AGRICULTURAL RESEARCH FOUNDATION
INTERIM REPORT
FUNDING CYCLE 2016 – 2018

TITLE: Can Quinoa be a Reliable Alternative Crop in Malheur County?

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SUMMARY: There is continued interest in developing alternative crops that may be successfully grown in Malheur County. One crop, which may have potential, is quinoa (*Chenopodium quinoa*). Quinoa, a member of the chenopodium family, is considered a pseudo-cereal which produces a grain-like seed which can be sold as a whole grain or used in bread, soups or other uses. In addition to its status as a gluten-free option for cereal based products, quinoa has very high in protein compared to wheat. Quinoa is believed to be tolerant to abiotic stresses including salinity, drought, and poor soil quality (Oelke et. al, 2009).

OBJECTIVES: The goal of this trial was to explore whether quinoa may be suitable for production in Malheur County. Quinoa is a close relative to the less desirable plant Lambsquarter, a common weed in Malheur County. If some lines are selected as suitable for mid-summer production, this would have value as a double-cropping option when used in a rotation with wheat or other early-maturing crops such as peas. Midseason planting would also enable the plant to perhaps avoid the worst of the summer heat during flowering. Kevin Murphy of Washington State University (Pullman) has shown that high heat during flowering can greatly decrease yield, he said that quinoa has some cold tolerance and survival to about 28°F.

In order for quinoa to be harvested mechanically with existing local equipment, it will be important have a uniform plant size to facilitate adjustment of the combine and efficient harvesting. Lines that have plants that mature at the same time are also critical. The seeds will need to mature at roughly the same time to be able to thresh the entire crop and optimize seed quality and minimize loss. Once the seed is mature in the field, moisture can cause the seed to sprout in the heads before harvest. This can be a quality issue, so producers will not want to leave mature seeds hanging unharvested while other parts of the field are still drying down.

PROCEDURES: A cultivar nursery was planted 28 July, 2016 at the Oregon State University Malheur Experiment Station on an Owyhee silt loam soil. Some of the cultivar seed was purchased from the online catalog company Wild Garden Seed (Philomath, OR) while much of the seed was selected from a nursery held in 2015 trial as individual plant selections. Many of the selections planted in 2016 were made in the fall while some were made from the overwintered plants left standing until spring. Selection criteria is based on the need for plants that mature uniformly, do not get above an optimal harvest height and have good standing strength. These criteria were developed in part by guidelines provided by *Quinoa: Botany,*

Production, and Uses (Bhargava & Srivastava). The trials were planted in plots which were four double rows wide and 25 ft long on 22-inch beds with a cone planter. The planting rate was 2.7 lb/ac and most entries were replicated four times. The trial was furrow irrigated. Watermark soil moisture sensors (Irrometer Co. Inc., Riverside, CA) were placed in the field to aid in irrigation scheduling. It should be noted that there was no available data for quinoa irrigation scheduling based on Watermark soil water tension data. The Watermarks were used only to monitor the moisture trends of the soil.

Quinoa was harvested by hand with the middle ten feet of the two rows of each plot being removed on 2 November. A majority of the plants were not sufficiently dry to make mechanical harvest possible. The samples were placed in a dryer in preparation for threshing. The dried samples were threshed by a Wintersteiger combine on 9 November. Grain samples were then run through a fan to remove more of the chaff and stems.

SIGNIFICANT ACCOMPLISHMENTS TO DATE: Plants grew rapidly with the average of the cultivars ranging from 47" to 66"tall 68 days after planting (Figure 1). To help identify selections that showed potential, plots were rated on a harvest index considering plant height, maturity, and stand ability (resistance to lodging). Selections were rated on a 1-5 scale with five representing the most desirable characteristics (Table 1). Lodging was severe in many of the entries especially those that were late maturing. These are very difficult to harvest mechanically or by hand.

Maturity ratings were based on a scale of 1-5 with five being the most mature. Plots with maturity ratings below 2.4 were not harvested. These cultivars did not meet several of the desired criteria (harvest index) in addition to not being mature enough to harvest even so late into the season. Sel. 204 showed the best maturity rating and showed good yield potential (Table 2).

Figure 1. Weekly plant heights (in) for quinoa planted on 18 July, 2016 at the Oregon State University, Malheur Experiment Station, Ontario, OR.

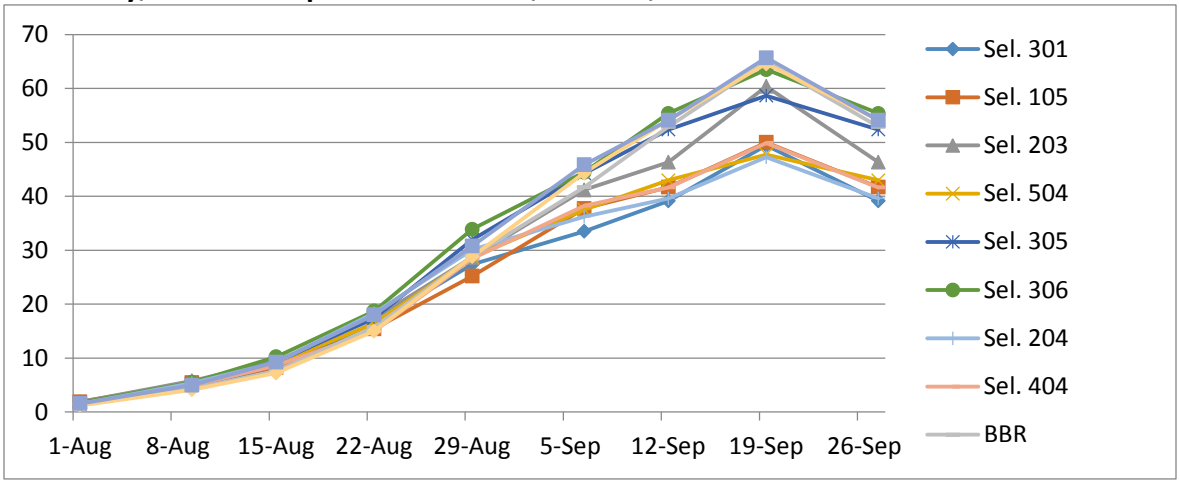

Table 1. Replicated in-season ratings for a quinoa nursery grown at the Oregon State University, Malheur Experiment Station, Ontario, OR in 2016.

Cultivar	Stand rating (%)(8 DAP)	Plant height (in) (68 DAP)	Harvest index* (68 DAP)	Percent lodged 11 Oct.	Plant maturity (1-5)(5=green) 23 Oct.
Sel. 301	47.5bc	49.4	3.1bcd	11.3d	3.8a
Sel. 105	77.5a	50.0	3.5ab	40.0bcd	4.0a
Sel. 203	60.0ab	60.4	3.4abc	70.0ab	2.4bc
Sel. 504	65.0ab	47.8	4.4a	10.0d	3.6a
Sel. 305	61.7ab	58.7	2.3cde	55.0abc	3.3ab
Sel. 306	53.3b	63.5	2.0de	81.7a	2.3c
Sel. 204	65.0ab	47.2	4.2ab	10.0d	4.2a
Sel. 404	74.0a	49.9	4.5a	26.0cd	3.7a
Br. Brilliant Rainbow	45.0bc	64.9	2.0de	55.0abc	1.8c
Cherry Vanilla	28.8c	64.6	2.3cde	73.8ab	2.3c
French Vanilla	57.5ab	65.7	1.6e	70.0ab	1.6c
lsd	20.4	ns	1.13	30.69	0.99
F Value	0.0013	0.0731	0.0001	0.0001	0.0001

*Harvest index is rated 1-5 (5=best) of the plant characteristics. Shorter profile, good stand-ability and plant maturity were primary factors.

Table 2. Non-replicated yields for a quinoa nursery grown at the Oregon State University, Malheur Experiment Station, Ontario, OR in 2016.

Cultivar	Yield/ac (lbs)
Sel. 301	2016
Sel. 105	1854
Sel. 203	3591
Sel. 504	3355
Sel. 305	2060
Sel. 306*	------
Sel. 204	3198
Sel. 404	3164
Br. Brilliant Rainbow*	------
Cherry Vanilla*	------
French Vanilla*	------

*Plots not harvested due to lack of maturity

Hand harvesting was very time consuming and not practical on a large scale. It is imperative that these trials help find lines that can be harvested mechanically. Selections from the 2016 nursery will be planted in a 2017 nursery in mid-to-late July. This will continue the effort to find suitable lines that can eventually be increased for commercial production of quinoa in the Treasure Valley.

ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM: Support for the first two years of this project (2014, 2015) was realized through S & W Seeds. This funding helped define the goals and objectives for the grant-funded project.

FUTURE FUNDING POSSIBILITIES: Specialty Crop Research Initiative (SCRI) funds could be pursued as the viability of this crop becomes apparent. As selections are made, there is a good chance that one or more viable lines will be found for production in this region.