

# Pungency Responses of Ten Onion Cultivars Grown in the Rio Grande Valley During Three Growing Seasons at Two Locations

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## ABSTRACT

A pungency study, measured by enzymatically produced pyruvic acid, was conducted over a three year period using ten short-day onion cultivars at two locations in the Lower Rio Grande Valley of Texas. Yearly variation ranged from 3.9 to 7.3  $\mu\text{mol}\cdot\text{g}^{-1}$  in pyruvic acid, and one location showed slightly higher pungency (5.7  $\mu\text{mol}\cdot\text{g}^{-1}$ ) than the other (5.2  $\mu\text{mol}\cdot\text{g}^{-1}$ ). Among ten cultivars, there was a variation ranging from 4.5 to 6.7  $\mu\text{mol}\cdot\text{g}^{-1}$ , with 'Texas Early White' being the most pungent. Yearly variation was the most significant source of difference in pyruvic acid. Cultivar, location, and the year by cultivar interaction were also significant. This study illustrated how much year to year environmental variation can influence the pungency of onion germplasm.

## RESUMEN

Se condujo un estudio acerca de la naturaleza picante de la cebolla, medida a través de la producción enzimática de ácido pirúvico, durante un periodo de tres años utilizando diez cultivares de día corto en dos localidades del Bajo Valle del Río Grande de Texas. La cantidad de ácido pirúvico varió anualmente de 3.9 a 7.3  $\mu\text{mol}\cdot\text{g}^{-1}$ ; una localidad mostró mayores cantidades de ácido pirúvico (5.7  $\mu\text{mol}\cdot\text{g}^{-1}$ ) que otra (5.2  $\mu\text{mol}\cdot\text{g}^{-1}$ ). De diez cultivares analizados, se observó una variación de 4.5 a 6.7  $\mu\text{mol}\cdot\text{g}^{-1}$ , siendo 'Texas Early White' el más picoso. Cultivar, localidad, y la interacción entre cultivar y localidad fueron también significativas. Este estudio mostró la medida en que la variación ambiental entre años puede influenciar la naturaleza picante del germoplasma de cebollas.

Sweet onions are a very important crop in Texas with a farm value of spring onions over \$72 million (Love, 1994). Therefore, serious efforts have been made in the breeding of locally adapted onion cultivars, as well as improvement in cultural practices. Some important breeding achievement included the development of new cultivars with higher storage quality, higher yield, more disease resistance, and lower pungency (Pike, 1986). Extensive research has been conducted to identify the possible role of environment on onion pungency (Platenius and Knott, 1941, Freeman and Mossadeghi, 1970, Vavrina and Smittle, 1993, Gamiely et al., 1991). Platenius and Knott (1941) demonstrated that high temperatures and less water applied to the onion crop can contribute to more pungent onions. Nitrogen form that is applied as fertilizer can also influence onion pungency (Gamiely et al., 1991). All of these factors are possible reasons for differences in onion pungency year to year. Recently, sweet onions with low pungency and high sugar content have become popular, and research in this area is needed to determine how locally adapted cultivars perform regarding these factors.

The objectives of this study were to determine what factors influence pungency in onions, including different locations, seasons, and cultivars.

## MATERIALS AND METHODS

Three experimental onion cultivars from Asgrow Seed Co. and seven other commercially available cultivars of short-day onions were grown at two locations for three consecutive years (1993 - 1995 harvest year) in the Lower Rio Grande Valley of Texas. The two locations included one located ~5 miles west of Rio Grande City, TX, (location A) and another located ~1 mile east of Rio Grande City, TX (location B). Location A was planted approximately one month earlier (mid-September) than location B (mid-October). Different management and cultural practices were used in each location. Location A was watered using a drip irrigation system, while the B location was furrow irrigated. Location A had sandy soil, but location B had loamy soil.

Each cultivar was planted with three replications in each location in a randomized complete block design. Plots were 15.2 m long and 101.6 cm wide. Seed was directly seeded in beds (two rows per bed) using a cone planter designed for experimental plots. Onions grown at location A were harvested approximately one month earlier each year than those grown at location B.

Samples of ten bulbs were taken from each plot at harvest for pungency analysis. Bulbs were analyzed for pyruvic acid

**Table 1.** The effects of year, location, and cultivar on the pungency of ten short-day onion cultivars grown during three seasons at two locations in the Lower Rio Grande Valley of Texas.<sup>2</sup>

Year <sup>1</sup>	Pungency <sup>1</sup>	Location <sup>2</sup>	Pungency <sup>3</sup>	Cultivar <sup>4</sup>	Pungency <sup>5</sup>
1994	7.3 a	A	5.7 a	Texas Early White	6.7 a
1995	5.3 b	B	5.2 b	Henry Special	6.2 ab
1993	3.9 c			Ringer	6.0 bc
				Granex 33	5.7 bcd
				6705	5.4 cd
				Early White Supreme	5.4 cd
				TG 502 PRR	5.3 d
				Savannah Sweet	5.1 d
				6702	4.5 e
				6707	4.5 e

<sup>1</sup>Mean separation in each column using LSD at P=0.05.

<sup>2</sup>Average pungency for all cultivars and locations for each year.

<sup>3</sup>Average pungency for all cultivars and years for each location.

<sup>4</sup>Average pungency for each cultivar over 3 years and 2 locations.

<sup>5</sup>Pungency = mol.g<sup>-1</sup> fresh weight as pyruvic acid.

content to estimate their pungency levels as described by Yoo et al. (1995). All data were analyzed using the SAS general linear model and treatment means were separated using LSD at the 5% level.

## RESULTS AND DISCUSSION

There were significant differences in pungency due to growing season (year) (Table 1). 1993 showed the lowest pungency (3.9  $\mu\text{mol}\cdot\text{g}^{-1}$ ) while 1994 showed the highest (7.3  $\mu\text{mol}\cdot\text{g}^{-1}$ ). Onions produced at location A were significantly higher in pyruvic acid than those at B, for each year however the small difference between means (0.5  $\mu\text{mol}\cdot\text{g}^{-1}$ ) seemed to be not of any practical significance. There was a wide range of pungency among the ten cultivars tested. They ranged from 4.5 to 6.7  $\mu\text{mol}\cdot\text{g}^{-1}$ , with 6702 and 6707 being lowest and Texas Early White highest.

The ANOVA table of the three year data of pungency revealed that all sources of variation tested (year, location, and cultivar) had highly significant effects on pungency, except for the cultivar by location and the year by cultivar by location interaction (Table 2). The largest source of variation was attributed to the variable year. The other two main effects

of cultivar and location, as well as the year by cultivar interaction, were also significant at P = 0.01 level.

Apparently, environmental changes from year to year are very important in determining the pungency level of onions. The cultivar differences were expected to occur due to the wide variation in germplasm. The significance of the year by cultivar interaction is important because it indicates that of the cultivars tested, not all responded consistently across years, although the MS value is relatively low. Vavrina and Smittle (1993) also found a significant year by cultivar interaction in a two year study conducted in Georgia. The non-significance of the cultivar by location interaction demonstrates consistent response of cultivars between the two locations.

Two Asgrow cultivars, 6702 and 6707, were lowest in pungency over the three years and two locations with 4.5  $\mu\text{mol}\cdot\text{g}^{-1}$  of pyruvic acid. The most pungent cultivar overall was 'Texas Early White'. It contained 6.7  $\mu\text{mol}\cdot\text{g}^{-1}$  of pyruvic acid. This result indicates that developing new cultivars consistently low in pungency is possible. However, there is possibility that in any given year these cultivars may not be the mildest or hottest due to the significant year by cultivar interaction. Since variation due to year is not a controllable factor, such as relative to annual changes in the weather, it is

**Table 2.** ANOVA table of pyruvic acid of short-day onion cultivars grown during three seasons at two locations in the Lower Rio Grande Valley of Texas.

Source	df	MS <sup>2</sup>
Year (Y)	2	198.2**
Location (L)	1	10.2**
Cultivar (C)	9	8.9**
Rep (Y x L)	12	1.5*
Y x L	2	7.9**
Y x C	18	2.2**
C x L	9	0.8 <sup>ns</sup>
Y x C x L	18	0.6 <sup>ns</sup>
Error	98	.8

<sup>ns</sup>, \*, \*\* Nonsignificant or significant at the P = 0.05 or 0.01 level, respectively.

best to breed new cultivars that express the lowest pungency over several years.

This information will be important in a breeding program by allowing the breeder to compare new genetic material with existing commercial cultivars under a variety of conditions. It will also be useful to onion growers who are interested in producing sweet onions on a consistent basis.

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