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A STRATEGIC LOOK TO THE FUTURE FOR VEGETABLE RESEARCH: THE WORLD VEGETABLE CENTER AND ITS PARTNERS

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ABSTRACT

Climatic change is expected to intensify the existing environmental stresses already plaguing the productivity of vegetables and is expected to have a significant impact on food systems worldwide. The developing countries in the tropics where the livelihoods of the majority are dependent on natural resources and agricultural productivity will be particularly at risk.

Vegetables are an important source of vitamins, minerals, and micronutrients for the daily dietary requirements of people worldwide. Among the Asian regions, Southeast Asia has the lowest productivity (3.6 t/ha) (FAO, 2008). Vegetables grow less well under hot, humid lowland conditions. Some of the factors affecting vegetable productivity are: high temperature, drought and limited water resources, salinity, and pests and diseases. Plant injuries due to high temperatures generally result in reduced productivity of crops grown in both tropical and temperate regions (Peet and Wolfe, 2000). More than any other environmental stressor, water deficit is a seriously limiting factor (Saini and Lalonde, 1998), while stress due to salinity constrains crop productivity by altering various cellular processes in plants including ion displacement and solute concentration which affect the structure and integrity of cell membranes (Cheikh, N. *et al* 2000),. Among the major crops AVRDC-The World Vegetable Center is working on, tomatoes, cucumbers, pepper and eggplants are moderately sensitive to salinity but onion is highly sensitive. Contamination of groundwater by highly saline irrigation water in inland areas or through the intrusion of seawater in coastal areas due to natural disasters such as tsunamis, can seriously affect soil fertility and render agricultural lands unproductive.

To develop climate-responsive vegetables AVRDC-The World Vegetable Center has broadened its focus to include largely adaptation research on crop production systems to address the anticipated impact and risk of climate change on vegetable productivity. In the last 25 years more than 100 heat tolerant tomato lines have been distributed to different countries and representative varieties have been released in 37 countries in the last 30 years. Using molecular markers, screening for heat and drought tolerance could now be accelerated and superior alleles from wild species improving heat tolerance can be efficiently identified and introgressed into breeding programs to develop not only high yielding but also drought and heat tolerant cultivars. Production of sweet pepper in the lowland tropics is possible only with heat-tolerant varieties. Heat tolerant test lines of sweet pepper have been identified from evaluations conducted at AVRDC under high temperatures in recent years and are now being distributed to cooperators in Africa and Southeast Asia. The hot pepper lines that are made available for testing and evaluation to AVRDC cooperators worldwide were rated as either 'good', or 'excellent' for heat tolerance.

To address the problem of increased incidence of pests and diseases anticipated with climate change, AVRDC conducts germplasm screening, evaluation and breeding for multiple resistance to the large number of diseases plaguing vegetable crops. AVRDC has also long been involved in developing technologies that address problems in vegetable production such as limited availability of irrigation water, flooding, disease incidence, and absence of appropriate soil nutrients. Production strategies include efficient use of irrigation water through drip irrigation; grafting to increase flood and disease tolerance; use of mulches, shelters and raised beds help to conserve soil moisture, and to prevent soil degradation, and to protect vegetables from heavy rains, high temperatures, and flooding; plus soil amendments to improve soil fertility and enhance nutrient uptake of plants. Such technologies are being improved further to become more efficient in addressing the potential impacts of climate change.

Most exotic crops and modern varieties are sensitive to harsh environmental conditions but many indigenous species are adapted to being grown under poor soil conditions. They can also often

be more resistant to pests and diseases. Production and consumption of plant species used as food can thus be diversified, not only to help sustain or improve health and nutrition among the poor in developing countries, or generate income and sustain ecosystems, but also to ensure food security in the face of climate change.

KEYWORDS
climate change adaptation, vegetable production risks, stress tolerant crops, rainshelters, grafting vegetables

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"Climate is what you expect, weather is what you get"

Robert A. Heinlein

A Strategic look to the future for Vegetable Research: The World Vegetable Center and its partners

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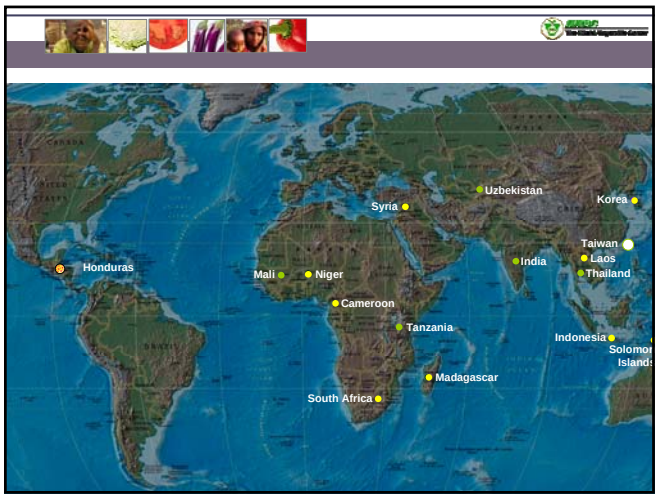
AVRDC The World Vegetable Center

Vegetables – a pathway out of poverty

- Smallholders often have a comparative advantage in producing vegetables, since there are limited economies of scale
- Vegetable production leads to higher farm income and generates more jobs than other crops
- Vegetable value chains contribute to commercialization of the rural economy



Typhoon Milenyo made a direct hit on IRRI Thursday, 28 September 2006

Research Center

Block G IRRI Farm:

Sudden flash floods killed many in Los Banos

IRRI

AVRDC The World Vegetable Center

Flooding - Asia

AVRDC The World Vegetable Center

Grafting

- Controls soil-borne diseases
- Provides flood-sensitive vegetable crops ability to tolerate water logging
- Increases plant survival after flooding
- Extends harvest period after high rainfall

Grafting - tomato

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Grafting - sweet pepper

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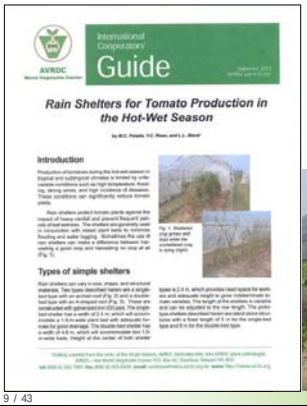
Rain shelters



Cucumber and snow pea under double-bed rain shelter

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Water-saving irrigation – under rain shelter

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Low cost drip irrigation kits for home and market gardens

Yield and water use of chili pepper grown under drip and furrow irrigation, AVRDC 2006

Irrigation Method	Regime (kPa)	Fruit yield (t/ha)	WUE (liters/kg)
Drip	-70	34.3 b	40
Drip	-50	35.7 b	100
Drip	-20	50.5 a	970
Furrow	-70	34.6 b	230
Furrow	-50	36.0 b	500
Furrow	-20	43.0 a	1890

Conserving soil moisture - mulching

- protect fruits from direct contact with soil
- minimize weed growth
- help reduce evaporation
- moderate soil temperature, soil runoff and erosion
- organic mulches, such as rice straw, enhance soil fertility

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Screening and mapping heat tolerance

Crosses made:

CA4 x CLN1621L, CL5915, CLN2026D
FLA456 x CLN1621L, CL5915, CLN2026D

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Drought tolerance from wild species

S. lycopersicum x S. pennelli

S. lycopersicum x S.pimpinellifolium

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Screening for salinity and nutrient use efficiency

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No half measures in drought tolerance research

Lysimetry Complex @ ICRISAT

Creating better vegetables

Building on genetic diversity to develop superior vegetable genotypes

- Higher and stable yields
- Adaptation to marginal environments
- Improved nutritional qualities
- Better resistance to pests and diseases

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Indigenous crops can thrive in marginal areas. They are also good candidates for crop diversification

Momordica charatina: **An option for crop diversification**

Slide 18 (06/2008) www.avrdc.org

Germplasm accessions conserved at AVRDC

	Principal crops	Other crops	Total
No. of accessions	**42,820**	**13,310**	**56,130**
(No. of species	111	226	337)
No. of countries of origin			150

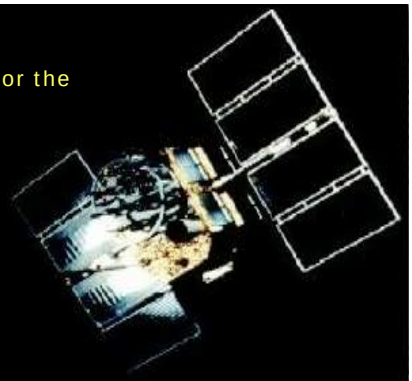
Not just yield but high quality and nutrition

- **"Golden tomatoes" (released 2004):**
  - High quality
  - Nutritious
  - Good marketability
  - Resistance to multiple diseases
- Contain 3 to 6 times more vitamin A than standard types
- **One single improved tomato can provide a person's full daily vitamin A requirements**

Vegetable production is knowledge intensive

VASAT

Virtual Academy for the Semi-Arid Tropics



Modern Methods for Scaling up

AVRDC - The World Vegetable Center

"Prosperity for the Poor & Health for All"

Thank You!