

## GROWTH BEHAVIOUR AND YIELD OF FIVE WATER CHESTNUT VARIETIES UNDER WATERLOGGED CONDITION

S. ROY CHOWDHURY\*, N. SAHOO AND H.N. VERMA

Water Technology Center for Eastern Region (ICAR), P.O. Chandrasekharapur, Bhubaneswar - 751023, Orissa

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### SUMMARY

Five local varieties of water chestnut; two green fruit type (Haldipada green and Balasore green) and three red fruit type (Haldipada red, Balasore red and KNP red) grown in waterlogged condition showed different growth patterns. The leaf area development was quicker in green type varieties and the decline of leaf area was also quicker in these types. The red fruit varieties, however, maintained leaf area for relatively longer duration. The elongation ability of water chestnut varieties with increase in water depth was also found positive (from  $r=0.83$  to up to  $r=0.98^*$ ) indicating their suitability for cultivation in flood prone areas. The green types flowered and fruited earlier than red types, but red types picked up towards later part. The total yield, however, was greater in green varieties.

**Key words:** Leaf area, plant height, pond environment, water chestnut, yield.

### INTRODUCTION

The water chestnut (*Trapa bispinosa* Roxb.) or 'Singhara phal' is one of the few neglected but economically important aquatic crops grown in different parts of India ranging from Assam in east to Jammu and Kashmir in the north. In the states like Bihar, Uttar Pradesh, West Bengal, the crop is popularly grown mainly in railway track side depressions or highway side depressions (Ahmed and Singh 1999, Banerjee and Thakur 1990, Hazra *et al.* 1996). The fruits are generally consumed either as fresh fruit or after boiling and are nutritionally rich (Gopalan *et al.* 1987). Commonly two types of fruits are available and sold in the market, *i.e.* fruits with green peel and fruits with red peel. Little information is available regarding growth, development and yield of this crop particularly in relation to these two types of water chestnut (Poddar 2003). The present study, therefore, attempted to analyse these aspects in two types of water chestnut varieties.

### MATERIALS AND METHODS

An experiment was conducted in Research Farm of Water Technology Centre for Eastern Region, Mendhasal during 2001 from June to December by growing water chestnut. Five local water chestnut varieties were grown in randomized block design with four replications. Among the five varieties, three were red fruit types, *viz.* KNP red, Haldipada red and Balasore red. The two green varieties were Balasore green and Haldipada green. The plot size was 2x3 m and was demarcated by 45 cm wide nylon net on the surface of the water body. The compost was applied @ 8 t/ha before planting. The fertilizers were applied @ 40, 60 and 40 kg ha<sup>-1</sup> of N, P and K respectively. The one third of N as urea and K as muriate of Potash with full P as single super phosphate was applied as basal dose. The remaining 2/3 N and K was applied in two splits at two and four months after planting. The dissolved oxygen content and temperature of water was recorded with a

\*Corresponding author : e-mail somnath\_rc@yahoo.com

YSI 550 hand held dissolved oxygen and temperature system (YSI Inc., Yellow Spring, Ohio, USA). The data of plant height was recorded by uprooting plant from bottom of the water body and represented the length of main shoot. The pH was measured with a hand held portable pH meter (Hanna Instruments, Portugal). The leaf area was calculated by detaching leaves and using a LiCor 3100 leaf area meter (LiCor Inc., USA). The flowering and fruiting started from about 95-100 days after planting. The fruits were harvested periodically from 14th weeks after planting onwards and continued upto 23rd weeks after planting till the crop decomposed and started disappearing from the surface of the water body. The least significant difference of treatment means, correlations and regressions of observations were calculated following Gomez and Gomez (1984).

**RESULTS AND DISCUSSION**

The waterlogged condition in which experiment was conducted had water depth varying from 0.76 m in June to 1.36 m in October. Throughout the growth period during July-Sept. monsoon period it ranged between 1.05 m to 1.36 m (Fig. 1). The water temperature steadily decreased over the period of growth (Fig. 2). The dissolved oxygen

level showed a sharp decrease from 2nd month after planting, reaching its lowest in 3rd month. The dissolved oxygen again started rising 5th month onwards. The pH of water, however, did not change appreciably over the period of crop growth (Fig. 2).

The plant height in water chestnut increased steadily upto 3rd month after planting in almost all the varieties (Fig. 3). The increase was found maximum in Haldipada green (H.P. green) and Balasore green (B. green) and was least in KNP red and HP red at four month stage. The rate of increase also varied from cultivar to cultivar. Most of the varieties showed highest rate of increase in height during the second month after planting (MAP). Var. Balasore green showed an increase as high as 42.52% during 2nd MAP whereas in HP red the peak rate of increase (26.56%) was attained during the third month. During 4th MAP, the rate of increase declined in all the cultivars (Table 1). In general, the plant height was positively correlated ( $r = 0.83$  to  $r = 0.98^*$ ) with depth of water in different cultivars (Table 2). This indicated that water chestnut plants adapt well under increasing level of water and can be grown in flood prone low lying areas where there is chance of increase in depth of water.

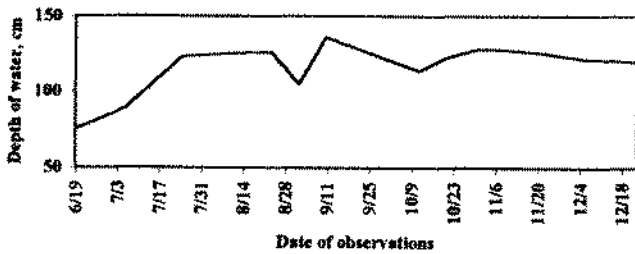


Fig. 1. The depth of pond water during growth period of water chestnut varieties

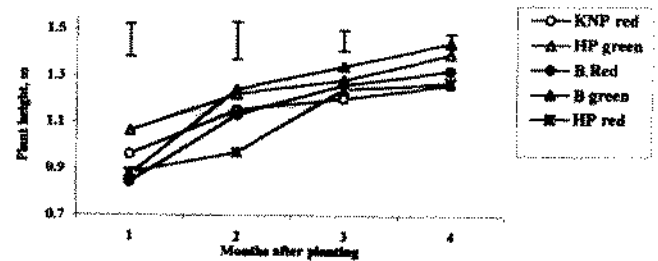


Fig. 3. The plant height of water chestnut varieties at various plant growth stages. Each value is mean of four replications. Vertical bars are LSD at  $p = 0.05$  level of significance

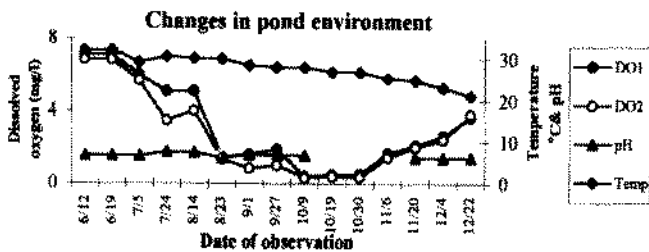


Fig. 2. The changes in dissolved oxygen concentration at 30 cm (DO1) and 60 cm (DO2) water depth, temperature and pH at 30 cm depth during the growth period of water chestnut varieties

*Trapa* species showed heterophylly with morphological variations in submerged and floating leaves (Bionti *et al.* 1996). However, floating leaves remain as main site for photosynthesis (Sculthorpe 1985). Growth attributes like number of leaves per head and number of branches per plant have been reported (Poddar 2003). Study on leaf area development per plant showed that the leaf area increased up to third month after planting in all the cultivars followed by a decline thereafter. The rate of increase as well as rate of decrease was sharpest in both

## GROWTH AND YIELD OF WATER CHESTNUT VARIETIES

**Table 1.** The rate of increase in height of water chestnut plants (primary stem) during different growth periods

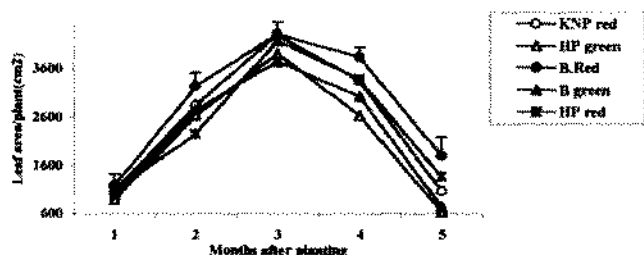
Varieties	Per cent increase		
	2 <sup>nd</sup> MAP	3 <sup>rd</sup> MAP	4 <sup>th</sup> MAP
KNP red	19.79	4.34	5.0
HP green	15.09	4.68	8.59
Balasure red	34.52	11.50	4.76
Balasure green	42.52	8.06	7.46
HP red	11.38	26.56	2.41

MAP = months after planting

**Table 2.** The relationship of increased water level (m) and plant height (m) in different cultivars of water chestnut (n=4)

Varieties	Correlation co- eff. (r)	Linear regression equation of plant height (Y)
KNP red	0.83	$Y=1.2745x-0.5367$
HP green	0.84	$Y=1.3645x-0.5602$
Balasure red	0.88	$Y=2.2134x-1.7786$
Balasure green	0.83	$Y=2.4520x-2.0067$
HP red	0.98*	$Y=2.2295x-1.8449$

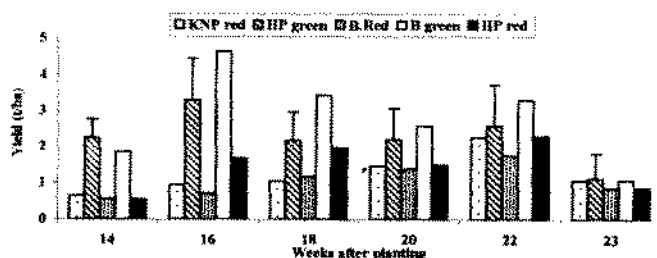
the green cultivars (Fig. 4). Among all the red cultivars, Balasure red maintained significantly higher leaf area for longer duration over entire period of crop growth.



**Fig. 4.** The changes in leaf area in five different water chestnut varieties at various plant growth stages. Each value is mean of four replications. Vertical bars are LSD at p=0.05 level of significance.

There were six harvests in the harvesting period of 75 days spread between 14 weeks after planting (WAP) to 23 WAP. The cultivars showed significant variability in terms of fruiting behavior. In general, the green cultivars flowered and fruited earlier (10-15 days) than red cultivars. Between two green cultivars, except first harvest, Balasure

green always maintained higher yield (Fig. 5). Among red cultivars, the HP red significantly out yielded other two red cultivars at 16 & 18 weeks harvests. In general the yield in all cultivars decreased at 6th harvest significantly (Fig. 5). The total yield was found highest in Balasure green (16.84 t/ha) followed by Haldipada green (14.09 t/ha) and was found lowest in Balasure red (6.67 t/ha). Among red cultivars, Haldipada red was highest yielder (8.83 t/ha).



**Fig. 5.** Fruit yield of water chestnut varieties at different growth stages. Each value is mean of four replications. Vertical bars are LSD at p=0.05 level of significance.

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