SUMMARY

Oyster mushrooms belonging to the genus *Pleurotus* are the third largest cultivated mushrooms in the world. China contributes 88% to the world production whereas India only 0.029%. The members of the genus, widely appreciated for their nutritional, flavor, medicinal and economic values, have ligno-cellulolytic properties and can be grown on a variety of agro-forest wastes. The cultivation technique is simple and well standardized on paddy straw, wheat straw and other region specific substrates such as sawdust, sugarcane bagasse, corn stalk, corn cobs and waste cotton, both in outdoor and indoor conditions. Moreover, it requires very less preparation time, space and investment and has been regarded as a promising income and employment generating enterprise that recycles lignocellulosic wastes by converting them into protein rich food and dietary supplements. Nevertheless, a cost effective production of oyster mushrooms depends mainly on the reliability, availability and cost of substrate ingredients besides optimum environmental conditions (temperature between 10-30°C with relative humidity between 70-90%) for superior mycelial run on the substrate and fruit body formation.

Despite of a favourable climatic condition throughout the year and availability of various ligno-cellulosic agro-forest wastes in enormous amount, oyster mushroom cultivation has not developed as an economically viable proposition in Arunachal Pradesh, the largest state in North-eastern region of India. The two major constrains hindering the cultivation in the state are non-availability of adequate quantity of paddy straw in the open market and lack of a suitable farm practice based on alternate potential substrates. Though paddy is a major crop in the region, yet there is a shortage of straw as substrate because a large proportion of the straw is left unused or burnt in the field itself after harvest due to lack of any prospective use in agricultural, horticultural or dairy related activities in the region.
Therefore, the present study was undertaken with the following objectives:

1. Assessment of yield potential of different species of oyster mushroom (P. sajor-caju, P. sapidus, P. citrinopleatus, P. flabellatus, P. ostreatus and P. florida) and a few locally collected wild species on various ligno-cellulosic agro-forest wastes.
2. To study the effects of temperature and relative humidity on mushroom yield by conducting cultivation trials in different seasons in indoor and outdoor conditions.
3. To study the effect of substrates supplementation with some locally available cheap materials on mushroom yield.
4. Documentation of different pests and diseases occurring during cultivation.
5. Refinement of cultivation practices and improvisation of mushroom house for a location specific farm practice.
6. To work out the economics of cultivation.

Experiments were conducted in AC fitted indoor mushroom house as well as in an improvised outdoor mushroom house constructed out of locally available cheap raw materials. The production capacity of outdoor mushroom house was 700 Kg per cropping cycle. The locally available substrates selected for cultivation were three wild grasses {Saccharum spontaneum, a worldwide weed (coded as G1), Neyraudia reynaudiana (coded as G2) and Imperata cylindrica (coded as G3)}, Wild banana plant (coded as BL), Wild bamboo {Dendrocalamus hamiltonii (coded as BC)}, and Wood shavings (coded as WD). Supplementing material used in the study were locally available cheap plant resources such as Mimosa pudica (a notorious common weed in tropic & sub-tropic forests belonging to Mimosaceae; coded as MP), Finger millet grains (a common agricultural crop mostly grown for brewing local beverages in Arunachal Pradesh; coded as MLT), Spent brewery grains (SBGs) of finger millet besides Urea as inorganic supplementing material.

Substrates were prepared mainly by chemical treatment method using 75 ppm Bavistin (Carbendazim 50% w/p) and 500 ppm formaldehyde solution. Spawning of the substrates was done @3% on wet weight basis by 'layering method' in
polypropylene bag @1 Kg wet substrate. Room temperature, relative humidity and light inside the cropping room was optimally maintained and recorded twice daily during the course of experiment. The total time taken for a complete colonization and fruiting was recorded for each treatment with five replicates.

Harvesting of fruit bodies was done from 3-5 flushes during entire cropping period and the Biological Efficiency (BE) of the substrate (Total Yield of mushroom from all flushes per 100 g dry weight of substrate) was calculated. The fruit body yield in the first flush, number of fruit bodies, their average weight together with size of quality fruit body (average weight of 10 largest fruit bodies) was recorded. Analysis of data was done by t-test, and ANOVA followed by DMRT (p<0.05) using Sigma plot 11.0 (Systat Inc.).

Six wild isolates of *Pleurotus* identified on the basis of macroscopic and microscopic characters as *P. ostreatus*, *P. sajor-caju*, *P. sujarrosulus*, *P. platypus* and *Pleurotus* sp. were raised as pure culture on potato dextrose agar and malt extract agar media and their radial colony growth was measured. *P. ostreatus*, *P. sajor-caju*, *P. sujarrosulus*, successfully grew on different growth media, viz. Malt extract broth, paddy straw and wood shavings in sterilized conical flask and formed small fruiting bodies but none of them could grow successfully on any of the substrates used during outdoor cultivation. Their mycelial growth on the substrate remained confined in small patches exceeding maximally up to 5 cm from the grain spawn even after forty five days of spawning.

Taking into account the yield obtained from cultivation done in different months, the average biological efficiency of PS, G1, G2 and G3 was 87.6, 87.9, 64.8 and 48.1% respectively for four summer species and 103.7, 101.4, 66.2 and 47.6% for two winter species. Among summer species, *P. citrinopleatus*, *P. sajor-caju* and *P. sapidus* gave highest BE on G1 (101.3, 91.8 and 88.5% respectively) slightly higher than that on PS whereas *P. flabellatus* gave highest BE (84.5%) on PS. Among winter species, *P. ostreatus* gave highest BE (110.5%) on G1 whereas *P. florida* on
PS (108.3%). Combination of any two of the above mentioned substrates in 1:1 ratio on dry weight basis gave BE between 70-90% for summer species, the highest being again for *P. citrinopleatus* on PS+G1 (105%) followed by *P. sapidus* (89.8%) and *P. sajor-caju* (88.3%). *P. flabellatus* gave 77.5% BE on this substrate. The average BE of two winter species on this substrate was approx. 100% with *P. ostreatus* giving 105.8% and *P. florida* 95.4%. The BE of PS+G2 was significantly less than PS+G1 for all *Pleurotus* spp. in comparison to PS+G1. It was also less than PS but more than G2.

Combination of PS with MP in 3:1 ratio on dry weight basis gave significantly more BE than PS alone for all summer species, however, it was almost equal for two winter species. The average increase in BE of summer species was approximately 15%. Combination of PS with BC (3:1) or WD or BL (1:1) gave average BE value between 82-92% for summer species and 80-93% for winter species.

Cultivation of four summer species of oyster mushroom was done on PS, G1, G2, G3, PS+G1, PS+G2 and PS+G3 in November, March and May months in outdoor mushroom house. They were also cultivated along with two winter species in January month on these substrates except G3 and PS+G3 in outdoor conditions. The winter species were cultivated on PS, G1, G2, G3, PS+G1, PS+G2 and PS+G3 in November and May months in AC fitted indoor mushroom house. Analysis of data by 3-way ANOVA showed a significant effect of month (period of cultivation), the type of substrate and species of *Pleurotus* on BE, first flush yield, average weight of fruit body and size of quality fruit bodies produced by summer species. The interaction of substrates x *Pleurotus* x month was also significant. The BE and fruit body production in the first flush was highest in November followed by March, January and May. There was a significant variation in winter species also.

In November, the BE of PS+G1, G1 and PS was significantly not different. *P. citrinopleatus* gave higher BE (120-150%) in comparison to other three summer species on PS+G1, G1 and PS. The BE of all four summer species on PS and PS+G2
was next to PS+G1. In March outdoor condition, the yield on PS, G1 and PS+G1 was almost equal but significantly higher than G2, PS+G2, PS+G3 and G3. The BE of *P. citrinopleatus* was significantly more than the other three summer species.

However in May, though PS, G1 and PS+G1 were again having equal BE but among fungi it was *P. sajor-caju* giving more yield than the rest three summer species that were on par with each other.

In January month of cultivation, PS, G1 and PS+G1 again proved to be the best substrates without any significant difference among them. The BE of *P. sajor-caju*, *P. sapidus* and *P. citrinopleatus* was approximately 85-89% and significantly not different from each other. The winter species also gave 83-86% BE and were not significantly different from each other.

All six *Pleurotus* spp. were cultivated in outdoor mushroom house in January month on PS+BC (3:1), PS+WD (1:1) and PS+BL (1:1) with PS as control. The BE of PS and PS+BL was approximately 93% and significantly more than PS+BC and PS+WD (81-84%). Except *P. florida* that gave significantly more yield (BE 96%), all other species were equally yielding with BE ranging between 83-88%.

The effect of supplementation with urea or MLT to PS, G1, G2, PS+BC, PS+WD and PS+BL was studied in January outdoor condition with four *Pleurotus* spp. viz. *P. sapidus*, *P. citrinopleatus*, *P. flabellatus* and *P. florida*.

Supplementation of PS and G1 showed a significant effect on BE whereas it was non-significant in G2. In all the three cases, a significant variation among species of *Pleurotus* was observed. Supplementation with urea was found to be better than MLT, the later failed to increase the BE in comparison to the control. The performance of all four species with SBGs supplementation to PS or G1 was significantly not different from each other. *P. florida* yielded significantly more on PS and G2 due to supplementation with urea than other three species but on G1 it was *P. sapidus* and *P. citrinopleatus*.
Supplementation of PS+BC with urea or MLT gave a significant increase in BE, however, there was not a significant effect of supplementation on BE of PS+WD and PS+BL. In all the three cases, there was a significant difference in BE due to species of *Pleurotus*. The interactive effect was found to be significant only in case of PS+BC but not for other two substrates. The supplementation of PS+BC with urea was better in comparison to MLT. The later was significantly not different from the control. *P. citrinopleatus* gave a higher BE (92%) on urea than the rest three species. On PS+WD, the BE of *P. sapidus, P. flabellatus* and *P. florida* was statistically equal both in case of supplemented or non-supplemented substrates than *P. citrinopleatus*. On the other hand, it was *P. citrinopleatus* that gave significantly more BE on PS+BL with urea supplementation than *P. flabellatus* and *P. florida*. The BE of all these species was more than 100% on urea supplementation.

Various competitor moulds, pathogens and insect pests were identified and documented. The noteworthy competitor moulds and fungal pathogens were *Penicillium* sp., *Mucor* sp., *Trichoderma* sp., *Coprinus* sp., and two species of Myxomycetes. A new insect pest, *Tritoma pallidipes* (Arrow) was recorded for the first time on mature fruit bodies of *Pleurotus* causing serious damages and deterioration of the marketable quality of fruit bodies.

The economics of mushroom production with a 700 kg cropping cycle was also calculated giving very good economic returns.

The new findings of the work includes, (1) Identification of four new potential alternate substrates (*S. spontaneum*, wild banana, *Mimosa pudica* and *D. hamiltonii*) giving BE equal to PS, (2) Identification of another substrate (*N. reynaudiana*) giving BE>70% when mixed with PS, (3) Identification of a new insect pest *Tritoma pallidipes* of *Pleurotus*. 