FEEDBACK
from the field

World Vegetable Center

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This bulletin provides information about application of the World Vegetable Center's technologies in the field and other topics of interest regarding vegetable production and consumption constraints around the world. It is issued quarterly. We welcome everyone to share any interesting news about vegetables – please send a short article with photos to tech_dissemination@worldveg.org. Thank you!

Innovative solar dryers for rapid and hygienic drying of chili peppers

*Solar heat collector-equipped dryer and cabinet solar dryer for drying chili peppers **(left)** and cabbage **(right)**.*

Over 50% of the world's chili peppers are produced in India, which is a leading consumer, processor and exporter of this important vegetable and spice crop. India's chili peppers are valued for their high pungency, flavor and color. Dried chili is extensively used as a spice and as a raw material for the production of extracts and oleoresin for the food, pharmaceutical and cosmetic industries. Drying helps reduce potential postharvest losses and increases the shelf life of harvested chilis. Sun-drying in open areas is the common practice; however, this requires large spaces and long drying periods (about 6-8 days), and exposes the produce to contaminants such as dust and insects. Increasingly, unseasonal rains can cause significant damage to the harvested chilis, resulting in a loss of income for the small and marginal farmers in the southern states of India. The risk of aflatoxin, produced by fungal infestations in moist or insufficiently-dried chili, is a major constraint hampering India's dried chili exports.

To overcome the constraints from open sun-drying, the World Vegetable Center in collaboration with national partners has developed several types of solar dryers including small-sized and higher capacity ones which work well with chili and other vegetables (e.g. tomato, eggplant, cabbage and cauliflower) in South and Southeast Asian countries. Solar dryers accelerate drying, protect the produce from rain, avoid food safety hazards, and produce better quality and safe products.

Chili peppers dried in the open on the bare ground in Karnataka, India.

*Hybrid solar dryer with solar collector and an artificial heating chamber for drying in the absence of sunlight **(left)**; greenhouse solar dryer for high volume and quality chili drying **(right)**.*

These solar dryers can maintain 15-35°C (12 noon) and 5-15°C (5 pm) higher temperatures than those under open sun-drying conditions. In addition, only 1-3 days are required for drying vegetables.

For drying chili peppers, the small-sized solar dryer with 50 kg capacity is suitable for small harvest volumes. These types of solar dryers were installed for farmer groups in Karnataka, India in 2015 to demonstrate sterile drying methods and familiarize farmers with the drying process. Fresh chili peppers can be dried to less than 10% moisture content in three days and dry weight is higher than with sun-dried fruits. About 15 farmers have tried the small-sized solar dryers. Farmers sell the dried chilis produced from solar dryers at INR120-130/kg (US$1.8-1.9/kg) which is higher than open sun-dried ones at INR70-80/kg (US$1.05-1.2/kg).

For higher volume and quality drying of chilis produced in commercial growing states of India, such as Andhra Pradesh and Karnataka, the greenhouse solar dryer may be more feasible. The greenhouse solar dryer is a parabolic greenhouse-like structure covered with polycarbonate sheet and has a black concrete floor. It has a solar-powered air circulation and ventilation system to achieve more uniform temperature distribution inside the dryer. This design can also avoid the build-up of high temperatures (>60°C) which can lower the quality of the dried products due to discoloration and loss of critical nutrients and antioxidants. World Vegetable Center scientists examined the suitability of a 1.5 ton capacity greenhouse solar dryer and found that chili with 80% initial moisture content can be dried to less than 10% moisture content within three days. The dried chilis have better color and are more hygienic than the open sun-dried ones. In Tamil Nadu, 300 kg capacity greenhouse solar dryers have been used by 40 farmers who observed the losses of chilis reduced to 10% from 20-30% under open sun-drying. However, there are structural challenges with the dryers, including discoloration of the polycarbonate sheets, which could reduce thermal efficiency and heat transfer capability.

Store dried chilis in thick plastic film (004 PP film).

Farmers indicate that the dryer's efficiency has degraded by as much as 15°C after operating for close to two years.

With increasing demand from chili farmers for large-volume drying, the World Vegetable Center in collaboration with the Karnataka State Government and target farmer clusters will soon establish a 1.5 ton capacity greenhouse solar dryer to serve 30 farmers who have lost two *kharif* harvests due to unseasonal rains in Giriyapura village, Kadurtaluk, Karnataka.

This research and development collaboration to enhance the efficacy and suitability of the solar dryer to local conditions and develop viable dried chili value chains is very crucial to farmers. Based on the results of these trials, the state government has plans to establish similar sized dryers in other regions of the state for chili and other horticultural products.

Source and photos:
Arshad Ahmad Pal, Antonio Acedo Jr., Ramesh Subramanian, World Vegetable Center South Asia, Hyderabad, India

World Vegetable Center's cucumber lines show good adaptability in Khyber Pakhtunkhwa Province, Pakistan

*A cucumber observational trial was conducted at the Agricultural Research Station Swabi, Pakistan **(left)**; VI033556 showed good potential for fruiting capacity and the fruit color turns light yellow when ripening **(right)**.*

Swabi is one of the prominent agricultural districts of Khyber Pakhtunkhwa Province, which is located in the north western region of Pakistan. It is hot and humid in summer (May to July) and cold in winter (December to January) with sub-tropical to humid temperate climate. Land used for agriculture in Swabi is about 58% of the total area and it is quite fertile with sufficient irrigation facilities and potential for producing good crops. Farmers mainly grow wheat, maize, sugar cane, tobacco, garlic, onion, potato, peas, watermelon, muskmelon, squash, tomato, cucumber and bitter gourd.

Cucumber is an important crop in Swabi and adjacent areas. Cucumber is mostly grown in flat beds in open fields, but some farmers grow it with high tunnel technology and a netting system. Cucumber is grown in two different growing seasons. Farmers mostly grow dark green, long, smooth and cylindrical cucumber varieties during February to April, but they prefer to grow light green bicolor, smooth and spiny type of varieties during May to August. However, new hybrids/varieties are not available to most farmers. Lack of production technology knowledge, imbalanced use of fertilizer, diseases (downy mildew) and insect pests (red pumpkin beetle and whitefly) are the major production constraints in the cucumber growing regions.

To select potential cucumber lines/accessions to meet farmers' needs, a screening and observational trial of 15 World Vegetable Center improved cucumber lines and accessions was conducted from March to June 2016 at Agricultural Research Station Swabi, Khyber Pakhtunkhwa Province, Pakistan. The trial focused on evaluating adaptability and morphological parameters; these included vine length, leaf area, sex type, male/female flower ratio, branching capacity, number of female flowers, number of fruits per plant, fruit length, color and yield. Due to limited amounts of seeds, only a non-replicated trial was carried out.

Accession VI033556 showed moderate fruiting capacity (5-8 fruits/plant), light green bicolor and long fruit (15-20 cm) in the observational trial. VI046529 also showed moderate fruiting capacity (5-10 fruits/plant) with light green bicolor and short fruit with spines. VI033555 showed early fruiting initiation, VI039980 and VI040149 showed good capacity to

*Fruits of cucumber accessions VI033556, VI033555, VI039980 and VI040149 **(left to right)**.*

AVCU1203 ***(left)*** *and AVCU1302* ***(right)*** *showed high female to male flower ratios and good yield potential during an observational trial conducted at the Agricultural Research Station Swabi, Pakistan.*

produce secondary branches. Improved lines AVCU1203 and AVCU1302 showed high female to male flower ratios and good yield potential. AVCU1205 and AVCU1206 produced white, short bicolor fruits with excellent fruit yield.

Around 110 g of seeds of selected lines/accessions were produced for further evaluation in March to April 2017. The cucumber accessions will be evaluated in a replicated trial for yield and yield parameters as well as disease resistance. The best performing accessions will be used in a breeding program to develop high yielding cucumber hybrids/varieties. The improved lines will also be evaluated in a replicated trial for yield and disease resistance. The best performing lines will be further evaluated in multi-locational and national trials for future release as improved cucumber varieties.

Seeds of selected cucumber accessions/lines were processed for further evaluation by the following steps ***(clockwise)*** *: cut the mature fruit into two halves, scrape out the seeds and pulp, ferment for 24 hours, wash with water thoroughly to get rid of the immature seeds and pulp, dry the seeds, and collect the mature seeds for storage.*

Source and photos:
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