



Postharvest Research Report

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- Studying the effect of Di-methyl naphthalene and variable speed fans on tuber weight loss in storage
- Studying the effect of Di-methyl naphthalene on emergence and stem number
- Screening Colorado cultivars for resistant starch
- Studying the powdery scab resistance mechanism in russet cultivars

➤ **Effect of Di-methyl naphthalene and variable speed fans on tuber quality in storage**

Objective: This project was designed to determine the effect of various storage practices on tuber quality. Data was collected regarding DMN treatment, variable speed fans, and pressure bruise from five different commercial storages. Tubers were retrieved when the storages were emptied and quantified for dry matter content, external & internal bruising and discoloration. **Procedure:** Four cultivars, Canela Russet, Russet Norkotah, Russet Nugget, and Rio Grande Russet were grown in plots at the SLVRC. Three different harvest dates were selected to study the effect of tuber maturity on pressure bruising. Vine kill was performed by cutting off the vines and followed by spraying with Reglone. Tubers were left in the field for approximately 21 days after vine kill to allow for proper skin set.

Eight tubers in mesh sacks representing each cultivar at each harvest date were put into each of the 5 chosen storage units at two different heights (4' and 10' from the floor). These storage bins were selected based on presence and absence of variable speed fans and DMN treatment. Sensors that record temperature and humidity every 12 hours were included along with the potato samples in plastic mesh bags.

Potato samples were retrieved when the bins were emptied along with sensors.

Temperature and humidity measurements of all the storage bins were downloaded onto a computer when the tubers were removed from storage. Tuber samples were

examined carefully for external and internal signs of pressure flattening and bruise and percent dry matter was determined.

**Screening soil samples for
powdery scab**

PCR based method is developed in postharvest laboratory at SLVRC to detect and estimate pathogen population in soil samples based on oligonucleotide DNA sequence designed by Dr. Barbara Christ at PSU.



Results: Tubers showed signs of pressure bruising externally and a few internal bruises were observed. The maturity of the tuber seemed to have some effect on bruise susceptibility as the most mature tubers showed less bruise symptoms in all cultivars except Canela Russet (Fig-1).

Effect of tuber maturity on bruising

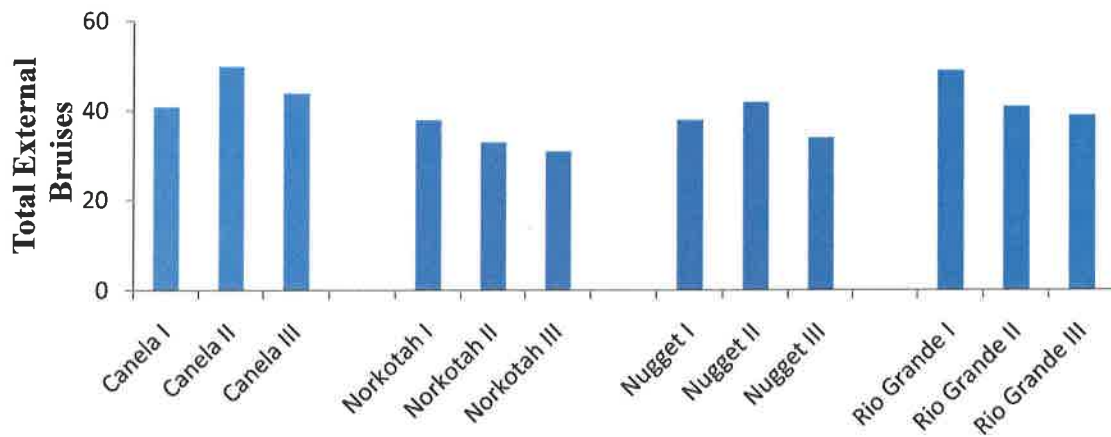


Figure-1

Harvest Dates	August 20 (90 days)	August 28 (100 days)	September 10 (110 days)	September 17 (120 days)	September 24 (130 days)
Cultivars	Norkotah I	Norkotah II	Canela I	Canela II	Canela III
		Rio Grande I	Norkotah III	Rio Grande III	
		Nugget I	Rio Grande II	Nugget III	
			Nugget II		

DMN treated storages had the higher percentage of dry matter in tubers of all cultivars (Fig-2).

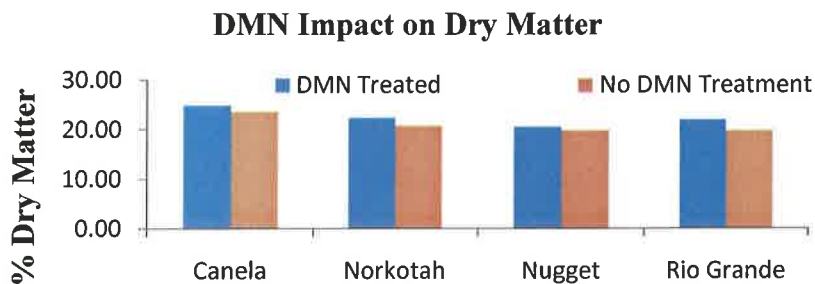


Figure-2

Variable speed fan storages produced tubers with higher dry matter in all cultivars except Rio Grande Russet (Fig-3).

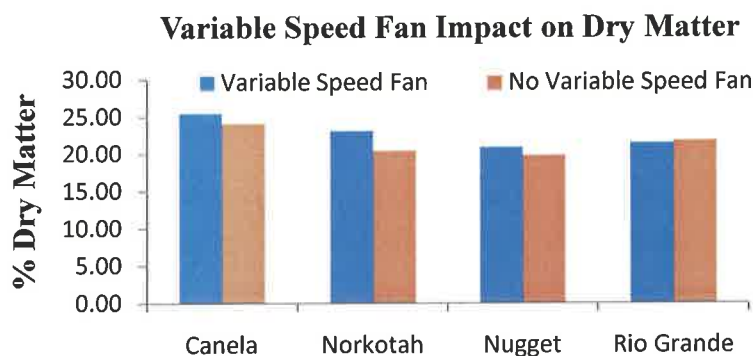


Figure-3

Conclusions: Losing less percentage of dry matter in commercial bins equipped with variable speed fans may be the result of less moisture loss from tubers and low respiration levels. These were first year results and more study is needed to verify findings and expand on the initial conclusions. One problem we encountered during the course of our study was that tubers were put in storage and taken out at different times and this may have affected some of our results.

➤ Effect of DMN on emergence and stem number

Objective: This project was designed to determine the effect of DMN (1,4 dimethylnaphthalene or 1,4 SIGHT) on seed pieces after planting. Specifically, rates of sprouting and stem numbers were studied. DMN is a naturally occurring substance in potatoes which has been applied to tubers in storage to discourage sprouting. This substance has been thought to promote more uniform sprouting and to increase the number of stems per seed piece.

Procedure: Four cultivars were selected for treatment: Canela Russet, Rio Grande Russet, Russet Nugget, and Russet Norkotah. The three treatments for each cultivar were: Control (No DMN), 10ppm DMN, and 20ppm DMN.

DMN treatment was carried out in 50 gallon drums equipped with fans and airtight lids. Tubers were weighed and put in the drums, and DMN was applied as a liquid on cheesecloth at the rate of 56ml DMN/1000kg tubers = 20ppm and 28ml DMN/1000kg tubers = 10ppm. This evaporated into the air and the tubers received it as a gas. Tubers were left in drums with fans running for 24 hours and then were stored at 37° F. This procedure was repeated on the tubers after one month.

Date of 1st treatment: 2/26/08

Date of 2nd treatment: 3/31/08

Seed pieces ranged from 2 to 3.75 oz. and three reps were planted on 5/14/08. Stem count was taken on 7/14/08 and plants were dug up to determine if seed pieces were whole or cut.

Results: Seed pieces that were not treated with DMN sprouted and grew much better than those treated with DMN. All control treatments showed vigorous growth and were flowering except Russet Norkotah, which was very healthy and budding. The pieces treated with 10ppm produced much smaller plants, and in the case of Rio Grande Russet, the plant had not emerged. The 20ppm treatment showed no plants that had emerged. Canela Russet and Russet Norkotah cultivars had sprouts on some seed pieces when dug up.

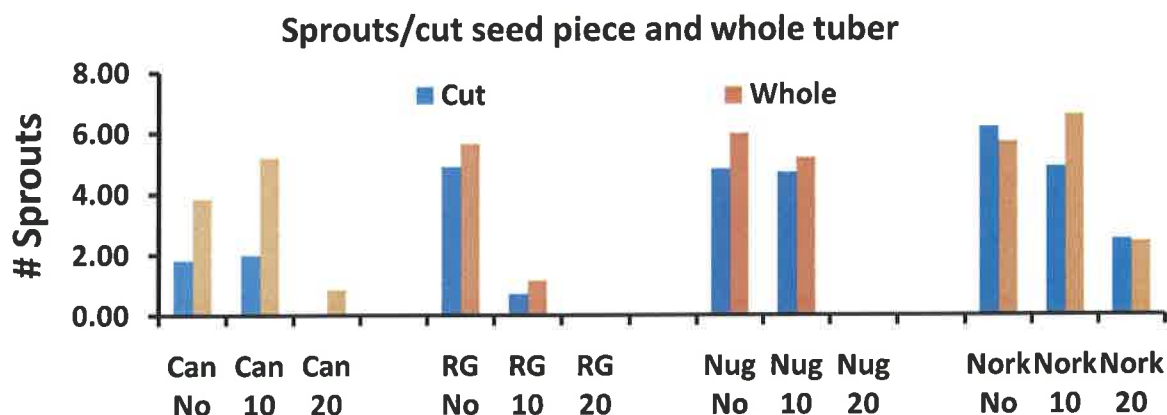


Fig-4

The above figure (Fig-4) shows the effect of DMN on number of sprouts. Sprouts include stems above ground as well as sprouts that were only visible on the seed piece after it was dug. The whole or single drop seed pieces produced more sprouts in all cultivars except Russet Norkotah. Whole seed pieces produced a significant increase in sprouts in the Canela Russet cultivar. Treatment with 10ppm DMN increased the number of stems with Canela Russet and Russet Norkotah. Russet Norkotah appears to be more tolerant of DMN than the other cultivars. DMN treatments were applied one month apart. This was a very heavy application as no emergence was seen in seed pieces treated with 20ppm at 2 ½ months after planting. The 10ppm treatment was stunted compared to the controls.

➤ **Screening Colorado grown potato cultivars for resistant starch**

Potatoes are rich in carbohydrates and are also a good source of minerals and vitamins. Recent low-carbohydrate diets and misconceptions of the potato painted a bad picture about the nutritional value of the potato. Contrary to the popular notion that a potato is fattening, a 6 oz potato offers less than 10% of the daily value of carbohydrates and complex carbohydrates which are a great source of energy. Potatoes also have one of the highest overall antioxidant activity among vegetables (National Potato Council website 2006-2007). The objective of this research is identifying cultivars with high levels of resistant starch (RS) and developing storage regimes and guidelines for processing methods can enhance the nutritive value of the potato. This can create a new market potential for the potato as a specialty crop. RS is attributed to potential health benefits including inhibition of intestinal infection and reduction in cancer risk and modifying the glycemic response. Higgins (2004) showed that RS intake increases lipid oxidation.

Replacement of 5.4% of total dietary carbohydrate with RS resulted in decrease of fat accumulation by 30%.

Preliminary results: We have been working on estimating the RS and amylose content in potato cultivars developed in Colorado. Our initial results indicate that there are significant differences in russet and specialty cultivars. Some of the cultivars having high RS in raw tubers lose RS significantly when they are baked (Table 1). RS in Yukon Gold raw tubers have the highest amount of RS but after baking it drop to the lowest among cultivars tested. RS in the numbered russet line AC96052-1RU did not change significantly even after baking.

Cultivars	Total starch (g/100g potato material)	RS (g/100g total starch)		NRS (g/100g)
		RS –Raw	RS- Baked	
Dark Purple Flesh	63.37	12.06	4.76	95.45
Purple Majesty	70.46	13.43	3.24	96.86
Yukon Gold	60.10	34.64	2.32	97.73
Rio Grande Russet	59.84	23.71	9.70	91.16
Rio Colorado	63.32	17.98	3.73	96.40
Mountain Rose	62.16	12.15	6.71	93.72
Lenape	63.90	14.52	6.14	94.22
CO94035-15RU	68.49	20.27	5.33	94.94
CO95051-7W	71.81	32.86	5.72	94.59
AC96052-1RU	66.37	14.62	10.38	90.60
CO97226-2R/R	60.48	9.81	8.77	91.93
CO97232-1R/Y	66.00	23.78	5.49	94.80
AC97521-1R/Y	61.02	23.76	7.07	93.39

Table 1

➤ Studying the powdery scab resistance mechanism in russet cultivars

Powdery scab disease caused by *Spongospora subterranea f. sp. subterranea* is one of the major concerns for potato producers in potato production regions in North America. This is a soil borne pathogen that infects root hairs, stolon epidermal cells, lenticels, eyes and wounds of developing tubers. Infected tubers and roots may have white gall-like growths, which in turn develop into brown powdery scab lesions on tubers as they mature. Powdery scab can cause significant economic losses in both fresh and seed markets. Depending on the severity of symptoms, tubers could become non-marketable or grade may be lowered in fresh and seed markets. Smooth skin mutants of Centennial Russet and Russet Nugget identified by David Holm have shown partial russet skin. The smooth skin area of the same tuber is susceptible to powdery scab. This skin mutation offers an opportunity to study the genetics of a specific russetting phenotype. Out of 10,000 genes analyzed on potato microarray (NSF Potato Functional Genomics Project), 1157 genes were up-regulated and 1238 genes were down regulated when healthy and infected cortex tissue of mutant were compared. In the mutant healthy and infected periderm tissue experiment, 23 genes were up regulated and 52 genes were down regulated. Nine out of 23 up-regulated gene functions from periderm tissue are unknown. Up-regulated genes in periderm tissue were further confirmed by RT-PCR (reverse transcriptase – polymerase chain reaction) and the role of each gene is being investigated in powdery scab disease resistance/susceptibility mechanisms.