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Production and Yield Of Selected Edible Greens in Hydroponic Ponds (Float Beds) in a Greenhouse

Robert G. Anderson, Extension Floriculture Specialist

Kentucky has over 40 acres of greenhouses with modified pond or tank hydroponic beds for "float" tobacco transplant production. These facilities could be used to grow other crops during the fall, winter and spring. Previous work has demonstrated that lettuces can be easily grown in such production systems (Anderson and Schmidt, 2001; Thompson, et al, 1998). The production of selected types of edible greens has been evaluated in hydroponic ponds over the past two years in conjunction with the University of Kentucky New Crops Opportunity Center. This produce could be sold in local markets or to wholesale or retail Asian vegetable markets.

The Production System

Fifteen typical "float beds" or hydroponic ponds were constructed for these evaluations. These ponds were 12 ft^2 in size and were built in five rows of three on one side of a 30 x 60 ft plastic greenhouse that had sidewalls for natural ventilation. Tanks were lined with black polyethylene and filled with water to a depth of 6" to make a tank volume of approximately 38 gallons.

Plants were grown in 1 oz. plastic soufflé cups ("ketchup" cups) manufactured and sold by Solo Cup Company, Urbana, IL. Holes were drilled in the bottom of the cups (Fig. 1) and the cups were filled with growing medium. The cups were placed into holes were cut into polystyrene sheets (36" x 22" x 1") that floated on the tank or "float bed". The holes were 1.5" in diameter and spaced 5 x 6 inches apart. A commercial inorganic water-soluble fertilizer (Peter's 20-10-20, Scotts' Horticultural Co, Maryville, OH) was added to the water in each tank and maintained at an EC of 1.2 mS m^{-1} (approximately 160 ppm NO_3-N).

Figure 1 Plants were grown in small plastic "soufflé" cups placed in holes in styrafoam boards that floated on the water.

Seed of the edible greens were purchased from Johnny's Selected Seeds, Albion ME. Chinese cabbage varieties 'Mei Qing Choi' Pac Choi (*Brassica rapa* Chinensis group) and 'Tatsoi' (*Brassica rapa* Narinosa group) were grown in February 2001. 'Mei Qing Choi' (*Brassica rapa* Chinensis Group) and 'Kyona Mizuna' (*Brassica rapa* Japanese Group) Chinese cabbage were grown from December 2001 to January 2002. 'Green Wave' mustard greens (*Brassica juncea*) and upland cress or creasy greens (*Barbarea verna*) were grown from January to February 2002.

Soufflé cups were filled with a peat-based germination medium (Redi-Earth, Scotts' Horticultural Co, Maryville, OH) and placed in trays. Seeds were sown in the cups and germinated at 68° Fday/76 ° F

night temperature. Seedlings were fertigated twice per week with 150 ppm 20-10-20 fertilizer before placement in the hydroponic tanks. The plants were placed in the hydroponic ponds on 14 to 18 days after germination and were grown under natural light conditions. The greenhouse had a heat set point of 60 ^{o} F and a ventilation set point of 75 ^{o} F.

The primary objective of these trials was to determine whether these edible greens could be grown in hydroponic tanks. Aeration of the tanks was evaluated as well. Electric water pumps were placed in each tank and operated up to 24 hours per day to oxygenate the water; previous work demonstrated that oxygen levels would be maintained at 4-6 ppm with this procedure. Plants were harvested from the tanks after approximately 30 days of growth. Both fresh weights and dry weights were measured. Plants were grown with three replicates in a randomized complete block.

Results

Thirty days was sufficient to grow high quality heads of 'Tatsoi' and 'Mei Qing Choi' pac choi Chinese cabbage (Fig. 2). 'Mei Qing' has a relatively typical pac choi head with large, nearly white, thick petioles. On the other hand, 'Tatsoi' forms a lose head of long thickened petioles with dark green leaf blades. It seems both would be fine for stir-fry cooking and salads, but petioles of 'Tatsoi' are more like celery in form, rather than a pac choi.

'Kyona Mizuna' Chinese cabbage, 'Green Wave' mustard greens and upland cress also, can be harvested in 30 days as individual plants (heads), but may also be harvested and sold as bunches of leaves.

The plant density in this study was 4.8 plants per square foot. The yield of edible greens varied from ½ oz to 3 oz per plant or 0.17 to 0.90 pounds per square foot of bed space (Table 1). The Chinese cabbage cultivars had the highest fresh weight of the edible greens that were grown while upland cress plants were quite small.

Aeration of the hydroponic solution is clearly necessary for the production of these plants in greenhouses. Dry weights were nearly double for the 'Mei Qing Choi' and 'Tatsoi' plants aerated for 24 hours each day compared to those in non-aerated treatments (Figure 3). Plants were significantly larger when hydroponic solutions were aerated for 24 hours/day when compared to aeration for only 6 or 1 hour per day, 1 hour per 6 days or not aerated (Tables 2 and 3). These non-aerated conditions are typical of standard practices for tobacco transplant production in a "float" bed. Aeration is just as important for lettuce in tank or "float" bed production (Anderson and Schmidt, 2001; Thompson, *et al*, 1998; Goto, *et al*, 1996). Although aeration is somewhat difficult to arrange for "float" beds, it is an important factor to optimize plant growth and to the success of vegetable plant production in this type of hydroponic system.

Figure 2. 'Mei Qing Choi' (left) and 'Tatsoi' Chinese cabbage at harvest.

Table 1. Yield of the selected edible greens grown in these studies in pounds of produce per square foot of hydroponic tank area.

	Pounds per square foot
'Mei Qing'	0.90
'Tatsoi'	0.86
'Kyona Mizuna'	0.67
'Green Wave' mustard	0.51
Upland Cress	0.17

Figure 3. Mean shoot dry weight (oz.) of 'Mei Qing Choi' and ' Tatsoi' Chinese cabbage grown in aerated (24 hours per day) and non-aerated hydroponic ponds with inorganic fertilizer.

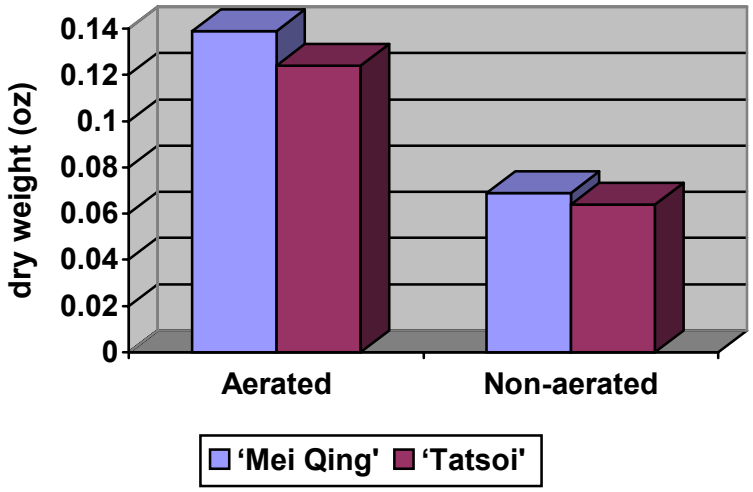

Table 2. The effect of the amount of aeration in hydroponic tanks during crop production on the yield of Chinese cabbage, December 11, 2001 to January 14, 2002.

	Mean Fresh Weight (oz.) ± standard error	
Hours of aeration in 30 days	'Mei Qing'	'Kyona Mizuna'
0	2.06 ± 0.10	1.27 ± 0.08
5 (1 hr/6 days)	2.03 ± 0.12	1.28 ± 0.08
30 (1 hr/day)	2.03 ± 0.08	1.18 ± 0.09
180 (6 hr/day)	2.52 ± 0.08	1.83 ± 0.07
720 (24 hr/day)	3.01 ± 0.11	2.22 ± 0.10

Table 3. The effect of the amount of aeration in hydroponic tanks during crop production on the yield of mustard greens and upland cress, January 21 to February 22, 2002.

	Mean Fresh Weight (oz.) ± standard error	
Hours of aeration in 30 days	'Green Wave' Mustard Greens	Upland Cress
0	0.57 ± 0.04	0.30 ± 0.02
5 (1 hr/6 days)	0.66 ± 0.04	0.31 ± 0.02
30 (1 hr/day)	0.91 ± 0.06	0.36 ± 0.03
180 (6 hr/day)	1.31 ± 0.08	0.41 ± 0.03
720 (24 hr/day)	1.68 ± 0.08	0.57 ± 0.04

Literature Cited

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