2007 Precision Cultivation Studies

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Summary: These trials summarize evaluations of alternative cultivators. Trial No. 1 evaluated the use of the brush hoe for use on high density plantings on 80-inch wide beds with 14 seedlines. Brush hoe cultivation removed a substantial portion of the weeds present in the field and reduced weeding time, but may have reduced yields of the baby lettuce. The remainder of the studies compared the Bezzerides and torsion weeders. These cultivation implements were used to supplement standard cultivation, and as such, were mounted on the back of the cultivator rig. The Bezzerides cultivator has stiff tines that are not designed to come into contact with the crop. They were useful in reducing the width of the uncultivated band around the seedline. In one evaluation they were particularly effective on a hard crusty soil. The torsion weeders come in two widths, 7 and 9 mm. They are designed to undercut small weeds and, given the oblique angle that they move through the soil, can contact the crop without damaging it. They were effective in reducing the number of weeds in the seedline. The 9 mm torsion weeder was more effective than the 7 mm in one trial. Soil conditions affected their efficacy, as they were not effective in hard soil, but worked effectively in loose soil. In two trials the torsion weeders did not reduce crop growth or yield. Use of the torsion cultivation implement did not slow the cultivation operation down. It had sufficient promise to warrant continued evaluations in the coming year.

Methods:

Trial No. 1: This trial was conducted with Israel Morales of American Farms in Chualar on a planting of baby lettuce on 80 inch beds. The beds had 14 seedlines with about 4 inches between seedlines. The brushhoe cultivator (Bartchi Fobro) was modified to in the shop at American Farms to be able to cultivate between the seedlines on a 14 seedline 80-inch bed. A plot was established on May 16 in a planting of green leaf lettuce that was planted on April 29. Each plot was one bed wide by 90 feet long and pairs of cultivated and uncultivated plots were arranged in a randomized complete block design with 5 replications. Precultivation counts were made on May 16 by counting all weeds in the plot. The plots were cultivated later the same day by guiding the brushhoe with the steering mechanism operated by person sitting behind the cultivator. Post cultivation counts and time of weeding were conducted on May 17; yield evaluations were conducted on June 1 by sampling biomass from 1 m^2 per plot.

Trial No. 2: This trial was conducted with Israel Morales of American Farms in Chualar on a planting of fennel on 80-inch beds. The beds had 6 seedlines with 10 spacing between seedlines. The purpose of this trial was to augment the standard cultivation rig with the Bezzerides and torsion weeders; these implements were adjusted to reduce the width of the uncultivated band around the seedline. The trial was set up as a preliminary evaluation of these two weeders. The trial was conducted in a field of direct seeded fennel that was heavily infested with purslane. Each plot was one bed wide by 30 feet long and pairs of cultivated and uncultivated plots were arranged in a randomized complete block design with 4 replications. The field had been cultivated on August 21

with a standard cultivation rig that left a 5 inch wide band around the seedline. Precultivation counts were made on August 22; the field was then cultivated again the Bezzerides and torsion weeders attached to the cultivation rig and adjusted to leave an uncultivated band 2.0 - 2.5 inches wide. Post cultivation counts were conducted on August 23 and time of weeding evaluation on August 24. This was the first time that we had used the torsion weeders and the first attempt failed due to hard soil conditions and the large size of the weeds and therefore only the Bezzerides vs the standard cultivation treatment results are shown.

Trial No. 3: This trial was conducted with Dave Rose of Major Farms in Soledad. It was conducted in a field of transplanted celery with two seedlines on a 40-inch bed. This site was selected because the soil was sandy loam that was soft and would provide a good evaluation of the torsion weeders. Two diameter torsion weeders were included in the study: 7 and 9 mm. The 9 mm weeder is stiffer than the 7 mm and potential could remove more weeds, but also potentially could cause more damage to the crop. Transplanted celery was selected for the evaluation because it is a transplanted crop that is well established and the torsion weeders may be able to be aggressively adjusted to take weeds out of the seedline with out damaging the crop and reducing the yield. Torsion weeders can be adjusted to brush up against the crop and have the potential of damaging the crop if adjusted too aggressively. Plots were one 40-inch bed wide by 75 feet long and were arranged in a randomized complete block design with four replications. Cultivation was conducted 3 weeks following transplanting. Pre cultivation weed counts were made on August 28 by counting all weeds on the bed top per plot. Post cultivation weed counts were made immediately following cultivation on August 29. Yield evaluations were made on November 19.

Trial No. 4: This trial was conducted with Israel Morales of American Farms in Chualar on a planting of specialty lettuces on 80-inch beds. The beds had 6 seedlines with 10 spacing between seedlines. The cultivators examined in this trial were: 9 mm torsion weeder; the Bezzerides weeder; and the standard cultivation rig which was set to leave a 5 inch wide uncultivated band. The treatments consisted of one seedline of the bed in which the above mentioned cultivators passed. The tractor cultivated one bed at a time and each treatment was assigned to a seedline. The treatments were moved as the tractor moved to another bed in order to randomize the treatments. The trial consisted of three treatment beds and five replicated sample areas were set up in each bed to conduct the weed counts and other evaluations. The pre and post cultivation weed counts were conducted in an area 14 inches wide by 30 feet long. Pre cultivation counts were conducted on September 4 and post cultivation counts and time of weeding were conducted on September 7. Harvests were conducted on October 25.

Trial No. 5: This trial was conducted with Phil Foster in San Juan Bautista. The trial was established in a planting of leeks that had been transplanted September 10. The treatments used in this trial included: 7 mm and 9 mm torsion weeders compared with a standard cultivation rig set up to leave 5 inch wide uncultivated band. The torsion weeders were adjusted to 1.0 inch apart. Each treatment was one 40-inch wide bed by 50 feet long and arranged in a randomized complete block design with four replications.

Precultivation weed counts were made on September 26 by counting all weeds in a 10 foot long by one foot wide strip in the middle of the plot; post cultivation weed counts were made in the same area on October 2. Time of weeding evaluations was made of the time it took to weed the entire 50 foot plot on October 2. Soil conditions at the time of weeding were moderately crusty which affected the effect of the torsion weeder; they tended to lift up pieces of crust in which small weeds were growing, so we waited a full week to do the post cultivation counts to see if those weeds would die. Evaluations of the impact of cultivation on crop growth were conducted on November 15 by measuring the height and diameter of 10 plants per plot.

Results:

Trial No. 1: Cultivation with the brush hoe significantly reduced the number of weeds and weeding time in this trial (Table 1). Cultivation reduced weeding time by 35%, but there was a trend that indicated it may have reduced yields.

Trial No. 2: This trial is difficult to interpret. There was an significantly higher population of weeds in the standard cultivation treatment which influenced the post cultivation weed evaluations and as a result, it is difficult to conclude that cultivation alone was responsible for the reduced weed populations and weeding time observed in this trial (Table 2).

Trial No. 3: This trial was conducted under ideal soil conditions and the torsion weeders easily cut under the uncultivated band left by the standard cultivation. They could be seen undercutting many weeds in the strip up against the crop. They removed an additional 20-30% of the weeds over standard cultivation (Tables 5&6). There is a trend that indicates that the 9 mm torsion weeder removed more weeds than the 7 mm weeder. Torsion weeders did not reduce the yield of celery.

Trial No. 4: The soil conditions at this trial were hard and were not ideal for the torsion weeder. The 9 mm torsion weeder mostly skidded on top of the soil surface and did not undercut weeds effectively. The Bezzerides weeder is much stiffer and was able to dig into the soil and undercut weeds. As a result, there was no impact of the torsion weeder on weeds at this site, but the Bezzerides was able to remove an additional 10% of weeds over the standard cultivation and reduced weeding time by 3 hours per acre over the standard cultivation treatment (Tables 5&6). The stand was spotty in this trial and yield evaluation results are difficult to interpret, but the Bezzerides had the highest tonnage which could be related to improved weed control in this treatment.

Trial No. 5: Soil conditions at this site were suitable for the torsion weeder. The torsion weeder removed an additional 25-30% of the weeds over the standard cultivation treatment (Tables 7&8). However, given the close spacing of the crop and relatively high weed population the torsion weeders did not reduce weeding time. The torsion weeders did not impact the growth of the leeks.

Torsion weeders on back of cultivation rig.

Torsion weeders cultivating

Standard cultivation

Torsion cultivator

Close up of seedline after torsion cultivation

Leeks before cultivation

Seedline following standard and torsion cultivation

Table 1. Trial No. 1. Baby leaf lettuce: Pre and post cultivation weed counts, percent weed control, weeding time and yield.

Treatment	Pre cultivation counts – May 16				Post cultivation counts – May 17				Malva % control	Total weeds % control	Weed time hrs/A	June 1 Yield Lbs/A
	Malva	Burr Clover	NL Goosefoot	Total Weeds	Malva	Burr Clover	NL Goosefoot	Total Weeds				
Brush hoe Cultivation	47.0	1.6	6.4	55.0	22.2	1.0	6.0	29.2	53.1	47.8	11.0	11,731
No Cultivation	98.8	0.6	11.4	110.8	98.8	0.6	11.4	110.8	0.0	0.0	17.0	13,765
LSD (0.05)	ns	ns	ns	ns	75.4	ns	ns	ns	18.2	19.0	3.0	ns

Table 2. Trial No. 2. Fennel: Pre and post cultivation weed counts, percent weed control and weeding time

Treatment	Pre cultivation counts – August 22			Post cultivation counts – August 23			Percent Weed Control			Aug 24
	Purslane	Shepherd's Purse	Total	Purslane	Shepherd's Purse	Total	Purslane	Shepherd's Purse	Total	Weed time hrs/A
Bezzerides Cultivation	35.7	5.3	47.5	27.5	3.8	36.5	22.9	12.7	21.0	63.2
Standard Cultivation	73.3	12.0	88.8	58.3	12.0	73.3	0.0	0.0	0.0	116.6
LSD (0.05)	17.6	n.s.	39.4	13.7	8.3	28.6	5.9	n.s.	6.9	30.5

Table 3. Trial No. 3. Celery: Pre and post cultivation weed counts

Cultivation Treatment	Precultivation Counts – August 28					Post Cultivation Counts – August 29				
	Nettle	Malva	Shepherd's Purse	Purslane	Total	Nettle	Malva	Shepherd's Purse	Purslane	Total Weeds
Standard	21.6	22.1	3.6	8.6	64.1	9.8	9.5	2.1	6.1	33.6
7 mm Torsion	7.3	39.8	3.7	16.8	76.2	0.5	13.5	1.3	3.5	20.8
9 mm Torsion	6.0	62.8	4.3	15.3	96.3	0.5	13.8	0.0	1.3	16.8
LSD (0.05)	n.s.	29.1	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	3.3	n.s.

Table 4. Trial No. 3. Celery: Percent weed control and yield on November 19

Cultivation Treatment	Nettle	Malva	Shepherd's Purse	Purslane	Total Weeds	Yield Tons/A	Yield No/A	Mean head Wt lbs
Standard	63.1	61.7	34.8	29.4	49.2	31.85	40,021	1.59
7 mm Torsion	94.1	66.8	66.6	60.7	71.9	32.52	41,164	1.57
9 mm Torsion	91.7	76.2	100.0	89.5	82.4	32.35	40,184	1.61
LSD (0.05)	22.2	9.4	31.4	45.5	11.7	n.s.	n.s.	n.s.

Table 5. Trial No. 4. Lettuce: Pre and post cultivation weed counts

Cultivation Treatment	Precultivation Counts – Sept 4					Post Cultivation Counts – Sept 7				
	Malva	NL Goosefoot	Nightshade	Clover	Total Weeds	Malva	NL Goosefoot	Nightshade	Clover	Total Weeds
Standard	23.1	64.7	2.1	2.1	99.5	8.8	21.2	0.3	0.9	34.3
Bezzerides	27.2	51.0	0.8	1.5	83.1	7.0	16.1	0.0	0.1	23.3
9 mm Torsion	24.6	62.6	1.5	2.1	98.1	10.0	22.5	0.1	0.7	34.6
LSD (0.05)	n.s.	n.s.	n.s.	n.s.	n.s.	2.8	n.s.	n.s.	0.6	10.2

Table 6. Trial No. 4. Lettuce: Percent weed control, weed time on September 7 and yield evaluations on October 25.

Cultivation Treatment	Malva	NL Goosefoot	Nightshade	Clover	Total Weeds	Weed Time Hours/A	Yield Tons/A	Yield No/A	Mean head Wt lbs
Standard	60.4	67.2	48.2	55.1	65.5	12.0	15,816	75,784	0.22
Bezzerides	74.3	67.9	66.6	71.1	72.6	9.6	22,091	86,274	0.25
9 mm Torsion	61.3	63.7	46.6	47.7	63.5	12.0	16,208	88,235	0.19
LSD (0.05)	9.6	9.2	39.8	31.4	6.7	n.s.	4,586	n.s.	0.06

Table 7. Trial No. 5. Leeks: Pre and post cultivation weed counts

Cultivation Treatment	Precultivation Counts –September 26					Post Cultivation Counts – October 2				
	Nettles	Purslane	Chickweed	Sow Thistle	Total Weeds	Nettles	Purslane	Chickweed	Sow Thistle	Total Weeds
Standard	91.6	20.8	12.3	5.7	132.5	60.3	8.7	5.6	4.0	82.5
7 mm Torsion	132.0	20.5	15.5	5.5	176.7	48.5	2.0	7.0	2.5	63.0
9 mm Torsion	121.0	22.2	12.5	8.0	165.7	28.5	5.2	3.0	3.2	40.2
LSD (0.05)	64.9	8.9	7.5	6.9	64.7	34.2	4.7	4.6	2.1	38.2

Table 8. Trial No. 5. Leeks: Percent weed control, hours per acre to weed on October 2 and growth evaluation on November 15.

Cultivation Treatment	Nettles	Purslane	Chickweed	Sow Thistle	Total Weeds	Weed Time Hours/A	Growth: Stem dia. (inch)	Growth: Height (inches)
Standard	31.4	56.0	54.6	26.0	27.2	43.3	0.73	8.39
7 mm Torsion	64.6	88.9	43.8	48.7	51.1	41.8	0.72	8.36
9 mm Torsion	76.8	74.8	61.2	52.0	57.0	41.3	0.73	8.45
LSD (0.05)	19.0	20.8	49.6	56.6	20.1	8.1	n.s.	n.s.