Research Reports

Sowing Date, Transplanting Date, and Variety Effect on Transplanted Short-day Onion Production

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Additional index words. spring onions, nonstorage, bareroot, seedling, Vidalia, yield, seedstems, double bulbs, planting

Summary. **Onions (*Allium cepa*) produced in southeastern Georgia's Vidalia-growing region are primarily grown from on-farm produced bareroot transplants, which are usually sown at the end of September. These transplants are pulled midwinter (November to January) and reset to their final spacing. This study was to evaluate sowing date, transplanting date, and variety effect on yield and quality of onions. Beginning in the first week of November, onions can be transplanted until the end of December with reasonable yield and quality. For example, in the 2003–04 season, total yield of onions transplanted on 22 Dec. 2003 did not differ from any onions transplanted on earlier dates in November or December. In the 2004–05 season, onions transplanted on 20 Dec. 2004, had lower total yield than onions transplanted in November, but were not different from onions transplanted on 4 Jan. 2005. The propensity of some varieties to form double bulbs can be reduced with later sowing and transplanting dates. Sowing the first week of October rather than the fourth week of September and transplanting in December rather than November can reduce double bulbs in some varieties.**

Onion is an important crop in Georgia, with a farm gate value over $125 million in 2005 (Boatright and McKissick, 2006). This important commodity is produced in southeastern Georgia in the Vidalia-growing region, which is protected by Federal Market Order 955 (Boyhan and Torrance, 2002). This high-value crop is produced from transplants on-farm in high-density plantings (Boyhan and Kelley, 2007). Onion seeds are sown in September at a rate of 800,000 to 2,000,000 seeds/acre. These plants are grown for 8 to 10 weeks at which time they are harvested and transplanted to their final spacing of 60,000 to 80,000 plants/acre.

Using transplants for onion production is labor intensive and is not practiced in all onion-producing regions. A number of different aspects of transplant production have been investigated concerning onions. Al-Abdulsalam and Hamaiel (2004) investigated planting date and fertilizer and found that 20 Oct. was the optimum planting date with moderate fertilizer application in comparison with 20 Sept. or 20 Nov. transplanting dates in Al-Hasa, Saudi Arabia. In another study from the Middle East, El-Rehim et al. (1997) found that at the Shandaweel Experiment Station, Egypt, the best yields were with transplants set on 15 Nov. compared with 5 Feb.

With short- and intermediate-day onions grown in Queensland, Australia, it was found that the highest yields occurred with April plantings (70–84 t·ha^{-1}) compared with February/March (54–56 t·ha^{-1}) or May/June (60–63 t·ha^{-1}) plantings (Jackson et al., 2001). In another study evaluating transplant date and variety, the best transplanting date for total yield was on 15 July compared with 30 July, or 15 or 30 Aug. (Pandey et al., 1992).

Sowing date was shown to have an effect on onion production in Louisiana, with the best yields for onions sown on 3 Oct. compared with 23 Sept. or 10 Oct., with the former planting date resulting in increased bolting (Mulkey and Talbot, 1991).

Fall-planted onion sets had greater losses compared with spring-planted sets, with temporary plastic covers having no effect on yield in Poland (Tendaj and Gruszecki, 2002).

Herison et al. (1993) found that older transplants (12 vs. 8 weeks old) resulted in larger bulbs and increased yield at harvest. Transplant age has also been investigated in the tropical West African nation of Ghana. Kanton et al. (2002) found that maximum yield was produced from transplants

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Units

To convert U.S. to SI, multiply by	U.S. unit	SI unit	To convert SI to U.S., multiply by
0.4047	acre(s)	ha	2.4711
0.3048	ft	m	3.2808
2.54	inch(es)	cm	0.3937
1.1209	lb/acre	kg·ha^{-1}	0.8922
2.2417	ton/acre	t·ha^{-1}	0.4461
(°F – 32) ÷ 1.8	°F	°C	(1.8 × °C) + 32

that were 20 to 40 d old, and 40-d-old transplants produced the heaviest bulbs. In addition, the lightest bulbs were from 70-d-old transplants.

There were several objectives for these experiments. One objective was to determine how long onions could be transplanted after transplants were judged ready, while still having good yields of quality onions. Onion transplants are ready in 8 to 10 weeks from sowing, but typically require 8 weeks or longer for the entire onion crop to be transplanted. In addition, onions with a propensity for double bulbs were evaluated for the effect of sowing and transplanting date on reducing this phenomenon.

Materials and methods

All experiments were conducted at the Vidalia Onion and Vegetable Research Center in Lyons, GA (lat. 32°11′N, long. 82°17′W) on a Tifton soil (fine-loamy, siliceous, thermic Plinthic Paleudults). The experimental design in all experiments was a randomized complete block design with four replications.

All seeds were sown on high-density plant beds according to University of Georgia Cooperative Extension Service recommendations (Boyhan and Kelley, 2007). Beds were prepared on 6-ft centers with four twin rows planted per bed. There were 12 inches between the twin rows and there was 1 cm in-row for each of the twin rows, resulting in ≈60 seeds per linear foot of row (about 240 seeds per linear foot of bed). All harvested transplants had 50% of their tops removed before transplanting as bareroot plants.

All plants were transplanted to a final spacing of 5.5 inches in-row and 12 inches between-rows. Four rows were planted on beds prepared on 6-ft centers. Each experimental unit was 20 ft of planted bed.

All onions were harvested when judged mature for that variety except for the 2003–04 experiment. Criteria for judging a variety mature was based on bulb size, weakness in the neck, and/or plants broken over at the neck. The tops and roots of harvested bulbs were immediately removed and total yield was recorded for each experimental unit. Onions were then heat cured with forced air for 24 h at 95 °F and were then graded into jumbo- (≥3 inches diameter) and medium- (≥2 and <3 inches diameter) sized onions according to U.S. Department of Agriculture (1995) standards.

Data from all studies were analyzed with Excel (version 11.3.5; Microsoft, Redmond, WA) and Stata (version 10.0; StataCorp, College Station, TX). Count data (seedstems and doubles) were transformed with square root (x) before analyses and reported values were back-transformed to their original units.

In the 2003–04 season, 'Sweet Vidalia' (Nunhems, USA, Parma, ID) seeds were sown on 15 Sept. 2003. Onion transplants were harvested about every 2 weeks from the transplant beds beginning on 5 Nov. 2003 and continuing until 15 Mar. 2004 (Table 1).

Onion seedstems (flowering) and doubled bulbs were counted on 5 Apr. 2004. All onions were harvested on 28 Apr. 2004 when onions transplanted on 2 Mar. 2004 were judged mature.

A second factorial experiment evaluating varieties and transplanting dates was conducted in the 2004–05 growing season. Seeds of 'Sugar Belle' (Shamrock Seed, Salinas, CA), 'Sweet Vidalia', and 'Pegasus' (Seminis, St. Louis) were sown on 21 Sept. 2004. Onion plants were transplanted on seven different dates beginning on 12 Nov. 2004 and continuing until 8 Feb. 2005 (Table 2).

Seedstems and doubles were counted on 15 Apr. 2005 for each experimental unit. Individual treatment combinations (variety/transplant date) were harvested when judged mature (Table 2).

Also in the 2004–05 season, an experiment was conducted to evaluate sowing and transplanting date as well as variety effects on yield, graded yield, seedstems, and doubles. Varieties Ohoopee Sweet, Sweet Advantage, and Mr. Buck (D. Palmer Seed, Yuma, AZ) were used for this experiment. 'Ohoopee Sweet', 'Sweet Advantage', and 'Mr. Buck' were sown on 24 Sept. 2004 in a high-density plant bed as described above. In addition, 'Sweet Advantage' and 'Mr. Buck' were sown on 1 and 7 Oct. 2004 in this high-density arrangement. All three varieties from each sowing date were transplanted on 22 Nov., 6 and 20 Dec. 2004 as described previously. This resulted in an unbalanced factorial arrangement with a randomized complete block design of four replications.

All the 'Ohoopee Sweet' treatments were harvested on 19 May 2005. 'Sweet Advantage' sown on all three dates and transplanted on 22 Nov. and 6 Dec. 2004 were harvested on 4 May 2005, while 'Sweet Advantage' sown on all three dates and transplanted on 20 Dec. 2004 were harvested on 11 May 2005. 'Mr. Buck' sown on 24 Sept. 2004 and transplanted on 22 Nov. and 6 Dec. 2004 were harvested on 19 May 2005. All of the remaining 'Mr. Buck' treatments were harvested on 25 May 2005.

Table 1. Effect of transplant date with short-day onions on yield, graded yield, seedstems, and doubles for 'Sweet Vidalia' in the 2003–04 season at Lyons, GA.[z]

Transplanting date	Total yield	Jumbo yield[y]	Medium yield[y]	Seedstems	Doubles
	(lb/acre)[x]			(no./plot)[w]	
5 Nov. 2003	25,809	17,642	563	75.4	6.9
24 Nov. 2003	35,619	25,700	1,661	21.6	1.7
8 Dec. 2003	24,112	15,346	3,458	23.1	21.6
22 Dec. 2003	30,365	20,691	2,432	15.4	5.2
5 Jan. 2004	18,749	7,487	5,400	91.6	31.3
20 Jan. 2004	34,476	20,963	3,421	10.2	11.4
2 Feb. 2004	25,083	9,438	5,636	66.5	29.2
19 Feb. 2004	16,644	3,748	5,953	29.6	8.0
2 Mar. 2004	10,600	200	5,309	1.4	15.3
15 Mar. 2004	—	—	—	0	0
		LSD (0.05)[v]			
	6,127	4,740	1,544	1.6	1.1

[z]Onions were harvested on 28 Apr. 2004.
[y]Jumbo ≥3 inches diameter, medium ≥2 and <3 inches diameter (1 inch = 2.54 cm).
[x]1 lb/acre = 1.1209 kg·ha^{-1}
[w]Plot size was 20 ft on 6-ft centers (1 ft = 0.3048 m); 1 seedstem or double per plot = 363/acre = 897/ha.
[v]Fisher's protected least significant difference at $P \leq 0.05$.

Table 2. Effect of transplanting date, for short-day onions, on yield, graded yield, seedstems, and doubles with varieties Sugar Belle, Sweet Vidalia, and Pegasus in the 2004–05 season at Lyons, GA.

Treatment[z]	Total yield	Jumbo yield[y]	Medium yield[y]	Seedstems	Doubles
Transplant date	(lb/acre)[x]			(no./plot)[w]	
12 Nov. 2004	43,321	32,023	3,092	5.1	13.6
23 Nov. 2004	39,437	29,772	4,066	1.7	15.6
6 Dec. 2004	37,322	27,219	3,745	5.1	13.8
20 Dec. 2004	30,244	21,599	4,925	8.8	18.4
4 Jan. 2005	23,138	13,540	4,849	17.5	17.8
25 Jan. 2005	11,562	3,818	3,969	13.1	16.0
8 Feb. 2005	8,703	1,107	4,525	21.7	21.9
Variety					
Sugar Belle	27,777	18,726	4,386	4.6	19.2
Sweet Vidalia	26,764	17,025	6,060	21.0	29.3
Pegasus	28,485	19,568	2,056	5.7	1.8
Probability					
Transplant date	0.000	0.000	0.002	0.000	0.051
Variety	0.587	0.247	0.000	0.000	0.000
Transplant date × Variety	0.024	0.696	0.000	0.003	0.013
			LSD (0.05)[v]		
	8,828	8,107	1,625	1.7	—

[z]Onions were harvested on 4, 11, and 19 May 2005 as individual treatments were determined mature.
[y]Jumbo ≥3 inches diameter, medium ≥2 and <3 inches diameter (1 inch = 2.54 cm).
[x]1 lb/acre = 1.1209 kg·ha^{-1}.
[w]Plot size is 20 ft on 6-ft centers (1 ft = 0.3048 m); 1 seedstem or double per plot = 363/acre = 897/ha.
[v]Fisher's protected least significant difference at $P \leq 0.05$ calculated for transplant date only.

Tops and roots were immediately removed when harvested and bulbs were weighed. These onions were then heat cured and graded into jumbo- and medium-sized classes.

Results

In the 2003–04 season, the highest total yield occurred with onions transplanted on 24 Nov. 2003 with 35,619 lb/acre. This treatment did not differ from onions transplanted on 22 Dec. 2003 or 20 Jan. 2004 (Table 1). The highest jumbo yield also occurred with onions transplanted on 24 Nov. 2003. This treatment did not differ from onions transplanted on 20 Jan. 2004 and were just significantly different from onions transplanted on 22 Dec. 2003, which had 20,691 lb/acre jumbo yield. The highest medium yield occurred with onions transplanted on 19 Feb. 2004 with 5953 lb/acre. This differed from onions transplanted on 20 Jan. 2004 as well as all onions transplanted on 22 Dec. 2003 or earlier.

Seedstems were greatest with those onions transplanted on 5 Jan. 2004 (Table 1). Other treatments with exceptionally high numbers of seedstems included onions transplanted on 5 Nov. 2003 and 2 Feb. 2004. The highest number of doubles occurred with onions transplanted on 5 Jan. 2004. Other transplant dates with high numbers of doubles included 8 Dec. 2003 and 2 Feb. 2004.

In the 2004–05 season, there was a significant difference in total yield between transplanting dates, but there was not a significant variety effect (Table 2). There was a downward trend in total yield with later planting dates having the highest total yield of 43,321 lb/acre for onions transplanted on 12 Nov. 2004. This yield did not differ from onions transplanted on 23 Nov. or 6 Dec. 2004, but did differ from later transplanted onions. The interaction effect, although significant (data not shown), did not differ much from the overall downward trend in total yield with later planted onions. Transplanting date also had a significant effect on jumbo yields with the highest jumbo yields for onions transplanted on 12 Nov. 2004. There was a downward trend in jumbo yields with later transplanting dates. Onions transplanted on 12 Nov. 2004 did not differ from those transplanted on 23 Nov. or 6 Dec. 2004, but differed from those transplanted later. There were no variety or interaction effects for jumbo onions. There was a significant difference based on transplant date and variety for medium yields. 'Sweet Vidalia' had the highest medium yield of the varieties in this experiment with 6,060 lb/acre.

The interaction effect for medium onion yield differed for each variety over the range of transplanting dates (Fig. 1A). 'Sugar Belle' generally showed increasing medium yields with later planting dates. 'Sweet Vidalia' had increasing medium yields with early transplant dates, but lower medium yields after 20 Dec. 2004. Finally, 'Pegasus' also had increasing medium yields with later transplant dates, but these yields were generally lower than 'Sugar Belle' or 'Sweet Vidalia'.

There were significant differences for seedstems for transplant date and variety, as well as a significant interaction effect. For 'Sweet Vidalia', the earliest transplant date, 12 Nov. 2004, had more seedstems than the 23 Nov. or 6 Dec. 2004 transplant dates (Fig. 1B). After the 6 Dec. 2004 transplant date, seedstems increased until the 4 Jan. 2005 transplant date when seedstems reached their maximum. For 'Sugar Belle' and 'Pegasus' seedstem numbers generally increased with later transplant dates, but at much lower rates than for 'Sweet Vidalia'.

There was a significant variety and interaction effect for doubles, with 'Sweet Vidalia' having the greatest number of doubles and 'Pegasus' the fewest (Table 2). For 'Sweet Vidalia', double numbers went down through the 6 Dec. 2004 transplanting date and increased to their highest level with the 20 Dec. 2004 transplanting date (Fig. 1C). 'Sweet Vidalia' double numbers then decreased until the 25 Jan. 2005 transplant date, finally increasing with the 8 Feb. 2005 transplant date. 'Sugar Belle' doubles increased from the 12 to the 23 Nov. 2004 transplanting dates. Double numbers remained the same through the 25 Jan. 2005 transplant date before increasing with the 8 Feb. 2005 transplant date. 'Pegasus' doubles remained relatively low for all the transplant dates.

In a second experiment in the 2004–05 season, varieties 'Ohoopee Sweet', 'Sweet Advantage', and 'Mr. Buck' were chosen because of problems with high doubled bulbs in these varieties. Based on conversations with the seed company owner, it was

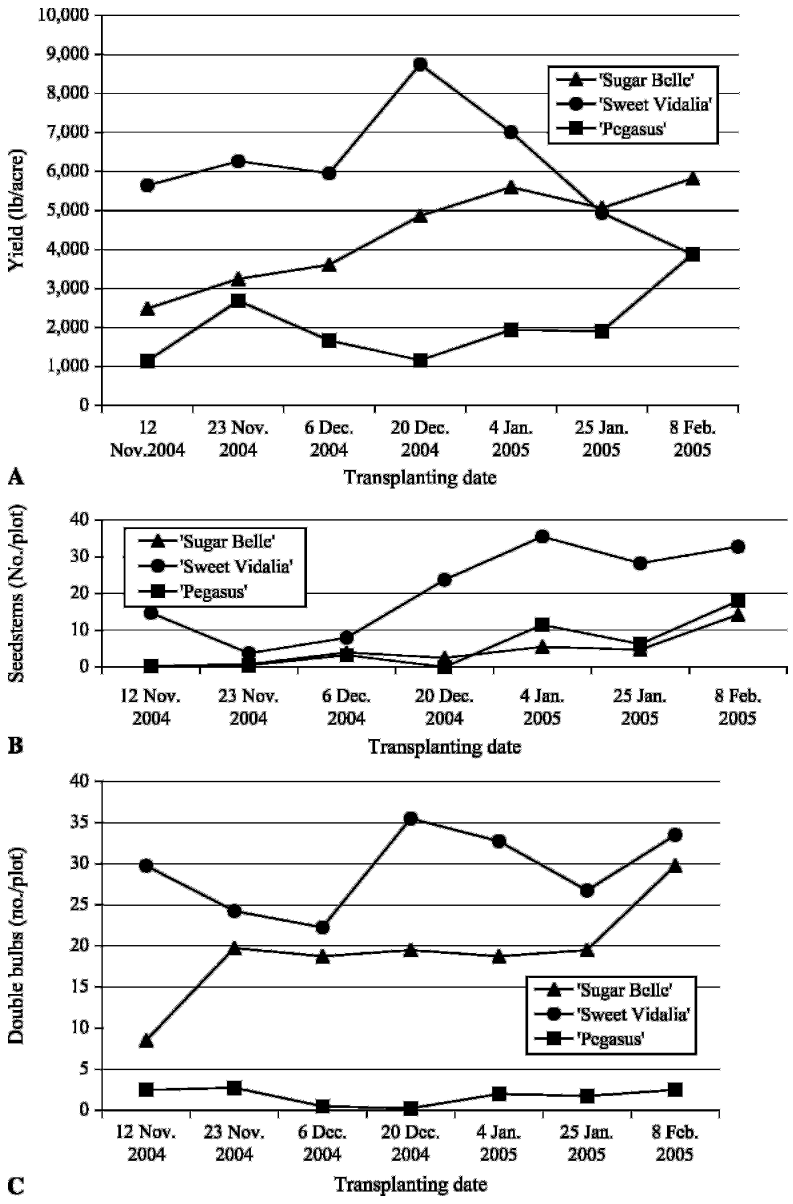

Fig. 1. Significant and meaningful interactions between variety and transplanting date with short-day onions for (A) medium yields [≥2 and <3 inches (1 inch = 2.541 cm)], (B) Number of seedstems per plot, and (C) number of double bulbs per plot in 2004–05 (1 seedstem or double per plot = 363/acre = 897/ha). Plot size is 20 ft on 6-ft centers (1 ft = 0.3048 m).

suggested that later sowing and transplanting dates may alleviate this problem, especially with 'Ohoopee Sweet' and 'Sweet Advantage' (D. Palmer, personal communication). For total yield, there were significant variety, sowing date, transplanting date, and interaction effects except for variety by sowing date (Table 3). The sowing date by transplanting date and the variety by transplanting date interactions did not differ appreciably (data not shown) from the combined effects. Later sowing and transplanting dates resulted in lower total yields regardless of variety.

For jumbo yields, there was a transplanting date effect as well as interaction effects for sowing date by transplanting date and variety by sowing date (Table 3). Onions sown on 7 Oct. 2004 showed an increase in jumbo yields with onions transplanted on 6 Dec. 2004 compared with those transplanted on 22 Nov. 2004, and then there was a decrease with onions transplanted on 20 Dec. 2004 (Fig. 2A). Onions sown on 24 Sept. or 1 Oct. 2004 showed a decrease in jumbo yields with later transplanting dates from 22 Nov. to 20 Dec. 2004.

'Sweet Advantage' had little change in jumbo yields between the sowing dates of 24 Sept. and 1 Oct. 2004, but those sown on 7 Oct. 2004 had a decrease in jumbo yields compared with previous sowing dates (Fig. 2B). 'Mr. Buck' showed a decrease in jumbo yield with onions sown on 1 Oct. 2004 compared with those sown on 24 Sept. 2004 and the greatest yield of Jumbo for those onions sown on 7 Oct. 2004.

For medium yields, there were a significant variety, sowing date, and variety by sowing date interaction effects (Table 3). The interaction effect was not appreciably different (data not shown) from the combined effects of varieties and sowing dates. 'Sweet Advantage' had significantly greater medium yield compared with 'Ohoopee Sweet' and 'Mr. Buck'. In addition, medium yield was greatest with onions sown on 24 Sept. 2004.

There were significant effects for seedstem numbers based on variety, sowing date, sowing by transplant dates, and variety by sowing date (Table 3). The interaction effects did not differ appreciably (data not shown) from the combined effects for seedstems. 'Mr. Buck' had slightly more seedstems than 'Ohoopee Sweet' or 'Sweet Advantage', and onions sown on 24 Sept. 2004 had significantly more seedstems than those sown on 1 or 7 Oct. 2004.

Doubles were also significantly affected by variety, sowing date, transplant date, sowing date by transplanting date, variety by sowing, and variety by transplanting date, (Table 3). The variety by transplanting date interaction was not appreciably different (data not shown) from the combined effects. The number of double bulbs for each transplant date was significantly affected by sowing date (Fig. 2C). Onions sown on 24 Sept. 2004 had the greatest number of doubles with the 22 Nov. 2004 transplanting date. The number of doubles was significantly less with the 6 and 20 Dec. 2004 transplanting dates. Onions sown on 1 Oct. 2004 showed an increase in the number of doubles with later transplanting dates, but were much less overall than onions sown on 24 Sept. 2004. Onions sown 7 Oct. 2004 showed no appreciable change in doubles, regardless of transplanting date.

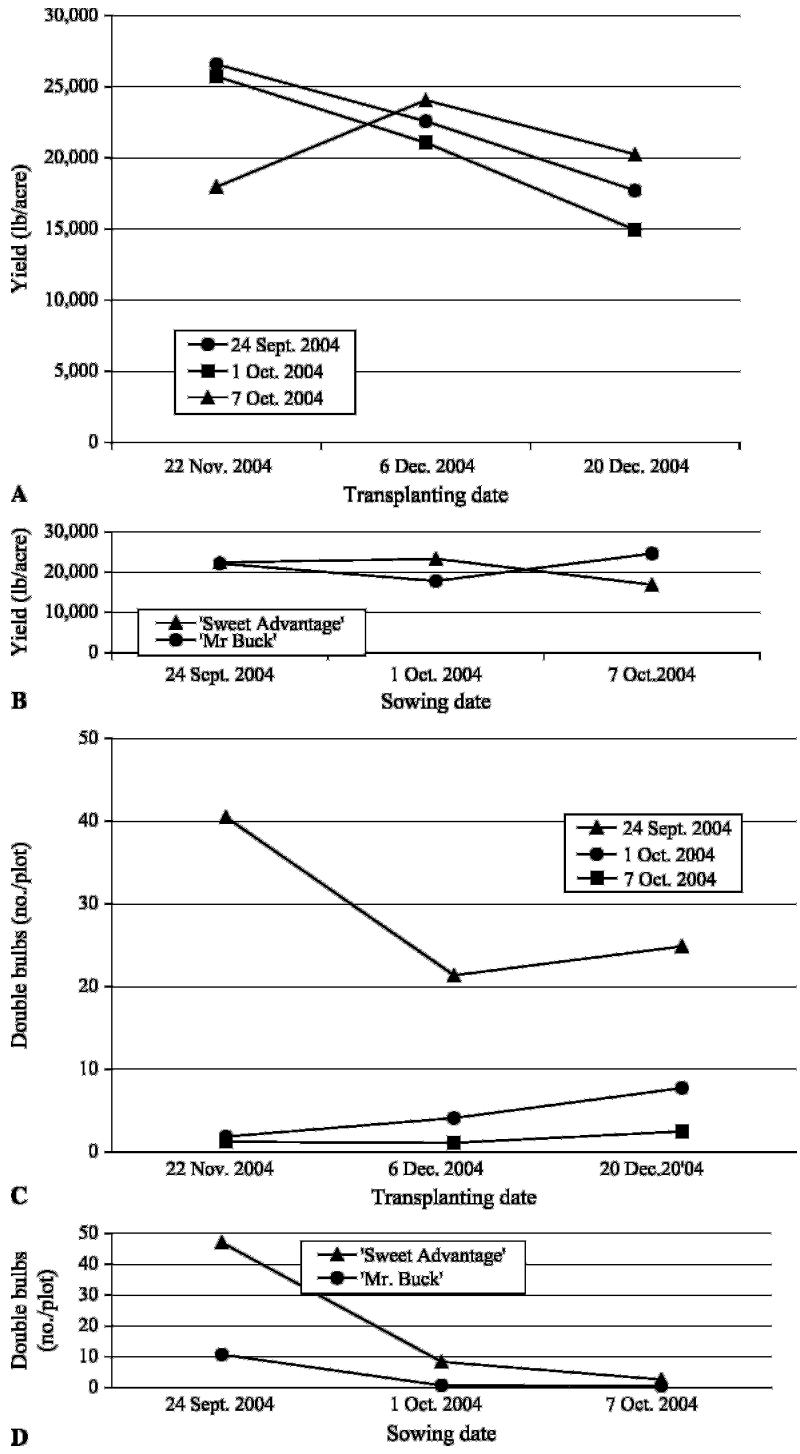

Fig. 2. Significant interactions of short-day onions for sowing by transplanting dates and variety by sowing dates for jumbo yield [≥3 inches (1 inch = 2.54 cm)] (A and B), and sowing by transplanting dates and variety by sowing date for number of double bulbs/plot (C and D). Plot size is 20 ft on 6-ft centers (1 ft = 0.3048 m); 1 lb/acre = 1.1209 kg·ha^{-1}, 1 seedstem or double per plot = 363/acre = 897/ha.

The sowing date by variety interaction indicated that both varieties, 'Sweet Advantage' and 'Mr. Buck', had less doubled bulbs with later sowing dates, but that the magnitude of the difference differed with variety (Fig. 2D). 'Sweet Advantage' had much greater number of doubled bulbs with the early sowing date of 24 Sept. 2004 compared with 'Mr. Buck'. With the 7 Oct. 2004 sowing date, there was no difference with the number of doubled bulbs between the varieties.

Discussion

Total yield is a good indicator of the potential a particular cultural practice or variety can have on onion yield. Based on the 2003–04 season, acceptable yields through the end of January were possible, but with the 2004–05 data, the end of December would be the last date for production of acceptable yields. This coincides with grower practices generally. Growers try to have all of their onions transplanted by the end of December, but there are always some onions transplanted in January. It is rare to hear of onions being transplanted in February, but this is done occasionally due to some unusual environmental factor such as poor transplanting conditions earlier or favorable market forces.

Jumbo is the most important size, with the majority of the onions marketed in this size class. The results with this size class in 2003–04 and in 2004–05 mirrors the results for total yield. Onions are generally of good quality when they are harvested if the percentage of marketable onions (jumbo and medium) is 75% or more of total yield. Dramatic differences between total and jumbo yields reflect quality problems (usually diseases or seedstems) resulting in a high number of culls. As examples, the marketable yield with onions transplanted on 2 Feb. 2004 and 25 Jan. 2005 were 60% and 67%, respectively.

As jumbo yields decrease with later transplanting dates, medium yields often will increase. This is reflected in the 2003–04 data, but not in the 2004–05 data.

The 2003–04 season had particularly high numbers of seedstems and doubles (Boyhan et al., 2004). This reflects environmental conditions that year that favored these undesirable characteristics. Seedstems are usually greater when cool temperatures (<50 °F) occur late in the season (March and April) when plants have sufficient leaf numbers to respond to these conditions and enter a sexual phase, which did occur in the 2003–04 season (Brewster, 1994). Although not reliably tested, doubled bulbs seem to appear with more frequency during years with very cold weather (<20 °F). It is postulated that the meristem is damaged in such a fashion that two meristems result,

Table 3. Evaluation of selected short-day onion varieties, sowing, and transplanting dates effect on yield, graded yield, seedstems and doubles in the 2004–05 season at Lyons, GA.

Treatments[z]	Total yield	Jumbo yield[y]	Medium yield[y]	Seedstems	Doubles
Variety	(lb/acre)[x]			(no./plot)[w]	
Ohoopee Sweet	34,294	18,108	2,480	0.7	17.0
Sweet Advantage	30,825	20,888	6,572	0.9	19.4
Mr. Buck	38,759	21,538	2,009	1.5	4.0
Sowing date					
24 Sept. 2004	37,159	20,900	4,515	2.6	24.9
1 Oct. 2004	34,075	20,585	3,539	0.0	4.6
7 Oct. 2004	31,710	20,758	3,799	0.0	1.6
Transplanting date					
22 Nov. 2004	38,505	23,170	3,967	1.7	16.0
6 Dec. 2004	36,229	22,440	3,762	0.6	9.8
20 Dec. 2004	29,429	16,698	4,366	1.1	11.5
Probability					
Variety	0.000	0.137	0.000	0.000	0.000
Sowing date	0.005	0.558	0.000	0.000	0.000
Transplanting date	0.000	0.000	0.431	0.532	0.045
Sowing date × Transplanting date[v]	0.004	0.003	0.058	0.001	0.000
Variety × Transplanting date	0.049	0.569	0.963	0.158	0.016
Variety × Sowing date[v]	0.154	0.000	0.000	0.001	0.000

[z]Onions were harvested on 4, 11, 19, and 25 May 2005 as individual treatments were judged mature.
[y]Jumbo ≥ 3 inches, medium <3 inches and ≥2 inches (1 inch = 2.54 cm).
[x]1 lb/acre = 1.1209 kg·ha^{-1}.
[w]Plot size is 20 ft on 6-ft centers (1 ft = 0.3048 m); 1 seedstem or double per plot = 363/acre = 897/ha.
[v]Excludes 'Ohoopee Sweet'.

which produce two bulbs. The 2003–04 season had several occasions when temperatures were below 20 °F. Seedstems and doubles were not nearly as bad overall in the 2004–05 season, therefore the numbers reported this year are more reflective of the treatment effects rather than the environmental effects. This can be seen by increasing numbers of seedstems with later transplanting dates. Doubles were unaffected at the 0.050, but the probability was marginally significant at 0.051.

With the D. Palmer Seed Co. varieties, sowing date had a dramatic effect on doubles. As the company owner had indicated, later sowing dates reduced the number of doubles. Later transplanting, however, was only effective with early-sown onions. Later sowing and later transplanting resulted in a slight increase in doubles, which suggests that sowing date is the more important consideration in reducing doubles. This is something of which growers of these varieties should be aware. Although these cultural practices (later sowing and transplanting dates) can alleviate this problem, it is still an undesirable characteristic in a variety. Varieties should be more forgiving and perform under a reasonably wide range of cultural practices such as sowing and transplanting dates.

This reduction in doubles was particularly pronounced with 'Sweet Advantage'. 'Sweet Advantage' is an older variety than 'Mr. Buck' or 'Ohoopee Sweet' and, in general, the newer introductions perform better.

In conclusion, short-day onions in southeastern Georgia should be transplanted before the end of December; however, reasonable yields can still be expected with those transplanted in January. In addition, certain varieties such as those from D. Palmer Seed Co. can benefit from later sowing to reduce doubled bulbs.

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