**Timing Planting for Overwintered Brassica Production in Low Tunnels**

**INTRODUCTION**

In response to increasing demand for local vegetables, growers are extending their production into the colder months. Low tunnels are one cost-effective option for prolonging the fall harvest season until just prior to snowfall, as well as for growing hardy crops for early spring harvest. These temporary, unheated structures afford less winter protection than the more widely used high tunnels, and are often inaccessible after snowfall. However, low tunnels with quick hoops can be erected for $0.50-$1.00 per square foot, estimated to be 5% of the cost of a 4-season greenhouse (Coleman 2009) or 15-30% of the cost of an unheated tunnel (Sideman). They also offer the advantage of being easily moved, allowing rotation of winter production areas. Low tunnels have been shown to provide sufficient winter protection for hardy fall-planted crops to survive, and speed up spring harvest by 4-5 weeks. Farmers have found that low tunnels can work for overwintering crops of the Brassica, allium, Chenopodia and umbel families. We explored the potential for inexpensive production of Brassicas under low tunnels, and evaluated the effect of planting date on maximizing spring yield and quality.

**METHODS**

We established 100’ long low tunnels over 5’ raised beds covered with black plastic mulch. Our hoop system consisted of 10’ PVC pipe bent over rebar spaced 2.5’ apart. We tested Siberian Kale (*Brassica napa*), Mizuna-Tatsoi-Maruba cross (*Brassica rapa*), and Mixed Mustard greens (*Brassica juncea*). Greens were planted in three intervals: the first round was seeded August 29 and transplanted September 26, the second round was seeded September 14 and transplanted October 11, the third round was seeded September 26 and transplanted October 19. A harvest from the first planting was done on November 3. A layer of 1.25 oz row cover was applied on November 7, around the date of first frost, and a layer of 6 mil Greenhouse plastic was added on December 13. Greenhouse plastic and row cover were removed for all trials on March 21. We harvested Brassicas for a second time on March 21/22, and a third time on April X. At times of harvest, we recorded % survival, % bolting, and marketable weights.

**RESULTS**

Our Mizuna-Tatsoi-Maruba cross quickly bolted, and was not situable for commercial production, so we focused only on production of Siberian Kale and Mixed Mustard greens. Survival of overwintered plants was high, averaging 96% for kale and 92% for mustard. Survival was high across all planting dates, though slightly lower for the first planting date in mustard (average of 83%). Due to the long growing season, bolting became an issue by the third harvest. In kale, about 10% of plants were bolting at the second harvest, and 90% had bolted by the third. In mustard, the numbers were a bit lower, with only 1% bolted at the second harvest, and 39% by the third. In kale, the early planting dates were the first to bolt, but in mustard, the opposite was true (see Figure 1 below). Only 23% of the first round of mustard had bolted by April X, compared to about half of plants from the second and third plantings.

**Figure 1**. Bolting of kale and mustard limited harvest options later in the season.

In both crops, we harvested from the first planting in late fall, but did not harvest from the later planting dates until spring. The combined marketable weight from the two spring harvests was highest for the first planting date. Overall, this meant that the first planting date (August 29) had much higher production of marketable greens than later plantings (Figure 2). For kale, the first planting date had a combined harvest that was 1.7 times greater than the second planting date, and 2 times greater than the third planting date. For mustard, the first planting had a total harvest that was 2.3 times greater than the second planting date, and 2.7 times greater than the third. Since bolting was so high at the third harvest, we did not anticipate it would be possible to get a fourth harvest in for any of the plants, even those planted later in the season. This suggests that if you do choose to plant in the fall, planting earlier will generate greater yield, even if in some cases it leads to higher rates of bolting in the spring.

**Figure 2**. Total harvest was highest for the first planting date in both kale and mustard.