VEGETARIAN NEWSLETTER

A VEGETABLE CROPS EXTENSION PUBLICATION

VEGETARIAN 04-01 JANUARY 2004

PRINT VERSION

PLANTING DATE AFFECTS EARLY SEASON FRUIT YIELD OF STRAWBERRY IN A SUPTROPICAL ENVIRONMENT

Abstract

A study was conducted to determine the effect of planting date on the fruit yields of strawberry (*Fragraria xAnanassa* Duch.) transplants grown in a winter annual hill production system. Bare-root and plug transplants of 'Sweet Charlie' and 'Camarosa' from a high latitude or high elevation nursery were planted each week during October 1999 and 2000 at Dover, Fla. Planting date had a significant effect on December yield, with transplants planted in early October generally having higher December yields than transplants planted in late October. Planting date also had significant effects on January, February, and March yields, but these effects were not consistent across years or cultivars.

Introduction

The annual hill production system is used in west central Florida and other subtropical areas, such as southeastern Queensland, Australia and north central Argentina, to produce strawberry fruit during late fall and winter. Fruiting fields are reestablished each year by planting fresh dug or plug transplants in October (northern hemisphere) or April (southern hemisphere). These plants usually start producing a few flowers within three to six weeks of planting, and this flowering continues until spring. Flowers typically develop into ripe fruit within 30 days. In Florida, acceptable total season yields have been obtained when transplants are planted anytime during October, but in previous studies with locally propagated transplants, the highest early season yields were obtained when transplants were planted in early October (Albregts and Howard, 1977; Albregts and Howard, 1980; Chandler et al., 1991). Growers should be able to benefit financially by taking steps to increase their early season yield, particularly their November/December yield. November/December production amounted to only 10% of the total crop yield in Florida during the ten-year period 1991-2001 (Florida Agricultural Statistics, www.nass.usda.gov/fl), but that production was valuable. It returned the highest average value per 5.4 kg flat, $16.25, compared to $12.86, $10.13, and $7.00 for January, February, and March respectively.

Currently, the majority of Florida's 2800 hectares of strawberries (>95%) is planted using bare-root, non-defoliated transplants from high latitude (≥42° N) or high elevation (> 900 m) nurseries. The remaining acreage is planted with plug plants that are also from high latitude or high elevation nurseries. Growers prefer transplants from these areas because they tend to have fewer disease problems and begin to flower sooner than locally produced transplants. Bare-root transplants are produced in open fields where daughter plants remain attached to the mother plant and are allowed to root into the soil. Plug plants are produced by removing and placing young daughter plants in standard transplant trays, misting them until sufficient roots are formed, and allowing them to grow and develop in the trays for four to six weeks (Durner et al., 2002). This may be done in greenhouses or open fields. Relatively low cost and ample supply make bare-root plants an attractive option for growers. Water savings at establishment and potentially earlier yields make plug plants desirable (Hochmuth et al., 2001); however, their cost can be twice as much as that for bare-root plants.

The objective of this study was to determine the effect of planting date on fruit yields of strawberry transplants from high latitude/high elevation nurseries.

Materials and Methods

Bare-root and standard (75 cm^3) plug transplants of 'Sweet Charlie' and 'Camarosa' were obtained from a commercial nursery in Nova Scotia, Canada and western North Carolina, respectively. Transplants were dug (in the case of the bare-roots), packed, and immediately shipped by refrigerated truck to Florida so that they arrived at the Gulf Coast Research Center - Dover three days before the intended planting date. Transplants were planted on Oct. 1, 8, 15, and 22 in 1999, and Oct. 2, 9, 16 and 23 in 2000. Four replications of each of the 16 treatments (two cultivars x two transplant types x four planting dates) were arranged in a randomized complete block design. Each plot contained 16 plants on two-row raised beds, with plants spaced 30 cm apart within and between rows. Micro-overhead irrigation, applied intermittently, was used for 10 days to establish the plots of bare-root transplants, while no overhead irrigation was used to establish the plug transplants. After the establishment period, drip irrigation was used to meet the plants' water requirement. University of Florida Cooperative Extension Service recommendations for fertilizer and pest management (Maynard and Olson, 2000) were followed throughout the season. Berries were harvested, graded, and weighed twice weekly beginning on 3 Dec. 1999 and 15 Dec. 2000. Data for bare-roots and plugs were analyzed separately (by analysis of variance, SAS Institute, 2001) because the bare-roots were propagated in a different location than the plugs, and nursery location has been shown to have a significant effect on the fruit yield of strawberry transplants in west central Florida (Stapleton et al., 2001).

Results and Discussion

For bare-root transplants, which are by far the most important type of strawberry transplant in Florida, planting date significantly affected December yield (Table 1). Transplants planted during the first week of October had higher December yield than transplants planted during the third and fourth week of October, and transplants planted during the second and third week of October had higher December yield than transplants planted during the fourth week of October. In fact, the transplants planted during the third and fourth week of October produced only 64% and 32%, respectively, of the December fruit yield produced by transplants planted in the first week of October. Production after December was also affected by planting date, but the influence of planting date was not consistent across years or cultivars (Table 1). 'Camarosa' transplants planted during the third week of October had significantly higher January yield than 'Camarosa' transplants planted during the first week of October, but a significant planting date effect on 'Sweet Charlie's January yield was not detected. Beyond January, the effect of planting date on the yield of bare-root transplants was minimal.

The effects of planting date on the December and January yield of plug transplants appears to be similar to that obtained with bare-root transplants (Table 2). Plug plants planted in early October tended to have higher December yields than the plug plants planted in late October. In terms of December yield, the second and third weeks of October were the best weeks to plant 'Sweet Charlie', while the first and second weeks were the best weeks to plant 'Camarosa'. However, 'Camarosa' transplants planted during the first week in October 1999 had lower January yield than the transplants planted later in October (data not shown). This association of high yield one month with low yield the next has been noted in other strawberry field trials in west central Florida (Bish et al., 2002; Chandler and Kemerait, 2002). The February yield of 'Sweet Charlie' plug plants planted during week one, two, and three were similar, while the plug plants planted during week four produced significantly less fruit than those planted during week two (Table 2). The February yield of 'Camarosa' plug plants was not affected by planting date.

The 1999-2000 season had a higher monthly air temperature in October, November, December, January, and March, but a lower monthly air temperature in February, than did the 2000-2001 season (http://fawn.ifas.ufl.edu). These differences in air temperature could have contributed to the year x planting date interactions detected in this study.

The influence of planting date on the high latitude/high elevation transplants in this study was similar to the influence of planting date on the locally propagated transplants used by Albregts and Howard (1977 and 1980) and Chandler et al. (1991). For both high latitude/high elevation and locally propagated transplants, planting date had a consistent effect on early season yield, but its effect on late season yields was variable.

Based on this study, growers in west central Florida should plant transplants during the first or second week in October to obtain the highest possible December yields. High December yields may result in lower January yields during some years, but this tradeoff is probably acceptable considering the value of December fruit. The Florida strawberry industry uses over 100 million transplants each year, and it would be virtually impossible for the nurseries to dig, grade, pack, and ship all of these plants to growers so they would arrive (fresh) within the first two weeks in October. Equipment, labor, and weather are factors that limit how fast this operation can be accomplished. Also, even if all the transplants could be obtained in the first two weeks of October, growers in Florida probably would not be able to obtain enough labor to plant all of the transplants, which, currently, are totally set by hand. But, in view of the fact that transplants delivered to growers in late October are likely to have relatively low December yields, there might be justification for adjusting the price of transplants according to delivery date. In other words, growers may be justified in paying more for transplants that are delivered to them in early October and less for transplants that are delivered to them in late October.

Literature Cited

Table 1. Effect of planting date on fruit production (flats per acre) of bare-root strawberry transplants at Dover FL.

	Dec.	Jan '00	Jan '01	Jan SCx	Jan Cam	Feb '00	Feb '01
Planting Date							
Week 1	211ay	211b	264	186	288b	390	349ab
Week 2	173ab	333a	218	237	349ab	435	314b
Week 3	134b	365a	246	202	413a	390	448a
Week 4	67c	294ab	243	176	365ab	410	378ab
Significance							
	Dec	Jan	Feb	March			
Plating Date (P)	***	**	NS	NS			
Year (Y) X (P)	NS	**	**	NS			
Cultivar (C)	NS	**	NS	NS			
P X Y X C	NS	NS	NS	*			

z Week 1-4 represents planting dates of 1, 8, 15 and 22 Oct. 1999 and 2, 9, 16, and 23 Oct. 2000.

y Mean separation within columns by Fisher=s protected LSD at *P* # 0.05.

xSC = Sweet Charlie; Cam = Camarosa

NS, *, **, ***Nonsignificant or significant at *P* # 0.05, 0.01 or 0.001, respectively.

Table 2. Effect of planting date on fruit production (flats per acre) of plug strawberry transplants at Dover FL.												
	Dec '99	Dec '00	Dec SC^{x}	Dec Cam	Jan '00	Jan '01	Jan SC	Jan Cam	Feb SC	Feb Cam	Mar SC	Mar Cam
Planting Date												
Week 1	186ab^{y}	150a	109b	227a	90b	109	115	83c	333ab	144	131	976
Week2	224a	189a	176a	237a	182a	99	138	144b	358a	150	163	998
Week 3	147b	186a	173a	166b	230a	125	138	218a	336ab	154	170	892
Week 4	134b	83b	198a	134b	198a	125	128	195ab	250b	227	118	717
Significance												
	Dec	Jan	Feb	Mar								
Planting Date (P)	***	**	NS	***								
Year (Y) X P	**	**	NS	NS								
Cultivar (C) X P	***	*	**	**								
P X Y X C	NS	*	NS	NS								

^{z} Week 1-4 represents planting dates of 1, 8, 15 and 22 Oct. 1999 and 2, 9, 16, and 23 Oct. 2000.
^{y} Mean separation within columns by Fisher=s protected LSD at *P* # 0.05.
^{x} SC = Sweet Charlie; Cam = Camarosa
NS, *, **, ***Nonsignificant or significant at *P* # 0.05, 0.01 or 0.001, respectively

(**John R. Duval, Craig K. Chandler, and Elizabeth Golden - GCREC-Bradenton - Vegetarian 04-01**)

VIRUS IN YELLOW SQUASH IN HILLSBOROUGH COUNTY

In October 2003 in Hillsborough County, a field of 'Gentry' yellow crookneck squash was severely affected by the watermelon strain of papaya ringspot virus (PRSV-W) (Fig. 1), formerly called WMV-1. PRSV-W infects cucurbits almost exclusively but does not infect papaya. It is the most important of the aphid-transmitted viruses affecting cantaloupe, watermelon, and squash in central and south Florida. The virus is spread in a nonpersistent manner by over 20 species of aphids. Aphids do not retain the virus for very long but can acquire and transmit it in very brief probes of the leaf surface.

Both foliage and fruit symptoms observed in ‘Gentry’ were severe. The leaves of the plants were distorted and mottled, with the newer leaves reduced in size and very narrow (laciniate or filiform). The squash were knobby instead of smooth with green veining over the fruit. Yield was greatly reduced. In this field, you could see where the virus had first infected squash on the north side where an old abandoned orange grove overgrown with weeds was present. It was easy to tell that the plants next to the grove had been infected at an early age. By the time of harvesting, the plants on this side of the field were severely stunted and were distorted with little to no fruit. The fruits present were small and gnarled with much green veining. The spread of the virus through the field appeared to follow the prevailing winds. As you moved south across the field away from the grove, symptoms were milder. More distant plants had normal lower leaves and fruit with only the upper portion of the plants and youngest fruit distorted, indicating that these plants had been infected later than plants near the grove.

The grower noticed no aphids on the plants but it is unlikely that he would have noticed transient winged aphids without using yellow sticky traps or yellow pan traps to monitor their presence. To transmit the virus, the aphid does not have to be settling down to feed on the squash but can be merely probing the surface of the leaf to determine if the plant is a suitable host. In the process, it can acquire virus from an infected squash plant and move it to another or transmit a virus that it may have already acquired. Most insecticides do not act quickly enough to prevent transmission. Many of the aphid vectors are transients coming from weeds and do not reproduce on cucurbits. Melon aphid, which does reproduce on squash, can transmit the virus but may not be an important vector because it does not move as readily as aphids looking for other host plants.

Samples were collected from the field and tested by ELISA for nine viruses known to infect cucurbits. Of 39 samples, 38 were positive for PSRV-W. The sample not infected with PRSV-W had severe viral symptoms. We were able to reproduce the symptoms by rubbing the sap from the ground sample onto squash seedlings in the greenhouse. Further tests are being done to determine what this virus might be. Nine samples of the predominant weed in the abandoned grove, balsam apple, (*Momordica charantia*), were also tested (Fig. 2). The vines of this weed almost covered some of the old trees. All of balsam apple samples were positive for PRSV-W, although no sample had obvious symptoms. This weed and another, creeping cucumber (*Melothria pendula*), have been shown in the past to be important sources of PRSV-W.

The grower also had three varieties of zucchini squash (‘Dividend’, ‘Cash Flow’, and ‘Payroll’) growing just east of the block of yellow squash. The zucchini did very well all season. Only at the very end of the season were mild virus symptoms seen on ‘Dividend’ and ‘Cash Flow’. None was seen on ‘Payroll’. According to Rogers (Syngenta Seeds), ‘Payroll’ has tolerance to zucchini yellow mosaic virus (ZYMV) and watermelon mosaic virus (WMV-2) (also found in Florida), ‘Dividend’ has tolerance to these two viruses and cucumber mosaic virus (CMV), and ‘Cash Flow’ has tolerance to ZYMV. No claim is made for tolerance to PRSV-W, although in this case it appears that these varieties may not develop severe symptoms when infected. However, no samples of the zucchini varieties were tested.

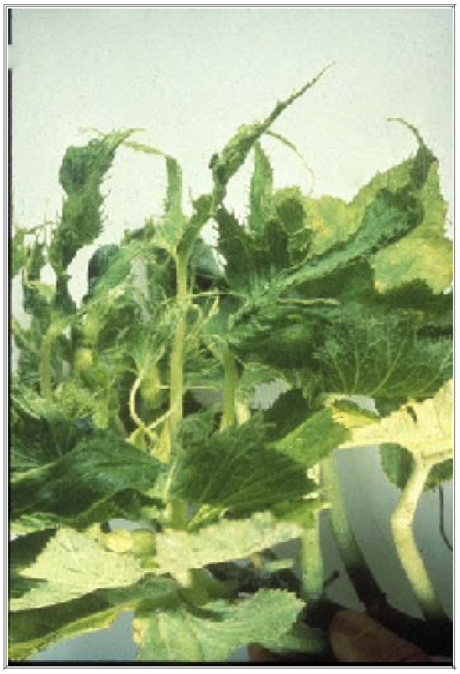

Fig. 1. PRSV-W symptoms in squash.
Photo credit: Gary Simone

Fig. 2. Balsam apple growing on a ditchbank in southwest Florida.
Photo credit: Warren Adlerz

(Alicia Whidden - Hillsborough Co. ext. agent II & Susan Webb - assoc. prof., Ent. and Nem. Dept. - Vegetarian 04-01)

Extension Vegetable Crops Specialists

Daniel J. Cantliffe Professor and Chairman	Mark A. Ritenour Assistant Professor, postharvest
John Duval Assistant Professor, strawberry	Steven A. Sargent Professor, postharvest
Chad Hutchinson Assistant Professor, vegetable production	Eric Simonne Assistant Professor and EDITOR, vegetable nutrition
Elizabeth M. Lamb Assistant Professor, vegetable production	William M. Stall Professor, weed science
Yuncong Li Assistant Professor, soils	James M. Stephens (retired) Professor, vegetable gardening
Donald N. Maynard (retired) Professor, varieties	Charles S. Vavrina Professor, transplants
Stephen M. Olson Professor, small farms	James M. White Associate Professor, organic farming
Rafael Munoz-Carpena Assistant Professor, hydrology	

Related Links
University of Florida
Institute of Food and Agricultural Sciences
Horticultural Sciences Department
Florida Cooperative Extension Service
North Florida Research and Education Center - Suwannee Valley
Gulf Coast Research and Education Center - Dover
UF/IFAS Postharvest