## Volunteer Potato Control with Maleic Hydrazide

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Mechanical harvesters do not remove all tubers from potato fields. Incorrect harvester operation, imperfect soil conditions during harvest, small tuber size, and many other factors influence the amount of tubers left in the field. Tubers buried in the soil have the potential to overwinter, emerge the following spring, and become volunteer weeds in the following crop. In the early spring, volunteers grow rapidly and compete aggressively with rotational crops for light, water, and nutrients. Volunteer potato plants are difficult to control with tillage or herbicides because of non-uniform emergence and their ability to vigorously resprout from the tuber. Besides being a competitive weed, volunteer potato plants can contribute to an increase in many pest problems. Unharvested tubers act as reservoirs for potato leaf roll virus and plant parasitic nematodes. Volunteer plants growing within rotation crops are not treated to control insects such as the Colorado Potato Beetle and Green Peach Aphid or diseases like potato late blight, potentially worsening local epidemics in neighboring potato fields.

To better identify the sources of the tubers responsible for producing volunteer plants, after harvest surveys were conducted in the fall of 1997, 1998, and 1999 in the Columbia Basin and Skagit Valley potato growing regions of Washington State. The fall surveyed potato fields were sampled the following spring to determine volunteer plant populations. Results of the three fall surveys showed that the number of tubers remaining after harvest ranged from a low of 25,602 to a high of 183,485 per acre, with a mean of 73,549 tubers per acre. Average tuber size ranged from 0.2 oz. to 3.5 oz. with a three-year mean size of 0.98 oz. These tubers were distributed throughout the soil profile in the harvested potato fields. Nearly 50% of the tubers were attached to vines, located on the surface, or in the upper 2 inches of the soil. However, 18% of the tubers were deeper than 6 inches in the soil, where killing temperatures are unlikely to occur in either the Columbia Basin or the Skagit Valley. Winters temperatures were mild enough to allow some tubers to remain viable and produce volunteer plants in each of the three years of the study. The spring surveys of fall sampled fields found a range of zero to 41,284 plants per acre with a three-year mean of 8,120 plants per acre.

Several methods have been identified to help suppress volunteer potato plants. In some rotation crops, herbicides are registered for volunteer potato control, but the differential size and deposition of the tubers in the soil result in non-uniform emergence of the plants making application timing difficult. If the herbicide is not translocated to the tuber, the treated plants have a high potential to resprout from the relatively large amount of stored carbohydrate in the tubers. Proper harvester maintenance and management can greatly reduce the number of tuber leavings in the field. In-season management to reduce the amount of small tuber production can help reduce the number of tuber leavings. Proper planting,

irrigation, fertility, and disease control that result in a full season crop that has mostly large easily harvested tubers will help reduce the amount of small tubers produced, potentially reducing the amount of leavings. Tuber survivability is affected by tillage methods. Post harvest tillage with a moldboard plow results in soil inversion that buries tubers to depths where killing temperatures are unlikely in the potato growing regions of Washington State. Volunteer plants have been observed emerging from as deep as 20 inches following fall tillage with a moldboard plow. Rotary disking can cut tubers and create more seed pieces in the soil. Tillage implements that do not invert the soil or cut tubers such as para-plowing or cultivating can reduce tuber survivability if the winter temperatures are severe enough.

Maleic hydrazide (MH-30) has long been used as a sprout inhibitor in potatoes and onions. The compound is applied to the potato crop during the growing season and suppresses tuber sprouting in storage. Results from research on maleic hydrazide as a tool for volunteer suppression have been mixed. Studies in Europe have shown some promise (1). Thomas found that MH-30 gave good suppression one year and poor suppression the next (3). In a previous study, three MH-30 treatments applied to Russet Burbank potatoes resulted in tuber residues high enough to suppress plant emergence by as much as 95% (Fig. 1).

During the spring surveys, volunteer plants were found in many fields that had been treated with MH-30. Volunteers were especially prevalent in fields of Ranger Russet that had been treated, an indication of a potential cultivar by MH-30 interaction. Another influencing factor on the efficacy of MH-30 could be the size of the tuber leavings. The tuber leavings found in the surveys had location means of 0.2 oz. to 3.5 oz in size with a three-year mean of 0.98 oz. Most of the early MH-30 volunteer control studies used Russet Burbank tubers that were much larger than the tuber leavings identified in the surveys. A preliminary study of the effect of cultivar and tuber size gave some indication that both factors influence the level of MH-30 tuber residue in tubers, resulting in reduced suppression of volunteer potato plants (Fig. 2). Tubers from treated Russet Burbank plants had much higher MH-30 residue regardless of tuber size compared to the treated Ranger Russet tubers. With the exception of the 0-2 oz. size category that had 9.3 ppm, the treated Russet Burbank tubers had residues greater than 10 ppm, the level found to sufficient for good sprout suppression. The tubers from treated Ranger Russet plants had much lower tuber residue levels. Only the 4-10 oz sized tubers had MH-30 residue high enough to suppress sprouts. The results of this experiment and indications from the surveys led to a cultivar by tuber size experiment designed to test the effect of both cultivar and tuber size on the ability of MH-30 to suppress volunteer potato plant populations.

## Methods

Four cultivars, Shepody, Russet Norkotah, Ranger Russet and Russet Burbank were studied in 1998, 1999, and 2000. The plants of all four cultivars were left untreated or treated with 3 lb. A.I. MH-30 at label timing (when 8-10 tubers per hill were greater than 1.5 inches in diameter). All MH-30 treatments were applied in the morning to assure cool air temperatures and avoid the potential for any high

temperature induced foliage damage. Uniroyal Chemical product development representatives assisted in determining the desired time to apply the MH-30 to each cultivar. The plants from all cultivars were harvested and the tubers separated into four size categories, 0-2, 2-4, 4-10 and >10oz. Samples were removed from the harvested tubers by cultivar and size category for at-harvest and post-storage residue levels and for a spring replant trial. Tubers were stored in refrigerated storage at 40°F until planting in late March. Potato plant emergence was recorded twice weekly from first emergence until there was no change in emergence for four consecutive readings.

**Residue Results**

MH-30 tuber residue is affected by both cultivar (Fig. 3) and tuber size (Fig. 4). The cultivar effect differs due to season despite great care in trying to assure that plant growth stage was the same each application for all cultivars and each season. Shepody tubers had the highest residue each of the three seasons averaged over all size categories. MH-30 residue in the tubers of the other three cultivars varied from year to year, with Russet Burbank having the lowest residue in 1999 and Russet Norkotah having the lowest residue in 2000. The low tuber residue in Russet Norkotah tubers in 2000 was a result of poor vine condition at the time of application resulting from early dying. Tubers of Ranger Russet, which had previously been difficult to get sufficient tuber residue to control sprouting (Fig. 2), had more than 10 ppm in all three years of the experiment.

The 0-2 oz tubers had the lowest tuber residue levels in all three years when averaged across cultivars (Fig. 4). The differences in tuber residue due to tuber size were greatest in 1998. The response to tuber size in 1999 was similar to that in 1998 but at a lower residue level. In 2000 the 2-4 oz tubers had the highest residue followed by the 4-10 oz tubers which had residue similar to the 0-2 oz. category. The 2000 results were unexpected and the 2001 replant trial may help explain these results. The effect of cultivar and tuber size on tuber residue is not the same in all years (Fig. 5). While similar response profiles were seen in 1998 and 1999, the 2000 results were much different. In 2000 all cultivars, with the exception of Russet Burbank, had higher residues in 2-4 oz tubers than in 4-10 oz tubers. In Russet Burbank the 0-2 oz tubers had considerably more residue than the 2-4 oz tubers in 2000. In 1998 and 1999 the 4-10 oz tubers had the highest residue levels, followed by the 2-4 oz tubers.

**Replant Results**

The emergence of volunteer plants was affected by both cultivar and tuber size. In both the 1999 and 2000 replant trial, Russet Norkotah had the highest emergence in the 0-2 tubers followed by the 2-4 oz tubers and 4-10 oz tubers respectively (Fig. 6). Nearly 40% of the small tubers remained viable and produced plants after MH-30 treatment. These small tubers are the most common in after harvest leavings. The residue results show that Shepody tubers have a higher level of tuber residue as compared to the other cultivars in this experiment (Fig. 3). As a result of the relatively high tuber residue, the emergence of Shepody was lower than the other cultivars in both years (Fig. 7). Only 20% of

the tubers emerged from the smallest tuber sizes in 1999 and 15% from the 4-10 oz tubers. More plants emerged from the 0-2 oz tubers in 2000 than in 1999, but very good control was observed in the 4-10 tubers, with only 5 % emergence. The tuber size effect on emergence was very apparent in the Ranger Russet tubers (Fig. 8). The 4-10 oz tubers had very good suppression with only 2% emergence. The smaller tuber size had much greater emergence, with more than 55% of the 0-2 oz tubers producing plants in the spring of 2000. These results help understand why so many volunteer plants were present in spring surveyed MH-30 treated Ranger Russet fields. Many of the 0-2 oz Russet Burbank tubers remained viable resulting in more than 50% emergence in both years, despite the MH-30 treatment (Fig 9). Better suppression occurred with tubers of the other size groups in 1999 than in 2000. In both years suppression in the >2 oz tubers was superior to the <2 oz tubers.

## Conclusions

Both the after harvest and spring surveys indicate that the majority of the tubers producing volunteer plants are in the <2 oz size range. However, comparing the MH-30 treated tubers with the nontreated control, it is apparent that MH-30 does reduce the amount of plants emerging from the treated tubers in all size categories and all cultivars tested (Fig. 10 and 11). MH-30 should be considered as a tool in an integrated management plan for suppression of volunteer potato plants. In situations where larger tubers are present, such as green vine or wet soil harvests, MH-30 is especially effective. MH-30 should be combined with other control methods, such as tillage and herbicides to obtain the needed level of suppression.

## Literature Cited


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3. Thomas, P., Zielinska, Smith, D. 1978. Virus diseases of potatoes in Washington, their costs and controls. Proceedings, *1978 Washington State Potato Conference and Trade Fair*, Washington State Potato Commission, Moses Lake, WA.

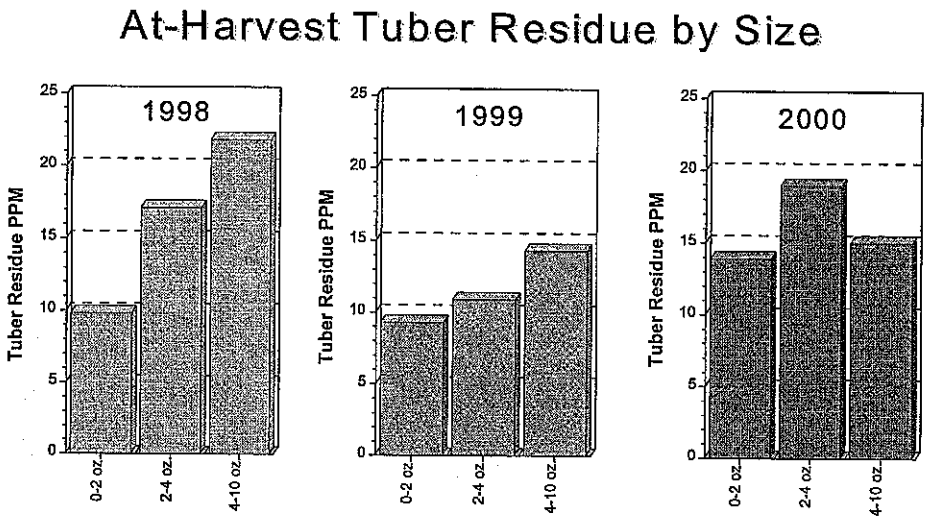


**Figure 1.** The at-harvest tuber residue of the size categories averaged over cultivars in the 1998, 1999, and 2000 MH-30 Cultivar by Tuber Size Trials. Nontreated controls had little to no residue.

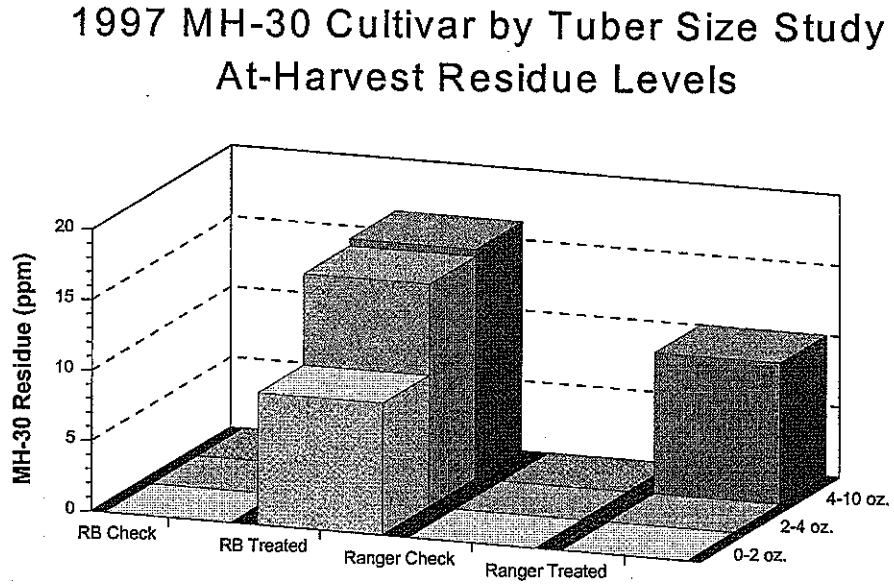


**Figure 2.** Results from the 1997 Volunteer Control Study. The 2-4 oz. And 4-10 oz. Treated Russet Burbank tubers have adequate residue for volunteer plant suppression. Only the 4-10 oz. Treated Ranger tubers had any MH-30 Residue.

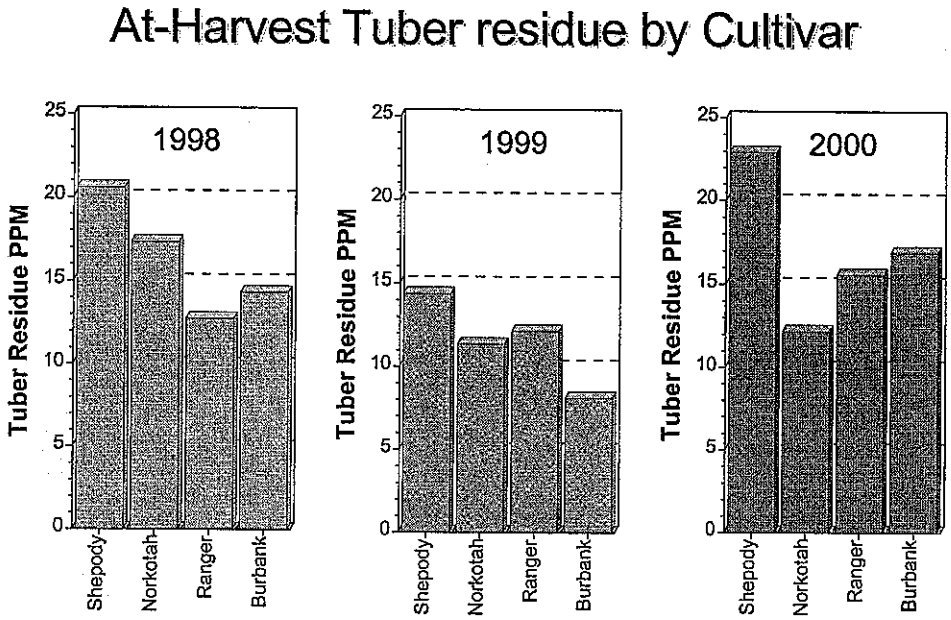


**Figure 3.** The at-harvest tuber residue of the treated cultivars averaged over all size categories in the 1998, 1999, and 2000 MH-30 Cultivar by Tuber Size Trials. Nontreated controls had little to no residue.

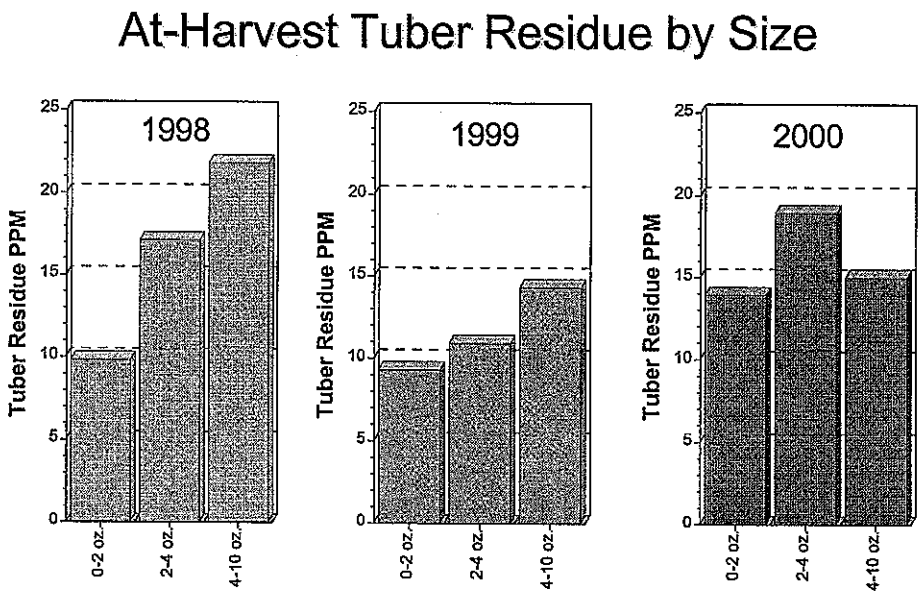


**Figure 4.** The at-harvest tuber residue of the size categories averaged over cultivars in the 1998, 1999, and 2000 MH-30 Cultivar by Tuber Size Trials. Nontreated controls had little to no residue.

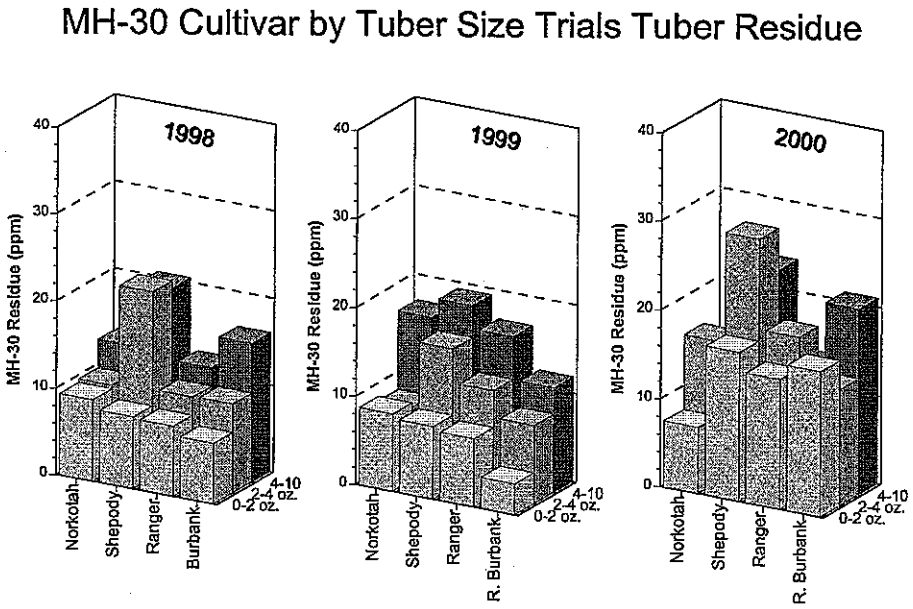


**Figure 5.** The at-harvest tuber residue of the cultivars by size category in the 1998, 1999, and 2000 MH-30 Cultivar by Tuber Size Trials. Nontreated controls had little to no residue.

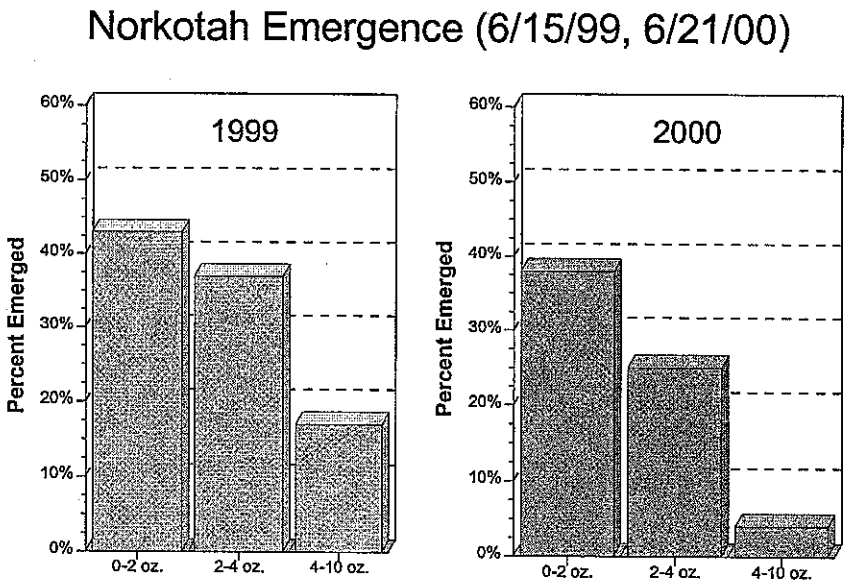


**Figure 6.** Percent emergence of plants from tubers from treated Norkotah plants in the 1999 and 2000 Replant Trials.

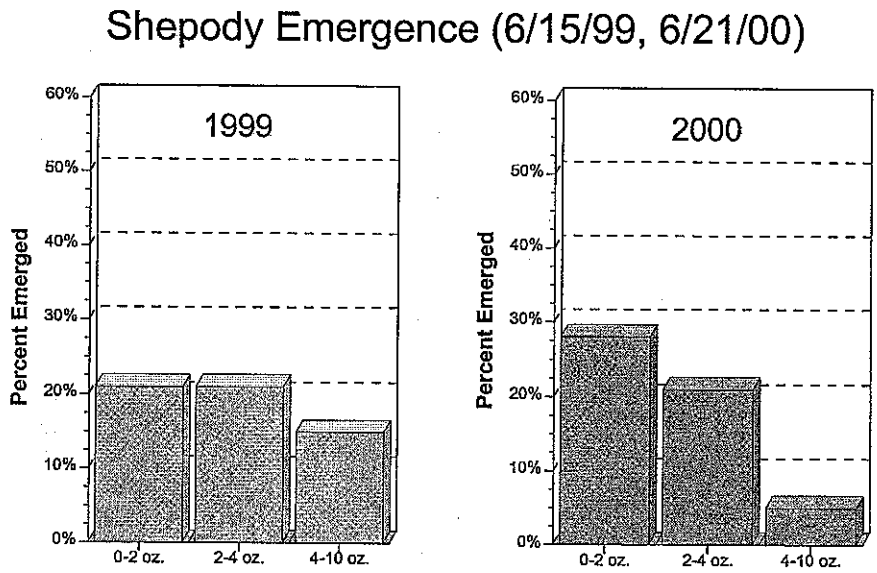


**Figure 7.** Percent emergence of plants from tubers from treated Shepody plants in the 1999 and 2000 Replant Trials.

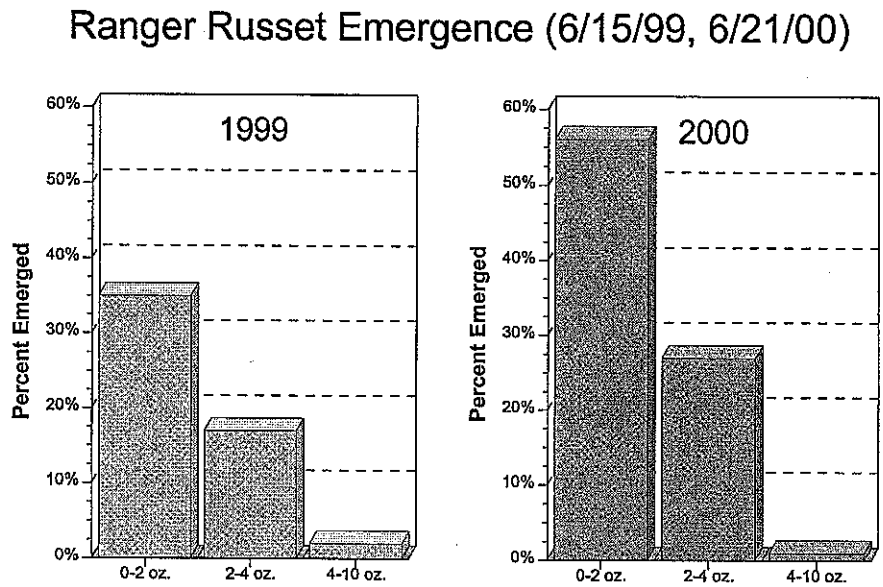


**Figure 8.** Percent emergence of plants from tubers from treated Ranger plants in the 1999 and 2000 Replant Trials.

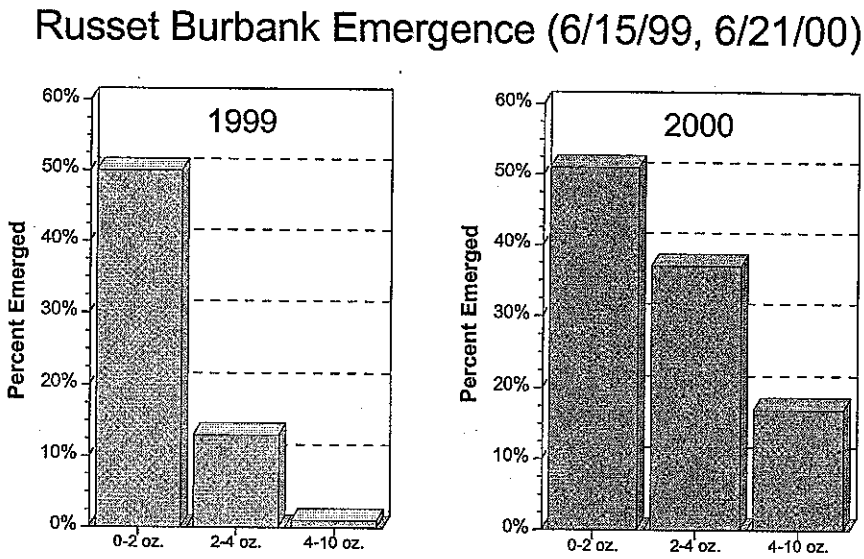


**Figure 9.** Percent emergence of plants from tubers from treated Russet Burbank plants in the 1999 and 2000 Replant Trials.

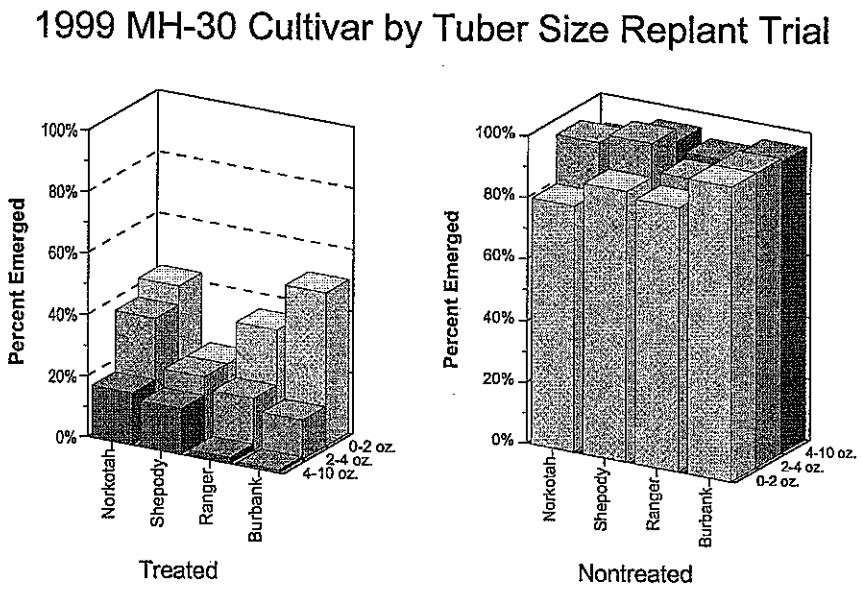


**Figure 10.** Percent emergence of plants from tubers for each cultivar by tuber size in the 1999 Replant Trial.

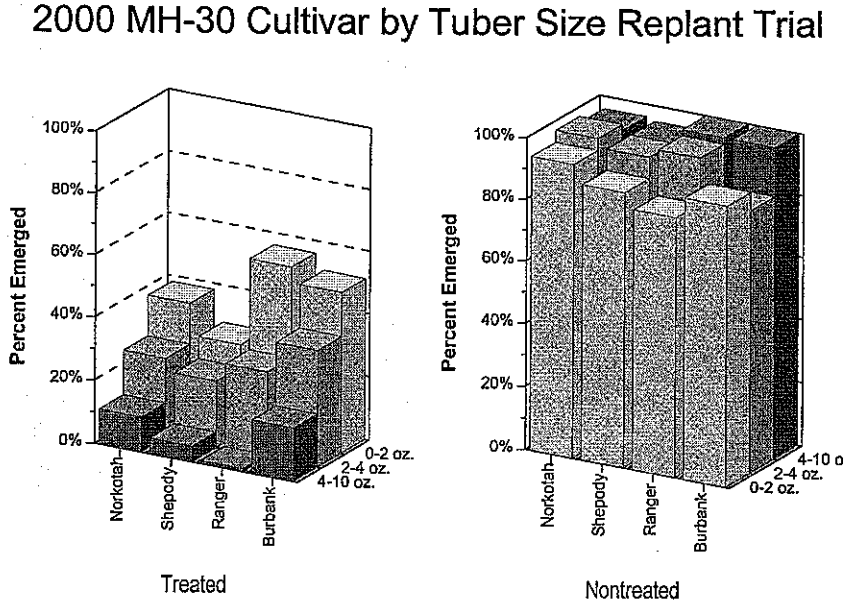


**Figure 11.** Percent emergence of plants from tubers for each culitvar by tuber size in the 2000 Replant Trial.