dr.O.P. Ahlawat, Principal Scientist
4. Sh.Jiwan Lal, AFACO
5. Sh.Rishi Ram, AAO

Staff Side

1. Sh.R.K. Bhatnagar, Member CJSC
2. Sh.L.R. Rana, Secretary IJSC
3. Sh.Bhim Singh, Asstt.
4. Sh.Gian Chand, T-4
5. Sh.Tej Ram, SSS
6. Sh.Ajeet Kumar, SSS

During the year three meetings were held at this Directorate on 25.02.2010, 09.07.2010 and 01.12.2010.

(g) Grievance Cell

1. Dr.R.C. Upadhyay, Principal Scientist	-	Chairman
2. Dr.Satish Kumar, Sr.Scientist	-	Member

3. Administrative Officer	-	Member
4. Sh.Jiwan Lal, AFACO	-	Member
5. Sh.Rajinder Sharma	-	Member
6. Sh.Guler Singh, T-2	-	Member
7. Sh.Raj Kumar, SSG-II	-	Member

Due to non-receipt of any grievance, no meeting was held.

(h) Consultancy Processing Cell (CPC)

Three meetings of Consultancy Processing Cell (CPC) were held on 12.02.2010, 09.12.2010 22.01.2011 and 04.03.2011

(i) Complaint Committee at Institute for prevention of sexual harassement of women employees

1. Smt. Reeta Bhatia	-	Chairman
2. Administrative Officer	-	Member
3. Mrs. Shailja Verma	-	Member
4. Mrs. Shashi Poonam	-	Member
5. Mrs. Sunila Thakur	-	Member Secretary

Meeting of Women Complaint Committee

i) First Quarter meeting held on 15.03.2010

ii) Second quarter meeting held on 18.06.2010

iii) Third quarter meeting held on 22.09.2010

iv) Fourth quarter meeting held on 28.12.2010

(j) Rajbhasa Implementation Committee (Hindi Committee)

राजभाषा कार्यान्वयन समिति (हिन्दी समिति):

डा. मनजीत सिंह, निदेशक	–	अध्यक्ष
डा. आर.सी. उपाध्याय, प्रधान वैज्ञानिक	–	सदस्य
डा. के. मणिकंडन, वैज्ञानिक	–	सदस्य
श्री के.के.सूद, प्रशासनिक अधिकारी	–	सदस्य
श्री ऋषि राम, स0प्र0अ0/प्रभारी राजभाषा कार्यान्वयन	–	सदस्य

श्रीमती रीता, तकनीकी अधिकारी	–	सदस्या
श्रीमती सुनीला ठाकुर, आशुलिपिक	–	सदस्या
श्री दीप कुमार ठाकुर, आशुलिपिक	–	सदस्य सचिव

राजभाषा कार्यान्वयन समिति द्वारा वर्ष 2010–11 के दौरान किये गए कार्यों का संक्षिप्त विवरण

भारत सरकार की राजभाषा नीति के कार्यान्वयन को सुनिश्चित करने तथा निदेशालय द्वारा संपादित किये जाने वाले कामकाज में हिन्दी का प्रयोग सुनिश्चित करने के उद्देश्य से निदेशालय में राजभाषा कार्यान्वयन समिति का गठन किया गया है। राजभाषा कार्यान्वयन के लिए निदेशालय में अलग से कोई अधिकारी व कर्मचारी न होने के बावजूद राजभाषा कार्यान्वयन समिति द्वारा किए गये प्रयासों के फलस्वरूप निदेशालय में हिन्दी के कामकाज व प्रचार–प्रसार में अपेक्षित सफलता प्राप्त हुई है। निदेशालय द्वारा वर्ष 2010–11 के दौरान किये गये कार्यों का संक्षिप्त विवरण निम्नानुसार हैः–

राजभाषा वार्षिक कार्यक्रम पर कार्यान्वयन

राजभाषा विभाग, गृह मंत्रालय, भारत सरकार द्वारा जारी राजभाषा वार्षिक कार्यक्रम पर निदेशालय की राजभाषा कार्यान्वयन समिति की त्रैमासिक बैठकों में चर्चा हुई तथा दिए गए दिशा–निर्देशों के अनुरूप लिए गए निर्णयों के अनुसार कार्रवाई की गई तथा निदेशालय के सभी अधिकारियों व कर्मचारियों को वार्षिक कार्यक्रम के अनुसार निर्धारित लक्ष्य प्राप्त करने हेतु पत्राचार किया गया।

राजभाषा विभाग, नई दिल्ली एवं भारतीय कृषि अनुसंधान परिषद्, नई दिल्ली से प्राप्त पत्रों/परिपत्रों पर कार्रवाई

इस अवधि में राजभाषा कार्यान्वयन सम्बन्धी नवीनतम निर्देशों/नियमों से सम्बन्धित विभिन्न प्रकार के पत्र/परिपत्र आदि राजभाषा विभाग, भारतीय कृषि अनुसंधान परिषद से प्राप्त हुए जिन पर कार्रवाई वांछित थी, के ऊपर कार्रवाई की गई तथा उन्हें सभी संबंधित अधिकारियों व कर्मचारियों को उनकी जानकारी व आवश्यक कार्रवाई हेतु परिचालित किया गया।

तिमाही हिन्दी प्रगति रिपोर्ट का संकलन तथा समीक्षा

निदेशालय में राजभाषा कार्यान्वयन सम्बन्धी प्रगति के आँकड़े प्राप्त कर जारी त्रैमासिक रिपोर्ट प्रोफार्मा में सभी आँकड़ों को संकलित कर निदेशालय की समेकित हिन्दी प्रगति रिपोर्ट तैयार की गई। इस समेकित रिपोर्ट को भारतीय कृषि अनुसंधान परिषद को भेजा गया। इस रिपोर्ट की समीक्षा की गई तथा पाई गई कमियों को इंगित कर दूर करने के लिए सभी अधिकारियों व कर्मचारियों को प्रेषित किया गया।

हिन्दी प्रोत्साहन योजना का कार्यान्वयन

राजभाषा विभाग द्वारा जारी निर्देशों के अनुरूप निदेशालय में सरकारी कामकाज मूल रूप में हिन्दी में करने के लिए प्रोत्साहन योजना सभी अधिकारियों व कर्मचारियों के लिए लागू की है। पूरे वर्ष में किए गए कार्यों को मध्य नजर रखते हुए एक मूल्यांकन समिति का गठन किया जाता है जो फाईलों व अन्य कार्यों का अवलोकन कर प्रथम, द्वितीय व तृतीय पुरस्कारों का निर्णय करती है।

त्रैमासिक बैठकों का आयोजन

राजभाषा कार्यान्वयन समिति की त्रैमासिक बैठकों का नियमित आयोजन किया गया। बैठकों में राजभाषा वार्षिक कार्यक्रम में निर्धारित किए गए लक्ष्यों को प्राप्त करने, समय–समय पर राजभाषा विभाग एवं भारतीय कृषि अनुसंधान परिषद् से प्राप्त निर्देशों/आदेशों के अनुपालन पर चर्चा की गई तथा इन बैठकों में लिए गए निर्णयों को लागू करने के लिए कार्रवाई की गई।

त्रैमासिक राजभाषा कार्यशालाओं का आयोजन

निदेशालय में त्रैमासिक राजभाषा कार्यशालाओं का नियमित आयोजन किया गया। इन कार्यशालाओं में हिन्दी में कार्य करने में आ रही बाधाओं पर चर्चा की गई तथा उनका निराकरण करने के लिए उपाए सुझाए गए।

निदेशालय के सभी अधिकारियों व कर्मचारियों के लिए सभी प्रकार के प्रपत्र द्विभाषी रूप में तैयार किए गए व सभी के कंप्यूटरों पर डाउनलोड किए गए ताकि वे दिन–प्रतिदिन कार्यालय प्रयोग में इन प्रपत्रों को प्रयोग में लाएं।

हिन्दी सप्ताह का आयोजन

14–25 सितम्बर, 2010 तक 'हिन्दी सप्ताह' के दौरान हिन्दी में आयोजित प्रतियोगिताओं व वर्ष (अक्टूबर, 2009 से 13 सितम्बर, 2010) में सर्वाधिक कार्य करने वाले अधिकारियों/कर्मचारियों के दिनांक 25.09.2010 को नकद पुरस्कार दिए गए जिसका विवरण निम्नलिखित हैः–

1. श्रुतलेखन प्रतियोगिता (DICTATION) (कुल 7 प्रतिभागी)

प्रथम – श्री दीप कुमार, आशुलिपिक (ग्रेड–III)

द्वितीय – श्रीमती शशी पूनम, निम्न श्रेणी लिपिक

तृतीय – श्री ऋषि राम, सहायक प्रषासनिक अधिकारी

2. सुलेख प्रतियोगिता (सुन्दर लिखाई) (कुल 26 प्रतिभागी)

प्रथम – श्रीमती सुनीला ठाकुर, निजी सहायक

द्वितीय – श्री दीपक शर्मा, कम्प्यूटर ऑपरेटर

तृतीय – डा0 गोरक्ष चिमाजी वाकचौरे, वैज्ञानिक

कनसोलेशन पुरस्कार : श्री अर्जुन दास, संदेशवाहक

3. निबंध प्रतियोगिता– (कुल 4 प्रतिभागी) (विषयः समाज में नैतिक मूल्यों का गिरता स्तर)

प्रथम – श्री दीप कुमार, आशुलिपिक (ग्रेड–III)

द्वितीय – श्री लेख राज राणा, तकनीकी सहायक (टी–3)

4. टिप्पणी प्रतियोगिता – (कुल 5 प्रतिभागी) (विषयः निजी सचिव से प्राप्त कम्प्यूटर की खरीद के लिए भण्डार अधिकारी के पास प्राप्त प्रस्ताव पर टिप्पणी लिखना)

प्रथम – श्री दीप कुमार, आशुलिपिक (ग्रेड–III)

द्वितीय – श्रीमती शशी पूनम, निम्न श्रेणी लिपिक

तृतीय – श्रीमती शैलजा वर्मा, तकनीकी अधिकारी(टी–6)

5. सामान्य व तकनीकी ज्ञान प्रतियोगिता – (6 प्रतिभागी)

प्रथम – श्री जीत राम, तकनीकी सहायक(टी–2)

द्वितीय – श्री गुलेर सिंह(टी–2)

तृतीय – श्री परमानंद(टी–3)

6. कम्प्यूटर पर टंकण प्रतियोगिता (4 प्रतिभागी)

प्रथम – श्रीमती शशी पूनम

द्वितीय – श्री रोशन लाल

चित्र–3. श्री रोशन लाल कम्प्यूटर पर टंकण प्रतियोगिता में द्वितीय पुरस्कार प्राप्त करते हुए

7. पत्र लेखन प्रतियोगिता (5 प्रतिभागी) (विषयः साईकिल की खरीद के लिए अग्रिम के लिए आवदेन पत्र)

प्रथम – श्री अर्जुन दास, संदेशवाहक

द्वितीय – श्री विनय शर्मा, संदेशवाहक

तृतीय – श्रीमती मीरा देवी, प्रयोगशाला परिचर

8. वैज्ञानिक उपलब्धियां लिखना – (7 प्रतिभागी)

यह प्रतियोगिता वैज्ञानिक के लिए थी जिसका विषय था निदेशालय की पिछले एक साल की वैज्ञानिक उपलब्धियां लिखना(सितम्बर, 2009 से अगस्त, 2010)।

प्रथम – डा. सतीश कुमार, वरिष्ठ वैज्ञानिक

द्वितीय – डा. आर.सी. उपाध्याय, प्रधान वैज्ञानिक

तृतीय – डा. गोरक्ष चिमाजी वाकचौरे, वैज्ञानिक

कंसोलेशन पुरस्कार – डा. के. मणीकंडन, वैज्ञानिक

9. क्वूज प्रतियोगिता– इस प्रतियोगिता में 34 प्रतिभागियों ने भाग लिया। इसमें शब्द अनुवाद, फोटो दिखाकार फोटो को पहचानना, मशरूम के बारे में प्रश्न, वैज्ञानिक व गैर वैज्ञानिक, खेलों संबंधी जानकारी, नवीनतम जानकारी इत्यादि संबंधी जानकारी प्रश्न पुछे गए।

सभी 34 प्रतिभागियों को सही उत्तर देने पर विजेताओं को नकद पुरस्कार दिए गए।

भारतीय कृषि अनुसंधान परिषद, नई दिल्ली के पत्र संख्या 1(13)/96–हिन्दी दिनांक 11 मई, 2001 के अनुसार सरकारी कामकाज मूल रूप से हिन्दी में करने के लिये प्रोत्साहन योजना के तहत दिये गये पुरस्कार

1. प्रथम पुरस्कार (2 पुरस्कार प्रत्येक 800/– रूपये)

1) श्री दीप कुमार, आशुलिपिक (ग्रेड–III)

2) श्रीमती शशी पूनम, निम्न श्रेणी लिपिक

2. द्वितीय पुरस्कार (3 पुरस्कार प्रत्येक 400/– रूपये)

1) श्री भीम सिंह, सहायक

2) श्री एन.पी. नेगी, उच्च श्रेणी लिपिक

3) श्रीमती सुनीला ठाकुर, निजी सहायक

3. तृतीय पुरस्कार (5 पुरस्कार प्रत्येक 300/– रूपये)

1) श्रीमती शैलजा वर्मा, तकनीकी अधिकारी

2) श्री तुलसी दास, उच्च श्रेणी लिपिक

3) श्री ऋषि राम, सहायक प्र.अ.

4) श्री रोशन लाल नेगी, निम्न श्रेणी लिपिक

5) श्री धर्म दास, निम्न श्रेणी लिपिक

इन सबके फलस्वरूप निदेशालय के वैज्ञानिक/अधिकारियों/कर्मचारियों में हिन्दी में कार्य करने की प्रवृत्ति बढ़ी है और वर्तमान में काफी प्रशासनिक कामकाज हिन्दी में संपादित हो रहा है। इसमें निदेशालय के वैज्ञानिकों, अधिकारियों व कर्मचारियों का सतत् सहयोग प्राप्त हुआ है जिसके परिणामस्वरूप निदेशालय लक्ष्य को प्राप्त करने की ओर अग्रसर हो रहे हैं।

निदेशालय की वार्षिक हिन्दी प्रगति संबंधी मुख्य गतिविधियाँ एवं उपलब्धियाँ

राजभाषा कार्यान्वयन समिति की प्रमुख–प्रमुख गतिविधियों और उपलब्धियों का सार–गर्भित संक्षिप्त–विवरण वार्षिक हिन्दी प्रगति रिपोर्ट के रूप में प्रस्तुत किया जाता है।

1. निदेशालय के 80 प्रतिशत से अधिक कार्मिक हिन्दी में प्रवीणता/कार्यसाधक ज्ञान प्राप्त है इसलिए यह निदेशालय राजभाशा नियम 10(4) के अंतर्गत भारत सरकार के गजट में हिन्दी कार्यालय के रूप में अधिसूचित किया जा चुका है।

2. दिनांक 03.05.2010, 09.08.2010 व 21.10.2010 को राजभाषा कार्यान्वयन समिति की बैठकें संपन्न हुई। सभी बैठकों की कार्यसूची वार्षिक कार्यान्वयन की अपेक्षाओं के अनुसार एवं अध्यक्ष महोदय, राजभाषा कार्यान्वयन समिति के अनुमोदन के बाद ही तय की गई।

3. दिनांक 12.02.2010, 05.03.2010, 01.05.2010, 20.05.2010, 25.09.2010 व 18.12.2010 को राजभाषा कार्याशालाओं को आयोजन किया गया जिसमें निदेशालय के सभी अधिकारियों व कर्मचारियों ने स्वेच्छा से भाग लेकर कार्यशालाओं के लक्ष्यों को सफलतापूर्वक प्राप्त किया।

4. हिन्दी में प्राप्त या हिन्दी में हस्ताक्षरित सभी पत्रों में से जिन पत्रों का उत्तर देना अपेक्षित समझा गया, उन पत्रों का उत्तर केवल हिन्दी में अथवा हिन्दी–अंग्रेजी द्विभाषीय रूप में दिया गया।

5. निदेशालय की अधिकतर बैठकों को कार्यवृत्त हिन्दी में तैयार किए गए।

6. राजभाषा अधिनियम, 1963 की धारा 3(3) तथा अन्य नियमों की अनुपालना के संदर्भ में निदेशालय के प्रत्येक अधिकारी व कर्मचारी को समय–समय पर कार्यालय आदेश जारी किए गए व इनकी शत–प्रतिशत अनुपालन सुनिश्चित करवाने के प्रयास किए जा रहे है।

7. हिन्दी पत्राचार के निर्धारित लक्ष्यों को प्राप्त करने की दिशा में सतत्–प्रयास जारी है।

8. सभी 46 मानक फॉर्मों को द्विभाषी रूप में तैयार कर लिया गया है तथा सतत् कोशिशें की जा रही है की सभी कार्मिक इन्हें हिन्दी में ही भरें।

9. निदेशालय के सभी 30 कम्पयूटरों में हिन्दी सॉफटवेयर को डाउनलोड किया गया है। इससे कम्पयूटर पर काम करने वाले प्रत्येक अधिकारी व कर्मचारी को अपनी इच्छानुसार हिन्दी में अथवा हिन्दी और अंग्रेजी दोनों में किसी भी भाषा में एक साथ काम कर सकते है।

10. निदेशालय के सभी अधिकारियों का हिन्दी की जानकारी संबंधी रोस्टर तैयार किया गया है।

11. निदेशालय के सभी साईन बोर्ड, सूचना बोर्ड, नाम पट्ट व अन्य इसी प्रकार के बोर्ड द्विभाषी रूप में तैयार करवाए गए हैं।

12. निदेशालय के प्रशिक्षण कार्यक्रमों के लिए प्रशिक्षण सार–संग्रह(ट्रेनिंग कम्पेडियम) हिन्दी व अंग्रेजी दोनो भाषाओं में उपलब्ध है।

13. कोड मैनुअलों और अन्य कार्यविधि साहित्य हिन्दी में उपलब्ध है।

14. निदेशालय के अधिकारियों तथा कर्मचाारियों के हिन्दी शब्द ज्ञान को बढ़ाने के उद्देश्य से पुस्तकालय में श्यामपट्ट (ब्लैक बोर्ड) पर तथा ई–मेल के माध्यम से कम्पयूटर पर 'आज का शब्द' शीर्शक के अन्तर्गत प्रतिदिन हिन्दी का एक शब्द उसके अंग्रेजी समानार्थ के साथ लिखा जाता है ताकि अधिकारियों व कर्मचारियों के शब्द ज्ञान में वृद्धि हो सके।

15. निदेशालय में प्रत्येक वर्ष की भांति इस वर्ष भी मशरूम मेले का आयोजन 10 सितम्बर, 2010 को आयोजित किया गया। इस अवसर पर मुख्य पंडाल के सभी चित्रों के शीर्षक, ग्राफ, हिस्टोग्राफ आदि हिन्दी में प्रदर्शित किए गए। मल्टीमीडिया के माध्यम से मषरूम संबंधी जानकारी आकर्षक ढंग से प्रस्तुत की गई तथा किसानों, छात्रों व अन्य अंगतुकों को मशरूम साहित्य हिन्दी में उपलब्ध कराया गया।

16. हिन्दी पुस्तकों की खरीद के लिए एक समिति बनाई गई है जो हिन्दी पुस्तकालय के लिए पुस्तकें खरीदने की सिफारिश करती है। पुस्तकालय में प्रत्येक वर्ष राजभाषा विभाग द्वारा निर्धारित लक्ष्य के अनुसार पुस्तकें खरीदने का प्रयास किया जा रहा है। निदेशालय की पुस्तकालय में हिन्दी में उपलब्ध सभी प्रकाशनों की सूची में निदेशालय की वेबसाइट पर उपलब्ध कराई गई है।

17. दूरदर्शन तथा आकाशवाणी पर भी निदेशालय के वैज्ञानिकों व तकनीकी अधिकारियों की मशरूम विषय पर हिन्दी में वार्ताएं प्रसारित होती रहती है जिनसे मशरूम उत्पादकों की समस्याओं का समाधान होता है।

18. इसके अतिरिक्त खुम्ब संबंधी प्रौद्योगिकियों पर 8 फोल्डरों का नवीनीकरण कर हिन्दी में पुनः प्रकाशित किए गए।

19. इसके अतिरिक्त डा. मनजीत सिंह, निदेशक एवं अध्यक्ष, राजभाषा कार्यान्वयन समिति के सतत् निजी–सहयोग और मार्गदर्शन के तहत हिन्दी की तिमाही बैठकों व कार्याशालाओं का समय पर आयोजन व निदेशालय में कार्यरत सभी अधिकारियों व कर्मचारियों के आपसी सहयोग और मेलमिलाप के साथ राजभाषा कार्यान्वयन संबंधी गतिविधियां निरंतर प्रगति की ओर अग्रसर हो रही है।

7. WINTER/SUMMER SCHOOL/SEMINARS/ SYMPOSIA/ CONFERENCES ATTENDED

Name of the Symposium/ Workshop	Held at	From — To	Attended by
Knowledge Discovery in Databases: Data, Information and Knowledge	ISI, Kolkatta (W.B.)	11th -15th Jan., 2010	Dr. Maniknadan
Production of quality seeds and plant material-Health management in Horticultural crops	NASC, Complex, New Delhi	11th -14th March, 2010	Dr. R.C. Upadhyay Dr.V.P. Sharma Sh Mahantesh Shirur
IT based Decision Support System for GIS for Rural Livelihood Assessment	NIRD, Hyderabad(A.P.)	11th -20th March, 2010	Dr. Maniknadan
Creative writing on agriculture	IIMC, New Delhi	15th -19th March, 2010	Dr. Satish kumar
ICAR-Zonal Technology Management & Business Planning and Development Meeting-cum-Workshop 2009-10 North Zone	IARI, New Delhi	19th -20th March, 2010	Dr. V.P.Sharma
Horticultural biodiversity for livelihood, economic development and health care	University of Horticultural Sciences, Bagalcot, Bangalore Campus, Karnataka	28th - 30th May, 2010	Dr. R.C. Upadhyay Dr. B. Vijay Dr. V.P. Sharma Dr. O.P. Ahlawat Dr. Satish kumar Dr.G. C. Wakchaure
XII AICRP workshop	Indian Institute of Horticultural Research, Bangalore, Karnataka	31st May -1st June, 2010	Dr. R.C. Upadhyay Dr. B. Vijay Dr. V.P. Sharma Dr. O.P. Ahlawat Dr. Satish kumar Dr.G. C. Wakchaure
Brain Storming session on Mushroom Research and development in India-Current scenario and future needs	Indian Institute of Horticultural Research, Bangalore, Karnataka	2nd June, 2010	Dr. R.C.Upadhyay Dr. B. Vijay Dr. V.P.Sharma Dr. O.P. Ahlawat Dr. Satish kumar Dr.G. C. Wakchaure
Workshop on software on NISM-GP	NBPGR Regional Station, Phagli, Shimla (H.P.)	3rd July 2010.	Dr. Shwet Kamal
Biotechnology Meet	NASC complex, New Delhi	26-27th July 2010.	Dr. Shwet Kamal
Geospatial Knowledge Management for sustainable livelihood security	NAARM, Hyderabad (A.P.)	17th -27th Aug., 2010	Dr. Maniknadan
Diversification for Sustaining profitability in Mushroom Production	Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni (H.P.)	26th - 27th Nov., 2010	Dr. R.C. Upadhyay Dr. B. Vijay Dr. V.P. Sharma Dr. Satish kumar Dr. Shwet Kamal Dr.G. C. Wakchaure Dr. Maniknadan
Workshop on IPR and Bio-Technology	Hotel Holiday Home, Shimla (H.P.)	13th Dec. , 2010	Dr. V.P. Sharma Dr. Satish kumar
International Training on Marker Assisted Selection	INRA, Bordeaux, France	30th Aug. - 26th Nov., 2010	Dr. O.P. Ahlawat

8. DISTINGUISHED VISITORS

- Sh. C. Sazo, Parliamentary Secretary, Social Welfare and Women Development, Nagaland visited DMR, Solan on 30.04.2010.
- Md. Mofazzal Hossain, Deputy Secretary, Ministry of Agriculture, Govt. of Bangladesh, Dhaka and Saleh Ahmed, Project Director, Mushroom Development Project, Dhaka, Bangladesh and nine officers of Horticulture Department of Bangladesh visited DMR during their study visit to India from 3rd-14th May, 2010.
- Dr. R.T. Patil, Director, CIPHET, Ludhiana visited DMR on 08.05.2010 for collaborative project on PHT.
- Dr. H.P. Singh, Deputy Director General (Hort.), ICAR, KAB-II, New Delhi visited Directorate on 10.9.2010.
- Prof. Mohammad M. Anwer, Director on Seed Spices, Ajmer, Rajasthan visited Directorate on 10.9.2010.
- Shri Honchun Ngandam, Minister of Horticulture, Govt of Arunachal Pradesh visited Directorate on 18.11.2010.
- A team of IAS Probationers visited DMR, Solan on 20.12.2010 under protocol of District Administration.

9. PERSONNEL AND FACILITIES

SANCTIONED STRENGTH OF DMR, SOLAN

SN	Category	Sanctioned	Filled	Vacant
1	RMP	01	01	—
2	SCIENTIFIC	16	11	5
3	TECHNICAL	14	13	1
4	ADMINISTRATIVE	14	16	1
5	SKILLED SUPPORT STAFF	10	09	2
	G.Total	55	48	9

Due to revised Cadre Strength of Administrative Staff two posts of LDC is excess which will be adjusted in near future.

STAFF IN POSITION DURING 2010

SN	Name of employee	Designation
	Scientific Staff	
1	Dr.Manjit Singh	Director
2	Dr.R.C. Upadhyay	Principal Scientist
3	Dr.B. Vijay	Principal Scientist
4	Dr.V.P. Sharma	Principal Scientist
5.	Dr.O.P. Ahlawat	Principal Scientist
6	Dr.Satish Kumar	Senior. Scientist
7	Dr.Shwet Kamal	Senior Scientist
8	Sh.Yogesh Gautam	Scientist (SS)
9	Dr.Goraksha Chimaji Wakchaure	Scientist
10	Sh.Mahentesh Shirur	Scientist
11	Dr.K. Manikandan	Scientist
	Administrative Staff	
1	Sh.Raj Kumar	AO
2	Sh.Jiwan Lal	AFAO
3	Sh.Rishi Ram	AAO
4	Sh.Surjit Singh	PS
5	Sh.R.K. Bhatnagar	Assistant
6	Sh.Rajinder Sharma	Assistant
7	Sh.Bhim Singh	Assistant
8	Sh.T.D. Sharma	Assistant
9	Smt.Sunila Thakur	PA
10	Sh.Deep Kumar Thakur	Steno Gr.III
11	Sh.N.P. Negi	UDC
12	Sh.Satinder Thakur	UDC

SN	Name of employee	Designation
13	Sh.Dharam Dass	LDC
14	Smt.Shashi Poonam	LDC
15	Sh.Roshan Lal Negi	LDC
16	Sh.Sanjeev Sharma	LDC
	Technical Staff	
1	Sh.Sunil Verma	TO (T-6)
2	Smt.Reeta	TO (T-6)
3	Smt.Shailja Verma	TO (T-6)
4	Sh.Jia Lal	TO (T-5)
5	Sh.Gian Chand	T-4
6	Sh.Lekh Raj Rana	T-1-3
7	Sh.Ram Swaroop	T-3
8	Sh.Parmanand	T-1-3
9	Sh.Dala Ram	Driver T-3
10	Sh.Ram Lal	Driver T-3
11	Sh.Jeet Ram	T-2
12.	Sh.Guler Singh Rana	Electrician T-2
13	Sh.Deepak Sharma	T-3
	Skilled Supporting Staff	
1	Smt.Dayawanti	SSS
2	Sh.Naresh Kumar	SSS
3	Sh.Nika Ram	SSS
4	Sh.Tej Ram	SSS
5	Smt.Meera Devi	SSS
6	Sh.Raj Kumar	SSS
7	Sh.Ajeet Kumar	SSS
8	Sh.Arjun Dass	SSS
9	Sh.Vinay Sharma	SSS

Promotions

1. Sh. Deepak Sharma, Electronic-cum-Computer Operator (T-2) promoted as Electronic-cum-Computer Operator (T-3) w.e.f. 27.10.2009.
2. Sh. Ram Swaroop, Technical Assistant (T-2) promoted as Technical Assistant (T-3) w.e.f. 03.04.2010.
3. Sh. Surjit Singh, PA promoted as Private Secretary w.e.f. 04.09.2010 (AN).
4. Smt. Sunila Thakur, Steno (Gr.III) promoted as Personal Assistant w.e.f. 06.09.2010 (FN).
5. Sh. T.D. Sharma, UDC promoted as Assistant w.e.f. 16.11.2010 (AN).

Modified Assured Career Progression (MACP)

1. Sh. R.K. Bhatnagar, Assistant, granted financial upgradation in the pay band of 9300-34800 + GP 4600 w.e.f. 01.09.2008 (FN).
2. Sh. Rajinder Sharma, Assistant, granted financial upgradation in the pay band of 9300-34800 + GP 4600 w.e.f. 01.09.2008 (FN).
3. Sh. Surjit Singh, PA, granted financial upgradation in the pay band of 9300-34800 + GP 4600 w.e.f. 01.09.2008 (FN).
4. Sh. T.D. Sharma, UDC, granted financial upgradation in the pay band of 5200-20200 + GP 2800 w.e.f. 01.09.2008 (FN).
5. Sh. N.P. Negi, UDC, granted financial upgradation in the pay band of 5200-20200 + GP 2800 w.e.f. 01.09.2008 (FN).

Transfers

Sh. Raj Kumar, Administrative Officer has been transferred from DMR, Solan to IARI, New Delhi (relieved on 19.01.2010 AN).

Retirement

Sh. Ram Ditta, Driver (T-3) superannuated from Council's services on 12.08.2010 (AN).

New Appointments

Dr. Shwet Kamal joined at DMR on 16.03.2010 (FN) as Senior Scientist.

Sports

A contigent of 22 men from Directorate of Mushroom Research participated in ICAR Zonal Sports Meet held at Indian Institute of Pulses Research, Kanpur w.e.f. 6th April to 9th April, 2010.

Infrastructural facilities developed

1. Additional Toilets in Hostel Building

Three additional toilets were got constructed through CPWD for providing better facilities to the trainees/farmers/visitors staying in the Training Hostel at DMR, Solan.

2. Providing steps/stair case approach to Ground Floor of TTC Building

The stair case approach to Ground Floor of TTC Building from the Ground floor lawn of main building to the Museum in the ground floor of TTC building.

3. Preparation of Parali hut (Haryana pattern) for seasonal growing of mushrooms

The Parali Hut (Haryana pattern) was got prepared for seasonal growing of mushroom for the demonstration/ exhibition to the trainees/visitors.

4. Solar Water Heating System

The facilities of Solar water heating system in Mushroom Growing Houses, Laboratory Building and Hostel/Guest House building were developed.

5. Re-construction of Shed for research work of specialty mushrooms

The Re-construction of Shed (48′ x 16′ x8′) out of old dismantled material was got constructed for research work on Specialty mushrooms.

6. Re-construction of Composting yard

The Re-construction of composting yard out of old dismantled material for the preparation of substrate of oyster mushrooms was got constructed.