BED TYPE AND SOIL FUMIGANTS EFFECTS ON YIELD, QUALITY, AND PINK ROOT INCIDENCE AND SEVERITY IN ONIONS IN THE TREASURE VALLEY, 2013

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Overview

Onion fields in the Treasure Valley typically are fumigated to manage soil-borne diseases that can significantly affect onion yield and quality. The most commonly used materials for soil fumigation in the Treasure Valley are metam-sodium- or chloropicrin-based products. With the evolving regulations and restrictions on fumigation, it is important to assess how different application methods may affect the performance of fumigants. In this project, the performance of different fumigants was evaluated in beds that were left unpacked or were packed at the time of fumigation. The evaluations were based on the effect of fumigant and bed type on the incidence of a major soil-borne disease, pink root, which is caused by the fungal pathogen *Phoma terrestris,* and on the yield and quality of onions.

Materials and Methods

Onions were grown at the Malheur Experiment Station in a field with a history of pink root. The field was an Owyhee silt loam (30% sand, 52.5% silt, and 17.5% clay) with a pH of 7.6 and 1.1% organic matter; it was previously planted to wheat. In the fall of 2012, the wheat stubble was shredded and the field was irrigated. Based on a soil analysis done in the fall of 2012, 49 lb of phosphorus/acre, 200 lbs of sulfur/acre, and 1 lb of boron/acre were broadcast before plowing. The field was then disked, moldboard plowed, groundhogged, and bedded at 22 inches.

Fumigation treatments occurred on October 23, 2012. Fumigation treatments were applied with a commercial 8-row mark-out unit fitted with injection shanks at a 12-inch depth below the top of the onion bed.

Fumigation treatments:

1. Telone® C-17 (16 gal/acre)
2. Telone C-35 (9.4 gal/acre)
3. Tri-Clor (4 gal/acre)
4. Pic-Clor 60 (6.6 gal/acre)
5. Untreated check

Bedding treatments:

1. Beds left unpacked after fumigation (current standard)
2. Beds packed with a bed press immediately after fumigation

Beds were packed with a 4-row bed press after fumigation treatments were applied.

Onion seed ('Vaquero'; Nunhems; and 'Red Bull', Scott's Seed) was planted on March 15 in double rows, spaced 3 inches apart at 9 seeds/ft of each single row, giving 150,000 seeds/acre. Each double row was planted on beds spaced 22 inches apart. Planting was done with customized John Deere Flexi Planter units equipped with disc openers. Immediately after planting, Lorsban® 15G insecticide was banded at 3.7 oz/1,000 ft of row (0.82 lbs ai/acre), and the soil surface was rolled.

The experimental design was a randomized complete block-split plot with three replicates. Bed type and fumigant treatments were assigned in a factorial arrangement to the whole plots. Onion varieties were the subplot treatments. Each of these subplots were 4 beds wide (7 1/3 ft) by 60 ft long, which allowed for in-season sampling of plant growth and pink root incidence.

Onions were grown under drip irrigation. The field had drip tape laid at 4-inch depth between 2 onion beds during planting. Drip tape (Toro Aqua-Traxx, Toro Co., El Cajon, CA) with emitters spaced 12 inches apart and an emitter flow rate of 0.22 gal/min/100 ft was laid at 4-inch depth between 2 onion beds at the time of planting. The distance between the tape and the center of each bed was 11 inches. The water application rate was 0.06 inch/hour.

The field was irrigated as necessary to maintain soil water tension at 20 cb at 8-inch depth. Soil water tension was monitored by six granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200SS, Irrometer Co. Inc., Riverside, CA) centered at 8-inch depth below the onion row. The sensors were automatically read three times a day with an AM-400 meter (Mike Hansen Co., East Wenatchee, WA).

Other cultural and crop maintenance practices (e.g., fertilization, irrigation, weed, foliar disease and insect management) were standard for the area and applied uniformly across the experiment.

On three dates during the growing season (11 July, 12 August, 5 September), 10 onion bulbs from each subplot were evaluated for size and pink root incidence (Fig. 1). For each bulb, diameter was measured with calipers, and then the total number of roots and number of pink roots were counted.

The onions were lifted on September 10 to field cure. Onions from the middle two double rows in each plot were topped by hand and bagged on September 24. The onions from each plot were graded on October 7. During grading, bulbs were separated according to quality: bulbs without blemishes (No. 1s), split bulbs (No. 2s), neck rot (bulbs infected with the fungus *Botrytis allii* in the neck or side), plate rot (bulbs infected with the fungus *Fusarium oxysporum*), and black mold (bulbs infected with the fungus *Aspergillus niger*). The No. 1 bulbs were graded mechanically with a Kerian Speed Sizer (Kerian Machines, Inc., Grafton, ND) according to diameter: small (<2¼ inches), medium (2¼-3 inches), jumbo (3-4 inches), colossal (4-4¼ inches), and supercolossal (>4¼ inches). Bulb counts per 50 lb of supercolossal onions were determined for each plot of every variety by weighing and counting all supercolossal bulbs during grading. Marketable yield consisted of No. 1 bulbs larger than 2¼ inches.

Because of differences between yellow and red varieties, data for the varieties were analyzed separately. All data were analyzed by ANOVA, using the SAS statistical program.

Results

Because of the lack of moisture during the late winter and early spring, the field was irrigated on March 27-28 to help onion emergence. There was an appreciable difference in the movement of the wetting front across the two bed types. Irrigation water spread faster and more uniformly across the packed beds than across the unpacked beds (Fig. 2). This difference was probably a result of soil particles being more closely appressed in the packed beds, which would have facilitated the movement of water. The top of the packed beds also remained stable throughout the growing season whereas the top of the unpacked beds tended to collapse in the middle (over the drip tube lines).

In-season Evaluations

Bulb diameter was significantly negatively correlated with the incidence of pink root on all three evaluation dates for yellow onions and on the first and third evaluation dates for the red onions. These results indicate that pink root is a limitation on onion production in the Treasure Valley.

The first evaluation for pink root and bulb size was done early in the bulb initiation phase on July 11. Bed type had no effect on incidence of pink root in the yellow onions (Vaquero) at the first evaluation. There were differences among the fumigation treatments in the incidence of pink root (proportion of bulbs with symptoms). Pic-Clor and Tri-Clor had significnatly lower levels of pink root than the other fumigant treatments (Fig. 3). Also, the severity of infection (proportion of infected roots per bulb) did not differ by bed type but did differ by fumigation treatment (Tables 1 and 2) with Pic-Clor and Tri-Clor tending to outperform the other fumigants. The total number of roots per bulb for yellow onions was not affected by bed type, fumigant, or their interaction.

In terms of bulb size (as measured by bulb diameter), there was no significant fumigant by bed interaction. The different fumigants did not affect yellow onion bulb size. However, bed type did affect bulb size, with onions grown on unpacked beds being significantly larger than those grown on packed beds. Bulbs from unpacked beds were about 12% larger on average than bulbs from packed beds.

For the red onions at the first evaluation, bed type did not affect the incidence of pink root, but incidence was significantly different among the fumigant treatments, with Pic-Clor and Tri-Clor tending to outperform the other treatments (Fig. 3). There was no significant effect of bed type, fumigation treatment or interaction of those factors on the severity of pink root. The total number of roots per bulb for red onions also was not affected by bed type, fumigant, or their interaction. Likewise the size of red onion bulbs was not affected by bed type, fumigant, or their interaction.

The second evaluation during the growing season was conducted on August 12. The early season difference among fumigants in the incidence of pink root was not apparent on the second or third evaluations ($P > 0.05$). For the second evaluation, the severity of pink root in the yellow onions was not affected by bed type, fumigation treatment, or the interaction of those two factors. The total number of roots for yellow onions was not affected by bed type, fumigation treatment, or the interaction of those two factors.

In terms of bulb size, fumigant by bed interaction was not significant, and the different fumigants did not have a significant effect on bulb size. However, bed type did affect bulb size, with yellow onions grown on unpacked beds being significantly larger than those grown on packed beds. The difference was not as great as at the first evaluation, with bulbs from unpacked beds being about 5% larger on average than bulbs from packed beds.

The incidence of pink root in the red onions was not affected by bed type, fumigation treatment, or the interaction of those two factors at the second evaluation. The total number of roots for red onions also was not affected by bed type, fumigation treatment, or the interaction of those two factors. Bulb size at the second evaluation for red onions was not affected by bed type, fumigant, or their interaction.

On the third evaluation, the incidence of pink root in the yellow onions was not affected by bed type, fumigation treatment or the interaction of those two factors. The total number of roots for yellow onions was not affected by bed type, fumigation treatment, or the interaction of those two factors. Bulb diameter of yellow onions at the third evaluation was not affected by bed type, suggesting that the onions on packed beds had begun to compensate for the early season difference. However, there was a significant effect of the fumigation treatment on bulb size at this point in the growing season. Onions grown with Telone C-35 were significantly smaller than those grown with either Telone C-17, Pic-Clor or Tri-Clor.

The incidence of pink root in the red onions at the third evaluation was not affected by bed type, fumigation treatment, or the interaction of those two factors. The total number of roots for red onions was not affected by bed type, fumigation treatment, or the interaction of those two factors.

There was a significant bed type by fumingant interaction effect on bulb size of red onions on the third evaluation. Bulbs grown on unpacked beds with either Pic-Clor or Tri-Clor as the fumigant were significantly larger than bulbs grown on the packed beds with those fumigants. The size difference was approximately 4-5% on average. There was no effect of bed type on bulb size for either Telone C-17 or Telone C-35.

Yield

Total marketable yield for yellow onions was affected by fumigant treatment but not by bed type (Tables 4 and 5). Telone-17 and and Tri-Clor treatments had significantly higher total marketable yields than Telone C-35. When the yields of supercolossal and colossal onions were pooled, the unpacked beds tended to have higher yields than the packed beds. Yields were the highest for Telone C-17, Pic-Clor, and Tri-Clor treaments on unpacked beds compared with the other fumigant by bed type combinations.

The yields of the largest size categories of yellow onions tended to be higher on unpacked beds than on packed beds. However, the yield of jumbo-sized yellow onions was significantly higher on packed beds than on unpacked beds. For each of the fumigant treatments, the yield of jumbo yellow onions was higher on packed than on unpacked beds.

The yield of medium-sized yellow onions was also significantly greater from packed beds than from unpacked beds. This result is most likely an artifact stemming from the reduced number of larger yellow onions on packed beds, rather than a beneficial effect of the bed structure.

Relatively few unmarketable small onions or rotted onions were present in this trial. Marketable yield of yellow onions as a percentage of the total yield exceeded 98% for all fumigant by bed type treatment combinations.

The average size of supercolossal bulbs can be an important marketing consideration, but there were no significant differences among the treatments in the number of supercolossal bulbs per 50-lb sack, with the numbers ranging from 26 to 38 bulbs per 50-lb sack.

For the red onions, there was a significant interaction effect between the fumigant treatments and bed type on the total marketable yield (Tables 4 and 6). In particular, marketable yields were higher for the Pic-Clor treatment on packed beds than for Pic-Clor on unpacked beds.

The red onions produced very few supercolossal or colossal bulbs. The yield of jumbo-sized red onions was significantly affected by the fumigation treatments. There was also an interaction between fumingant and bed type. This effect was most pronounced for Pic-Clor, with the yield of jumbo reds being significantly higher on packed beds treated with Pic-Clor than on unpacked beds treated with Pic-Clor.

There was no significant effect of bed type or fumigant on the yield of medium or small red onions. As with the yellow onions, there were relatively few small or rotted onions in the trial. The marketable yield as a percentage of total yield ranged from approximately 95 to 98%.

Summary

Few consistent trends in the performance of fumigants or bed type were observed in the results. None of the fumigation treatments significantly reduced the incidence of pink root. Results of this study indicate that packing beds at the time of fumigation does not substantially improve the effectiveness of chloropicrin-based fumigants and their effect on the yield and quality of yellow onions. Yields of the largest size class of yellow onions tended to be higher from unpacked beds than from packed beds. Consequently, total marketable yields were higher from the unpacked beds than from the packed beds.

In contrast, the total marketable yield for red onions was significantly higher on packed beds than on unpacked beds. The increase in yield for packed beds averaged 10% across all fumigation treatments.

Fumigant effects on pink root incidence and severity tended to dissipate after the first evaluation date, which was soon after bulb initiation. Pic-Clor and Tri-Clor tended to provide the best early-season management for pink root, but the benefits were minor and did not translate into substantially improved yields.

Acknowledgments

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Figure 1. A yellow (left) and red (right) onion displaying symptoms of pink root in August 2013. Malheur Experiment Station, Oregon State University.

Figure 2. Effect of bed type on the movement of water at the first irrigation. In the packed beds (beds on the left), water moved uniformly and more rapidly from the central location of the drip tube to the sides of the beds. Water movement in the unpcked beds (beds on the right) was slower and less uniform. Malheur Experiment Station, Oregon State University, 2013.

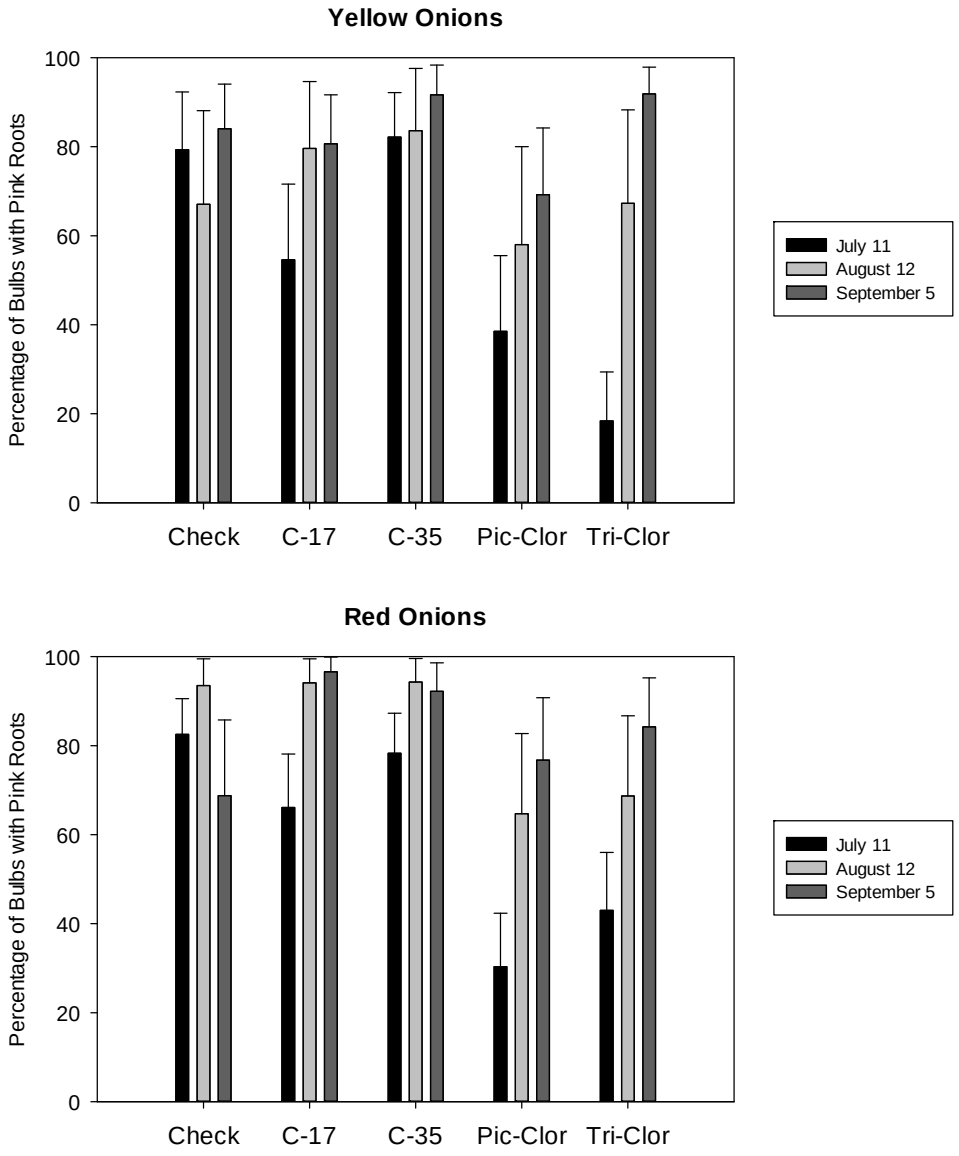

Figure 3. Incidence of pink root in yellow (Vaquero) and red (Red Bull) onions grown under different fumigation treatments at the Malheur Experiment Station, Oregon State University, Ontario, OR, 2013. On the first evaluation date (July 11), yellow onions grown in beds treated with Tri-Clor had significantly lower incidence of pink root than other fumigants except for Pic-Clor. Pic-Clor had significantly lower incidence of pink root than the untreated check and Telone C-35 treatments. For red onions on the first evaluation date, the Pic-Clor treatment had significantly lower incidence of pink root than all other fumigants except for Tri-Clor. Tri-Clor had significantly lower incidence of pink root than the untreated check and Telone C-35 treatments. There were no significant effects of bed type on any evaluation dates, and there were no differences among fumigant treatment after the first evaluation date.

Table 1. Analysis of variance (ANOVA) results for the effects of fumigation treatment and bed type on incidence of pink root (proportion of pink roots), total root number, and bulb diameter of yellow and red onions grown at the Malheur Experiment Station, Oregon State University, Ontario, OR, 2013.

			July 11			August 12			September 5		
Treatment effect	df		Pink root (%)	Total roots	Bulb diameter (in)	Pink root (%)	Total roots	Bulb diameter (in)	Pink root (%)	Total roots	Bulb diameter (in)
						Yellow onion (Vaquero)					
Fumigant	4	*F*	**5.27**	0.35	0.55	1.29	0.78	0.26	1.33	1.16	**3.58**
		P	**0.005**	0.84	0.70	0.31	0.55	0.90	0.30	0.36	**0.026**
Bed type	1	*F*	0.17	0.03	**6.66**	0.04	1.25	**8.16**	0.87	0.26	0.11
		P	0.69	0.86	**0.019**	0.86	0.28	**0.-01**	0.36	0.61	0.74
Fumigant x bed	4	*F*	1.39	0.67	0.54	1.17	0.71	0.89	1.51	0.83	1.65
interaction		*P*	0.28	0.62	0.71	0.36	0.59	0.49	0.24	0.53	0.21
Error	18										
						Red onion (Red Bull)					
Fumigant	4	*F*	2.42	0.80	0.86	1.06	1.99	0.91	1.50	**2.43**	**3.96**
		P	0.09	0.54	0.50	0.40	0.14	0.48	0.24	**0.085**	**0.018**
Bed type	1	*F*	0.01	0.41	1.72	0.21	0.06	0.19	0.57	0.81	**11.89**
		P	0.94	0.53	0.21	0.65	0.81	0.67	0.46	0.38	**0.003**
Fumigant x bed	4	*F*	0.48	0.95	0.84	0.34	0.28	0.44	1.25	1.48	**3.84**
interaction		*P*	0.75	0.46	0.52	0.84	0.88	0.78	0.33	0.25	**0.02**
Error	18										

Table 2. Effects of fumigation treatment and bed type on incidence of pink root, numbers of roots, and bulb size of yellow (Vaquero) onions, measured at three times during the growing season at the Malheur Experiment Station, Oregon State University, Ontario, OR, 2013.

		July 11			August 12			September 5		
Fumigant	Bed type	Pink root (%)	Total roots	Bulb diameter (in)	Pink root (%)	Total roots	Bulb diameter (in)	Pink root (%)	Total roots	Bulb diameter (in)
Check	Packed	6.99	38.83	1.66	15.53	34.33	3.28	27.63	34.93	3.78
Check	Unpacked	8.70	42.50	1.93	9.39	29.17	3.49	14.09	31.00	3.63
Telone C-17	Packed	4.12	44.33	1.84	26.89	24.67	3.23	19.14	33.45	3.90
Telone C-17	Unpacked	8.05	40.67	2.08	16.75	29.33	3.53	28.18	36.17	3.83
Telone C-35	Packed	6.78	37.68	1.78	13.28	30.67	3.43	22.27	29.00	3.60
Telone C-35	Unpacked	17.52	38.17	1.79	35.47	27.17	3.42	32.34	28.83	3.60
Pic-Clor	Packed	4.16	40.30	1.71	8.44	29.00	3.30	22.14	31.37	3.73
Pic-Clor	Unpacked	1.77	45.00	2.02	15.81	24.00	3.42	5.52	30.73	3.88
Tri-Clor	Packed	1.72	43.67	1.79	13.54	33.00	3.26	29.77	26.10	3.71
Tri-Clor	Unpacked	0.74	38.50	2.03	13.81	29.00	3.43	27.66	32.50	3.88
Overall	Packed	4.73	41.01	**1.75**	15.54	30.33	**3.30**	24.22	30.95	3.74
Mean	Unpacked	7.36	40.97	**1.97**	18.24	27.73	**3.46**	21.56	31.85	3.76

Table 3. Effects of fumigation treatment and bed type on incidence of pink root, numbers of roots, and bulb size of red (Red Bull) onions, measured at three times during the growing season at the Malheur Experiment Station, Oregon State University, Ontario, OR, 2013.

		July 11			August 12			September 5		
Fumigant	Bed type	Pink root (%)	Total roots	Bulb diameter (in)	Pink root (%)	Total roots	Bulb diameter (in)	Pink root (%)	Total roots	Bulb diameter (cm)
Check	Packed	13.52	34.66	1.61	30.39	14.73	2.82	31.13	14.77	3.13
Check	Unpacked	20.83	29.00	1.77	42.89	14.10	2.75	74.32	9.50	3.07
Telone C-17	Packed	9.07	38.10	1.68	34.06	17.67	2.88	25.86	17.47	3.33
Telone C-17	Unpacked	6.31	32.33	1.86	30.93	18.57	3.01	27.96	27.87	3.39
Telone C-35	Packed	6.90	35.67	1.84	30.87	19.67	3.02	21.44	18.70	3.41
Telone C-35	Unpacked	15.59	35.33	1.73	33.44	17.33	2.88	27.93	22.53	3.45
Pic-Clor	Packed	10.42	30.36	1.68	20.69	20.67	2.93	32.33	22.83	3.00
Pic-Clor	Unpacked	2.68	34.97	1.91	20.67	24.00	2.92	19.46	22.20	3.44
Tri-Clor	Packed	5.24	35.97	1.81	41.75	19.20	2.93	40.00	21.50	2.97
Tri-Clor	Unpacked	5.09	36.17	1.88	21.56	18.00	2.97	23.66	25.33	3.53
Overall	Packed	8.98	34.99	1.73	31.56	18.39	2.91	30.12	19.05	3.17
Mean	Unpacked	10.10	33.56	1.83	29.90	18.40	2.91	32.43	21.49	3.38

Table 4. Analysis of variance (ANOVA) results for the effects of fumigation treatment and bed type on yields of yellow and red onions grown at the Malheur Experiment Station, Oregon State University, Ontario, OR, 2013.

			Marketable yield by grade									
Treatment effect	df		Total	>4 in	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	Rot	Small	Marketable yield (% total yield)	Bulb counts >4¼ in
						Yellow onion (Vaquero)						
Fumigant	4	*F*	**3.44**	2.69	0.72	2.55	0.82	1.16	0.81	1.49	1.53	1.71
		p	**0.03**	0.065	0.59	0.07	0.53	0.36	0.53	0.25	0.24	0.21
Bed type	1	*F*	2.38	**9.62**	3.24	**10.25**	**4.81**	**13.43**	2.97	1.16	1.00	0.05
		p	0.14	**0.006**	0.10	**0.005**	**0.04**	**0.002**	0.10	0.30	0.33	0.83
Fumigant x bed interaction	4	*F*	2.23	1.99	0.73	2.05	0.33	2.00	0.50	0.35	0.27	0.56
		P	0.11	0.14	0.58	0.13	0.85	0.14	0.73	0.84	0.89	0.70
Error	18											
						Red onion (Red Bull)						
Fumigant	4	*F*	**4.63**	2.78	n/a	2.65	**6.79**	2.69	0.25	1.59	1.67	n/a
		p	**0.01**	0.10		0.11	**0.002**	0.06	0.91	0.22	0.20	
Bed type	1	*F*	**6.09**	1.25	n/a	2.06	3.90	3.14	2.36	0.09	0.32	n/a
		p	**0.02**	0.30		0.19	0.06	0.09	0.14	0.76	0.58	
Fumigant x bed interaction	4	*F*	**3.45**	0.58	n/a	0.73	**3.57**	0.97	0.12	0.67	0.16	n/a
		p	**0.03**	0.69		0.60	**0.03**	0.45	0.97	0.61	0.95	
Error	18											

Table 5. Yield of yellow onions (Vaquero) in response to fumigation and bed type treatments. Malheur Experiment Station, Oregon State University, Ontario, OR, 2013. Yield data are expressed as means in cwt/acre. Means for packed versus unpacked beds within a fumigant type that are denoted with different lower case letters are significantly different ($P < 0.05$). Means are means of three replicates for each fumigant and bed type treatment.

			Marketable yield by grade									
Fumigant	Bed type	Total yield	Total	>4 in	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	Rot	Small	Marketable yield	Bulb counts >4¼ in
		cwt/acre									(% of total yield)	#/50 lb
Check	Packed	1180.64	1173.37	280.47	16.39	264.08	857.22	35.68	2.41	7.27	99.17	26.56
Check	Unpacked	1142.21	1133.98	324.45	19.04	305.40	784.22	25.31	1.03	8.23	99.19	26.35
Telone C-17	Packed	1169.27	**1156.29a**	**308.11a**	16.94	**291.17a**	812.29	**35.90a**	4.79	12.98	98.48	37.63
Telone C-17	Unpacked	1274.37	**1266.65b**	**509.57b**	37.22	**472.34b**	741.80	**15.29b**	13.81	7.71	98.33	32.98
Telone C-35	Packed	1144.89	1138.01	332.13	16.80	315.32	776.54	29.34	2.17	6.89	99.21	35.81
Telone C-35	Unpacked	1106.95	1102.06	311.84	16.18	295.66	755.54	34.68	10.54	4.89	98.64	31.03
Pic-Clor	Packed	1129.91	1124.27	282.50	9.71	272.79	812.05	29.72	4.03	5.65	99.12	34.19
Pic-Clor	Unpacked	1173.34	1168.72	357.26	7.47	349.79	794.21	17.25	5.72	4.61	99.12	34.56
Tri-Clor	Packed	1180.67	1172.89	**330.61a**	19.28	311.33a	805.36	**36.91a**	4.24	7.78	98.97	30.59
Tri-Clor	Unpacked	1260.49	1253.50	**509.81b**	35.98	473.83b	726.51	**17.18b**	11.43	6.99	98.55	36.39
Overall mean	Packed	1161.08	**1152.96a**	**306.76a**	15.83	**290.94a**	812.69	33.51	3.53	8.11	98.88	32.88
	Unpacked	1191.47	**1184.98b**	**402.59b**	23.18	**379.40b**	760.45	21.94	8.51	6.49	98.76	32.37

Table 6. Yield of red onions (Red Bull) in response to fumigation and bed type treatments. Malheur Experiment Station, Oregon State University, Ontario, OR, 2013. Yield data are expressed as means in hundred weight (cwt) per acre. Means for packed versus unpacked beds within a fumigant type that are denoted with different lower case letters are significantly different (P < 0.05).

			Marketable yield by grade									
Fumigant	Bed type	Total yield	Total	>4 in	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	Rot	Small	Marketable yield	Bulb counts >4¼ in
		cwt/acre									(% of total yield)	#/50 lb
Check	Packed	561.26	534.05	4.89	0.00	4.89	425.51	103.65	1.83	27.20	95.10	-
Check	Unpacked	491.04	475.27	2.07	0.00	2.07	377.89	95.32	5.82	15.77	95.50	42.89
Telone C-17	Packed	652.92	642.35	10.57	0.00	10.57	546.66	85.12	1.31	10.57	98.21	-
Telone C-17	Unpacked	679.13	671.65	16.87	4.10	12.78	595.48	59.30	4.27	7.47	98.26	-
Telone C-35	Packed	635.74	619.93	5.17	0.00	5.17	525.37	89.39	1.72	15.81	97.20	-
Telone C-35	Unpacked	557.57	545.28	1.31	0.00	1.31	439.84	104.13	7.06	12.29	96.52	-
Pic-Clor	Packed	691.45	**672.03a**	**13.81a**	0.00	13.81	**582.36a**	75.86	3.68	19.42	96.59	-
Pic-Clor	Unpacked	482.26	**468.80b**	**11.98b**	0.00	11.98	**412.88b**	43.94	9.37	13.46	95.29	-
Tri-Clor	Packed	577.27	568.42	11.81	0.00	11.81	487.08	69.52	3.75	8.85	97.79	-
Tri-Clor	Unpacked	613.08	598.69	15.63	1.72	13.91	537.05	46.01	4.72	14.39	96.94	-
Overall mean	Packed	623.73	**607.36a**	9.25	0.00	9.25	513.40	84.71	16.37	2.46	96.98	-
	Unpacked	564.62	**551.94b**	9.57	1.16	8.41	472.63	69.74	12.68	6.25	96.50	45.26