ALTERNATIVE PRODUCTION SYSTEMS IN PERENNIAL AND ANNUAL CULTURE OF JUNE-BEARING STRAWBERRY

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Summary

In *Fragaria x ananassa,* 'Redcrest', a 38cm double matted row was compared to 20cm double and 20cm triple hill systems in annual or perennial production. Plants in the perennial system were fruited in 1994-95. Plants in an annual production system were harvested in 1994, then were mowed and the beds rototilled. Raised beds were subsequently reformed and planted with cold-stored plants on July 14th, two weeks after last fruit harvest. The 20cm triple hill had a greater yield than the 38cm double matted row in the first and second production seasons. In 1994, there was little effect of production system on fruit weight. The 20cm triple hill also tended to require the longest time to harvest, although only on the first pick in the first production season. In 1995, there was also no difference in yield between the annual plots (planted July 14, 1994) and the second year perennial plots. The annual plants produced 39 to 97% larger fruit than the perennials. Also, the annual plots had 8% rot compared to 28% in the perennial plantings. Picking time later in the season in the annual treatments was less than half that of the perennial plots. Annual treatments had fewer plants and crowns/meter, but a larger crown diameter.

1. Introduction

Growers in the Pacific Northwest (Oregon and Washington, USA and British Columbia, Canada) use various perennial production systems for June-bearing strawberry, including a single or double matted row on raised beds or flat ground. Plantings are typically kept for three and sometimes four fruiting seasons after the non-productive planting year. However, perennial production systems are difficult to manage when pests, particularly Phytophthora root rot and root weevils (*Otiorhynchus* sp.), become prevalent in the planting.

Raised beds have been shown to improve drainage and decrease soil compaction (Goulart and Funt, 1985) and have been associated with decreased incidence of red stele (*Phytophthora fragariae*) and other *Phytophthora* species (Strand, 1993). Annual planting of certified plants has also been implicated in a reduction of Phytophthora diseases (Strand, 1993). Mechanical destruction of leaves shortly after harvest, as is done when tilling in plants in preparation for continuous annual planting, has reduced the severity of grey mold fruit rot in the following season (Sutton *et al.*, 1988). This practice has also been suggested

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to reduce root weevil damage, because the adults are deprived of a food source during a period when they are ovipositing (Collins and Fisher, 1993). In addition, mortality of root weevil eggs, which are deposited on the soil surface, was highest when the soil surface was exposed to direct solar radiation (Shanks and Finnigan, 1973).

Annual planting is commonly used in strawberry production in California. However, new plantings can be established in summer or winter after fumigation for pest control (Welch, 1989). To our knowledge no work has been done to study feasibility of re-planting strawberries, after fruit harvest, without pre-plant fumigation in a more temperate climate. Dozier *et al.* (1993), in Alabama, found that yield and berry weight decreased with planting dormant nursery plants from July 18 to Nov 21. Previous work has demonstrated that increasing plant density can increase yields (Dozier *et al.*, 1993; Hesketh *et al*, 1990; Martin, 1976; Norton *et al.*,1973; Unger and Strik, 1988). Thus higher planting densities could perhaps be used in late planting dates to increase yield.

The objectives of our study were to determine the feasibility of planting strawberries annually after fruit harvest, without preplant fumigation, in comparison to the traditional perennial system. Various production systems were studied to try to maximize yield.

2. Materials and methods

The June-bearing strawberry 'Redcrest' (OSU/USDA, 1990), a processing cultivar that is susceptible to root rot, was studied. A 0.08 hectare planting was established at the North Willamette Research and Extension Center, Aurora, Oregon in spring, 1993. Soil was fumigated with a mixture of methyl bromide and chloropicrin in spring 1993 with plots established on raised beds. Three spacing/runner management treatments were assigned to plots consisting of two adjacent 9.1m rows spaced 1m apart (center of bed to center of next bed): 38cm double matted row (49,400 plants/ha); 20cm triple hill system (69,470); and a 20cm double hill system (90,750). Treatments were arranged in a split plot with annual or perennial culture as main plots and spacing/runner management as subplots, with four replications.

Plants in an annual production system were harvested in 1994, then were mowed and the beds rototilled. Raised beds were subsequently reformed and planted with cold-stored crowns on July 14, 1994, two weeks after last fruit harvest. These plants were then harvested in 1995. Plants grown in a perennial production system were harvested in 1994 and in 1995 (second fruiting season).

In 1994 and 1995, yield data were collected from a 3m section of row for each treatment. Plots were harvested four times at one-week intervals during the season and the time required to harvest each plot was recorded for the first two harvests. Data for the annual plots were pooled with the perennial plots and analyzed as a randomized block design in 1994 only, since the annual treatment was not imposed until after harvest in 1994. In 1995, annual and perennial treatments were compared by split plot analysis of variance.

3. Results and discussion

There was no effect of spacing/runner management system on fruit weight, or percent rotted fruit in 1994 (Table 1). The 20cm triple hill had a greater yield than the 38cm double matted row in the first production season. This also tended to be true for the second harvest year (Table 1). The 20cm triple hill also tended to require the longest time to harvest,

Table 1. Effect of annual and perennial production systems on 'Redcrest' strawberry at NWREC, 1994 and 1995.

Production system	Yield (t/ha)	Fruit weight (g)			Rot (%)	Picking time/plot (min.)	
		Early	Mid-	Late		First	Second
1994							
38 cm double matted row	45.1 b	19.3 b	16.7	14.3	14.6	5.3 ab	9.8
20 cm triple hill	52.8 a	20.8 ab	17.6	15.5	14.4	5.9 a	9.7
20 cm double hill	49.2 ab	21.3 a	16.9	14.9	19.2	4.7 b	10.6
Sig.[z]	0.015	0.058	NS	NS	NS	0.009	NS
Annual	48.1	20.1	16.7	15.2	15.9	5.1	10.1
Perennial	50.1	20.8	17.5	14.6	16.3	5.6	9.9
Sig.	NS	NS	NS	NS	NS	NS	NS
1995							
38 cm double matted row	15.0 b	11.3	11.2 ab	8.4 b	16.9	11.6	7.7
20 cm triple hill	17.3 ab	11.9	11.7 a	9.8 a	18.6	12.5	8.9
20 cm double hill	17.5 a	11.8	10.9 b	9.1 ab	17.8	11.9	11.6
Sig.	0.0722	NS	0.0855	0.0073	NS	NS	NS
Annual	15.5	13.9 a	13.1 a	12.0 a	7.8 a	9.9	5.9 a
Perennial	17.7	9.4 b	9.4 b	6.1 b	27.7 b	13.5	12.8 b
Sig.	NS	0.0034	0.0092	0.0086	0.0098	NS	0.0024

[z] P value or indication of non-significance (NS) as determined by analysis of variance.

although only on the first pick in the first production season (Table 1). We did not see a significant reduction in fruit weight in the highest density planting system, the 20cm double hill, in the second fruiting year.

There was no significant difference between annual and perennial production systems in 1994; This was expected, as both systems were planted at the same time in 1993. However, in 1995 there was also no difference in yield between the annual plots (planted July 14, 1994) and the second year perennial plots (Table 1). There was no interaction between production system (annual or perennial) and spacing/runner management treatments for yield, fruit weight, percent rot, or picking time. Thus main and subplot effect means (averaged over the other treatments) are presented in Table 1. Picking time later in the season in the annual treatments was less than half that of the perennial plots (Table 1). The annual plants produced 39 to 97% larger fruit than the perennials, probably due to the larger average crown diameter and fewer number of crowns per plant (Table 2). Also, the annual plots had 8% rot compared to 28% in the perennial plantings. Perennial plots may have had a greater amount of gray mold as a result of a denser canopy and fall fruiting in 1994. In June-bearing cultivars, non-harvested fall fruit has been implicated as an important source of inoculum for *Botrytis cinerea* in strawberry (Johnson and Strik, 1995).

Although this type of annual production system is extreme in that it involves planting strawberries right after strawberries without fumigation, results to date look very promising. The annual plantings offered many advantages including large fruit weight and simplicity of fruit harvest (as is the case in all first year plantings) and would also simplify pest management. Additional studies are underway, further evaluating the importance of planting date, production system and pre-plant fumigation in annual and perennial systems. An economic comparison of all systems is planned.

Table 2. Effect of annual and perennial production systems on plant growth of 'Redcrest', post-harvest, 1995.

Treatment	Plants/meter	Crowns/meter	Crown diameter (mm)
38 cm double matted row	30.1	68.0	10.4
20 cm triple hill	12.0	66.3	11.1
20 cm double hill	19.6	71.6	10.0
LSD[z]	7.9	NS	NS
Annual	16.6	38.6	11.4
Perennial	24.6	98.7	9.5
LSD[z]	NS	13.9	NS

[z] Fisher's protected LSD ($P < 0.05$). There was no significant interaction of spacing with production system. Thus, means presented are for the main effects.

4. Acknowledgements

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5. Literature Cited

Collins, R. and G. Fisher, 1993. Root weevil control in strawberries and raspberries. Proceedings of the Oregon Horticultural Society 84:172-173.

Dozier, W.A., D.G. Himelrick, A.W. Caylor and J.A. Pitts, 1993. Planting date and plant spacing of 'Delite' strawberry in Alabama. Advances in Strawberry Research 12:54-58.

Goulart, B.L. and R.C. Funt, 1985. The influence of raised bed systems on strawberry growth and yield. Advances in Strawberry Production 4:15-19.

Hesketh, J.L., G.W. Eaton and T.E. Baumann, 1990. Strawberry plant spacing on raised beds. Fruit Varieties Journal 44:12-17.

Johnson, K. and B. Strik, 1995. Managing botrytis in strawberry. Proceedings Oregon Horticultural Society 86:175-177.

Martin, L. W., 1976. Performance of 'Olympus' strawberry in Oregon. Proceedings of the Western Washington Horticultural Association :153-154.

Norton, R. A., Crandall, P. C., Martin, L. W. and Matlock, D. D., 1973. New cultural systems for increasing profits. Proceedings of the Western Washington Horticultural Association :113-122.

Shanks, C.H. and B.F. Finnigan, 1973. Temperature and relative humidity effects on eggs and first-stage larvae of the black vine weevil, *Otiorhynchus sulcatus.* Environmental Entomology 2:855-858.

Strand, L.L., 1993. Integrated Pest Management for Strawberries. University of California Press. Pp. 92-93.

Sutton, J.C., T.D.W. James and A. Dale, 1988. Harvesting and bedding practices in relation to grey mould of strawberries. Annals of Applied Biology 113:167-175.

Unger, M. and B. Strik, 1988. How I got 18 tons/acre of Totems. Proceedings of the 30th Annual Lower Mainland Horticultural Improvement Association :115-117.

Welch, N.C., 1989. Strawberry Production in California. Cooperative Extension Service, University of California, USA, leaflet number 2959.