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Effect of different doses of GA_3 application at primordia initiation stage on the growth and yield of Oyster mushroom

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Abstract

Gibberellic acid (GA_3) was sprayed with eleven doses viz. 0, 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100 ppm at the primordia initiation stage to evaluate its effect on the growth and yield performance of Oyster Mushroom. At 10 ppm level GA_3 gave the highest economic yield and dry weight. Application of GA_3 increased the fresh economic yields to about 30% and 34%, while 80% and 115% dry weights increase occurred compared to the control at first and second harvests, respectively. GA_3 showed a positive effect on number of effective fruiting body, stalk length, pileus diameter, biological yield, economic yield and dry economic yield. The result suggested that GA_3 at 10 ppm/packet would be the best possible concentration for production of Oyster Mushroom.

Keywords: Oyster mushroom, Gibberellic acid (GA_3), Primordia initiation stage, Growth, Yield

Introduction

Mushroom is popularly known as vegetable crop in the world. Most recently it has occupied a very important place in human diet as a food item and has always been appreciated for its delicacy. The mushroom conversion has been named the “Non-green Revolution”. In Bangladesh, it is not so much familiar as a vegetable to the common people and only 8 cultivated mushrooms are found and most of these belong to the Basidiomycetes class. The *Pleurotus* species are called as “Oyster mushrooms” or Dhingri now ranks second among the cultivated mushrooms in the world (Chang and Miles, 1991). *Pleurotus ostreatus* commonly known as Oyster mushroom is gaining popularity and acceptability very fast among the farmers, because it can be grown all the year round under the climatic conditions of Bangladesh. With the popularization of mushroom farming and/or industrialization, mushroom production continues to increase worldwide. It is estimated that more than 10 million metric tons of edible and medicinal mushrooms are produced in various countries (Royse, 2005). Considering the importance of plant hormone on the yield of mushroom, the experiment was carried out to find out optimum concentration of GA_3 for maximizing growth and yield of mushroom.

Materials and Methods

The experiment was conducted in laboratory of the Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh during the period from December 2010 to April, 2011. A plant growth regulator Gibberellic Acid (GA_3) was tested to see its effects on growth and yield of Oyster Mushroom by applying its eleven different levels of concentration at primordia initiation stage. The experiment was laid out in Completely Randomized Design with four replications. Eleven concentration levels were (i). 0 (control), (ii). 10 ppm, (iii). 20 ppm, (iv). 30 ppm, (v). 40 ppm, (vi). 50 ppm, (vii). 60 ppm, (viii). 70 ppm, (ix). 80 ppm,(x). 90 ppm and (xi). 100 ppm. There were a total of 44 spawn packets of mushroom. The variety was Oyster mushroom for this experiment.

The 500 g spawn packet was made with the components of i.e. 192.5 g saw dust, 87.5 g wheat bran, 10 g rice husk, and 1g $CaCO_3$ which were mixed and moisture was adjusted at 50% by adding water. The mixture was filled into 7″× 10″ poly propylene bags. A hole (about 5 cm) was made with a sharp end stick at the center for space to put the inoculums. It was plugged with cottons and covered with brown paper placing a rubber band to hold it on place. In such a way 44 prepared packets were sterilized for 2 hours at 120°C and 1.5 kg/cm^2 pressure and kept 24 hours for cooling. Then one teaspoon of mother culture media containing mycelia supplied from Horticulture Center, Kewatkhali, Mymensingh was placed

aseptically through the hole of each packet separately. The packets were plugged with cottons and covered with brown paper placing a rubber band to hold in place. The packets were then marked treatment wise and kept on the rack in an incubation room at 20-25°C under 65-67% relative humidity. After 18-28 days of incubation, when colonization was completed the spawn packets were used for the cultivation of Oyster mushroom.

The spawn packets were opened by 'D' shaped cut on the shoulder side. The open surface of substrate was scraped slightly with a blade for removing the thin whitish mycelial layer. The spawn packets were soaked in water for half an hour and squeezed to remove excess water. The packets were then placed randomly side by side on the rack in the culture house. Eleven different levels of GA_3 were sprayed on the packets at primordia initiation stage.

Proper care was taken in case of disinfecting the culture room. The relative humidity of 70- 80% and the temperature of 20-30°C were maintained by watering twice a day in the room.
The data obtained from the experiment for every parameter were analyzed statistically using MSTAT-C computer program. The means were compared following Duncan's multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

The growth and yield of *Pleaurotus ostreatus* varied significantly at different levels of GA_3 application which are described below.

Number of primordia: At first harvest, the number of fruitbodies ranged from 17-80 and varied significantly (Table 1). The highest number of fruitbodies (80) was found in 10 ppm and the lowest number of fruitbodies (17) was found in 50 ppm concentration of GA_3. At second harvest, number of primordia was not affected significantly. The number of fruitbodies ranged from12-33.75 (Table 2). Numerically the highest number of fruitbodies (33.75) was found in 20 ppm and the lower number fruitbodies (12) was found in 80 ppm concentration.

Number of effective fruiting body

At first harvest, the number of effective fruiting body varied significantly (Table1). GA_3 produced the highest number of fruiting body with 10 ppm concentration which was the most productive for effective fruiting body production. While 50 ppm concentration produced the lowest number of fruiting body. At second harvest, the number of effective fruiting body varied significantly (Table 2) among different concentrations. The concentration level 10 ppm and 20 ppm produced the highest no. of effective fruiting body. The lowest was found with control condition and 40 ppm which was statistically identical to all other treatments.

Diameter of pileus: At first harvest, the diameter of pileus varied significantly (Table1). The highest diameter was found in 50 ppm and the lowest diameter of pileus was recorded in 10 ppm. At second harvest, the diameter of pileus varied significantly (Table 2). The highest diameter was found in control condition followed by 40 ppm and the lowest diameter of pileus was recorded in 10 ppm followed by 20 ppm and 100 ppm.

Thickness of pileus: At first harvest, no significant difference was found among the treatments (Table1). The thickness ranged from 0.58 cm to 0.80 cm. Apparently the highest thickness was found in 100 ppm and the lowest thickness was observed in control condition. At second harvest, thickness of pileus varied significantly (Table 2) among different concentrations. The highest thickness was found in both 30 ppm and in control concentration. The lowest diameter of pileus was recorded in 70 ppm followed by 100 ppm.

Length of stalk

At first harvest, length of stalk differed significantly under different treatments (Table1). The highest length of stalk was found in 60 ppm followed by 30 ppm, whereas the lowest length of stalk was found in 70 ppm. At second harvest, length of stalk differed significantly under different treatments (Table 2). The highest length of stalk was found in 60 ppm whereas the lowest length of stalk was found in 100 ppm followed by 20 ppm.

Diameter of stalk

At first harvest, no significant difference was observed in the diameter of stalk and it ranged from 1.76 cm to 2.58 cm (Table 1). Apparently the highest diameter of stalk was recorded in 40 ppm and 70 ppm and the lowest diameter of stalk was recorded in 10 ppm. At second harvest, significant difference was observed in diameter of stalk (Table 2). The highest diameter of stalk was recorded in 40 ppm and the lowest diameter of stalk was recorded in 20 ppm.

Biological yield

At first harvest, the biological yield differed significantly under different treatments (Table 1). The highest yield was found in 10 ppm GA_3. The lowest biological yield was found in 50 ppm. At second harvest, the biological yield differed significantly under different treatments (Table 2). The highest biological yield was found in 10 ppm GA_3. The biological yield obtained in 30 and 20 ppm concentration of GA_3 were similar to that of 10 ppm concentration of GA_3. The highest number of primordia and highest number of effective fruiting bodies found in these treatments were mainly responsible for the highest biological yield. The lowest biological yield was found in 90 ppm followed by 70 ppm and in control treatment.

Economic yield

At first harvest, the economic yield differed significantly under different treatments (Fig.1). The highest economic yield 87.31 g was found in 10 ppm GA_3. The lowest economic yield was found in 50 ppm which was identical to the rest of the levels (60-100 ppm). At second harvest, the economic yield differed significantly under different treatments (Fig.3). The highest economic yield 43.25g was found in 10 ppm GA_3. The lowest economic yield was found in 70 ppm followed by 90 ppm and 100 ppm.

The result was almost similar to the findings of Dey (1996), Ashrafuzzaman *et al.* (2005). Dey (1996) reported that GA_3 at the rate of 5-15 mg/L is very effective to obtain a good yield. The highest yield was obtained by Ashrafuzzaman *et al.* (2005) from15 mg/L GA_3.

Table 1. Effect of different concentrations of GA_3 on growth and yield attributes of *Pleaurotus ostreatus* (Oyster mushroom) at first harvest

Treatments	No. of primordia	No. of effective fruiting body	Diameter of pileus (cm)	Thickness of pileus (cm)	Length of stalk (cm)	Diameter of stalk (cm)	Biological yield (g)
0 ppm	30.00h	11.50bc	5.82abc	0.58	4.30ab	2.25	69.05b
10 ppm	80.00a	30.50a	4.62c	0.60	4.33ab	1.76	89.64a
20 ppm	41.50c	16.50b	5.74abc	0.75	4.33ab	1.92	84.79ab
30 ppm	32.00g	9.00cd	6.19ab	0.75	4.50a	2.23	74.24b
40 ppm	41.25c	9.00cd	6.36ab	0.71	4.55a	2.58	73.39b
50 ppm	17.00j	3.75d	6.79a	0.77	3.60cd	2.48	55.5c
60 ppm	34.25f	9.00cd	6.43ab	0.76	4.66a	2.35	72.28b
70 ppm	43.50b	13.50bc	5.45abc	0.78	3.45d	2.58	70.22b
80 ppm	39.50d	11.25bc	5.20bc	0.60	3.80bcd	1.85	70.37b
90 ppm	35.75e	10.00bcd	6.68ab	0.72	4.38a	2.54	72.86b
100 ppm	28.25i	7.75cd	6.59ab	0.80	4.19abc	2.43	71.36b
Level of significance	**	**	*	NS	**	NS	**
CV (%)	12.25	8.25	4.25	10.52	6.32	13.25	4.52

Table 2. Effect of different concentrations of GA_3 on growth and yield attributes of *Pleaurotus ostreatus* (Oyster mushroom) at second harvest

Treatments	No. of primordia	No. of effective fruiting body	Diameter of pileus (cm)	Thickness of pileus (cm)	Length of stalk (cm)	Diameter of stalk (cm)	Biological yield (g)
0 ppm	15.50	2.25b	7.64a	0.95a	3.40bc	2.95ab	33.70d
10 ppm	31.50	7.00a	5.68b	0.73bc	3.33bc	1.93bc	44.43a
20 ppm	33.75	7.00a	5.49b	0.78abc	2.84c	1.73c	40.96ab
30 ppm	15.50	3.75b	7.14ab	0.95a	4.06ab	2.49abc	44.08a
40 ppm	14.25	2.25b	7.39a	0.84abc	3.68abc	3.15a	35.97cd
50 ppm	32.50	3.75b	5.69b	0.83abc	3.15bc	1.95bc	34.92cd
60 ppm	24.25	3.75b	6.98ab	0.82abc	4.64a	2.45abc	39.17bc
70 ppm	21.25	4.50b	6.18ab	0.65c	2.94bc	1.92bc	32.96d
80 ppm	12.00	3.75b	6.38ab	0.75abc	3.38bc	2.08bc.	38.94bc
90 ppm	12.25	3.25b	7.21ab	0.92ab	3.48bc	2.95ab	32.95d
100 ppm	19.50	4.25b	5.65b	0.67c	2.60c	2.18abc	34.79cd
Level of significance	NS	**	*	*	*	*	**
CV (%)	15.45	4.58	5.30	4.70	5.35	6.40	7.52

In a column, figures with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT.

* = Significant at 5% level of probability
** = Significant at 1% level of probability
NS = Not significant

Dry weight

At first harvest, the dry weight differed significantly under different treatments (Fig. 2). The highest dry weight (6.72 g) was found in 10 ppm GA_3. The lowest (3.2 g) was found in 50 ppm. At second harvest, the dry weight differed significantly under different treatments (Fig. 4). The highest dry weight (3.48 g) was found in 10 ppm and the lowest (1.60 g) was found in 100 ppm followed by control treatment.

Alam *et al*. (2007) found that application of GA_3 increased the biological and economic yield by 18% and 16%, respectively. Hans (1997) stated that application of GA_3 in high concentration increased biological and economical yield by increasing cell division and enlargement as it was evident from the study since application of GA_3 resulted in enlargement of pileus diameter and pileus girth and elongation of stalk length.Barclay (1985) suggested that hormone application timing and concentration might be critical and important factor for production of mushroom.

From the above discussion, it revealed that the highest biological and economic yield and also dry weight were obtained when 10 ppm GA_3 was applied on primordia initiation stage. At 10 ppm level GA_3 gave the highest economic yield of 87.31g and 43.25 g, and dry weight of 6.72 g and 3.48g at first and second harvest, respectively. The lowest economic yield and dry weight were recorded in 50 ppm at first harvest and at second harvest it was recorded in 100 ppm. GA_3 showed a positive effect on number of effective fruiting body, stalk length, biological yield, economic yield and dry economic yield. An appropriate concentration of GA_3 would maximize the yield which would benefit the growers and pave the way in marketing it at a lower price.

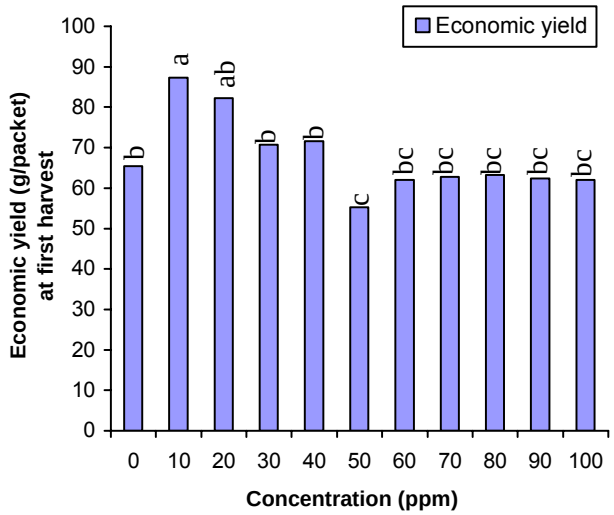

Fig. 1. Effect of different doses of GA_3 on the economic yield of Oyster mushroom at first harvest

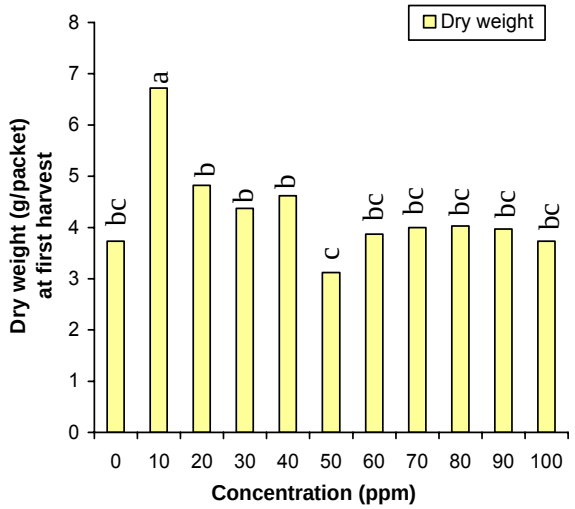

Fig. 2. Effect of different doses of GA_3 on dry weight of Oyster mushroom at first harvest

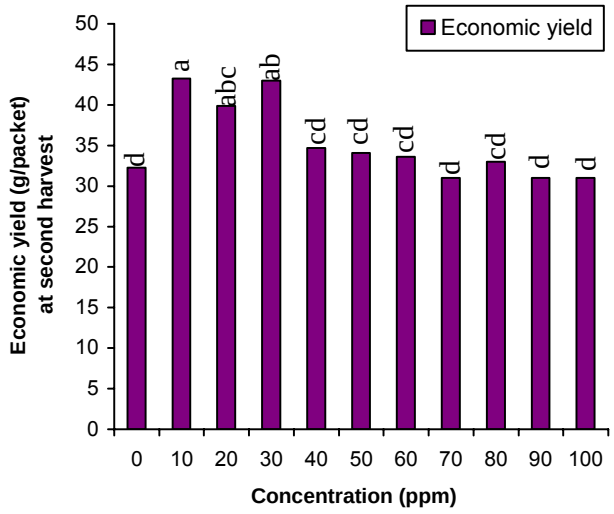

Fig. 3. Effect of different doses of GA_3 on the economic yield of Oyster mushroom at second harvest

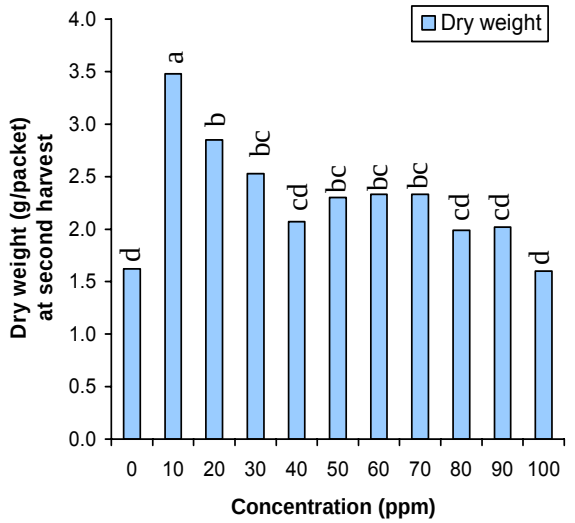

Fig. 4. Effect of different doses of GA_3 on dry weight of Oyster mushroom at second harvest

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