

Evaluation of Automated Lettuce Thinners

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Summary:

Methods: An evaluation of automated thinners was conducted during the summer of 2014. Trials were conducted with cooperating growers on seven commercial lettuce fields in the Salinas Valley, CA. Each field was split in half with one side thinned by hand (standard practice) and the other side thinned with an automated thinner. Thinning time was evaluated by recording the time it took to thin a designated area; this information was converted to hours per acre. Four to six replicate areas two 40-inch beds wide by 90 feet were established in each treatment in each field; these areas were used to conduct stand and weed count evaluations, which were made prior to and following the thinning operation. Following the thinning operation, the numbers of doubles (two lettuce plants closely spaced) were counted, and the distance between plants was measured to determine mean plant spacing and spacing distribution. Approximately 7-14 days following the thinning operation, a hand crew passes through the field to remove doubles and weeds; the time to conduct this double/weeding operation was measured and converted to hours per acre. Immediately prior to commercial harvest, 24 head from each evaluation area were cut and weighed to determine mean head weight. Plants were subsampled and sent to the UC Davis Analytical Laboratory for total N analysis. In addition, the number of head infected with lettuce head drop (*Sclerotinia minor*) were counted. Commercial yield was measured in each treatment by obtaining box counts and sizes from the harvest crew. All commercial yields were converted to boxes per acre. The number of unharvested heads were counted in the evaluation areas following harvest. A side trial was conducted to evaluate the impact of size unthinned plants on the final plant size. In three of the fields, 20 heads of small and large plants were marked and plant diameter was measured three times during the crop cycle. Final plant weight was measured at harvest.

Results: On average automated thinners took 0.91 hours/A (range 0.24 to 2.0 hours/A) and hand thinning took 6.56 hours/A (range 4.68 to 9.12 hours/A) (Table 1). However, the double removal/weeding operation 7-14 days following thinning took 6.57 hours/A in the machine thinned treatment and 5.31 hours/A in the hand thinned treatment. One possible explanation for the increase in time it took for double removal and weeding in the machine-thinned area was due to the greater number of double in the automated thinner treatment than hand thinning, 1,024.0 vs 148.5 doubles/A, respectively. The total time for thinning and double removal/weeding in both treatments was 7.48 hours/A and 11.87 hours per acre in the machine thinned and hand thinned areas, respectively. The desired spacing for each of the fields in this study was 10 inches. The mean plant spacing in the machine thinned treatment was 10.3 inches (range 10.0 to 10.9 inches) and 10.5 inches in the hand thinned treatment (range 9.6 to 11.6 inches). The percent of plants that were between 9 and 11 inch spacing in the machine thinned and hand thinned treatments was 71.1 and 57.0, respectively. Overall, the automated thinner was faster than hand thinning and more precise. However, the automated thinner left many more doubles per acre than hand thinning.

Table 1. Background information on thinning operations and fields

Trial No.	Lettuce type	Bed configuration	Date of thinning Automated	Date of thinning Hand	Material Used to thin	Soil type	Harvest dates
1	Head	40"; 2 seedlines	May 20	May 30	14-0-0-5	Salinas clay loam	Jul 15-17
2	Head	40"; 2 seedlines	May 9	May 22	14-0-0-5	Salinas clay loam	Jul 1-4
3	Romaine	40"; 2 seedlines	May 26	June 4	14-0-0-5	Salinas clay loam	Jul 14-18
4	Head	40"; 2 seedlines	June 11	June 24	Shark	Chualar loam	28-Jul
5	Head	40"; 2 seedlines	June 27	July 5	Shark	Chualar loam	11-Aug
6	Green Leaf	80"; 6 seedlines	June 18	June 24	NpHuric	Chualar loam	Jul 30-Aug 1
7	Romaine	40"; 2 seedlines	July 25	August 5	14-0-0-5	Chualar loam	No data

Table 2. Details on thinning time and spacing

Trial No.	Thinning Time Hrs/A		Total Weed/thin				No. doubles/A		Mean plant spacing inches		Percent plants between 9 to 11 spacing	
	Auto	Hand	Auto	Hand	Auto	Hand	Auto	Hand	Auto	Hand	Auto	Hand
1	---	---	13.5	9.8	---	---	---	---	10.9	10.6	64.7	57.7
2	2.00	6.24	---	---	---	---	---	---	10.0	10.4	71.8	58.4
3	0.72	5.83	7.5	5.8	8.22	11.63	---	---	10.4	10.6	66.5	51.2
4	0.64	4.68	2.6	3.9	3.24	8.58	1,002.6	174.4	10.3	10.5	75.5	63.7
5	1.53	4.90	6.7	4.3	8.23	9.2	2,615.4	29.1	10.1	10.2	71.1	60.5
6	0.24	8.57	4.3	4.6	4.54	13.17	129.2	242.2	10.3	11.6	75.9	51.8
7	0.34	9.12	4.8	3.5	5.14	12.62	1,024.0	148.5	10.1	9.6	72.4	55.8
mean	0.91	6.56	6.57	5.31	7.48	11.87	1024.0	148.5	10.3	10.5	71.1	57.0

Auto = automated thinner

Table 3. Details on pest issues and harvest

Trial No.	Percent Weed Control		Percent Plants with Sclerotinia		Commercial Yield						Small Plot		Unharvested Head	
	Auto	Hand	Auto	Hand	30's /Acre		24's /Acre		Total /A		Head wt (lbs) ¹		Percent	
					Auto	Hand	Auto	Hand	Auto	Hand	Auto	Hand	Auto	Hand
1	43.4	66.4	3.0	2.4	173.2	165.7	643.9	621.1	817.1	786.8	2.56	2.42	4.4	5.8
2	69.9	68.6	2.5	2.3	85.2	15.4	1,091.1	1,123.1	1,176.3	1,138.5	2.92	2.88	3.4	4.5
3	---	---	2.4	2.1	16.9	23.6	1,082.7	975.8	1,099.6	999.4	1.54	1.79	3.5	3.6
4	---	---	2.6	2.3	---	---	1,171.70	1,079.80	1,171.7	1,079.8	1.63	1.67	3.8	4.6
5	---	---	2.4	1.7	---	---	1,079.8	1,148.7	1,079.8	1,148.7	1.95	1.96	7.0	8.2
6	78.4	72.0	13.3	13.3	---	---	1,252.5	1,124.5	1,252.5	1,124.5	1.08	1.02	---	---
mean	87.6	83.4	---	---	91.8	68.2	1,053.6	1,012.2	1,099.5	1,046.3	1.95	1.96	4.4	5.4

1 – Untrimmed head weights