

## EVALUATION OF ONION HARVESTING METHODS, 1997-1999

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### Introduction

Onion growers would like to reduce harvesting costs yet still achieve high quality onions out of storage. Decay and weight loss from all sources during storage was compared for sweet Spanish onions harvested with five different methods. Three mechanical harvesting methods were compared with two manual methods used as controls.

### Methods

*1997-1998 Trial.* Vega sweet Spanish onions were planted March 15 on the farm of Ken Teramura, Ontario, OR at 4-in spacing in two double rows on 40-in beds. The planting rate was 156,800 seeds/acre and the actual stand achieved was about 80 percent or 125,000 plants/acre.

The soil had a cation exchange capacity of 20 meq/100 g and received fall fertilization of 80 lb N/acre and 100 lb/acre of phosphate as 16-20-00. Spring N fertilization consisted of 170 lb N/acre as ammonium nitrate.

The flailed treatment was flailed on September 7. Onions were lifted September 8, and the onions were harvested from September 18-20, 1997.

*1998-1999 Trial.* Vision sweet Spanish onions were planted April 18 in Umapine silt loam in a field farmed by Ontario Produce, Ontario, OR. The crop had complete nutrient, weed control, and disease control management according to standard commercial practices.

The flailed treatment was flailed on September 21. Onions were lifted September 22, and the onions were harvested October 1-3, 1998.

All treatments made in 1997 were repeated in 1998 to assure research quality and the presence of appropriate check treatments. Six bins were prepared per treatment as follows:

*Both Years.* Five onion topping techniques were used:

1. *Topper/loader.* Harvest with a topper loader (Top Air, Parma, ID) to a truck and from there to bins.
2. *Topper/windrower.* Harvest with a topper windrower (Parma, Parma, ID). Onions were loaded in a truck and from the truck to bins.
3. *Flailer.* Top onions with a flailer before lifting (Slyter Flailer, Weiser, ID). Onions were loaded in a truck and from the truck to bins.
4. *Hand-topped.* Onions were topped by hand and poured directly into bins.
5. *Untopped.* Onions were placed untopped into topping baskets and poured directly into bins.

In 1998, three bins from each treatment were placed directly into storage and three bins were heat-treated then stored. Heat-treated bins were heated until onion bulb pulp temperature at 1 cm depth reached 90 °F. All 30 bins were then stored at 34-42 °F at the Malheur Experiment Station for grading in January. Onions were graded out of storage on January 7, 8, and 9, 1998, and on January 7, 8, and 11, 1999. Onions were separated into the following categories: onions showing mechanical injury, botrytis infection (on side or neck rot), black mold, translucent scale, plate rot, sprouted onions, and healthy onions. The healthy onions were graded into split double onions and by diameter into small, medium, jumbo (3-4 in) and colossal sized onions. Onions were rated visually for color, top retention, and skin retention out of storage.

### Results and Discussion

*1997 Topping Trial.* In the 1997, defective onions averaged a moderate 6.4 percent (Table 1). Vega onions with botrytis gray mold in the onion neck and on the shoulders averaged 5.5 percent, but the topping and handling methods did not significantly affect botrytis in this trial. Mechanical injuries differed significantly between every treatment, with untopped onions suffering the least mechanical injury and topper/windrower resulting in the greatest amount of mechanical injury (Table 1).

Untopped onions had 1.07 percent tops out of storage and less total pack out in terms of weight per bin because there were 13 percent fewer onions in each bin. Untopped onions held their skins well, had the lowest percentage of mechanical injury and had a low amount of black mold. Untopped, hand topped, and topper/loader treatments were among the best in percentage of pack out (Table 2).

The topper/loader treatment had only 5.2 percent defective onions and was among those with the lowest total shrink losses and with the best percentage pack out, 90.2 percent (Table 2). It would be desirable for growers to be able to reduce harvest cost while retaining onion quality in storage and pack out. One-time-over mechanical harvest with the topper/loader in 1997 reduced onion damage without affecting storability, compared to onions that were windrowed then further cured before loading.

Over all bins, independent of topping and loading, the percentage of loss to black mold tended to occur in the bins with the highest percentage of mechanical injuries. This may be a factor of wider importance to the industry: rough handling could cause the loss of skins and bulb damage, predisposing onions to greater risk of loss from decomposition in storage.

At pack out, onions from each topping and handling treatment were set aside for visual evaluations of color and skin retention (Table 2). Topper/windrower onions that were windrowed then loaded appeared lighter in color because less skin was retained. These onions suffered more damage in the grading process than the other treatments and were not as visually attractive as the onions from the other four treatments.

*1998 Topping Trial.* The onions in the 1998 topping trial had small losses to black mold, botrytis neck rot, translucent scale, and plate rot totaling on average only 0.44 percent (Table 3). The incidence of mechanical damage not infected with black mold or botrytis was negligible in 1998, and sprouted onions were also negligible. Pack out was excellent for all topping treatments, suggesting that with well-managed and well-cured Vision onions, topping method per se is not as critical as topping cost and proper management of the equipment (Table 4). Such high packout is not to be expected using onions inadequately cured or with the tops flailed when immature.

Skin retention was better for untopped onions than any of the topping methods (Table 4, Fig. 1). Skin retention was poorest where onions were topped and windrowed, then lifted. Bulb color followed a similar pattern as skin retention, with the darkest bulbs being those from the untopped treatment and the lightest from the onions that were topped, windrowed, then lifted (Table 4, Fig. 1).

In previous studies, we have shown decomposition during storage can be reduced by heating onions after harvest so that the onion bulb temperature at 1 cm depth reaches 90-95 °F. Averaged over topping treatments, heat treatment in 1998 reduced diseased onions by half, but the magnitude was small. Untreated onions suffered losses to disease of only 0.58 percent while the heat treated onions had losses of 0.29 percent ( $LSD (0.05)_{heat} = 0.13$  percent). Subjective evaluation of skin retention and color were favored by heat treatment (Fig. 2).

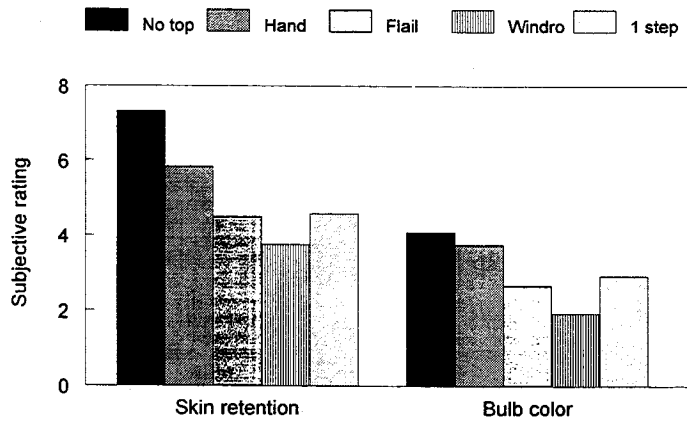


Figure 1. Visual evaluation of skin retention on a scale of 0-10 and bulb color on a scale of 0-5 from Vision onions subjected to five topping treatments in the onion topping trial (Malheur Experiment Station, Oregon State University, and Ontario Produce, Ontario, OR, 1998-1999). Skin retention was different ( $LSD (0.05)_{topping} = 0.38$ ) and bulb color was different ( $LSD (0.05)_{topping} = 0.59$ ).

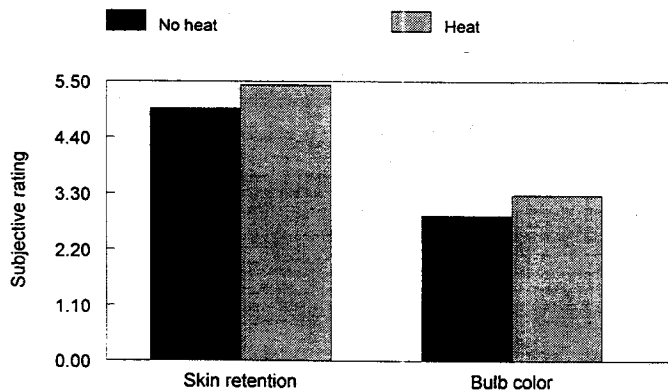


Figure 2. Visual evaluation of skin retention on a scale of 0 -10 and bulb color on a scale of 0 - 5 from Vision onions subjected to heat treatments in the onion topping trial (Malheur Experiment Station, Oregon State University, and Ontario Produce, Ontario, OR, 1998-1999). Skin retention was different ( $LSD (0.05)_{heat} = 0.31$ ) and bulb color was different ( $LSD (0.05)_{heat} = 0.34$ ).

Table 1. Percentages of infected, defective, or injured Vega onions from five topping and handling treatments, Malheur Experiment Station, Oregon State University and Teramura Farms, Ontario, OR, 1997-1998.

Treatment	<i>Botrytis</i>	Plate	Black	No. 2	Sprouted	Mechanical	Total
	mold	rot	mold				
-----%							
Topper/loader in one pass	4.4	0.11	0.39	0.01	0.01	0.3	5.2
Topper windrower then loader	6.63	0.09	0.86	0.05	0	1.3	8.9
Flail then loader	6.94	0.01	0.19	0	0	0.2	7.3
Hand topped then hand load	4.49	0.03	0.2	0.02	0	0.5	5.2
Untopped then hand load	5.12	0.04	0.01	0	0	0.1	5.3
Mean	5.52	0.06	0.33	0.02	0	0.5	6.4
LSD (0.05)	NS	0.06	0.53	NS <sup>†</sup>	NS	0.04	2.6

<sup>†</sup>NS: not significant

Table 2. Total pack out, shrink, and appearance of Vega onions after five topping and handling treatments, Malheur Experiment Station, Oregon State University and Teramura Farms, Ontario, OR, 1997-1998.

Treatment	Percent by weight				Visual evaluations	
	Leaves	Total shrink	Small onions	Pack out	Color	Skin retention
-----%						
Topper/loader in one pass	0	9	0.8	90.2	3.5	4
Topper windrower then loader	0	12.8	0.4	86.8	2	3
Flail then loader	0	11.2	0.9	87.9	3.5	4
Hand topped then hand load	0	9	0.9	90.1	4	4.5
Untopped then hand load	1.07	10.2	0.7	89.1	4	5
Mean	NA <sup>†</sup>	10.5	0.7	88.8	NA	NA
LSD (0.05)	NA	2.6	0.3	2.5	NA	NA

<sup>†</sup>NA: not applicable

Table 3. Percentages of infected, defective, or injured Vision onions from five topping and handling treatments, Malheur Experiment Station, Oregon State University and Ontario Produce, Ontario, OR, 1998-1999.

Treatment	Botrytis mold	Plate rot	Black mold	Translucent scale	Sub-total	No. 2	Total defective
	-----%-----						
Topper/loader in one pass	0.19	0.19	0.13	0.05	0.56	0.57	1.12
Topper windrower then loader	0.21	0.21	0.19	0.03	0.65	0.56	1.21
Flail then loader	0.14	0.24	0.18	0.07	0.63	0.5	1.13
Hand topped then hand load	0.08	0.1	0.03	0.02	0.23	0.33	0.57
Untopped then hand load	0.05	0.05	0.02	0.01	0.13	0.37	0.5
Mean	0.14	0.16	0.11	0.04	0.44	0.47	0.91
LSD (0.05)	NS <sup>†</sup>	NS	NS	NS	0.29	NS	0.35

<sup>†</sup>NS: not significantly different

Table 4. Total pack out, shrink, and appearance of Vision onions after five topping and handling treatments in the 1998-1999, Malheur Experiment Station, Oregon State University and Ontario Produce, Ontario, Oregon.

Treatment	Percent by weight				Visual evaluations	
	Leaves	Total shrink	Small onions	Pack out	Color	Skin retention
	-----%-----				0-5	0-10
Topper/loader in one pass	0	5.3	0.29	94.7	2.9	4.6
Topper windrower then loader	0	5.3	0.25	94.7	1.9	3.8
Flail then loader	0	5.1	0.12	94.9	2.7	4.5
Hand topped then hand load	0	4.7	0.24	95.3	3.8	5.8
Untopped then hand load	1.07	5.5	0.15	94.5	4.1	7.3
Mean	NA	5.2	0.21	94.8	3.1	5.2
LSD (0.05)	NA <sup>†</sup>	0.4	NS <sup>‡</sup>	0.4	0.6	0.4

<sup>†</sup>NA: not applicable, <sup>‡</sup>NS: not significantly different