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13.0 Performance and adaptation of Quinoa varieties

Project duration: 2017-2019
Collaborators: Percy Phillips-NorQuin

Objectives

- To determine yield potential of 7 quinoa varieties across different locations in Manitoba

Background

Bolivia and Peru are the world's top producers of quinoa followed by Ecuador, USA, China, Chile, Argentina, France and Canada, which altogether contribute 15 to 20% to the world's total production (Bazile, et al., 2016). Quinoa has a vast genetic diversity resulting from its fragmented and localized production over the centuries in many regions around the world. The crop can withstand low temperature around -1.1°C but if it gets below -2.2°C during mid-bloom stage it can cause more than 70% yield loss due to flower abortion. Significant yield losses also occur when exposed to temperature below -6.7°C before dough stage (AAFRD, 2005). On the other hand, elevated temperature above 35°C for lengthened periods during the reproductive stage can cause dormancy and pollen sterility in quinoa (OMAFRA, 2012). A major setback in growing quinoa in Canada and in high altitude regions is the short growing season because the crop requires up to 150 days from planting to seed harvest (Jacobsen, 2003). In this regard, early maturity becomes the most important characteristic when selecting varieties suitable under these conditions especially on the Prairies that experience cooler and shorter growing season.

Quinoa is one of the few crops that can help maintain productivity on rather poor soils and under conditions of erratic rainfall and high salinity. As a result, it becomes an alternative crop that could play a significant role in sustainable agriculture. Apart from its usefulness in marginal agricultural lands, the crop is an exceptionally nutritious food source that has high protein content with all essential amino acids, high content of calcium, magnesium, iron and health promoting compounds such as flavonoids (Ruiz et al., 2014). Other positive values of quinoa are the saponins present in the seed hull and lack of gluten.

Materials and Methods

The trial was conducted at four locations in Manitoba: Melita, Roblin, Carberry and Arborg. It was arranged as randomized complete block design with 7 treatments (varieties) and 3 replicates over 4 site-years. Varieties seeded were: PHX16-01, PHX16-02, PHX16-03, PHX16-07, PHX16-08, PHX16-09 and PHX16-10. In Melita, the plots were seeded on the 3rd of May into good soil moisture at a depth of 0.5". Granular blend and liquid fertilizer were side banded at 108-35-20-7-2Zn (N-P-K-S) lb ac^{-1} during seeding. In-season post emergence weed control was done once using 0.15 L ac^{-1} Arrow + 0.5% v/v X-Act adjuvant. The major insect pests of concern were stem borer larvae (*Amauromyza karli*), which were controlled four times by alternating a weekly application of Cygon and Matador insecticides at rates of 0.133 L ac^{-1} and 0.0332 L ac^{-1} respectively. Data collected included: emergence date, plant stand, lodging, plant vigor, days to maturity, grain yield and moisture content at harvest. The data were subjected to two way ANOVA using Minitab 18 for comparison of treatments.

Quinoa at heading stage (BBCH 80)

July 2nd 2019, Melita

Yellowish bottom leaves showing signs of Downy mildew

Results and Discussion

Days required to reach maturity were significantly different and ranged from 129 to 135 among varieties. Late maturity entries such as PHX16-10 which required 134 days to reach maturity also yielded significantly more grain (P=0.001) compared to the other varieties. Grain yield ranged from 1882 to 4038 kg ha^{-1}). PHX16-09 had the highest lodging rating of 3 which could have likely caused grain losses resulting in low yield of 1882 kg ha^{-1}. The highest coefficient of variation of grain yield was caused by PHX16-10 entry which had almost double the grain yield compared to the rest of the entries. All treatments showed high vigor especially considering that the rating ranged from 6 to 8 and this was a sign of healthy plants.

The variety trial had a few challenges with stem borer larvae that required chemical control more than 3 times during the season. The caterpillar penetrates and feed inside the stem causing severe lodging and eventually reduces grain yield and quality. However, there was better timing of scouting and application of alternating insecticides for better control of the stem borer compared to 2018 growing season.

Table 13.0. Analysis of variance for quinoa lodging, days to maturity, plant vigor, test weight, thousand kernel weight and yield of wheat at Melita in 2019

Entry Name	Trt	Lodging 1-5	DTM	Vigor 1-9	Test weight	TKW	Yield kg ha^{-1}
PHX16-01	1	2.3bc	132bc	8a	304a	2.0a	2133bc
PHX16-02	2	2.7ab	133b	7ab	306a	1.6b	2780b
PHX16-03	3	2.7ab	129d	6b	305a	2.0a	2138bc
PHX16-07	7	2.7ab	131cd	7ab	305a	2.0a	2261bc
PHX16-08	8	3.0a	132bc	7ab	285b	2.0a	1882c
PHX16-09	9	2.0c	135a	6b	282b	1.9a	2096bc
PHX16-10	10	2.0c	134ab	7ab	290b	2.0a	4038a
	CV	**14**	**1**	**11**	**2**	**7.0**	**17**
	P Value	**0.028**	**<0.001**	**0.123**	**<0.001**	**<0.001**	**0.001**
	LSD (p<0.05)	**0.6**	**2**	**NS**	**10**	**0.2**	**763**

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