Effect of different stocking densities of grass carp (*Ctenopharyngodon idella*) in Halwana plant leaves diet on fish growth and net production

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Abstract

Stocking density is important parameter in fish production. It has direct effects on growth and survival of the fishes which finally affect the fish production. In present investigation, different stocking densities (5000, 7500, 10,000 and 12,500 No./ha) in Halwana leaves based diet were evaluated to know the influence on growth and net production of grass carp. Best growth in terms of average length was recorded in T_1 (5000 no./ha stocking density) (39.34 cm), followed by T_2 (7500 no./ha stocking density) (37.75 cm) T_3, (10,000 no./ha stocking density) (35.60 cm) and T_4 (12,500 no./ha stocking density) (33.02 cm) but no significant change in the average length was observed among different stocking densities. Best growth in terms of average weight was observed in T_1 (5000 no./ha stocking density) (212.68 g) followed by T_2 (7500 no./ha stocking density) (205.34 g), T_3 (10000 no./ha stocking density) (199.35 g) and T_4 (12500 no./ha stocking density) (179.39 g) respectively (Table 2). The study indicated that, stocking density from 5000 to 12500 fish/ha does not affect significantly on average weight of the grass carp but weight was slightly decreased with increasing stocking density. The net production was significantly higher in T_3-10000 (3522.04 g/18m^2) followed by T_4-12500 (3229.02 g/18m^2) and T_2-7500 (2737.86 g/18m^2).

Keywords: Stocking density, grass carp, Halwana leaves and net production

1. Introduction

India is the world's second-largest producer of culture fisheries. China, with one-fifth of the world's population, produces one-third of total fish harvested and two-thirds of fish cultivated (FAO, 2016). Over the last two decades, Indian aquaculture has grown six and a half times, with freshwater aquaculture accounting for more than 95 per cent of total aquaculture production. India has 3.15 million hectares of reservoirs, 2.36 million hectares of ponds and tanks, and 0.19 million hectares of rivers and canals. Freshwater aquaculture, which had a 34 per cent share of inland fisheries in the mid-1980s, has risen to around 80 percent in recent years (DADF, 2017).

Grass carp (*Ctenopharyngodon idella*) is a subtropical to temperate species found in major rivers and lakes of eastern Asia. Aquatic plants are almost completely eaten by grass carp. Grass carp have also been reported to consuming terrestrial plants that are suspended in the water. Aqua-farming is more

profitable if we use natively available feed rather than depending on outsource for feed. Halwana (*Erythrina variegata*) is a small deciduous tree with prickly stems and roots, triangular leaflets, and large coral red flowers (Lahari et al., 2015). This tree was predominantly seen in the Malnad region of Karnataka (India). Hence Halwana leaves were used as feed in rearing of grass carp. Stocking density also known as per-unit stocking amount or stocking rate, refers to the quantity of fry or fingerlings per unit of water area. Stocking density is an important parameter in fish culture operations, since it has direct effects on the growth and survival and hence on production. It is an established fact that growth rate of fishes progressively increase as the stocking densities decreases and vice-versa (Hasan et al., 2010). But, information related to impact of stocking density on growth performance of grass carp in terrestrial leaves based diet not known. Hence the present investigation was carried out to know the optimum stocking density of grass carp in Halwana leaves based diet and their impact on fish growth and net production.

2. Material and methods

Feed: Fresh Halwana leaves (*Erythrina variegata*) used as feed for grass carp production.

Seed Source: Normal fingerlings of grass carp (*Ctenopharyngodon idella*) were brought from Main Research Station, Hebbal, Bangalore.

Preparation of cement ponds

The cement ponds having a diameter of 6 m x 3 m x1 m with a soil base of 15 cm were drained and limed @ 200 kg/ha (360 g/pond). These ponds were dried for a week. The cement ponds were then filled with water drawn from farm pond. The water level in the ponds was maintained at 70 to 75 cm throughout the experimental period.

Stocking and rearing

The normal fingerlings of grass carp (*Ctenopharyngodon idella*) were stocked in triplicate @ 5,000, 7500, 10000 and 12500 no/ha each stocking density was served as a different treatment. The average initial length and weight of the fingerlings were 5.2 cm and 3.5 g respectively.

Feeding

Chopped leaves of Halwana was fed daily once during morning hours @ 100% of their body weight and the quantity of feed given was adjusted based on the growth ascertained during every fifteen days sampling.

Measurement and Net production

The growth performance of fish in different treatment was recorded once in fifteen days. During every sampling day, from each pond minimum 50% of stocked population was collected and individual

length and weight of fish was recorded. At the end of the experiment, all the cement ponds were drained to collect the fishes, the individual length and weight of each fish was recorded, based on that, net production was calculated.

Statistical analysis

The standard error values were calculated using MS Excel (2007). One way Analysis of Variance (ANOVA) was carried for growth and net production in different treatments. Duncan Multiple Range Test (DMRT) was applied to know the significance (0.05) difference between treatments.

3. Results and Discussion

Stocking density is important parameter in fish production. It has direct effects on growth and survival of the fishes which finally affect the fish production. It is an established fact that growth rate of fishes progressively increase as the stocking densities decreases and vice-versa. This was because of relatively less number of fish in a pond of similar size could get more space, food and dissolved oxygen at the same time. To obtain maximum economic returns it would be necessary to stock the ponds at optimum stocking densities for optimum growth in relation to inputs and productivity of the water body.

In present investigation, different stocking densities (5000, 7500, 10,000 and 12,500 No./ha) in Halwana leaves based diet were evaluated to know the influence on growth and net production of grass carp. The growth gained by grass carp (*Ctenopharyngodon idella*) in different treatments and the data relating to growth performance in terms of average length (cm) and average weight (g) was recorded. Best growth in terms of average length was recorded in T_1 (5000 no./ha stocking density) (39.34 cm), followed by T_2 (7500 no./ha stocking density) (37.75 cm) T_3, (10,000 no./ha stocking density) (35.60 cm) and T_4 (12,500 no./ha stocking density) (33.02 cm) but no significant change in the average length was observed among different stocking densities (Table 1). The study found that, stocking density from 5000 to 12500 fish/ha does not affect significantly on length of the grass carp but length was slightly decreased with increasing stocking density. Best growth in terms of average weight was observed in T_1 (5000 no./ha stocking density) (212.68 g) followed by T_2 (7500 no./ha stocking density) (205.34 g), T_3 (10000 no./ha stocking density) (199.35 g) and T_4 (12500 no./ha stocking density) (179.39 g) respectively (Table 2). The study indicated that, stocking density from 5000 to 12500 fish/ha does not affect significantly on average weight of the grass carp but weight was slightly decreased with increasing stocking density. Similarly, Abou Zied (2007) reported the effect of two stocking density (25 and 50 fry/m^3) on growth and production of grass carp in artificial diet. They found that, grass carp fry at the rate of 25 fry/m^3 showed higher final weight, total gain and daily gain than that of the higher density. Sharma and Chakrabarti (1998) evaluated the effect of different stocking density (200, 400, 800 and 1600/m^3) on growth of grass carp (*C. idella*) in re-circulating culture system. They reported that, stocking density of 200/m^3 recorded higher final average weight compared to higher stocking densities. They concluded that, growth of grass carp decreased with increasing stocking density.

In present investigation, after completion of the experimental period of 120 days, each pond drained completely and recorded the net production. The net production was significantly higher in T_3-10000 (3522.04 g/18m^2) followed by T_4-12500 (3229.02 g/18m^2) and T_2-7500 (2737.86 g/18m^2). The lowest net production was noticed in T_1-5000 (1843.22 g/18m^2) (Table 3). It was found that, lower stocking density resulted in lesser net production and extreme stocking density also decreased the net carp production. Hence, optimum stocking density 10000 was ideal to get higher carp yield. Similar study was carried out by Asadujjaman et al. (2016), on optimization of stocking density for Azolla based carp polyculture. Three stocking densities viz., 10000 fish ha^{-1}, 11500 fish ha^{-1} and 12500 fish ha^{-1} were evaluated. Among the evaluated densities, 12500 fish ha^{-1} showed the significantly higher production compared to other densities. But in terms of total cost, gross benefit, net benefit, net profit margin and cost benefit ratio, 10000 fish ha^{-1} stocking density was found to be best. Survival rate was non-significant among the treatments. They concluded that, stocking density @ 10000 fish ha^{-1} could be a good option for low cost Azolla based fish farming in Bangladesh. Roy et al. (1996) demonstrated that, monoculture of grass carp stocked @ 1000/ha resulted an average net production of 21.0 kg/ 0.02 ha/8 months (1501 kg/ha/yr).

4. Conclusion:

Stocking density from 5000 to 12500 fish/ha does not affect significantly on average weight of the grass carp but weight was slightly decreased with increasing stocking density. Stocking density (up to 12500 no./ha) does not affect significantly on average weight of the grass carp but weight was slightly decreased with increasing stocking density. But lower stocking density resulted in lesser net production and extreme stocking density also decreased the net carp production. Hence, optimum stocking density 10,000 No./ha was ideal to get higher carp yield.

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Table 1 : Effect of different stocking densities on average length (cm) of Grass carp in Halwana based diet

Treatments		Days								
		0	**15**	**30**	**45**	**60**	**75**	**90**	**105**	**120**
T_1 (5,000 No./ha)	1	5.20	17.51	21.20	24.14	28.93	31.35	36.00	39.20	40.71
	2	5.35	16.00	19.60	23.50	28.08	30.90	35.25	37.80	39.60
	3	5.08	16.74	18.18	22.59	26.60	28.44	32.25	36.67	37.73
	Avg	**5.21**	**16.75**	**19.66**	**23.41**	**27.87**	**30.23**	**34.50**	**37.89[a]**	**39.34**
	SE±	**0.08**	**0.44**	**0.87**	**0.45**	**0.68**	**0.90**	**1.15**	**0.73**	**0.87**
	SD±	**0.14**	**0.76**	**1.51**	**0.78**	**1.18**	**1.57**	**1.98**	**1.27**	**1.51**
T_2 (7,500 No./ha)	1	5.00	15.50	20.75	23.80	28.00	31.50	34.75	38.30	40.50
	2	5.30	17.67	20.65	22.54	27.47	30.70	33.20	37.55	39.00
	3	5.30	15.85	16.35	20.26	24.90	26.78	31.35	32.72	33.75
	Avg	**5.20**	**16.34**	**19.25**	**22.20**	**26.79**	**29.66**	**33.10**	**36.19[a]**	**37.75**
	SE±	**0.10**	**0.67**	**1.45**	**1.04**	**0.96**	**1.46**	**0.98**	**1.75**	**2.05**
	SD±	**0.17**	**1.17**	**2.51**	**1.79**	**1.66**	**2.53**	**1.70**	**3.03**	**3.54**
T_3 (10,000 No./ha)	1	5.20	15.22	19.10	20.25	25.75	26.30	30.92	31.69	31.98
	2	5.31	16.50	18.00	20.75	24.45	28.90	31.44	33.76	35.67
	3	5.24	15.29	19.40	22.45	26.60	30.36	33.64	37.00	39.15
	Avg	**5.25**	**15.67**	**18.83**	**21.15**	25.60	**28.52**	**32.00**	**34.15[ab]**	**35.60**
	SE±	**0.03**	**0.42**	**0.43**	**0.67**	**0.63**	**1.19**	**0.83**	**1.55**	**2.07**
	SD±	**0.06**	**0.72**	**0.74**	**1.15**	**1.08**	**2.06**	**1.44**	**2.68**	**3.59**
T_4 (12,500 No./ha)	1	5.30	14.90	18.22	20.86	23.40	26.68	30.00	32.00	33.36
	2	5.20	15.55	19.15	22.78	26.00	28.87	32.93	32.80	33.10
	3	5.10	13.65	15.31	16.66	24.10	26.35	29.77	31.50	32.62
	Avg	**5.20**	**14.70**	**17.56**	**20.10**	**24.50**	**27.30**	**30.90**	**32.10[b]**	**33.02**
	SE±	**0.06**	**0.56**	**1.16**	**1.81**	**0.78**	**0.79**	**1.02**	**0.38**	**0.22**
	SD±	**0.10**	**0.97**	**2.00**	**3.13**	**1.35**	**1.37**	**1.76**	**0.66**	**0.38**

Table 2: Effect of different stocking densities on average weight (g) of Grass carp in Halwana based diet

Treatments		Days								
		0	**15**	**30**	**45**	**60**	**75**	**90**	**105**	**120**
T_1 (5,000 No./ha)	1	3.67	27.29	68.85	96.38	126.29	157.82	193.27	209.28	220.45
	2	3.33	24.80	63.50	93.53	121.86	155.11	188.23	201.10	213.84
	3	3.50	25.94	58.90	89.90	115.44	142.76	172.21	195.08	203.75
	Avg	**3.50**	**26.01**	**63.75**	**93.27**	**121.20**	**151.89**	**184.57**	**201.82**	**212.68**
	SE±	**0.10**	**0.72**	**2.88**	**1.88**	**3.15**	**4.63**	**6.35**	**4.11**	**4.86**
	SD±	**0.17**	**1.25**	**4.98**	**3.25**	**5.46**	**8.03**	**11.00**	**7.13**	**8.41**
T_2 (7,500 No./ha)	1	3.41	25.75	66.65	99.09	123.76	159.44	192.03	209.67	220.99
	2	3.60	27.56	65.87	93.76	121.41	154.72	183.26	205.39	211.77
	3	3.55	24.72	52.15	84.28	110.05	134.97	173.05	178.97	183.26
	Avg	**3.52**	**26.01**	**61.55**	**92.37**	**118.40**	**149.71**	**182.78**	**198.01**	**205.34**
	SE±	**0.06**	**0.83**	**4.71**	**4.33**	**4.23**	**7.49**	**5.48**	**9.60**	**11.36**
	SD±	**0.10**	**1.44**	**8.16**	**7.50**	**7.33**	**12.98**	**9.50**	**16.63**	**19.67**
T_3 (10,000 No./ha)	1	3.55	24.00	60.17	85.05	115.87	134.41	173.13	177.05	179.08
	2	3.50	25.74	56.52	87.15	110.02	147.10	176.06	188.04	199.75
	3	3.45	23.85	60.91	94.29	119.70	154.53	188.40	206.10	219.24
	Avg	**3.50**	**24.53**	**59.20**	**88.83**	**115.20**	**145.35**	**179.19**	**190.39**	**199.35**
	SE±	**0.03**	**0.61**	**1.36**	**2.80**	**2.81**	**5.87**	**4.68**	**8.47**	**11.59**
	SD±	**0.05**	**1.05**	**2.35**	**4.84**	**4.88**	**10.17**	**8.10**	**14.67**	**20.08**
T_4 (12,500 No./ha)	1	3.65	24.08	56.64	87.77	105.88	136.43	159.12	172.00	181.31
	2	3.53	24.88	58.98	95.44	117.26	147.52	174.52	175.48	179.73
	3	3.46	21.84	47.15	69.80	108.69	134.64	157.78	168.52	177.12
	Avg	**3.54**	**23.60**	**54.25**	**84.33**	**110.61**	**139.53**	**163.80**	**172.00**	**179.39**
	SE±	**0.06**	**0.91**	**3.62**	**7.60**	**3.42**	**4.03**	**5.37**	**2.01**	**1.22**
	SD±	**0.10**	**1.58**	**6.26**	**13.16**	**5.93**	**6.98**	**9.30**	**3.48**	**2.12**

Table 3: Effect of different stocking densities on net production of grass carp in Halwana based diet

Treatment		Net production (g)/18m^2/120 Days
T_1 (5000 No./ha)	1	1914.12
	2	1701.44
	3	1914.12
	Average	**1843.22^d**
	SE±	**70.89**
	SD±	**122.79**
T_2 (7500 No./ha)	1	2874.76
	2	2669.42
	3	2669.42
	Average	**2737.86^c**
	SE±	**68.45**
	SD±	**118.55**
T_3 (10,000 No./ha)	1	3588.30
	2	3388.95
	3	3588.30
	Average	**3522.04^a**
	SE±	**66.45**
	SD±	**115.09**
T_4 (12,500 No./ha)	1	3229.02
	2	3049.63
	3	3408.41
	Average	**3229.02^b**
	SE±	**103.57**
	SD±	**179.39**