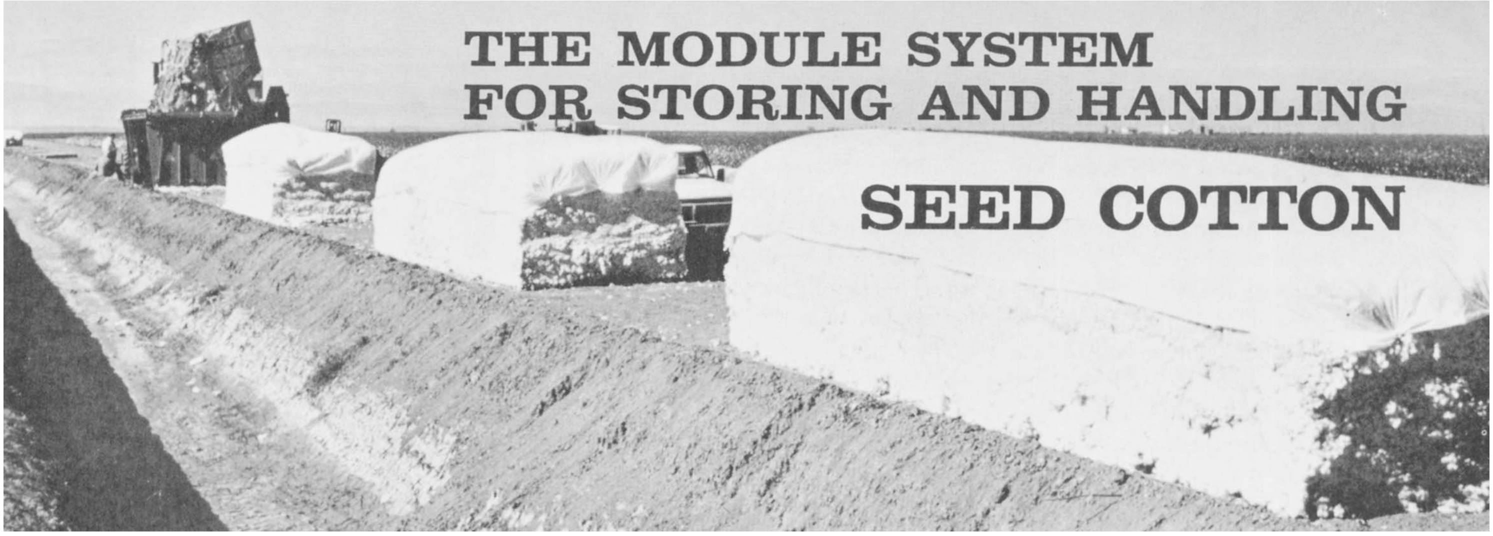
THE MODULE SYSTEM FOR STORING AND HANDLING SEED COTTON



Completed 32-ft modules of seed cotton covered with plastic. Modules should be covered on the same day they are built unless they will be ginned within a few days and rain is not likely. In the background a picker is dumping into the module builder.

The study reported here indicates that total picker-to-gin costs per bale can be significantly lower with the module system than with the conventional trailer system or ricking. If a grower already has trailers, the module system requires considerably more additional investment in equipment than the ricking system. But modules can be taken from the field immediately and are then available for ginning whenever needed. Storing part of the seed cotton between picking and ginning allows growers to continue picking whenever the weather is favorable, even though the gins may not be able to keep up. Seed cotton storage usually reduces ginning costs, and a gin's seasonal capacity is increased by being able to operate more hours per year.

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RICKING SEED COTTON has been practiced by a few California growers for a number of years, but the first use of the module system in California was for about 300 bales in 1972. With the ricking system, seed cotton is stored on the ground on the turnrow, in stacks usually 80 to 120 ft long, until needed by the gin. With the module system, the seed cotton is stored in high-density, free-standing stacks (modules) on wood or metal pallets that are 7 to 7½ ft wide and 24 or 32 ft long. For transporting, the modules are winched onto a specially built tilt-bed trailer. They may be ginned immediately, or they may be covered and stored, preferably in the gin yard, until needed by the gin. About 7,500 bales were moduled in California during the 1973 season, by six growers (5,000 bales by one grower).

Studies were conducted in 1972 and 1973 to compare the module, ricking, and conventional trailer systems under California conditions. Primary emphasis was on the ricking and conventional trailer systems in the 1972 studies (reported in the July, 1973 issue of *California Agriculture*) and on the module system in 1973.

Time-and-motion studies were made for the various operations under each of the three systems to determine the relative effects on picker performance and to serve as a basis for cost estimating. Additional cost information was obtained from growers, ginners, and equipment dealers. Values for the various factors assumed in calculating total costs, as well as additional information on equipment performance and total costs, are included in a more detailed report of the 1973 studies that is available from the authors. Equipment new costs used in the analysis were based on quoted 1974 prices in California, including freight and sales tax. Yields, performance rates, and module-building costs apply only for the first picking.

Performance

Picker dumping times and times waiting-to-dump are compared in table 1 for the module system and the trailer system. All the results except those for the D module system represent normal grower operations. The module builder for grower D was operated by University personnel. Dumping times (total time stopped in dumping position) averaged slightly less than 1 minute per dump with module builders, as compared with averages from 1.1 to 2.6 minutes for the trailer operations. Average times waiting to dump (i.e, waiting to move into dumping position) were 1 to 3 minutes with module builders serving three or four pickers and were quite small with trailers. Total waiting-plus-dumping times were slightly greater for the module-building operations than for the trailer operations. Idle travel time at the dump end of the field were comparable for the two systems. These three types of picker time losses are the only ones, other than waiting for empty trailers, that are likely to be affected by the seed cotton handling method.

The study indicates that under California conditions the module system is not likely to result in any significant increase in picker field efficiency (percent of total field time actually picking) in comparison with the trailer system, as long as trailers are always available.

The maximum total picking rate (bales per hour) that can be handled by a module builder without excessive picker waiting time and reduced field efficiency is influenced by the dump size and the desired degree of compacting. Items G-3, F, and D in table 1 tend to indicate that higher total picking rates can be accommodated without excessive picker waiting times when the dumps are large. High picking rates also tend to be accompanied by shorter compacting times, resulting in lower densities. Average densities were about 13 to 14 lb per cu ft for growers E and G, 10 lb per cu ft for grower F, and 11 lb per cu ft for grower D.

Module-building costs

When the total picking rate for one module builder was about 10 bales per hour, the module-builder operator and two extra ground men were needed, in addition to the picking crew. The two extra ground men, and a third man who was part of the normal picker crew, covered modules, picked up spilled cotton, relocated pallets when necessary, and cleaned picker heads when they had time. When picking rates were 5 to 7 bales per hour, only two extra men—the module-builder operator and one extra ground man—were needed.

Estimated costs of building and covering modules for various combinations of conditions are shown in table 2. Costs of $1.95 per bale for plywood pallets and 36¢ per bale for 3-mil cross-laminated plastic covers and tie-down materials were included. A 3-year average useful life was assumed for the plastic covers. The pallet cost, including repairs, was based on one use per year and an assumed life of 8 years.

Table 2 shows that the cost per bale increases rapidly as the annual use is decreased below about 200 hours. For growers having relatively small amounts to module, joint ownership of a module builder by several growers, gin ownership, or contract operations are economically desirable. Costs per bale are lower with a 24-ft module builder than with a 32-ft unit, as indicated in table 2, because overhead charges are lower.

The costs in table 2 do not reflect any changes in per-bale picking costs that would result from differences in picker waiting times with different numbers of pickers per module builder. Having too many pickers per module builder increases the picking cost per bale and the total time required to pick a given number of bales or acres per season per picker. The increased picking cost is at least partially offset by the reduced module-building cost resulting from the higher module-building rate and the greater number of bales per year per module builder. Having fewer than the optimum number of pickers per module builder does not significantly increase picker productivity or reduce picking costs but substantially increases the module-building cost per bale.

The effects of different numbers of pickers per module builder on picker productivity and total costs of picking-plus-module-building were calculated for two examples, estimating picker waiting times from the results in table 1. One example was for a first-picking yield of 2 bales per acre and 1,200-lb picker dumps (grower G, table 1). Under these conditions one module builder for every three pickers, with a total picking rate of about 8 bales per hour and a 6% picker waiting time loss, was judged to be the best combinaton. Using one module builder per four pickers, instead of one per three pickers, would increase the total picking time by 11% but would not appreciably reduce the per-bale cost of picking plus module building unless each picker was used for less than 200 acres per year. Using one module builder per two pickers, instead of one per three pickers, would reduce the total time by only 4% and would substantially increase the cost per bale. With four pickers, it is doubtful that the extra cost of using a second module builder would be justified by the 14% time saving.

The second example was for a yield of 2.35 bales per acre, 1,900-lb dumps, and a higher picking rate per picker (grower F, table 1). One module builder for every three pickers, with a total picking rate of about 11 bales per hour, is the best choice in this situation also, even though the resulting picker waiting time loss was 11%. But with four pickers, two module builders would be better than one.

These examples illustrate the fallacy of having so few pickers per module builder that pickers lose very little time waiting to dump. A combination which, when well managed, results in a 5 to 10% average picker time loss while waiting to dump appears to be best in regard to balancing minimum cost against reduced picker productivity.

Hauling modules

Although California law in 1972 required complete covering of seed cotton loads moved on public roads, primarily to facilitate pink bollworm control, this requirement was relaxed in 1973. In this study some modules were hauled on trailers having van enclosures. Others were covered with plastic that extended about 2 ft down the sides and ends, and were hauled on open trailers. When the front and rear openings of the van trailers were covered, there was no loss of cotton at normal freeway speeds of 50 to 55 mph. The open trailers, usually pulled at 35 to 45 mph when loaded, had appreciable losses from the partially covered modules at speeds above 25 mph. The total time per trip for a 25-mile haul with the van trailers, mostly on a freeway, was about 1¾ hours. The open trailer averaged just under 1 hour per trip for a 9½-mile haul.

Estimated module hauling costs are presented in table 3. Trailers were assumed to be pulled with one-ton trucks used only for hauling modules. For a given combination of conditions, the cost per bale is inversely proportional to the number of bales per module. The table shows that hauling costs per bale are 20

TABLE 1. PICKER WAITING AND DUMPING TIME LOSSES

Grower	No. of pick-ers	Bales per acre	Bales per hour	lb seed cotton per dump	Aver. min. per round: Wait to dump*	Stop to dump	Wait + dump
Module system							
E	2	1.6	5.0	1,800	0.23	1.01	1.24
G	3	2.0	7.9	1,200	1.00	0.95	1.95
G	4	2.0	9.1	1,200	2.90	1.15	4.05
F	3	2.35	10.9	1,900	2.31	0.90	3.21
D(1972)	4	2.6	17.5	3,100	2.04	0.92	2.96
Trailer system							
A(1972)	4	2.0	8.7	1,200	0.06	1.06	1.12
B(1972)	5	1.2	7.8	1,500	0.34	1.57	1.91
C(1972)	5	2.2	16.4	1,400	0.06	1.11	1.17
D(1972)	4	2.3	15.8	3,000	0.06	2.52	2.58

* Time waiting to move into dumping position beside module builder or trailer. Does not include time stopped while cleaning picker heads or performing other service operations. Growers E and F used 32-ft module builders; others were 24-ft.

TABLE 2. COSTS OF BUILDING MODULES

Hours used per year	Cost in $ per bale for 32-ft modules: per hr 5 bales	per hr 7 bales	per hr 10 bales	Cost diff., $ per bale, 32-ft minus 24-ft: per hr 5 bales	per hr 7 bales	per hr 10 bales
50	11.26	8.75	7.16	0.90	0.64	0.45
100	7.81	6.29	5.44	0.45	0.32	0.23
200	6.09	5.06	4.57	0.23	0.16	0.08
300	5.51	4.65	4.29	0.15	0.11	0.08
400	5.22	4.45	4.14	0.11	0.08	0.06

TABLE 3. COSTS OF HAULING MODULES FROM FIELD TO GIN

Trailer size and type	Hours used per year	Total cost, $ per bale*: 5-mile haul	10-mile haul	15-mile haul	20-mile haul	40-mile haul
32-ft, open	100	1.54	2.06	2.57	3.11	5.20
	200	0.94	1.28	1.63	1.99	3.40
	300	0.75	1.04	1.34	1.63	2.82
	400	0.64	0.91	1.18	1.44	2.52
32-ft van-type	300	0.94	1.22	1.49	1.78	2.97
24-ft, open	200	1.18	1.63	2.06	2.54	4.24
	300	0.94	1.32	1.69	2.08	3.60
	400	0.80	1.17	1.51	1.85	3.24

* Assumed 12 bales per 32-ft module and 9 bales per 24-ft module.

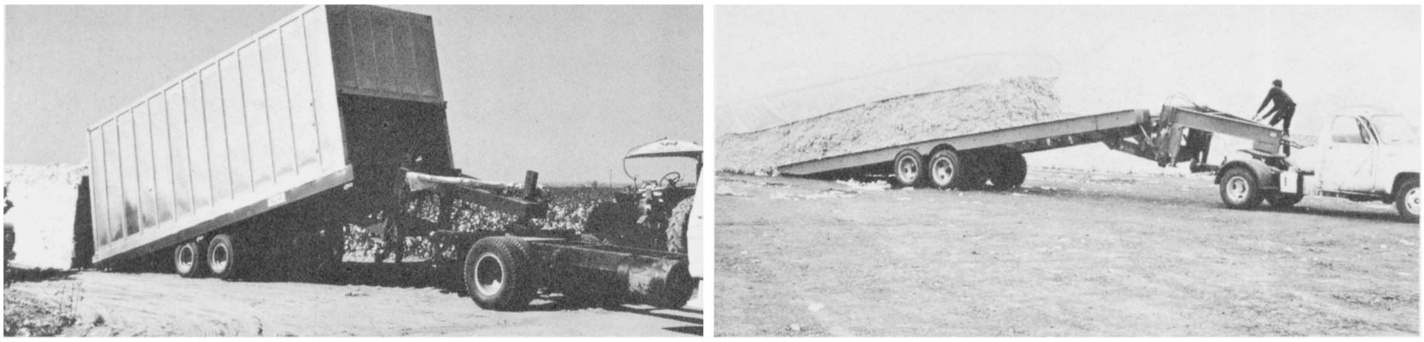
TABLE 4. COSTS OF MOVING MODULES AT GIN

Trailer size, no.	Ginning rate, bales per hr	Total cost, $ per bale: 2,000 bales per yr	4,000 bales per yr	6,000 bales per yr	8,000 bales per yr
Two 32-ft*	15	1.58	1.15	1.01	0.94
	25	1.32	0.89	0.75	0.68
One 32-ft	15	0.92	0.71	0.64	0.60
	25	0.75	0.53	0.46	0.43
Two 24-ft*	15	1.46	1.09	0.97	0.91
	25	1.20	0.83	0.71	0.64
One 24-ft	15	0.86	0.68	0.62	0.59
	25	0.69	0.50	0.44	0.41

* Two tractor-trailer combinations used alternately by the same driver. Modules ginned from the trailers.

TABLE 5. COSTS OF HANDLING SEED COTTON FROM PICKER TO GIN YARD WITH 8-BALE TRAILERS

Trips per year per trailer	Total cost, $ per bale: 5-mile haul	10-mile haul	15-mile haul	20-mile haul
6	7.39	7.76	8.13	8.50
8	5.86	6.23	6.60	6.97
10	4.95	5.32	5.69	6.06
12	4.34	4.71	5.08	5.45
16	3.57	3.94	4.31	4.68
20	3.14	3.49	3.86	4.23



A van-type trailer (left photo) in position for loading a module. A hydraulic-powered winch pulls the module into the van. Front and rear van openings are covered with canvas for transport. Right photo shows loading of a 32-ft module at the gin yard, preparatory to ginning. This type of open trailer shown pulled by a one-ton truck, is intended primarily for highway use. Gin-yard trailers are similar, but with straight tongues and no brakes or lights, and are usually pulled with farm tractors.

to 25% greater for 200 hours annual use of the trailer and truck than for 300 hours, and nearly twice as great for 100 hours per year as for 300 hours. Gin ownership and operation of the hauling equipment is one way of obtaining high annual use to minimize hauling costs.

Table 3 indicates costs 15 to 20¢ per bale greater with a 32-ft van-type trailer than with a 32-ft open trailer when both are used 300 hours per year. Hauling costs are less with a 32-ft trailer than with a 24-ft trailer by 1 to 2¢ per bale per mile hauled. This cost difference becomes increasingly significant as the hauling distance is increased above 15 miles.

The gin which served growers D, E, and F stored the modules on the gin yard. Two trailers and two tow vehicles were then used alternately to move modules to the dual suction station, where they were ginned without being unloaded. A more economical system would employ only one trailer, unloading each module under the suction pipe. In some cases, modification of the suction pipes would be needed to permit them to reach down to ground level and to be able to cover the full length of a 32-ft module (if this size is used).

Estimated costs for moving modules not over ½ mile from the storage area to the suction station are presented in table 4 for 2,000 to 8,000 bales per year. The assumption was made than each trailer would be pulled by a farm tractor rented (perhaps from a grower) at $3.50 per hour. The cost with gin-owned tractors having no other use would be considerably higher because of the low annual use. Differences in costs shown for 24-ft and 32-ft trailers are negligible, even when only 2,000 bales per year are ginned from modules. Using only one trailer and tractor and unloading each module under the suction pipe reduces the cost per bale by 40% at 4,000 bales per year.

Module-building costs are slightly less with a 24-ft unit than with a 32-ft unit, the difference increasing as annual use is decreased (table 2). As indicated above, hauling costs are less with a 32-ft trailer than with a 24-ft trailer, by 1 to 2¢ per mile hauled, and costs of handling modules at the gin are about the same for the two trailer sizes. When the module builder is used at 7 to 10 bales per hour for at least 200 hours per year and the hauling distance is not over 15 miles, there is no appreciable difference in picker-to-gin costs with the two sizes of systems. Lower moduling rates or low annual use of the module builder slightly favor the 24-ft system. Increased hauling distances tend to favor the 32-ft system.

There was no evidence in the 1973 studies of any advantage with the longer module builder in regard to ease of dumping the last load or two, but the largest dumps averaged only about 1¼ bales. With 2-bale dumps the 32-ft length might show some advantage. In moving modules from the storage area to the suction station, the larger modules are better if ginning rates are greater than about 25 bales per hour. The per-bale area required for central storage would be somewhat less with 32-ft modules than with the 24-ft size. The 32-ft empty pallets are more cumbersome to handle than the 24-ft length and tend to have more structural problems.

Comparative costs

Costs for handling seed cotton from the picker to the gin yard with conventional 8-bale (35-ft) trailers are shown in table 5. Labor costs for "tromping" cotton in the trailers (73¢ per bale) are included. The cost for a one-ton truck to pull single trailers was figured at 22¢ per mile. Handling costs with 6-bale (30-ft) trailers pulled singly would be 10 to 15% higher than shown for 8-bale trailers.

Cost differences between the module system and the trailer system may be illustrated by comparing costs for the two systems under the approximate conditions represented by the 1973 operations of growers G and F. Picker field efficiencies were assumed to be the same for the two systems in each case. Module insurance costs were not included because, in general, they are still in an indeterminate state. No separate costs were included for hauling empty pallets to the field and distributing them.

Grower G moduled 5,000 bales with two 24-ft module builders at an average rate of 8.5 bales per hour, giving an annual use of about 300 hours. Hauling 10-bale modules 25 miles with two van-type trailers required 250 trips each for a total annual use of 425 hours. Modules were hauled directly from the field to the dual suction station at the grower's gin, so there was no extra moving operation. Interpolation from table 2 indicates a module-building cost of $4.37 per bale. The calculated hauling cost is $2.16 per bale, giving a total of $6.53 per bale from picker to gin. If he had used 8-bale conventional cotton trailers, with eight trips per year for each, he would have needed 78 trailers and the handling cost would have been $7.34 per bale—81¢ higher than with the module system.

Grower F moduled his entire crop of 1,000 bales with a 32-ft module builder at an average rate of about 10 bales per hour, resulting in an annual use of only 100 hours. From table 2, the module-building cost is $5.44 per bale. Hauling 10 miles with an open-type trailer required 100 trips in about 100 hours. (His 32-ft modules average only 10 bales per module). If this were the only use for the module transport trailer, the hauling cost (from table 3) would be $2.06 × 12/10 = $2.47 per bale. But since the trailer was gin-owned, an annual use of 300 hours might normally be expected, which would reduce the hauling cost to $1.25 per bale. A reasonable cost for moving the modules from the gin yard to the suction station with one 32-ft trailer would be 60¢ per bale (table 4).

The total cost for the module system would then be $7.29 per bale, assuming 300 hours annual use for the module transport trailer. The cost with 8-bale cotton trailers used eight times per year (typical use in this gin community) would have been $6.23 per bale (table 5).

Increasing the annual use of the module builder would reduce the total module-system cost to $6.42 per bale for 200 hours per year and to $6.14 per bale for 300 hours per year. If 8-bale trailers were used only six times per year, the trailer-system cost would be $7.76 per bale.

These examples indicate that when module builders and transport trailers have reasonably high annual use, total picker-to-gin costs per bale can be significantly lower with the module system than with conventional trailers used only six to eight times per year. Ricking, on the other hand, has been found to increase picker-to-gin costs by $3.50 to $5.00 per bale (assuming no change in the number of trips per trailer per year).

Ginning costs

Cost summaries for 26 San Joaquin Valley gins (1971–72) were analyzed as a basis for predictng the potential effects of seed cotton storage on ginning costs. This analysis indicated that, with no change in total seasonal output, some gins could realize labor savings as great as $3.00 to $4.00 per bale if sufficient stored seed cotton were available to permit operating at a relatively constant daily output rate. Storage probably would result in only minor labor savings for some other gins.

Increasing the total seasonal output from a given gin by operating more hours per year (possible with seed cotton storage) would reduce plant overhead and administrative costs per bale. The analysis indicated that in most of the 26 cases a 50% increase in seasonal output from a given gin might be expected to reduce the cost per bale by $2.00 to $4.50. Doubling the seasonal output would reduce the cost per bale by $3.00 to $7.00.

A system involving module storage at the gin yard may have substantial added initial costs because of the relatively large, specially prepared storage area needed.

General considerations

Tests and grower experience have indicated that seed cotton can be stored in covered ricks or modules up to about two months with no reduction in lint or seed quality if the seed and seed cotton moisture contents do not exceed 11% and the trash content is not excessive. Longer storage periods may be satisfactory at lower moistures.

If a grower's trailers are still in good condition, the ricking system requires considerably less additional investment in equipment than does the module system. But modules can be taken from the field immediately and are then available for ginning at any time, regardless of the weather and field conditions. The module system also has the potential for mechanized handling and automatic feeding at the gin.

Good management is more important with the module system than with the trailer system or ricking.

From the grower's standpoint, the ability to continue harvesting whenever the weather permits, rather than having to stop because no empty trailers are available, is the principal advantage of any seed cotton storage system. Harvesting can be completed at an earlier date, thereby reducing the probability of grade reductions and yield losses due to rain. Getting the cotton harvested sooner also facilitates preparation of the land for subsequent crops.

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Applying a GROWTH RETARDANT THROUGH CONTAINER IRRIGATION SYSTEMS

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Several drip and spray irrigation systems have been designed and successfully used to apply precise amounts of water and fertilizer to container-grown nursery plants. The usefulness of these systems for application of smaller amounts of other chemicals had not been tested. In these studies, tests were made of the possibilities for application of a growth retardant, ancymidol (A-Rest), through the irrigation system.

Two irrigation systems were tested. The drip system utilized Drip Stick emitters, and the other system utilized the T-Spray nozzles. In the check containers, the growth retardant was mixed with a known amount of water and then added to each container.

Only enough water was added to wet all the soil in each container. The dosage of ancymidol for all treatments was 100 mg per plant. The test plant was *Eucalyptus globulus*, growing in egg cans with a soil mix of 66% redwood sawdust and 34% sandy loam soil. For both irrigation systems, the ancymidol was injected into the irrigation system just ahead of the sub main leading to the plants. At the end of 28 days, the amount of growth and the number of nodes above the last elongating internode at the time of treatment was measured. Only the central leader was used for measurement.

Application of ancymidol through the drip irrigation system seemed as effective as the control when only the average elongation was considered. However, considerably more variation between plants occurred when the growth retardant was applied through the drip irrigation system (see table).

GROWTH DIFFERENCES IN CONTAINER PLANTS FROM APPLICATION OF GROWTH RETARDANT ANCYMIDOL BY TWO METHODS OF IRRIGATION

Treatment method	Nodes	Average Elongation (inches)	Coef. of Variability
Drip irrigation system	8.8	28.3	10.9
T-Spray irrigation system	8.6	36.4	8.4
Hand application	7.5	25.3	5.6

These results indicate the possibility of applying growth retardants through container irrigation systems. Greater variability should be expected between plants than would occur if the chemicals were accurately measured to each plant. Refinement in application methods using the drip system may improve the uniformity of response.

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