

Responses of Growth, Yield and Capsaicinoids in 14 Cultivars of Hot Pepper (*Capcicum spp.*) at Two Different Elevations



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Hot pepper in Thailand

- Without hot pepper... without Thai food
- Thai daily consume hot pepper more than 1.5 million US\$

- Annually export hot pepper products (mainly paste and sauce) ~ 80 million US\$
- Annually import (mainly dry fruit) ~ 35 million US\$

- Production area ~ 75,000 ha, yield 4 ton/ha.



"Thai bird chilli"

Thai pepper production

Production system



In-season: rain-fed



Off-season: garden



Net-house

Situation

- **Small scale farmer: low input.. low income**
- **Environmental conditions: high temperature, soil, water etc.**
- **Diseases and insects: anthracnose, virus and fruit worm etc.**
- **Technological management: low to high; varieties, fertilizer, pesticide etc.**



Capsaicinoids is now popular used in health food and pharmaceutical industries.



Rationale



Factors affecting;

- Lots of variations on pungency among species, varieties, and within varieties.
- **Genetic and environment** affected growth, fruit yield and also pungency (Harvel and Bosland, 1997; Zewdie and Bosland, 2000; Senapati and Sarkar, 2002).

Environment;

- high temperature increased capsaicinoid contents
- poorer **soil type and water stress** produce low yield of hotter fruit (Sung, 2005)
- **Capsaicinoids** increased with increasing **elevations** (Tewksbury, 2006)

Rationale

G x E interaction effects

Genotype may change when tested over number of environment (Senapati, 2002; Wani et al., 2003)

Understand the role of genotype and environment interaction would be useful for evaluation and improvement of the superior chili varieties for specific location (Yan and Hunt, 2001)



G x E interaction : 3 experiments

Year I (2008-9): Rainy season

2 locations in Thailand

**Khon Kaen : Chiangmai
200 : 680 m (asl)**

Year II (2009-10): Rainy season

2 locations in Bhutan

**Lobesa : Thinleygang
1,400 : 1,650 m (asl)**

Year: III (2010-11) Dry season

2 locations in Thailand

**Khon Kaen : Chiangmai
200 : 680 m (asl)**

**G x E analysis
under different
locations/seasons**

Objective

To evaluate the effects of environments at different elevations on growth, yield and capsaicinoids content

To identify the suitable chili varieties with high yield and capsaicinoids under different elevations

Materials and Methods



Chiang Mai



680 m asl.

16° 28' N & 102° 48' E

Khon Kaen



200 m asl.

18° 51' N & 98° 45' E

asl. = above sea level

Materials: 14 varieties based on different origins, Species, Growth habits, Pungency levels etc.

Entry No.	Variety/Code	Origin	Fruit type	Pungency	Species	Characteristics
1	Baegup ema	Bhutan	long cayenne	Na	annuum	Large fruit, elongated big shape, pointed end.
2	Sha ema	Bhutan	long cayenne	Na	annuum	Large fruit, elongated big shape, blunt end.
3	KKU-P-11012	Thailand	long cayenne	Low	annuum	Medium fruit, elongated, pointed end.
4	KKU-P-21005	Indonesia	long cayenne	High	annuum	Large fruit , elongated and pointed end.
5	KKU-P-31108	Hungary	long cayenne	Na	annuum	Large fruit, elongated and pointed
6	KKU-P-21041	India	long cayenne	Na	annuum	Large fruit, elongated and pointed
7	KKU-P-11015	Thailand	long cayenne	medium	annuum	Medium fruit, elongated and pointed end.
8	KKU-P-21003	Bangladesh	long cayenne	medium	annuum	Small fruit, elongated, pointed end.
9	KKU-P-22006	Taiwan	bird chilli	High	annuum	Small fruit, elongated, blunt end.
10	KKU-P-12010	Mainmar	Bird chilli	High	frutescens	Small fruit, elongated, pointed end.
11	KKU-P-11175	Thailand	long cayenne	High	annuum	Large fruit , elongated and pointed end.
12	KKU-P-31141	Thailand	chilli	High	frutescens	Small fruit, elongated. Pointed end.
13	KKU-P-11003	Thailand	chill	High	annuum	Small fruit, elongated, pointed end.
14	Dallay khorsaney	Bhutan	Bird chilli	Na	chinense	Big round fruit



Methodology

Randomized complete block design using 14 varietal treatments, 3 replications with 10 plants each were used.

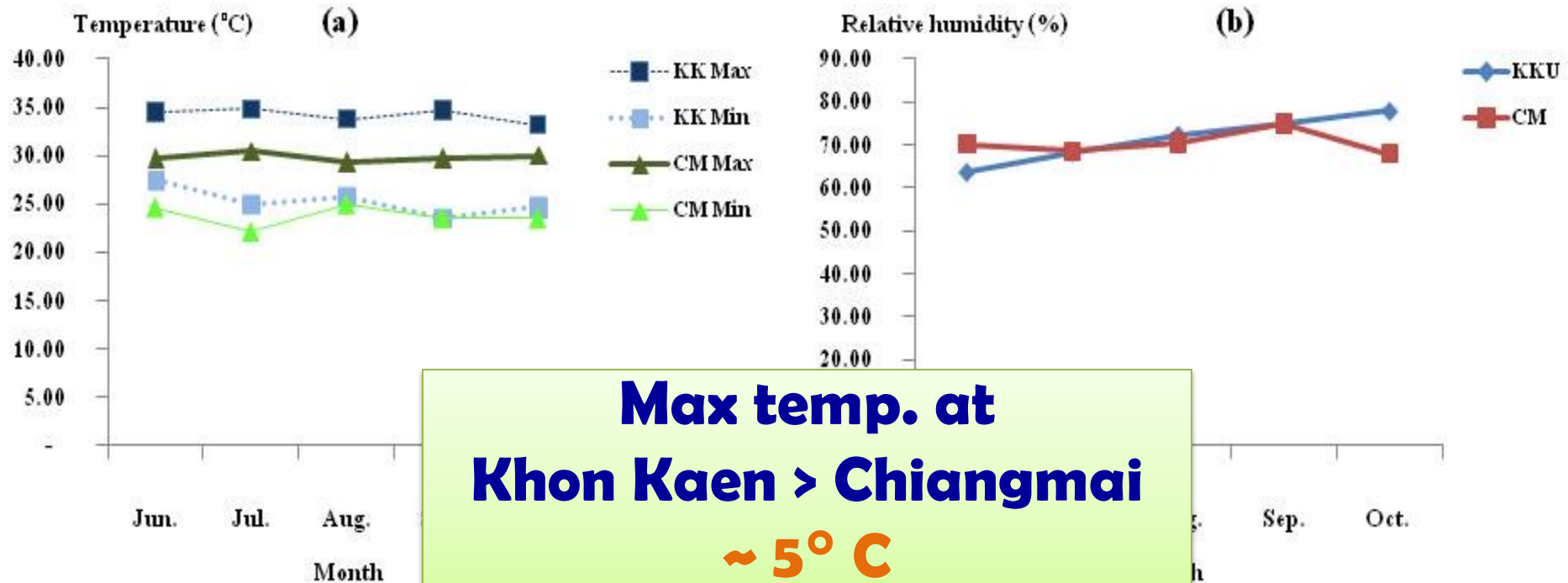
**Data recorded and analyzed:
Soil properties, weather conditions
plant growth, fruit yield
and capsaicinoids (Collin et al., 1995)**

Data from 2 elevations were combined for analysis.

Results and Discussion



Environmental condition



Khon Kaen;

Temp.; Max. = 34.8

Min. = 23.6

% RH = 60-75

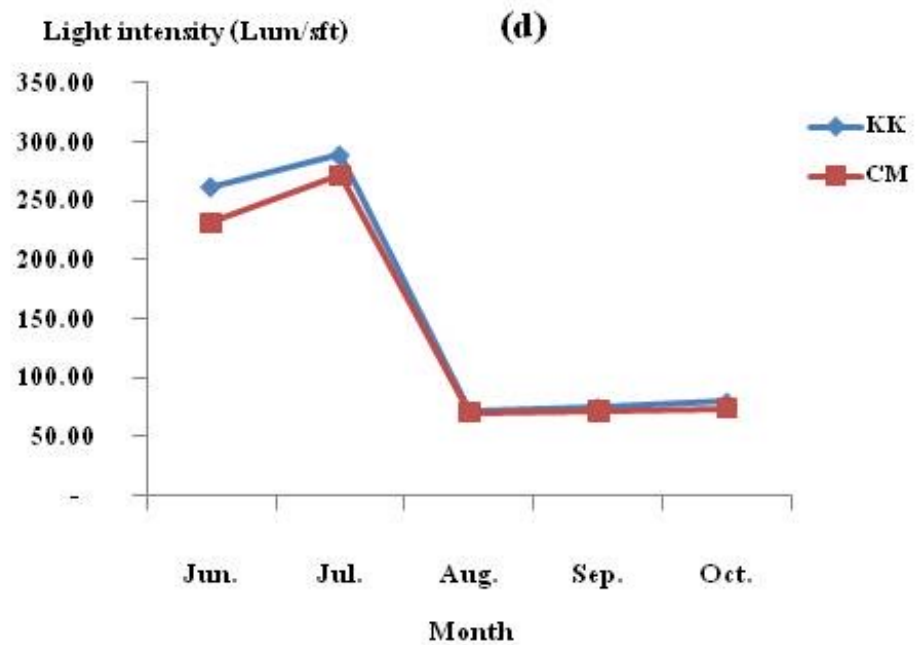
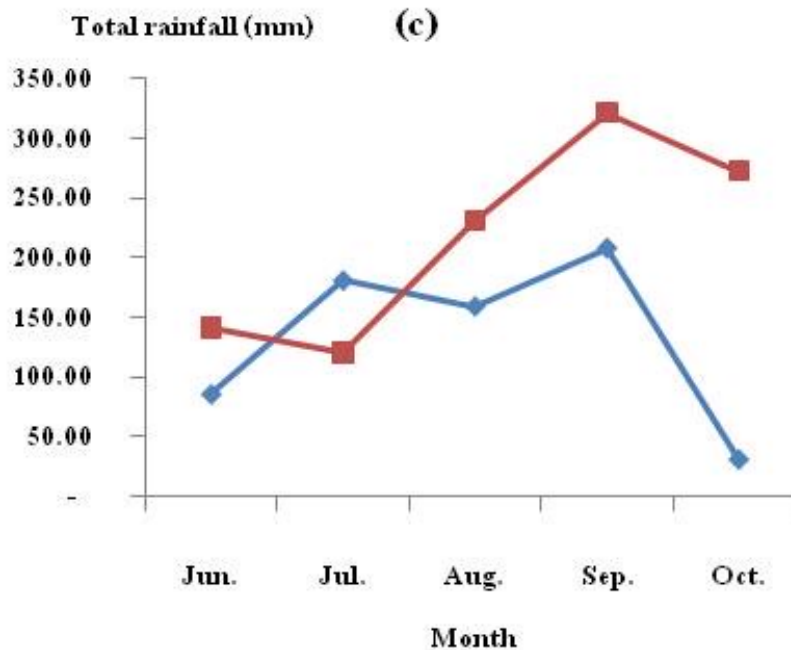
Chiang Mai;

Temp.; Max. = 30.42

Min. = 22.18

%RH = 70-75

Environmental condition



Rain fall at CM > KK

KK; 20-180 mm

CM; 200-330 mm

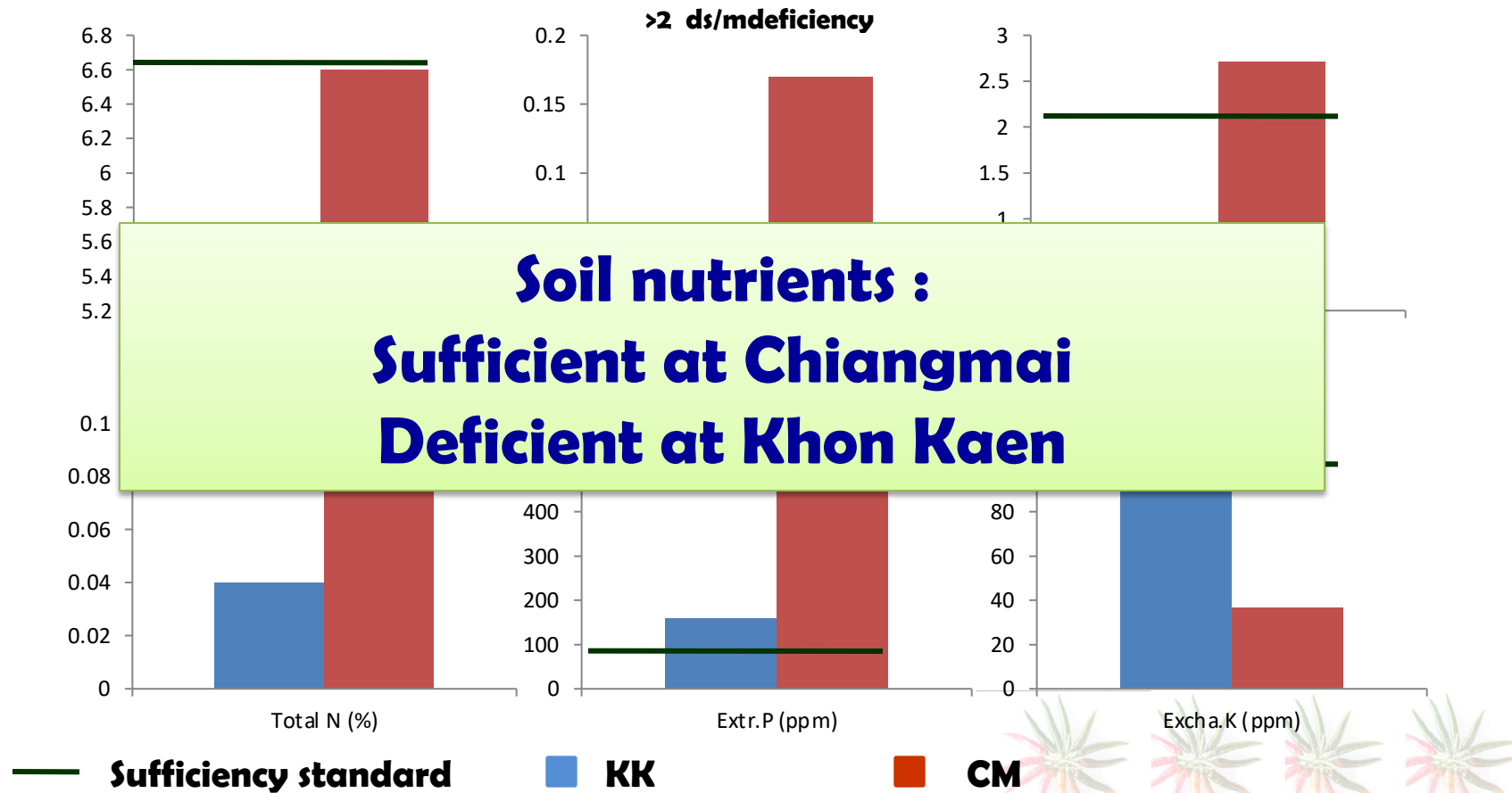
Light intensity between KK and CM were quite similar

Soil Properties

KK; Sandy loam

CM; red clay

Bulk density (gm/cm³) = 0.104



Plant growth responses

-Most of the varieties at CM gave better plant growth than KK.

-i.e. plant high, plant canopy and stem diameter

-Days to flowering and 1st harvest of almost varieties at CM were late, compared to KK.



Yield performances

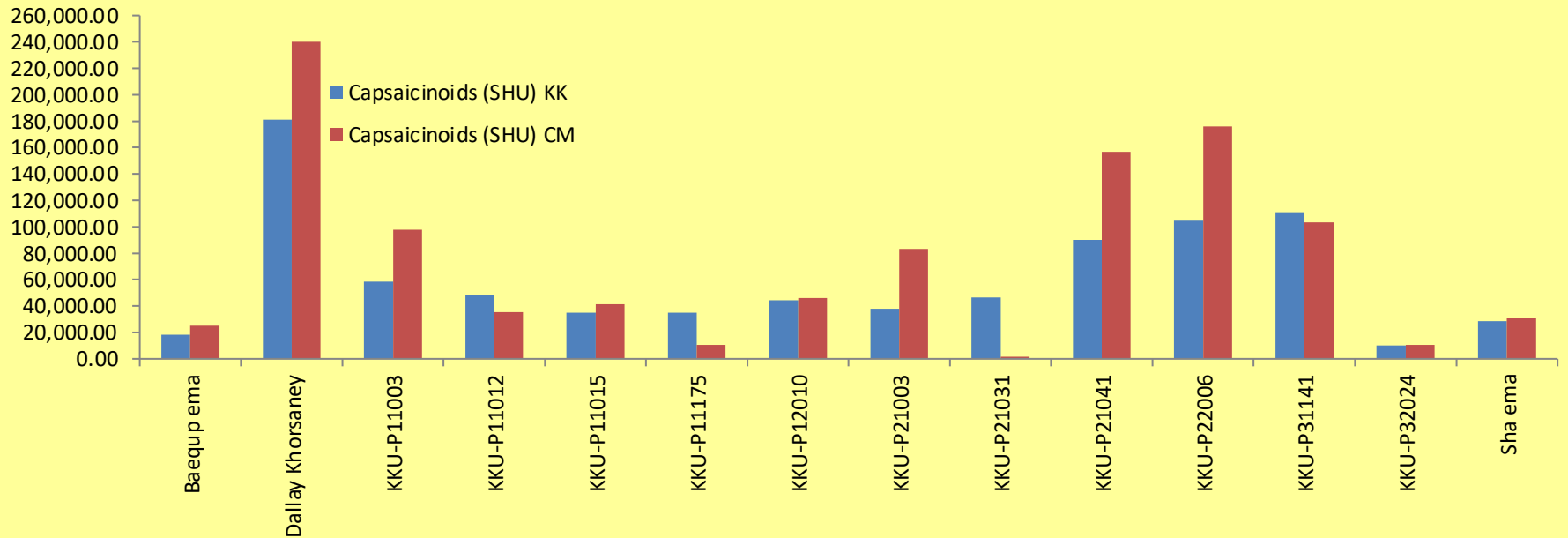


-Four varieties, i.e. Dally Khorsaney, K KU-P11175, K KU-P21031 and K KU-P32024 gave high fruit yield at CM (>150 g/plant).

- Six varieties, i.e. Dally Khorsaney, K KU-P11012, K KU-P11015, K KU-P11175, K KU-P21041 and K KU-P31141 gave high fruit yield at KK.

Capsaicinoids responses

SHU



-Four varieties gave high capsaicinoids contents (>100,000 SHU) and high capsaicinoids yield (~20 kg/pt.) at both locations, (i.e. Dally Khorsaney, KKU-P21041, KKU-P22006 and KKU-P31141).

-KKU-P31141 gave similar capsaicinoids contents for both locations, while the others gave higher contents at CM.

G x E interaction effects

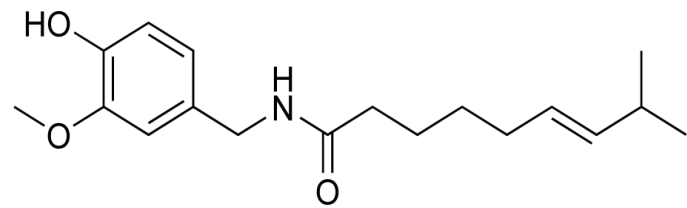
- Interactions between varieties and elevations were found in most of the traits except for fruit weight, fruit length and placenta length.

- High variations in the variety : % sum square for growth (47.0-91.7%), yield (42.4-97.4%) and pungency (80.0-84.7%).

- Indicated that genotypic differences among varieties could be classified into groups, especially based on pungency levels.



Capsaicinoids



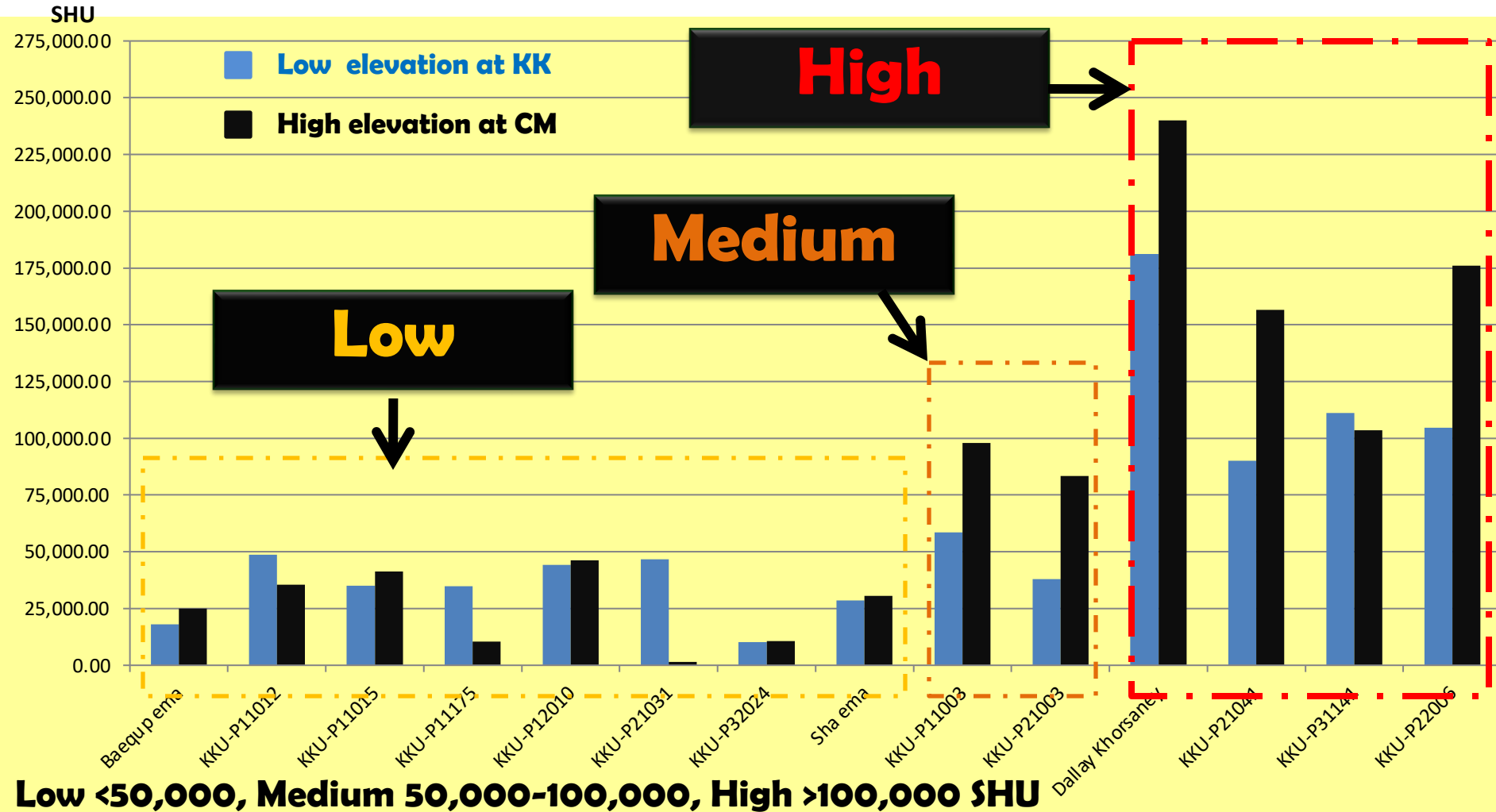
-Categorized the 14 vars. based on their pungency into 3 groups; low = 8 vars., medium = 2 vars. and high = 4 vars.

-The medium and high pungency varieties gave high capsaicinoids contents at high elevation.

-Capsaicinoids of low pungency varieties were fluctuated, some high pungency at low or high elevations; or some gave the similar pungency for both locations.



Most of the medium and high pungency varieties, except KKU-P31141 gave high capsaicinoids at high elevation, while low pungency varieties fluctuated.





Conclusion



Interactions between varieties and elevations were found in most of the characteristics studied.

Most of the high pungent varieties gave higher pungency at higher elevation.

KKU-P21041, KKU-P22006, KKU-P31141 and Dally Khorsaney gave high capsaicinoids yield at both elevations.



KKU-P21041



KKU-P22006



KKU-P31141



Dally Khorsaney

Further studies

The high fruit yield and capsaicinoids yield varieties will be further evaluated under different elevations and seasons in Bhutan (May-September 2010) and Thailand (October 2010-February 2011).



Thank you



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