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THE ASIAN VEGETABLE RESEARCH AND DEVELOPMENT CENTER PEPPER PROJECT

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Peppers (*Capsicum* spp.) are native to Central and South America. Portuguese traders introduced them to India, Indonesia, and other parts of Asia around 450-500 years ago. They quickly adapted to the wide range of agro-ecological zones found in Asia. They were adopted by local people so quickly that in 1542, the botanist Leonhard Fuchs of Germany recorded them as native to India. Today they are widely grown in many countries of the region and they form an integral part of the local cuisine, such as Indonesian sambal, Thai hot and sour soup, Korean kimchi, and Indian curry.

Botanically, chillies are classified among the Solanaceae, and are closely related to the tomato, nightshade, and potato. They belong to the genus Capsicum, which probably comes from the Latin *capsa*, meaning chest or box, because of its shape (the fruit encloses the seeds very neatly, as in a box). There are many names for chilli peppers in the different countries of Asia. In Bhutan, they are called "ema", in China they are called "la-jiao", in Indonesia they are called "cabe", in Thailand they are called "prik", and in India they are called "chilli". The early Aztecs of Mexico also called them "chilli", and that name is the most commonly one used today around the world, with some variant spellings (chile, chili, chilly, etc.).

Chilli peppers are important in almost every Asian country. They are the #1 vegetable in Malaysia and Bhutan, for example, and rank at or near the top in terms of growing area in most Asian countries. The area, production, and yield of chilli peppers is difficult to pinpoint. Data is simply not available for some countries, or it is not very accurate. India is the world leader in growing area devoted to chilli peppers, with ~900,000 ha annually (Table 2). China and Indonesia are ranked second and third among the world leaders in area devoted to chilli pepper. The area in China is probably much larger than reported in Table 1. According to the China APSA country report #1, published in 1994, China had 206,000 ha of chilli pepper in 1993, which produced 2.98 million metric tons, with a yield average of 14.4 t ha^{-1}.

Many different fruit types are known within the Capsicum species. Hot peppers in Asia are primarily the cayenne fruit type, with two general fruit sizes, long or short. Other hot pepper types are occasionally found in individual countries or regions. For example, keriting is an unusual fruit type grown in parts of Indonesia and Sri Lanka. Keriting fruits are approximately 12-15 cm long, only 0.5 cm wide, and curly, like a corkscrew. Bell peppers are also grown in the region, in limited quantities, primarily for the tourist trade. Their cultivation is limited by their lack of disease resistance and heat tolerance.

Long chilli peppers are usually straight, green or dark green at the immature stage, and bright or dark red at the mature stage. The length ranges from 9-15 cm long and the pungency ranges from very low to medium-hot. They may be marketed as fresh green fruits, fresh red fruits, dried red fruits, or processed into chilli sauce, chilli powder, etc. Varieties with high dry matter content are preferred for drying. Some representative chilli pepper varieties are listed by country of origin in Table 2. In some countries the area planted to hybrids is >90% (e.g. Korea and Taiwan), and hybrids are gaining popularity in China, India, Indonesia, and some other parts of Asia. Long chilli peppers vary somewhat in size and color but not in taste. Important fresh fruit quality parameters for processing include: free from blemishes caused by disease or sun bleaching, intense color (bright or deep red), good color stability after processing, and acceptable pungency (pungency level preferences vary according to region). Important dry fruit quality parameters include high dry matter, ease of grinding, good color retention after drying, good color retention after grinding, and free from diseases and insects. India is the major exporter of dry chilli peppers, followed by China. The major importing countries are the U.S. and Germany.

Short chilli peppers are usually straight, light green or green at the immature stage, and bright or dark red at the mature stage. The length ranges from 2-7 cm long and the pungency ranges from medium to very hot. They may be marketed as fresh green fruits, fresh red fruits, dried red fruits, or processed into chilli sauce, chilli powder, etc. They are added to dishes to provide flavor, color, aroma, and pungency. The species may be *Capsicum annuum* or *C. frutescens* (*C. frutescens* is preferred in some countries, such as Thailand). Some representative short-fruited chilli pepper varieties are listed by country of origin in Table 2. Very few short-fruited F_1 hybrids are grown because the cost of producing hybrid seeds is high. Many countries grow a short-fruited landrace that is nameless, or simply called "small chilli". In Thailand, these short-fruited types are called prik khee (*C. annuum*) or prik khee noo (*C. frutescens*). (Note: these are classes of peppers, not variety names). To add to the confusion, Thais (and other Asians) also refer to them as bird peppers, probably because birds consume them and then leave their droppings in other areas, spreading them.

Bell peppers are usually blocky, light green or green at the immature stage, and bright red at maturity. Size is typically 8 x 8 cm, and they are always sweet (non-pungent). Long shelf-life is important, as they are often transported long distances over bumpy roads and stored under hot conditions. They are usually marketed fresh, at the immature green stage, primarily for the tourist hotels and resorts, but some local consumption also occurs. A market for colored bell peppers (red, orange, yellow, etc) has developed in some of the more industrialized nations such as Japan and Taiwan. California Wonder is widely grown but the use of hybrids is increasing.

The AVRDC has conducted numerous pest and disease surveys in Asia to identify the major constraints to pepper production. The major insects that attack chilli peppers are aphids (*Aphis gossypii*, *Myzus persicae*), mites (*Polyphagotarsonemus latus*), and thrips (*Scirtothrips dorsalis*, *Thrips palmi*). The major diseases are cucumber mosaic virus (CMV), chilli veinal mottle virus (ChiVMV), bacterial wilt (causal agent *Ralstonia solanacearum*) (in the lowland tropics), Phytophthora blight (causal agent *Phytophthora capsici*) (in the highland tropics and temperate regions), and anthracnose (causal agent *Colletotrichum* spp.). Some diseases and insects are important only in some regions, such as tobacco mosaic virus (TMV) in Korea, or at certain times of the year.

The AVRDC pepper breeding project focuses on developing improved open-pollinated varieties for the poor farmers of Asia and Africa. Objectives are determined by the main market types (long chilli, short chilli, and bell pepper), main diseases (anthracnose, CMV, and ChiVMV), and main insects (mites, aphids, and thrips). Improved AVRDC varieties are tested in various countries by the local National Agricultural Research Services (NARS) and the results are reported back to the AVRDC. If a variety performs well in a given country, the NARS produces the seeds of that variety for local farmers and releases it for general cultivation.

To combat insects and diseases, farmers spray tremendous volumes of insecticides and fungicides on their fields. Farmers typically spray highly toxic "cocktails" (mixtures) containing 4-6 different pesticides every other day during the growing season, with

often only a one-day waiting period before harvest. Concern about pesticide residues on fresh peppers is growing in many countries in the region. The AVRDC has therefore produced two International Co-operator's Guides for hot and sweet peppers to help researchers and extension agents teach farmers integrated pest management (IPM) methods for their crop.

Table 1. Estimated area, production, and yield[z] of chilli peppers in selected countries.

Country	Area (000 ha)	Production (000 MT)	Yield (t ha^{-1})
Bangladesh	78.3	234	3.0
Bhutan	NA	NA	NA
China (PRC)	86.0	1,290	15.0-22.5
India	891.8	4,000	2.5-6.5
Indonesia	216.4	411	1.9
S. Korea	132.2	1,758	13.3
Malaysia	1.5	12	5.0-12.0
Nepal	9.5	67	7.0
Pakistan	57.6	374	6.5
Philippines	NA	NA	NA
Sri Lanka	40.4	263	6.5
Tahiland	60.5	466	7.7
Turkey	NA	NA	NA
Vietnam	NA	NA	NA

[z] Poulos, J.M. 1992. Problems and Progress of Chilli Pepper Production in the Tropics. *In* (C.B. Hock, L.W. Hong, M. Rejab, and A.R. Syed, eds.) Proceedings of the Conference on Chilli Pepper Production in the Tropics. pp. 98-129. October 13-14, 1992. Kuala Lumpur, Malaysia.
[y] No data available.

Table 2. Representative varieties of chilli peppers in selected countries.

Country	Long fruit size	Short fruit size[z]
Bangladesh	Zia, Bindu, Baisakhi, Chittagong	
Bhutan	Sha Ema, Begap, Toeb	
China (PRC)	F1 Chung Chiao, F1 Shiang Yen, F1 Su-Jiao, 8212 and 8819	
India	Byadgi, G-3, G-4, Pusa Jwala	Pant C-1, Pusa Sadabahar
Indonesia	Jatilaba, Paris Minyak, and Tit Super	Cabe Rawit
S. Korea	F1 Kumtop, F1 Chohong, F1 Hongilpum	
Malaysia	Cili Langkap, Kulai, and MC-12	Cili Burung
Nepal	Kolusania, Korsani	
Pakistan	Loung hi, Narwala, NARC-4	
Philippines	Hotshot, Matikas	Ligai Abay
Sri Lanka	Ruhunu Miris, Galkunda Miris	Arunalu, MI-2, Mullai
Thailand	Bangchang, Luang, Mun, and Yuak	Huay Sithon, Huarur, Nong Lan, and Chinada 2
Turkey	Demre, Carliston, Dolma Biber, Bursa	
Vietnam	IASSV#2, Van Ngo, SGI-2, Sungbo, PVR #9	