

RESEARCH ACHIEVEMENTS April 2022 to March 2023

Germplasm collection

Fungal surveys were undertaken in various parts of Himachal Pradesh during 2022-23. As a result 232 collections were made. Out of these 200 were identified up to genus level and approximately 150 specimens up to species level. Among these specimens some of interesting specimens namely *Bovista colorata*, *Coprinellus micaceus*, *Cruentomyces viscidocruenta*, *Dacomyces lacrymalis*, *Dacryopinax spathularia*, *Hygrophorus eburneus*, *Laccaria amythstina*, *Laccaria laccata*, *Laccaria torsilis*, *Scleroderma citrinum*, *Singerocybe humilis* etc.

Crop Improvement

- 175 Strains of *Agaricus bisporus* were evaluated for presence/absence of disease resistance gene. A total of 41 strains showed the presence of NBS sites of disease resistance gene. A total of 5 strains were used to study the gene expression analysis for up/down regulation of disease resistance genes using RT-PCR and three strains showed up regulation (Max 22 fold) in the cropping time. A total of 24 strains were selected on the basis of yield & morphological diversity with a maximum yield of 19.82%. A total of 31 strains are found highly susceptible whereas rest of 7 strains showed variable degree of resistance against wet bubble disease.
- 32 SSIs were isolated from *Flammulina* mushroom for hybrid development.
- A total of 110 strains of button mushroom are evaluated for wet bubble disease resistance. Besides that, a total eight brown strains of button mushroom evaluated for suitability assessment for portable mushroom. Strain 159 & 175 were selected on the basis of intense colour and higher fruit body weight.
- Based on sequencing results of bacterial 16s rDNA in 16 isolates, *Bacillus subtilis*, *B. rugosus*, *B. thuringiensis*, *Bacillus velezensis*, *Paenibacillus polymyxa*, *Bacillus cereus*, *Alcaligenes faecalis*, *Acinetobacter johnsonii* and *Pseudomonas* sp. were identified as dominant bacterial species in button mushroom compost.
- *Bacillus subtilis*, *Alcaligenes faecalis* and *Pseudomonas* sp were identified as dominant bacterial species in button mushroom casing soil.
- A total of five RNA extraction protocols were evaluated for RNA extraction of button and oyster mushroom. Three methods worked with Button mushroom.

Crop Production

- Compost formulations using mustard straw and wheat straw were evaluated on large scale on 2500 kg compost and results showed 15% BE in mustard straw in two flushes against wheat straw (10%).

- Oyster mushroom (DMRP-205 Pink Oyster) cultivation in SMS of Paddy Straw Mushroom indicate the BE of 26.3% while no spawn run observed for the Florida (P-136) strain.
- Cultivation technique for Turkey Tail mushroom (*Trametes versicolor*) using wheat straw was standardized with a total yield of 7.50 percent.
- Impact of 8 types of casing material on the yield of milky mushroom indicated maximum yield in the garden soil + sand casing material prepared by tunnel pasteurization, autoclave and formalin method as well as in formalin treated FYM + Sand casing. Lowest yield was observed in the coir pith casing material.
- Conducted cultivation trial of Sparasis mushroom on different substrates.
- Successfully cultivated *Pleurotus florida* on lemon grass.
- King Oyster and Oyster mushrooms were successfully cultivated on ginger leaves and turmeric leaves based substrate. Analysis regarding translocation of flavour components is being done.
- Three formulations were developed for button mushroom compost preparation using wheat, paddy and mustard straw using cotton seed cake instead of chicken manure. Quality compost is prepared and mustard straw based compost is giving superior yield.
- A preliminary economic analysis of ZEPT Adopter button mushroom growers from Bihar found the net returns as Rs. 65.81, Rs 80.50, and Rs. 143.60 / bag/ cycle of button mushroom for small, medium and large unit growers. The overall BCR was 2.91 for all the ZEPT adopter growers.
- Substrate formulations were developed on wheat straw, paddy straw and mustard straw without using chicken manure. The experiment was done on 250 bags of 10 kg each and mustard straw based compost was found to be the best yielder with 19.34% B.E.
- Five different strains of *Grifola frondosa* (DMRX969, DMRX-951, DMRX777, DMRO-218, DMRO94) were successfully cultivated on five different substrates (Saw dust+wheat bran, saw dust+rice bran, wheat straw+wheat bran, saw dust+rice bran+wheat bran, wheat straw +rice bran).

Crop Protection

- Higher activities of β -glucosidase and endoglucanases enzymes were recorded in *Mycogone perniciosa* as compared to Chitinase, Beta-1, 3-glucanase and Xylanase enzymes.
- Bacterial isolate B-16 was identified effective against *M. perniciosa* (Wet Bubble Disease) with growth inhibition of (91.89%) followed by B-14 (77.78%) and B-7 (76.39%).

Postharvest Technology

- Shiitake mushroom based seasoning has been developed.
- Shiitake mushroom supplemented wheat flour was developed and based on sensory analysis shiitake mushroom powder upto 10% in wheat flour was found acceptable.
- New modified design of hybrid solar dryer has been prepared.
- Design of hybrid solar drying chamber has been refined by using solar and air flow simulation technique.

- Sensory analysis of 8 formulations of mixed mushroom soup mix with Hericium mushroom showed that Hericium mushroom combines well with oyster and button mushroom in mixed mushroom soup mix.
- Mushroom supplemented baked tortilla chips have been developed with 10% shiitake mushroom powder incorporation. Mushroom powder supplementation improved protein, fibre, ash and antioxidant activity of the product. The developed tortilla chips showed good sensory acceptability and following nutritional composition; 14.15 % protein, 20.73% fat, 48.85% carbohydrate, 3.30% ash, 1.33 % crude fibre and 438.57 Kcal/100 energy value.
- Copyright of software “Graphic user interface for estimating the freshness of white button mushroom has been granted” Registration Number – SW-15614/2022 dated 13.07.2022.

Economics

- A preliminary economic analysis of Shiitake mushroom growers from Bihar found the overall net returns as Rs. 121.51 / bag/ cycle of Shiitake mushroom growers. The overall BCR was 1.35 from Shiitake cultivation.
- Net return and other economic parameters calculated from button mushroom cultivation using zero energy polytunnel composting method. The net returns are Rs.78.12, Rs.105.00 and Rs.133.80/bag/cycle for small, medium and large units. Similarly, the rate of return of capital was Rs.6.50 on an average.
- Economic and financial ratio analysis of ZEPT growers, long method compost, data collection is under process for Shiitake and Hericium growers.
- The ROVC from ZEPT was higher Rs.120.63, Rs.136.14, Rs.156.54 /bag/crop cycle for small, medium and large growers while from long composting ROVC was Rs.94.23, Rs.97.50, Rs.102.02 1 bag/crop cycle for small, medium and large growers, respectively.
- Data collected from Hericium and Cordyceps growers and preliminary economic and capital budgeting analysis along with constraint analysis was done.

Training programmes conducted

- Online training on mushroom cultivation was organized w.e.f. 11-14 November, 2022 which was attended by 19 participants.
- Mushroom Cultivation training was organized on 17.10.2022 under SC-SP which was attended by 65 participants.
- Economic analysis and data collection for Hericium & Shiitake Mushroom. Economic & ratio analysis of diff. substrates (WS, PS & MS) from Pulkit Industry has been done.
- Imparted three days hands on training programme on cultivation technology of Cordyceps from 27-29th October, 2022.
- Entrepreneurs mushroom cultivation training w.e.f. 14th – 19th November, 2022.
- Under SC-SP component, one day training programme on Mushroom cultivation was organized on 5th December, 2022 at ICAR-DMR, Solan attended by 21 farmers.

- Under SC-SP organized one day training on Mushroom cultivation at Taranji Khera, Sangrur (Punjab) on 9th December, 2022 attended by 100 farmers.
- Organized mushroom cultivation training under NEH on 23.12.2022 at AAU, Jorhat attended by 95 participants.
- Organized mushroom cultivation training for small/marginal farmers/growers w.e.f. 9th – 13th January, 2023 attended by 46 participants from across the country.
- Organized mushroom cultivation training under SC-SP on 16.03.2023 at Sundernagar, Mandi (H.P.) attended by 100 farmers.

Other activities

QRT meeting organized on 16.10.2022 (Hybrid mode), 16 & 17 February, 2023 (Virtual mode) and 14 and 16 March, 2023 (Virtual mode) Swachh Bharat Abhiyan was carried out from 2nd – 16th October, 2022 at ICAR-DMR, Solan and in adopted villages.