Research Reports

The Effect of Soil Moisture on the Motherstalk Method of Asparagus Production

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ADDITIONAL INDEX WORDS. *Asparagus officinalis*, water relations

SUMMARY. The effect of soil moisture levels on the yield and dry matter accumulation of asparagus (*Asparagus officinalis* L.) using the motherstalk method was examined in a greenhouse study. This technique allows for a spear to develop a mature fern while permitting harvest of later-developing spears. The motherstalk treatment resulted in significantly heavier spears as compared to the conventional practice without a motherstalk and harvesting all spears. In addition, crown weights between the motherstalk and the nonharvested treatment were similar at the end of the 12-week harvest period, but significantly lower when spears were harvested without

the benefit of a motherstalk. Optimizing soil moisture significantly increased yield in the motherstalk treatment and increased the fern dry weight but had no effect on crown dry weight. Our results indicate that the motherstalk system may allow for extended asparagus harvest in temperate areas but soil moisture may need to be carefully monitored to use this technique.

Asparagus grown in temperate climates is typically harvested for 6 to 8 weeks each spring. This limited harvest season has led researchers to investigate ways to extend the cutting season (Sanders, 1985; Shelton and Lacy 1980) or change harvest to summer (Dufault, 1995; Takatori et al., 1970) or fall (Brasher, 1956; Dufault, 1994; Jasmin and Laliberte, 1962; Robb, 1986). Although recent studies appear promising (Dufault, 1994, 1995), most attempts have failed due to the loss of crown storage carbohydrates necessary for the following season's spear production. Out of season harvests may also be affected by low soil moisture levels that may occur at this time. Although asparagus is generally considered a drought tolerant crop, low yields and declines in fern and crown dry weights have been attributed to low soil moisture levels (Wilcox-Lee, 1987).

The motherstalk method of asparagus production has proven successful in Taiwan and other tropical area and allows for year-round spear production (Hung, 1980). With this method, the first, second, or third spears are allowed to develop a mature fern, while subsequent spears are harvested for an extended period. The fern then becomes the photosynthate

source for the developing spears. This method may allow for extending the harvest season of asparagus in temperate climates (Reiners and Garrison, 1994; Robb, 1986). Soil moisture levels may be critical when using this method due to the presence of an actively transpiring fern. The objective of this study was to determine the effect of two soil moisture levels on the yield and dry matter accumulation of asparagus using the motherstalk method under greenhouse conditions.

Materials and methods

One-year-old 'Jersey Centennial' asparagus crowns were harvested from a southern New Jersey nursery, washed, graded, and refrigerated at 37 °F (3 °C). Five months later, healthy crowns weighing between 1 and 2 oz (28 to 56 g) were removed from storage and further selected for uniformity of bud count and size within each replication. Crowns were planted in 1-gal (3.8-L) plastic pots containing a steam sterilized 1 soil : 1 sand (v/v) mix and limed to pH 6.5. Potted crowns were placed in a greenhouse with air temperatures ranging from 70 to 85 °F (21 to 29 °C). The cutting treatments were 1) one motherstalk (1MS); 2) no motherstalk, all spears harvested (0MS); and 3) no harvest (FERN). The soil moisture treatments were 1) 25% or high soil moisture and 2) 75% or low soil moisture. To maintain moisture levels, pots were initially weighed after planting but before irrigation. They were weighed again following irrigation to saturation to account for the added water. Pots were watered when weights dropped to 25% or 75% of the saturated weight to approximate low and high soil moisture levels, respectively.

The experiment was arranged as a 2 × 3 factorial and the experimental unit consisted of ten crowns replicated four times within a randomized complete-block design. Motherstalks, the first large spears to emerge after planting, were staked to avoid lodging. All 6-inch (15-cm) spears that emerged after the motherstalk were harvested daily by cutting at the soil surface. Spear counts and weights were recorded and totaled on a weekly basis. Six weeks after planting, half of the plants in each experimental unit were removed from their pots. Crowns were separated from ferns and gently washed to remove soil. Fresh and dry weights were recorded. The remaining plants

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Table 1. The effect of cutting method and soil moisture levels with significant interactions on the cumulative number, weight, and average spear weight per plant. Treatments included one motherstalk (1MS) and no motherstalk, all spears harvested (OMS). Soil moisture treatments were watered when potted weights dropped to 25% (high) or 75% (low) of the saturated weight.

Treatment	Yields by time period								
	1–6 wks			7–12 wks			1–12 wks		
	No.	Wt (g)	Avg. wt (g)	No.	Wt (g)	Avg. wt (g)	No.	Wt (g)	Avg. wt (g)
OMS	7.4	5.4	0.73	3.1	1.8	0.58	10.4	7.2	0.69
1MS	3.0	2.5	0.83	4.2	6.8	1.61	7.2	9.1	1.26
HSD	1.9	0.7	NS	NS	2.2	0.54	2.1	NS	0.39
Low moisture	5.4	3.9	0.72	3.4	3.5	1.03	8.8	7.4	0.84
High moisture	5.0	4.4	0.88	3.9	5.0	1.28	8.9	9.1	1.02
HSD	NS	NS	NS	NS	1.3	NS	NS	1.6	0.16
Interaction	NS	NS	NS	NS	*	NS	NS	*	*
OMS × low moisture	---	---	---	---	1.6	---	---	7.0	0.66
OMS × high moisture	---	---	---	---	1.9	---	---	7.5	0.73
1MS × low moisture	---	---	---	---	5.4	---	---	7.8	1.11
1MS × high moisture	---	---	---	---	8.1	---	---	11.6	1.54
HSD	---	---	---	---	2.6	---	---	2.7	0.32

NS,*Nonsignificant according to HSD or significant at $P = 0.05$.

were harvested after 12 weeks and subjected to the same analysis. Data are presented on a per plant basis and were subjected to analysis of variance. Means were compared at $P \leq 0.05$ using the honestly significant difference (HSD) procedure.

Results

The OMS treatment produced significantly greater spear numbers and weights during the first 6 weeks of the study (Table 1). Yield suppression in the 1MS treatment during the first half of the trial was apparently due to the inhibitory nature of the developing fern. Previous work demonstrated that the yield inhibition of the motherstalk may last 2 to 3 weeks (Reiners, and Garrison, 1994). During the second half of the study, 1MS spear weights increased significantly above those of OMS while there was no difference in spear numbers. When the 12-week totals were analyzed, the OMS treatment still produced greater spear numbers while weights were no different. Spears in the OMS treatment were becoming smaller, probably as a result of lowered crown carbohydrate reserves. If the study were continued, it is possible that spear numbers and weights would have been significantly greater in the motherstalk treatment.

Soil moisture had no effect on spear numbers throughout the study. High soil moisture levels significantly increased spear weights during the second half of the study as well as for the 12-week totals. Significant interactions indicated that maintaining optimum

soil moisture levels had a much greater effect on spear weight in the 1MS treatment as compared to the OMS. There was a nearly 50% increase in spear weights with the higher soil moisture when a motherstalk was used as compared to a motherstalk and lower soil moisture. With no motherstalk, there was no significant increase in yield with high soil moistures.

As expected, the effect of total harvest for twelve weeks on crowns of this size was very significant (Table 2). Crowns in the OMS treatment weighed ≈ 5 g. These crowns were much smaller and of much poorer vigor than those

of the FERN treatment where no harvest occurred. Crowns in the 1MS treatment were no different in size and vigor than the FERN treatment despite 12 weeks of harvest. In addition, the similarity of crowns occurred despite the presence of a fern nearly three times larger in the FERN treatment as compared to the 1MS. This may have been due to large amounts of crown carbohydrate reserves used to produce the larger fern. Extending this study past 12 weeks may have increased crown size in the FERN treatment due to its greater photosynthetic capacity. Up to 3 months may be necessary to

Table 2. Effect of cutting method and soil moisture level with significant interactions on fern and crown dry weights 12 weeks after planting. Treatments included one motherstalk (1MS), no motherstalk, all spears harvested (OMS), and no harvest (FERN). Soil moisture treatments were watered when potted weights dropped to 25% (high) or 75% (low) of the saturated weight. Means are on a per plant basis.

Treatment	Fern dry wt (g)	Crown dry wt (g)
OMS	--- ^z	5.2
1MS	4.7	15.5
FERN	13.0	15.4
HSD	4.0	4.9
L moisture	6.8	11.3
H moisture	10.9	12.8
HSD	4.0	NS
Interaction	**	NS
1MS × low moisture	4.3	---
1MS × high moisture	5.0	---
FERN × low moisture	9.2	---
FERN × high moisture	16.9	---
HSD	5.5	---

^zNo fern produced in these treatments.

NS,**Nonsignificant at $P = 0.05$ according to HSD or significant at $P = 0.01$.

replenish storage carbohydrates used in spear and fern production (Scott et al., 1939).

Optimizing soil moisture levels resulted in significantly increased fern dry weight (Table 2), which agrees with Wilcox-Lee (1987). The interaction indicated that the treatment effect was not the same for all cutting treatments. The high soil moisture level was significant for only the FERN treatment.

The results indicated that the motherstalk method of asparagus culture may be a productive alternative to traditional cutting methods. Since crown dry weights in the motherstalk treatments remain high during the cutting season, it may be possible to extend the cutting season into early summer. These studies indicated that increased attention must be given to soil moisture levels if optimum yields are to be achieved with this technique. Further research is necessary to monitor and evaluate its usefulness and potential under field conditions in a temperate climate.

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Precision Seeder Uniformity Varies with Theoretical Spacing

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SUMMARY. Precision vegetable seeders were found to have unexpected variation in seed spacing uniformity. A belt seeder and vacuum seeder were evaluated using cabbage (*Brassica oleracea* L. *capitata* group) seeded at different seed spacings to determine if seeder uniformity improved with increasing seed spacing. Seeding uniformity of the belt seeder was not affected by seed spacing, but uniformity of the vacuum seeder was. Variation in seed spacing with the vacuum seeder was consistent in absolute units, thus seed spacing nonuniformity (expressed as a percentage of theoretical spacing) decreased with increasing seed spacing. Operating the vacuum seeder with the air pressure seed release mechanism disengaged improved seeder precision. Uniformity and precision of the belt seeder were better than that of the vacuum seeder.

An important feature of a precision seeder's performance is its ability to place seeds singularly a given distance apart. Recent studies evaluating seeding uni-

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