

# GOOD AFTERNOON

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Thailand**



# General Background

Thailand (+7 GMT ; Las Cruces -6 GMT)

**Location:** Southeastern Asia

**Coordinates:** 15 00 N, 100 00 E

**Climate:** tropical (warm to hot and moist year-round, a lot of rainfall);

**Rainy season (mid-May to September):** warm, cloudy southwest monsoon

**Dry season (November to mid-March):** cool northeast monsoon



# Important

**Thai Food** : One of World's Most **HOT & SPICY Food**.

- Daily local consumption (2¢/family) about \$US 1.5 million or \$US 600 million annually

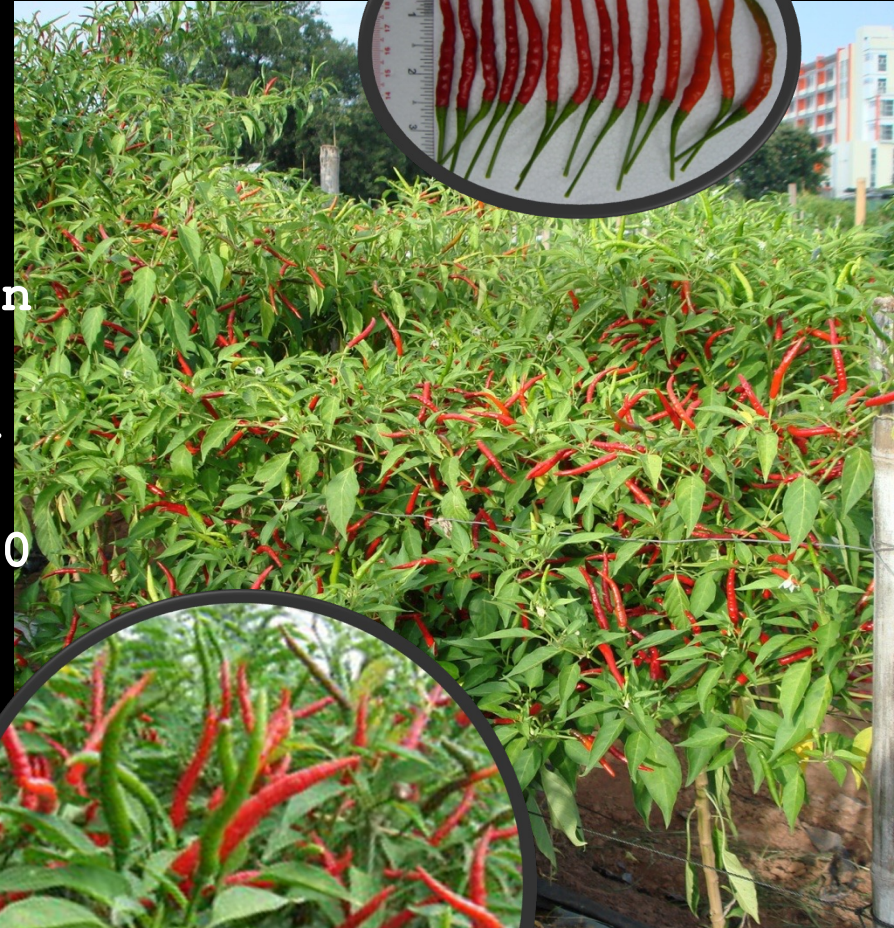


Big Mac in Thailand  
\$US 2½

# Important

## Food industry, Medical industry

- **Yodson** variety of KKU; capsaicin and dihydrocapsaicin about 43,000 and 28,600 SHU with 720 g/plt of fresh yield in rainy season and about 36,700 and 25,300 SHU with 380 g/plt of fresh yield in dry season under general field cultivation; was released to commercial use for medicinal produces : named **Capsika®** (Thai company)



Manufactured by Bangkok Lab & Cosmetic Co. Ltd. Thailand  
48/1 Moo 5 Nongshaesao Rd. Amphur Meung Ratchaburi 70000  
Distributed by Bangkok Drug Co., Ltd. : bangkokdrug.co.th  
874 Soi 23 Rama 6 Rd. Rajthevee Bangkok 10400

# Experiment background

## Varietal improvement & Physiological knowledge



- Pepper Breeding Program (Dr. Suchila Techawongstien)

- Biotic & Abiotic stress resistant/tolerant variety
- Cultural practices :

- Fertilizer technology
- Water stress
- Etc.




## Objective

Develop the pepper varieties for high yield and quality

- To Maximized pungent compounds





**INTERACTION EFFECTS OF NITROGEN AND  
POTASSIUM ON CAPSAICINOID CONTENTS IN  
CHILE PEPPER (*CAPSICUM ANNUUM* L.) VAR.  
YODSON**

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Resources, Faculty of Agriculture, Khon Kaen  
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**Presented at 20<sup>th</sup> International Pepper  
Conference, Las Cruces, New Mexico September  
12-14, 2010**

# Materials and Methods



## Experiments

- 2 experiments of chile pepper (*Capsicum annum* L.) var. Yodson grown under plastic-covered house were conducted over two seasons during May 2007 to May 2008.

## Cultural practices

- **Seedling media** : 2:1:1 of rice husk: rice husk charcoal: filter cake (fermented organic waste from sugar mill factory).
- **Transplant** at 6 leaves stage or 45 days after sowing.

**Growing media** :  
2:2:2:1 of rice husk:  
rice husk charcoal:  
filter cake: manure.



1.16~1.33%N 0.7~1.03%P 4.71~5.14%K



# Seedling management



**1-10 DAS**

- Under greenhouse with shading 50-75%
- Applied fertilizer 30-20-10 20 g/20 l



**11-20 DAS**

- Under greenhouse with shading 50%
- Applied fertilizer 10-52-17 20 g/20 l



**21-35 DAS**

- Under greenhouse no-shading
- Applied fertilizer 15-15-15 20 g/20 l



**35-45 DAS**

- Outside greenhouse no-shading
- **Hardening** the seedling before transplanting

- Watering 2 times/day
- Applied fungicide and insecticide every 5-7 days



# Greenhouse preparation & Transplanting



- Apply drip irrigation and mist-spray
- set data-logger: for measuring temperature, humidity and light intensity

Maximized plant density: >250,000 pt/ha (drip-line length 1.6 m for 2 rows with plant space 50 cm)



- Full-fill water into mixed media-plastic container by drip irrigation before transplanting

Transplant the seedling follows the experimental layout



# Materials and Metho



## Treatments

- 3x3 of N X K fertilizer combinations compared with water (control) (3x3+1 factorial in RCBD with 4 blocks x 10 plants).
- One liter of N (180, 225, 270 mg L<sup>-1</sup>) x K (117, 234, 351 mg L<sup>-1</sup>) or water was daily applied during transplanting to harvest in May – October (Rainy season) and during 50% bloom to harvest in November – May (Dry season).

## Data collection

- Growth information and yield were collected at harvest. Pungent compounds (Capsaicin, dihydrocapsaicin) was determined using HPLC techniques according to Collins 1995.

N x K concentration was reviewed from literature.

# Results

Effects of nitrogen and potassium fertilizer combinations applied during transplanting to harvest on pungent compounds and yield of Chile pepper var. Yodson

N	K	Capsaicin	Dihydrocapsaicin	Capsaicinoid	Capsaicinoid	Fresh yield	Dried yield
mg l <sup>-1</sup>		SHU			mg plt <sup>-1</sup>	g plt <sup>-1</sup>	
0	0	58,450 abc	26,890 bc	85,340 ab	357.37	351.86	124.63
180	117	43,631 c	20,082 c	63,713 c	250.90	351.71	116.80
	234	46,371 bc	22,612 bc	68,984 bc	314.68	447.53	140.15
	351	50,725 abc	24,516 bc	75,242 abc	226.98	301.54	90.85
<b>225</b>	117	54,726 abc	26,621 bc	81,347 abc	328.79	372.55	125.19
	<b>234</b>	<b>62,799 a</b>	<b>28,516 ab</b>	<b>91,315a</b>	372.36	324.25	121.34
	<b>351</b>	<b>63,352 a</b>	<b>29,116 ab</b>	<b>92,468 a</b>	349.11	295.13	109.98
270	117	59,712 ab	26,979 bc	86,690 ab	305.90	285.93	105.86
	234	61,580 ab	34,938 a	96,518 a	254.51	280.88	76.53
	351	61,268 ab	29,750 ab	91,018 a	391.35	342.20	126.64
	<b>N</b>	<b>L*</b>	<b>L**</b>	<b>L**</b>	ns	ns	ns
	K	ns	ns	ns	ns	ns	ns
	N x K	ns	ns	ns	ns	ns	ns

# Results

Effects of nitrogen and potassium fertilizer combinations applied during bloom to harvest on pungent compounds and yield of Chile pepper var. Yodson

N	K	Capsaicin	Dihydrocapsaicin	Capsaicinoid	Capsaicinoid	Fresh yield	Dried yield
mg l <sup>-1</sup>		SHU		mg plt <sup>-1</sup>		g plt <sup>-1</sup>	
0	0	75,633 d	66,548 d	142,181 d	114.16 c	95.06 a	24.56 g
180	117	192,136 ab	138,267 ab	330,403 b	263.75 ab	90.82 bc	33.93 b
	234	142,683 c	99,266 c	241,949 c	195.78 bc	90.90 bc	32.92 b
	351	214,138 a	153,516 ab	367,654 ab	325.46 a	98.94 a	39.42 a
<b>225</b>	117	186,080 b	139,811 ab	325,891 b	207.16 bc	89.24 bc	27.78 f
	<b>234</b>	<b>212,559 a</b>	<b>162,862 a</b>	<b>375,422 a</b>	<b>313.82 a</b>	91.56 bc	32.13 bcd
	351	63,659 d	54,198 d	117,857 d	105.03 c	91.71 bc	31.03 d
270	117	126,795 c	94,611 c	221,406 c	172.67 bc	92.65 bc	30.44 de
	234	201,089 ab	135,397 b	336,486 ab	245.58 ab	92.50 bc	25.31 g
	351	147,876 c	99,801 c	247,677 c	168.31 bc	88.39 c	28.73 ef
	N	Q**	L**	L**	ns	ns	L**
	K	Q**	Q**	Q**	ns	ns	L**
	N x K	Q x Q	L x Q	Q x Q	Q x Q	L x L	L x L

# Discussion

		Capsaicin	Dihydrocapsaicin	Capsaicinoid	Capsaicinoid	Fresh yield	Dried yield
Trans plant	N	L*	L**	L**	ns	ns	ns
	K	ns	ns	ns	ns	ns	ns
	N x K	ns	ns	ns	ns	ns	ns
Bloom	N	Q**	L**	L**	L*	ns	L**
	K	Q**	Q**	Q**	L*	ns	L**
	N x K	Q x Q	L x Q	Q x Q	Q x Q	ns	L x L

- N played the major role on capsaicin and dihydrocapsaicin content in both stage of application. The responses are mainly in linear form. It means that the plants response well to higher concentration.
- K did not express its effect when applied since early stage of growth but expressed as quadratic response when applied at reproductive stage. It may be means that the plants response to limited concentration.
- Interaction effects were only found when applied at reproductive stage.



# Discussion

		Capsaicin	Dihydrocapsaicin	Capsaicinoid	Capsaicinoid	Fresh yield	Dried yield
Trans plant	N	L*	L**	L**	ns	ns	ns
	K	ns	ns	ns	ns	ns	ns
	N x K	ns	ns	ns	ns	ns	ns
Bloom	N	Q**	L**	L**	ns	ns	L**
	K	Q**	Q**	Q**	ns	ns	L**
	N x K	Q x Q	L x Q	Q x Q	Q x Q	L x L	L x L

- At vegetative stage, Nitrogen enhanced growth then synthesized pungent compounds.
- At reproductive stage, inappropriate amount of N and K effected on pungent compounds synthesis.
- The results suggested that Nitrogen are important for pungent compounds synthesis at every stage of growth while Potassium will express its role when applied at right stage with appropriate amount to Nitrogen.



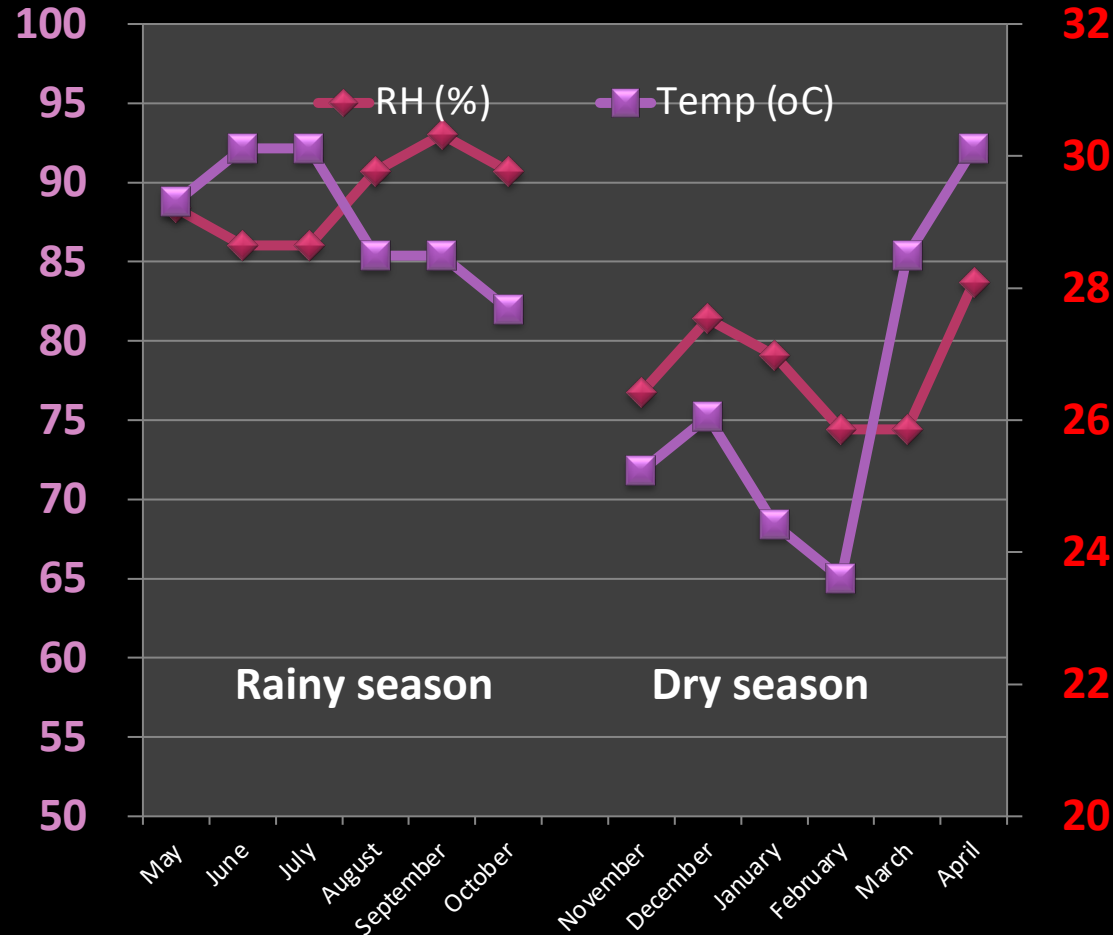
# Discussion

N	K	Fresh yield	Dried yield	Fresh yield	Dried yield
mg l <sup>-1</sup>		g plt <sup>-1</sup>		g plt <sup>-1</sup>	
0	0	351.86	124.63	95.06 a	24.56 g
180	117	351.71	116.80	90.82 bc	33.93 b
	234	447.53	140.15	90.90 bc	32.92 b
	351	301.54	90.85	98.94 bc	39.42 a
<b>225</b>	117	372.55	125.19	89.24 bc	27.78 f
	<b>234</b>	324.25	121.34	<b>91.56 bc</b>	<b>32.13 bcd</b>
	<b>351</b>	295.13	109.98	<b>91.71 bc</b>	<b>31.03 d</b>
270	117	285.93	105.86	92.65 bc	30.44 de
	234	280.88	76.53	92.50 bc	25.31 g
	351	342.20	126.64	88.39 c	28.73 ef
<b>N</b>	ns	ns	ns	ns	<b>L**</b>
K	ns	ns	ns	ns	<b>L**</b>
N x K	ns	ns	<b>L x L</b>	<b>L x L</b>	<b>L x L</b>

- Chile pepper grown in dry season always gave much higher pungent compounds but lower yield than those in rainy season. (Our previous experiments also revealed same results.)
- The applied amounts of fertilizer effected on dry yield only applied in dry season but did not effect on fresh yield in both season. The fruits of dry season may be dryer than those in rainy season and may be effected on higher amount of pungent compounds.

# Discussion

- The plants grow well in rainy season which high temperature and high humidity coincide with ample of fertilizer received during vegetative growth then effected on higher yield.
- Lower temperature as well as lower humidity caused on environmental stress to the plant in addition with shortage of fertilizer then effected on lower yield but higher pungent compounds synthesis.



**The information on fertilizer application with different stage of growth and season are useful for pungent compounds production for industrial uses.**





THANK YOU

Faculty of Agriculture KKU



# GOODBYE

- สวัสดี ครับ
- SAWAS DEE KRUB



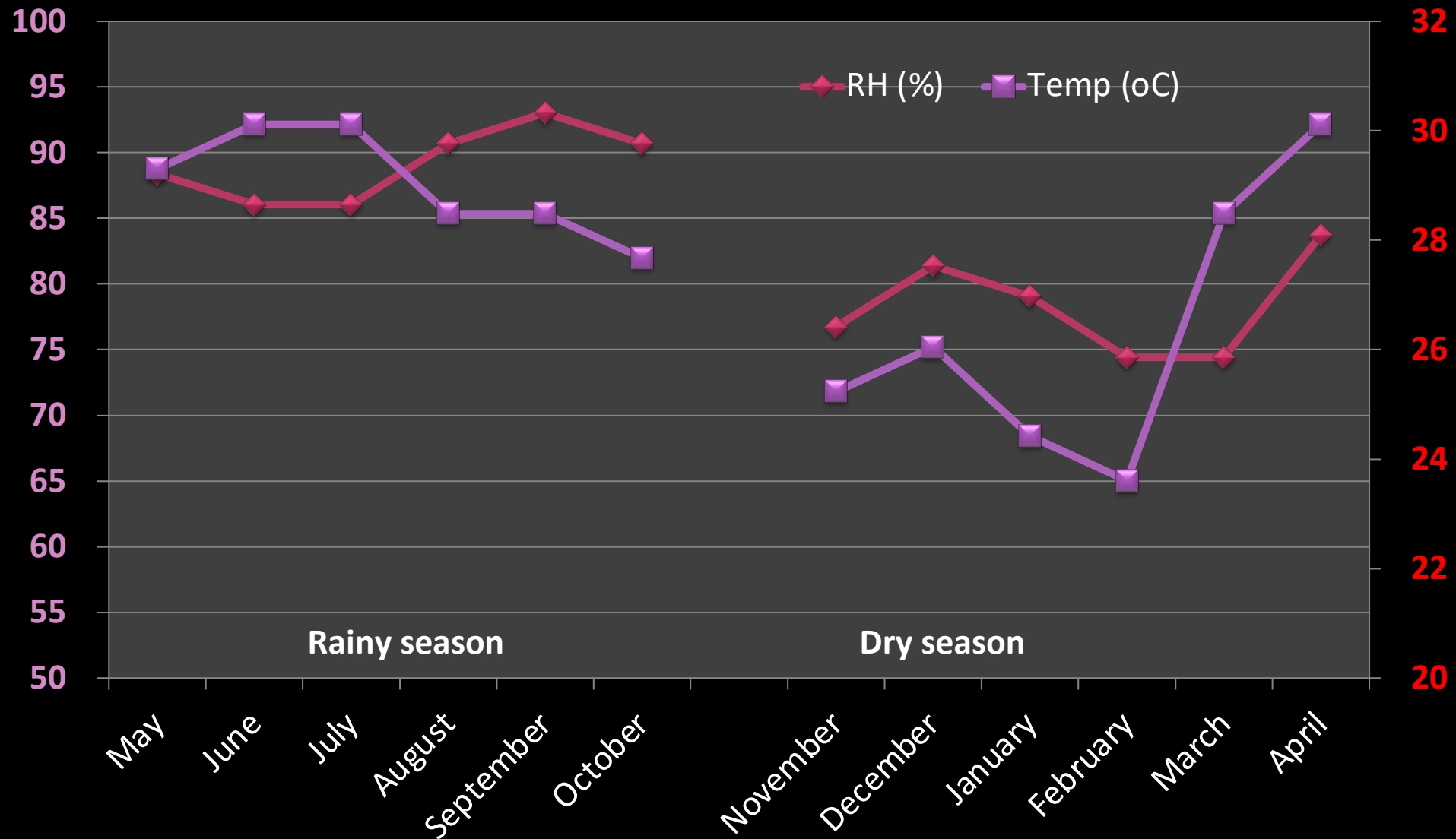
# Macro-Nutrient status in plant and growing media of transplant to harvest application experiment

N	K	N	P	K	N	P	K
mg l <sup>-1</sup>		Plant (%)			Growing Media (%)		
Prior expt.		3.76	0.25	9.01	1.33	1.03	5.14
0	0	2.56 e	0.2	5.74 c	2.19 a	0.79 cd	0.28 g
180	117	4.40 b	0.22	6.23 c	1.26 cd	0.83 a	0.29 f
	234	2.88 cde	0.21	6.89 bc	1.59 b	0.78 d	0.33 d
	351	4.56 b	0.29	6.25 c	1.19 cd	0.82 ab	0.37 b
225	117	5.20 a	0.16	7.69 b	1.33 bc	0.81 bc	0.31 e
	234	2.80 de	0.21	6.24 c	0.86 e	0.79 cd	0.33 d
	351	3.20 cd	0.21	9.83 a	1.06 cde	0.80 bc	0.40 a
270	117	3.28 c	0.26	6.16 c	1.00 de	0.72 e	0.33 d
	234	2.96 cd	0.25	6.78 bc	1.13 cde	0.68 f	0.35 c
	351	3.2 cd	0.25	6.47 bc	1.26 cd	0.82 ab	0.40 a
	N	L**	ns	Q**	L*	L*	L**
	K	L**	ns	L*	Ns	Q**	L**
	N x K	Q x L	ns	Q x Q	Q x Q	L x Q	L x L

# Macro-Nutrient status in plant and growing media of bloom to harvest application experiment

N	K	N	P	K	N	P	K
mg l <sup>-1</sup>		Plant (%)			Growing Media (%)		
Prior expt.		3.76	0.25	9.38	1.16	0.7	4.71
0	0	4.72 a	0.37	7.62	1.19 abc	0.84 a	0.58 a
180	117	4.56 ab	0.28	8.96	1.33 a	0.80 b	0.46 f
	234	4.64 ab	0.37	8.96	1.00 cd	0.73 c	0.40 h
	351	3.52 cde	0.28	7.08	1.13 abcd	0.74 c	0.52 c
225	117	3.92 bcd	0.33	7.81	0.99 cd	0.68 d	0.43 g
	234	3.36 de	0.35	8.29	1.06 bcd	0.64 e	0.47 e
	351	3.92 bcd	0.3	7.35	0.93 d	0.65 e	0.49 d
270	117	2.80 e	0.37	8.7	1.26 ab	0.67 d	0.47 e
	234	4.16 abc	0.28	6.72	0.99 cd	0.72 c	0.57 b
	351	3.36 de	0.31	7.5	1.19 abc	0.60 f	0.50 d
	N	L*	ns	ns	Q*	L*	L**
	K	ns	ns	ns	Q*	L*	L**
	N x K	L x L	ns	ns	Q x Q	L x Q	L x Q

# Relative humidity and temperature during the experiments.



# Fruit Growth and Capsaicinoids Content of Chile pepper var. Yodson.

