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Effect of repeated exposure of Auxin (indole 3 acetic acid) in Pleurotus Sajor -caju Mushroom Cultivation: A case study

Renu Garg[1], Usha Singh Gaharwar[2], Seema Gupta[3], Prof. Parveen Garg[4]*

[1,2] Department of Botany, Swami Shraddhanand College, University of Delhi

[3] Department of Chemistry, Swami Shraddhanand College, University of Delhi

[4] Department of Botany, Swami Shraddhanand College, University of Delhi

Abstract - Mushrooms have long been used for medicinal and food purposes. Pleurotus sajor- caju is edible mushroom species. In present study, Pleurotus sajor -caju was cultivated on wheat straw and during its growth various doses of Indole 3 acetic acid (IAA) a plant hormone at 10ppm, 50ppm and 100ppm were sprayed in mushroom substrate. Thereafter its effect on the growth and yield of all three flushes were recorded. Results showed that IAA was able to induce stimulation in growth and ultimately increase in yield is also recorded. Various doses of IAA resulted in increased biomass production from 14% to 30 % with reference to control. This study suggest that exposure of the hormone to substrate can be important tool to increase the production of mushroom and thereby increase nutrition demand can be fulfilled.

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INTRODUCTION

Mushrooms have been reported as good source of nutrition and other health benefits substances. Mushroom possesses several vitamins, minerals and high energy level therefore can be exploited as good food source across the world.

India is known for the commercial production of mainly three species includes *Agaricus bisporus, Volvariella volvacea and Pleurotus*. Several health related benefits (medicinal and nutritional values) (Dunkwal et al., 2007) have been observed in these species. Mushrooms are known to have antioxidant potential, thus mushroom intake may reduce oxidative stress level in body hence mushroom show protective properties also (Adams et al., 1999). Earlier studies reported that plant based food products protect us from many diseases such as cancer, cardiovascular diseases and also plays immunomodulatory role (Halliwell & Gutteridge., 1984).

Pleurotus species which are usually known as oyster mushroom, are mainly edible mushroom and also have commercial importance. *Pleurotus* mushrooms are highly rich in protein minerals and vitamins therefore considered to be healthy source of food (Feeney et al., 2014). It has been taken as functional food due its several advantages i.e. high medicinal value, nutrition substances and good taste and aroma. *Pleurotus* species (Oyster mushrooms) are very important species due to its medicinal, nutritional and commercial advantages and hence it is being cultivated globally (Knop et al., 2015).

Agricultural based countries are facing issue in order to manage the agricultural residue. Oyster cultivation attracted world due its ability to use agricultural residue as substrate to grow thus address the nutritional scarcity on one hand and environmental protection in other hand. More than 900 million tons of agro waste is being produced worldwide such as wheat, paddy and various cereals straw. The cultivation of the *Pleurotus* mushrooms helps in recycling the agricultural wastes and also became an alternative food source to combat with nutritional scarcity globally, especially in developing countries where growing population is major challenge in order to provide nutritional food. Thereafter, utilized substrate rich in protein content can be further used for different purpose includes production of biogases, cattle feed and also as organic fertilizer (Kakon et al., 2012). Low cost production techniques are being employed for the production of the *Pleurotus* species (Jegadeesh et al., 2018). All edible mushroom are reported to be delicious however, *P. sajor-caju* is one of the most cultivated species among all (Zhang et al., 2002). Zadrazil 1980, reported that *pleurotus* can make its colonies in sterilized wheat straw which is pasteurized (60°C-90°C and fermented (55°C, 120 days) since it has high saprophytic colonizing properties. Unsterilized

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residual of plant can also be utilized by the mushroom for their growth (Rangaswami et al., 1975). Mushrooms are reported to contain very low fat content and high protein content commonly 19 to 35% proteins (dry weight based) (Wani et al., 2010). Hence, identification and commercialization of many varieties of *Pleurotus* species has been done. Nonetheless, their medicinal aspect and other benefits are still to be evaluated.

Several plant hormones played promising role in the growth and development of plants (Costacurta & Vanderleyden., 1995). Existing studies reported that indolebutyric acid and 2,4- dichlorophenoxyacetic acid have been found effective in growth of Claviceps purpurea where it has been observed to induce increase in fresh weight as well as dry matter content however, Indole acetic acid only had positive effects in fresh weight while negatively affected dry matter content in (Rerabek., 1970). Agaricus campestris production also reported to increase in protein and biomass content by the application of indole-3-acetic acid (IAA) or kinetin (KIN) (Guha and Banerjee., 1974). Indole-3-acetic acid, kinetin and gibberellic acid have been observed to increase the biomass production in food yeast *Kluyveromyces fragilis* grown on deproteinized whey while protein content of biomass remain unchanged (Paul et al., 1994). Therefore, in this present study we have determined the effect of repeated exposure of indole-3-acetic acid on the total yield of the *P. sajor-caju* grown on wheat straw.

MATERIALS & METHODS

Microorganism/ Pure Culture

Spawn sample of *plurotus sajor caju* was procured from the N ational horticulture research institute, Janakpuri, New Delhi.

Substrate

Fresh Wheat straw was collected from nearby fields in Alipur (Delhi) area.

Plant Hormones suspension preparation

Indole-3 acetic acid was procured from the sigma Aldrich co. in and other chemical were used of the analytical grade. Solutions of different concentration i.e. 10 ppm, 50 ppm and 100 ppm were prepared by dissolving the IAA in alcohol and further diluting it in deionized water for the spray.

Cultivation

Small Scale cultivation was done in Swami Shraddhanand College, University of Delhi. 1 Kg (Wheat straw) substrate was prepared by the soaking the wheat straw in the water along with the formalin (Sagar et al., 2014) (40%) 500 ppm for 24 h thereafter extra water was removed to keep the moisture 65-70%. 2% spawn of substrate was thoroughly mixed in substrate and transferred to polythene bags. Bags were incubated in the incubation room for 12-14 days at 22± 2□C. Two holes were made in the bags for aeration of spawned substrate, and to avoid anaerobic patches.

Growth of mycelium

Polythene packets were observed twice daily for the any development sign. Mycelium growth was over after 14 days which was signified by the white run in the substrate. Mycelium bind to the substrate tightly then polybags were removed to observe their further growth.

Hormone Treatment

Total four groups were made for hormonal study. One bag has been considered as control however other three were treated with different concentrations of IAA hormone i.e. 10, 50 and 100 ppm. Hormonal exposure was achieved with the spray bottle. Three repetitive exposures have been done after three days each. Humidity and moisture content was maintained by the water spray at the regular interval.

Plucking of the fruits

Appearance of the pins was observed after three days once the packets were opened. Fruits were collected after 2 to three days of pinning. A total of three flushes were taken. They were kept under refrigerator or in – 20^{o}C for further study.

Yield measurement

Total yield was measured by the taking weight of each flush and it was recorded in grams.

RESULTS

The effect of the different concentration of the hormones was closely monitored daily and also various photographs were taken to study the growth (Figure 1). The effect of IAA was observed in growth and yield of the *pleurotus sajor- caju*. Total yield is shown in Figure 2 where all three doses were found to be effective however; maximum yield was recorded at 50ppm. Both the doses i.e. 10 ppm and 50 ppm were found to be more effective to the control one. The highest dose also showed increase in yield while it was quite lesser with respect to other two doses. 50ppm was found to be most effective dose as resulted in the best yield with respect to all groups. A slight decrease yield was noticed in 100ppm spayed substrate nonetheless it was also 14 % more yield with respect to control.

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Figure 1: different stages of *pleurotus sajor -caju's* growth 1) Spawn run throughout the wheat substrate after 15 days. 2) Development of pinning can be seen by appearance of young basidiocarps on wheat substrate. 3) Mature mushroom/ mature basidiocarps can be seen with gillson their surface and they are ready to harvest.

Table 1: Table depicts all flushes and yield in grams collected from each treatment groups after mushroom got mature. Control and IAA sprayed yield has been summarized with total yield from each treatment.

Treatment IAA (ppm)	First flush (g)	Second flush (g)	Third flush (g)	Total Yield (g)
Control	136	110	105	351
10	171	121	147	439
50	157.3	122.1	169.6	449
100	167	161	72	400

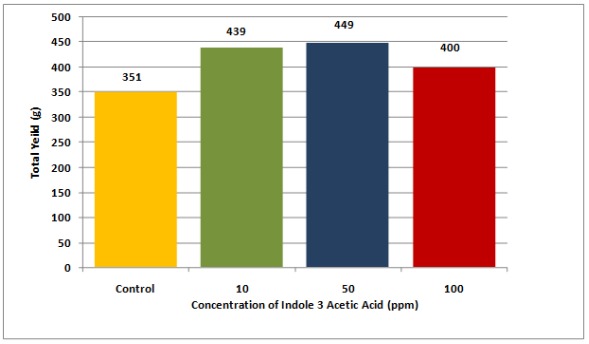

Figure 2: Total biomass production of *pleurotus sajor -caju* after the exposure of the Indole 3 acetic acid.

DISCUSSION

Growing demand of mushroom production opens the door for the different approaches which may induce increase biomass production of mushroom to fight with nutrition challenges over the world. Plant growth hormones have been reported to induce the significant changes in the growth either positively (Makarem & Alldridge., 1969; Paul et al., 1994) or negatively (Brian et al. 1954; Oravec et al., 1959). Therefore, aim of present study was to evaluate the stimulatory effect of the IAA hormone on *pleurotus sajor caju*'s biomass production and also dose dependent response was noticed in this study. Exciting results were observed in this study where different concentration were able to result increased biomass production. Our results are in line with the study by Mukhopadhyay et al. (2005) reported that IAA resulted in increase in biomass and protein concentration mushroom. In contrast, Gruen et al. (1959) reported that IAA does not have any evidence of growth promotion in fungi.

CONCLUSION

Present study suggests that the indole 3 acetic acid can be used as positive modulator to increase the productivity of the mushroom. Therefore hormonal spray may be exploited as promising strategy for the total yield of mushroom.

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Corresponding Author

Prof. Parveen Garg*

Department of Botany, Swami Shraddhanand College, University of Delhi

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