Introduction
The Pacific Northwest (PNW) has a long history of growing small grain cereal crops, such as wheat and barley. About 1.3 million hectares of land in the PNW is in a grain-fallow rotation and only 2% of this is planted into canola. It has been shown that canola is a good rotational crop when grown with wheat and barley, and adds diversification to dry-land farmers of the PNW. Rotational benefits include improved control of pests, grass weeds, and diseases in cereal production. These benefits, in addition to more competitive prices has created increased interest in growing spring and winter canola in the region. Initially, a major constraint on increasing canola acreage was the availability of suitably adapted cultivars. Over the past 20 years, the University of Idaho Canola Breeding Program has conducted winter and spring cultivar trials throughout the PNW region, and has tested cultivars and breeding lines from the University of Idaho breeding program alongside entries from private and other public breeding programs.

Materials and Methods
Researchers at the University of Idaho established the Pacific Northwest Spring and Winter Variety Trials (PNW-SVT and PNW-WVT) in 1992 and 1993. Over the past 20 years, spring canola cultivar testing has been conducted at an average of 4 locations in Idaho, 3 in Washington, and 2 different locations in Oregon. Winter canola varieties have been evaluated on average at 4 different locations across Idaho, 2 sites in Washington, and 2 locations in Oregon. The trial design for each variety trial location was a randomized complete block with four replications and an individual plot size of 1.5 x 5 m.

The PNW-SVT & PNW-WVT contained advanced breeding lines from the University of Idaho and commercial seed companies. Over 20 years of testing, 266 cultivars from 25 different companies have been submitted to the PNW-SVT and 160 different varieties tested from 20 different private and commercial breeding programs in the PNW-WVT. ‘Westar’ spring canola has been included in all spring trials as a control, and ‘Bridger’ winter rapeseed was included in all winter trials as a control. Both of these controls were then used as checks for comparison of yield improvements that were attributed to advances in crop genetics.

Results and Discussion
Over the 20 year period of cultivar testing, the most adapted (top 3 lines) winter canola cultivars yields have increased from 3,400 kg ha⁻¹ to over 4,400 kg ha⁻¹, an average increase of 52 kg ha⁻¹ each year (Figure 1). The winter rapeseed cultivar ‘Bridger’ also showed increased productivity from 2,601 kg ha⁻¹ to 3,070 kg ha⁻¹; a rate of 23 kg ha⁻¹ per year. The observed yield increase for Bridger can be attributed to improvements in agronomic practices throughout the region which include new pesticides (herbicides, insecticides, and seed treatment) and better fertility management. Comparison of the genetic and non-genetic yield gains show that winter canola genetic improvements were responsible for yield increases of 604 kg ha⁻¹ (or 55% of the total increase), while agronomic improvements only attributed 483 kg ha⁻¹ (or 45% of total increase).

Yield of the most adapted cultivars entered into the spring variety trials have made similar large gains from 1,950 kg ha⁻¹ over 2,500 kg ha⁻¹ (Figure 2). ‘Westar’ spring canola also showed yield gains of 1,665 kg ha⁻¹ to 1,844 kg ha⁻¹. Again, comparing genetic with non-genetic yield gain spring canola cultivars showed improvement in genetics of 470 kg ha⁻¹ (70% of the total increase), while agronomic improvements in spring canola production accounted for an increase in yield of 188 kg ha⁻¹ (30% of the total increase). The larger genetic yield gains of spring canola cultivars compared to winter varieties is perhaps due to a comparatively larger financial investment of commercial breeding programs. This is also reflected in the number of commercial cultivars entered into the different trials, where an average of 31 cultivars each year have been entered into the PNW-SVT and only 23 cultivars a year in the PNW-WVT; a 25% difference.

Conclusion
Over the past 20 years of variety testing, genetic improvements of cultivars has increased yield potential for spring and winter canola significantly. In recent years, the acreage of canola in the PNW has risen and continues to increase. The availability of new and adapted cultivars in combination with better understanding of the correct agronomic needs of the crop in the region, and the availability of local crushing has resulted in higher canola seed prices to the farmer.