

# Pungency of Chile (*Capsicum annuum* L.) Fruit is Affected by Node Position

Yayeh Zewdie<sup>1</sup> and Paul W. Bosland<sup>2</sup>

Department of Agronomy and Horticulture, New Mexico State University, Las Cruces, NM 88003

Additional index words. capsaicinoids, double haploid, red pepper

Chile plants branch dichotomously and produce a flower bud at each node. Because flowering is acropetal, they set fruit in sequential order. Even though only a small percentage of the potential fruit set (Turner and Wien, 1994), the fruit load per plant and overall competition among the fruits for photosynthate will increase with time and nodal development. Fruits maturing at different nodes may vary in their capacity to biosynthesize secondary plant metabolites because of this overall competition. Pungency or the sensation of heat in chile is due to alkaloids known as capsaicinoids and is influenced by genotype, cultural practices, and the environment (Deshpande, 1935; Harvell and Bosland, 1997). Therefore, this study evaluated the effect of node position on fruit pungency.

Fruits from five node positions (second, third, fourth, fifth, and sixth from the base) were evaluated for pungency by using a double haploid line, CaGC87, in a greenhouse and in the field. The first node position often does not set a fruit, therefore, the harvest began with the second node. The CaGC87 line was generated from the New Mexican pod-type cultivar, 'NuMex R Naký' (Munyon et al., 1989). Double haploids can be used as seed-propagated clones; each plant is genotypically identical with all its siblings.

The experiment was performed in the greenhouse at the Fabian Garcia Science Center, Las Cruces, N.M., from Jan. to June 1996. A randomized complete-block design was used with three replications. Seeds of CaGC87 were sown in the greenhouse. After 4 weeks, individual seedlings were transplanted to 1.25-L white plastic pots filled with a 1 peat moss : 1 sand : 1 loam soil mixture (by volume). Each plant was considered a replication. About 18 g of slow-release fertilizer (Osmocote® 14N-4.2P-11.6K; Scott's-Sierra Horticultural Products, Marysville, Ohio) was placed in each pot

at transplanting and again at flowering. Seedlings were watered twice a day to maintain optimum growth. Mature, red, succulent fruits were harvested from a given node position and then bulked for analysis.

The experiment was repeated in the field at Leyendecker Plant Science Research Center, 12 km south of Las Cruces, N.M., in a randomized complete-block design using six replications (plants) in 1996 and seven in 1998. Seeds of CaGC87 were sown in the greenhouse and transplanted to the field 6 weeks after sowing at a spacing of 30 cm between plants and 100 cm between rows. Plant population was equivalent to 33,333 plants/ha. The soil type was fine-silty, mixed calcareous thermic typic torrfluvents soil (Bullock and Neher, 1980). Fertilizer, at the rate of 50 kg·ha<sup>-1</sup> of N and 129 kg·ha<sup>-1</sup> of P, was broadcasted during land preparation. Standard growing practices for southern New Mexico were used (Bosland et al., 1994). The field was furrow-irrigated as needed, usually at 7- to 10-d intervals. The field was cultivated and hand-weeded as needed for optimal plant growth. As in the greenhouse, the mature, red, succulent fruits were harvested from a given node position and then bulked for analysis.

Capsaicinoids were extracted, separated, and quantified using high-performance liquid chromatography (HPLC) following the "short run" method described by Collins et al. (1995). Each sample was injected twice and the mean of two HPLC runs was used for the data analysis. The raw HPLC data were transformed to mg·kg<sup>-1</sup> and converted to Scoville Heat Units by multiplying by 15. Analysis of variance tables were computed using the general linear model (GLM) of the SAS computer program (SAS Institute, 1996) for each experiment separately. Orthogonal comparisons as well as linear, quadratic, and cubic trends were ascertained by single degree of freedom contrasts.

Node position affected pungency of the chile fruits in all tested years. The fruits harvested from the second node had higher mean pungency than did those from other node positions (Table 1). In addition, the orthogonal contrast determined that pungency decreased in a predominantly linear fashion as node position increased (Table 1). Except in the 1996 field experiment, fruit set at the sixth node had the lowest pungency level. The higher pungency at the lower nodes may be related to the number of fruits developed. At early devel-

opmental stages, there are fewer fruits per plant and competition among fruits for a substrate may be minimal. However, at later growth stages, there are more fruits per plant and competition for a substrate may be high, resulting in a low amount of capsaicinoid production per fruit. A similar pattern was reported in chile (*Capsicum annuum* L.) by Osman and George (1984); seeds from fruit borne at lower node positions weighed more, had higher germination rates and produced heavier seedlings than did those from fruits borne at the higher node positions.

In conclusion, our study suggests that node position has a significant effect on the fruit's pungency.

## Literature Cited

- Bosland, P.W., A.L. Bailey, and D.J. Cotter. 1994. Growing chiles in New Mexico. Guide H-230, New Mexico State Univ., Las Cruces.
- Bullock, H.E. and R.E. Neher. 1980. Soil survey of Doña Ana County, New Mexico. U.S. Govt. Printing Office, Washington, D.C.
- Collins, M., L.M. Wasmund, and P.W. Bosland. 1995. Improved method for quantifying capsaicinoids in *Capsicum* using high-performance liquid chromatography. HortScience 30:137-139.
- Deshpande, R.B. 1935. Studies in Indian chillies: 4) Inheritance of pungency in *Capsicum annuum* L. Indian J. Agr. Sci. 5:513-516.
- Harvell, K. and P.W. Bosland. 1997. The environment produces a significant effect on pungency of chile. HortScience 32:1292.
- Munyon, I.P., J.F. Hubstenberger, and G.C. Phillips. 1989. Origin of plantlets and callus obtained from chile pepper anther cultures. In Vitro Cell. Dev. Biol. 25:293-296.
- Osman, A.O. and R.A.T. George. 1984. The effect of mineral nutrition and fruit position on seed yield and quality in sweet pepper (*Capsicum annuum* L.). Acta Hort. 143:133-141.
- SAS Institute. 1996. SAS software release 6.12. SAS Inst., Cary, N.C.
- Turner, A.D. and H.C. Wien. 1994. Dry matter assimilation and partitioning in pepper cultivars differing in susceptibility to stress-induced bud and flower abscission. Ann. Bot. 73:617-622.

Table 1. Effect of node position on pungency of CaGC87, a double haploid chile line, evaluated under greenhouse and field conditions.

Node position	Pungency <sup>2</sup>		
	Greenhouse	Field 1996	Field 1998
2 <sup>nd</sup>	13673	9665	15531
3 <sup>rd</sup>	5641	6864	10200
4 <sup>th</sup>	3714	3213	10972
5 <sup>th</sup>	3782	3746	8094
6 <sup>th</sup>	3660	4501	5910
<i>Orthogonal contrasts</i>			
2 <sup>nd</sup> vs. others	*	**	**
3 <sup>rd</sup> vs. 4 <sup>th</sup>	NS	*	NS
4 <sup>th</sup> vs. 5 <sup>th</sup>	NS	NS	NS
4 <sup>th</sup> vs. 6 <sup>th</sup>	NS	NS	**
Node position <sup>3</sup>	L*	L*, Q*	L**

<sup>2</sup>Scoville Heat Units.

<sup>3</sup>Significant linear (L) or quadratic (Q) trends of node position.

ns, \*, \*\*Nonsignificant or significant at  $P < 0.05$  or 0.01, respectively.

Received for publication 13 Dec. 1999. Accepted for publication 11 May 2000. A contribution of New Mexico Agricultural Experiment Station, New Mexico State Univ., Las Cruces. The authors thank Dr. D. Smith, New Mexico State Univ., for statistical advice and Drs. M. O'Connell and M. Wall, New Mexico State Univ., for reviewing. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

<sup>1</sup>Postdoctoral Fellow. E-mail: ytarekeg@nmsu.edu

<sup>2</sup>Professor. E-mail: pbosland@nmsu.edu