

FEEDBACK

from the field

This bulletin provides information about application of AVRDC'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!

Summer tomato production brings high profits and improves farmers' livelihoods in Bangladesh



Farmers in Bangladesh are recommended to grow summer tomatoes under rain shelters to prevent severe damage from heavy rainfall.

Tomato is one of the most important and popular vegetable crops in Bangladesh and usually is grown from November to March (cool season). It is cultivated all over the country; however, the yield is very low in summer-rainy (hot-humid) season (from April to October). The maximum temperature in summer can reach 34-38°C and cause very poor fruit set. Bacterial wilt and tomato yellow leaf curl disease (TYLCD) are

the major constraints in both seasons. In addition, production is highly affected by heavy rainfall, cyclones and floods. Due to the excellent nutritional and processing qualities of tomato, demand in general is growing throughout the year, but production is far below demand, especially in the summer season. The net income from summer tomato production is 4-5 times higher than winter production.



Mr. Nur Mohammad Mia led the village to become a "tomato village" and the landless summer tomato growers were able to build their own houses and send their children to school.

By using AVRDC promising tomato lines as part of parental lines, Bangladesh Agricultural Research Institute (BARI) has developed and released heat tolerant hybrid tomato varieties, BARI no. 3 and 4, which are suitable to grow under summer conditions. BARI hybrid tomato no. 4 is the main variety that farmers plant in summer (more than 90% of total area). This variety is heat-tolerant with round shaped fruit. Its average fruit weight is 50 g and it has a long shelf life.

In addition, BARI has established a summer tomato production technology package and promoted it in Jessore, Satkhira, Netrokona, Comilla, Noakhali, Chittagong, Sylhet, Moulavibazar, Narail, Meherpur, Mymensingh, Dhaka and other districts since 2005. The package includes heat tolerant tomato varieties, raised beds, rain shelters, hormone and integrated crop management (training, pruning, staking, sanitation, disease and insect pest management). The major summer tomato production areas are Jessore, Satkhira, Netrokona, Moulavibazar, and Comilla districts.

The production plan recommended by BARI is to sow tomato seeds in May and transplant to the field in June. Thus, the seedbed and land preparation should start in mid-April and mid-May, respectively. Hormone spraying 5-6 times a month

from July to mid-October helps to increase the number of fruit-set per cluster and improves the fruit size. Farmers harvest the tomato from late July until the end of November.



Mr. Md. Shahab Ullah sells the tomato seeds and plants summer tomato. His high income from summer tomato cultivation inspires other farmers.



Left: Mr. Abu Daud Hasan planted tomato in early March on 480 m² land and caught the market supply gap in April to June for the higher tomato price (more than US\$1/kg).

Right: BARI hybrid tomato no. 4.

Many farmers' lives were changed and improved after planting summer tomato. Mr. Nur Mohammad Mia is one of the lead farmers in Jessore district. He started to plant summer tomato in 1996. After BARI released new tomato varieties for summer production, he led the villages of Balarampur and Dadpur to become "tomato villages." Due to high profits from summer tomato production, most of the landless farmers in these two villages now have new houses and are able to send their children to school.

tomato, he was able to help his parents support his four sisters' wedding costs. He is now building his own brick house. Although he is landless, his life has been greatly improved by planting summer tomato.

Mr. Abu Daud Hasan is an experienced tomato grower from Balarampur village, Jessore district. He wanted to catch the market supply gap and started raising tomato seedlings in early February, then transplanted them to the field in early March (three months earlier than the normal summer planting schedule). Mr. Hasan's harvest ran from late April to the end of June. He can get a good market price from April to June (more than US\$1/kg).



Mr. Taleb Ali (right), the lead tomato farmer from Dadpur village, indicated that growing summer tomato on 1000 m² land can generate the same profits as from rice on 8000 m² land.



Mr. Md. Noor Islam (center) is a landless tomato grower; because the high profits from summer tomato production, he is now able to build his own brick house.

Mr. Md. Shahab Ullah is a farmer from Senbagh village, Noakhali district. He is a seed dealer and summer tomato grower. He has earned high profits from summer tomato cultivation and has inspired other farmers in his village to plant summer tomato.

About 95% of the farmers in Dadpur village cultivate summer tomato, but most of them are landless. "Growing summer tomato on 1000 m² land can generate the same profits as from rice in 8000 m² land," according to Mr. Taleb Ali, the lead tomato farmer in the village. Bangladeshi farmers who successfully grow summer tomato earn high profits and their livelihoods have been substantially improved.

Source and photos:

Mandy Lin, Greg Luther, Global Technology Dissemination; Shahabuddin Ahmad, project vegetable sector leader in Bangladesh, AVRDC - The World Vegetable Center

Efficient natural enemies to manage the legume pod borer, *Maruca vitrata* on food legumes in tropical Asia and Africa



Scientists from International Institute of Tropical Agriculture (IITA) released the braconid wasp, *Apanteles taragamae* in cowpea fields in Benin.



Experimental releases of *A. taragamae*, the natural enemy for *M. vitrata* in cowpea fields in Benin and Ghana during 2007.

The legume pod borer (*Maruca vitrata*) is considered to be the most serious pest of food legumes in South and Southeast Asia and sub-Saharan Africa. *M. vitrata* larvae feed on flowers and pods. First instar larvae prefer to feed on flowers rather than pods or leaves. The mature larvae are capable of damaging pods. Up to 80% yield losses have been reported on cowpea in West Africa. In Bangladesh, the damage to lablab bean was 18%, even in pesticide-sprayed fields, and about 25% pod damage in yard-long bean was estimated in Indonesia.

At present, farmers rely almost exclusively on the application of chemical insecticides to combat *M. vitrata*, but without satisfactory control results. Using chemical pesticides is not considered a sustainable strategy mainly due to human and environmental health concerns. Hence, biological control is considered a viable component in the sustainable management of *M. vitrata*.

Although a substantial number of parasitoid species have been reported to attack *M. vitrata* in tropical Asia and Africa, they have not been exploited successfully in biological control programs. This is largely due to the low level of parasitism observed with all recorded species of parasitoids. However, a few parasitoids have been identified in recent years that could control *M. vitrata*. AVRDC scientists found that the parasitism of *M. vitrata* by a braconid wasp, *Apanteles taragamae* could reach as high as 63%. This parasitoid attacks early larval instars of *M. vitrata* and kills them before they damage the pods. After thorough studies on its efficiency, host specificity, inter-specific competition, etc., it was released in seven selected locations in Benin.

The other major parasitoid is a tachinid fly, *Nemorilla maculosa*, which lays eggs on the bodies of growing *M. vitrata* larvae, on which the developing fly maggots feed, ultimately killing its host. It prefers the late larval instars.



Legume pod borer (*Maruca vitrata*).



Legume pod borer larvae feed on flowers and pods.



Most farmers exclusively rely on chemical insecticide application to combat *M. vitrata*.

Greenhouse experiments at AVRDC headquarters (Taiwan) have shown that this parasitoid did not reduce the infestation of *M. vitrata* larvae on mungbean. Since it prefers the late larval instars but the *M. vitrata* larvae enter the pods when they are late first instar or early second instar, the fly is unable to prevent the pod damage. However, its infestation on the late larval stages of *M. vitrata* could reduce the subsequent population build-up of *M. vitrata*. This parasitoid was also recently introduced into Benin.

Although these natural enemies could cause higher parasitism under field conditions, most of them are generalists; the performance of generalist parasitoids in a new habitat is highly variable, as the host range is not definite. Some countries may not allow the introduction of



The braconid wasp, *Apanteles taragamae*, attacks early larval instars of *M. vitrata* and kills them before they damage the pods.



This tachinid fly (*Nemorilla maculosa*) lays eggs on the bodies of growing *M. vitrata* larvae and the developing fly maggots feed on the larvae and ultimately kill them (**left**); tachinid fly adult (**middle**) and pupa (**right**).

Source and photos:
R. Srinivasan, Entomology, AVRDC - The World Vegetable Center

generalist parasitoids for biological control programs. To address these issues, explorations were made in Lao PDR, Malaysia, Taiwan, Thailand and Vietnam to identify species-specific parasitoids of *M. vitrata*.

After two years of rigorous surveys, two candidates were identified: *Phanerotoma philippinensis* and *Therophilus maruca*. *P. philippinensis* is an egg-larval parasitoid and *T. maruca* is a larval parasitoid. The field parasitism rate of *T. maruca* was up to 38%. This parasitoid occurs predominantly in Lao PDR, Malaysia, Taiwan and Vietnam. However, *P. philippinensis* has been identified as a major parasitoid of *M. vitrata* in Thailand. In a monitoring survey during 2011, the field parasitism was recorded up to 21%. These two parasitoids could act synergistically, complementing the performance of each other, since they prefer different stages of the host insect. The parasitoid *P. philippinensis* already has been introduced into Taiwan. Mass-culturing methods currently are being developed for these parasitoids with an objective to explore their use in managing *M. vitrata*.

It is expected that the newly identified biological control agents could effectively control the infestation of *M. vitrata* on food legumes in tropical Asia and Africa, when the pesticide pressure is withdrawn from these production systems. In addition, newer formulations of entomopathogenic fungi and viruses are being developed with a view to combine them with these natural enemies.



Phanerotoma philippinensis (**left**) and *Therophilus maruca* (**right**) are the two parasitoids identified to control *M. vitrata*.

AVRDC's tomato grafting technology widely adopted by nursery operators in southern Vietnam



A large-scale rubber tubing grafting operation: laborers grafting the tomato scion onto the rootstocks (**top & left**) in Da Lat, Vietnam; grafted tomato seedlings (**right**).

Lam Dong province is located in the central highlands (1200-1500 m above sea level) of South Vietnam; however, the agroclimatic conditions are typical of the humid tropics. Vegetables have been cultivated in Lam Dong for 60-70 years and it is the largest tomato cultivation area in Vietnam. The two main tomato production districts are Don Duong and Duc Trong. Bacterial wilt (caused by *Ralstonia solanacearum*) has become the most serious disease on tomatoes in this area and it can cause up to 100% yield loss.

Scientists from the Institute of Agricultural Science for Southern Vietnam learned the grafting technology at AVRDC and introduced it to Lam Dong province. Grafting bacterial wilt-susceptible tomato varieties onto bacterial wilt-resistant

rootstock gives 95-100% control of the disease in southern Vietnam, according to local scientists. In 2001, the grafted tomato planting area was just a few hectares of pilot tested sites and it increased to 4500 ha in 2007. The current grafted tomato planting area is approximately 7000 ha and it is cultivated by 5000 farmers whose farm sizes range from 0.1 ha to 1 ha.

At present, all the farmers in Lam Dong province have adopted the tomato grafting technology and most of them purchase the grafted seedlings from commercial nurseries rather than grafting by themselves. AVRDC developed rootstocks 'Hawaii 7996' of tomato and 'EG203' and 'EG195' of eggplant have been selected as rootstocks for grafting



Tomato scions and rootstocks raised in the greenhouse, Da Lat, Vietnam.

tomato in the province. According to the nursery operators and farmers, tomato grafted onto 'Hawaii 7996' show comparatively better resistance to bacterial wilt under non-flooded conditions. Tomato grafted onto 'EG203' and 'EG195' rootstocks, however, show resistance to flooding, bacterial wilt, fusarium wilt and root-knot nematodes. Many hybrid rootstocks have been developed in East and Southeast Asia and Oceania and several of these are available in Vietnam.

Compared with non-grafted tomatoes, farmers reported 50 - 75% increases in yields (i.e., from 25-30 t/ha to 60 - 70 t/ha depending on the management practices employed). This represents on average a yield increase of 20 t/ha (i.e., US\$2000 per hectare increase in revenues). It is more than enough to offset the additional costs of grafting seedlings (US\$0.03 per grafted seedling). The demand for grafted tomato seedlings has been high since the introduction of the grafting technology. Despite the 20-30% increase in the cost of production (including nursing and management of scions and rootstocks) required to obtain a grafted union, operators presently earn up to 100% increase in profit compared with the production and sale of non-grafted seedlings.

Depending on the scale of operation, daily sales of 30,000 to 50,000 grafted seedlings amounting to US\$900-1500 can



Grafted tomato seedlings were transferred in the greenhouse for hardening.

be made. Around 60-70 grafted tomato nursery operators in the province operating on 1-2 ha fields to supply grafted seedlings to farmers all year round. The major market outlet for grafted tomatoes from the Lam Dong province is Ho Chi Minh City, the largest city of Vietnam located in the southern part of the country with an estimated population of 7 million.



Grafted tomato seedlings ready for transport to farmers.



A grafted tomato production farm in Lam Dong province, Vietnam.

Currently, nursery operators employ 15-40 laborers depending on the scale of operation. One laborer can produce 1680-2000 grafted plants in an 8-hour daily shift period at a monthly wage rate of US\$120. This constitutes an appreciable income for laborers engaged in the industry as this represents approximately 35% increase above the

national minimum wage rate of US\$77.5 (VND 1.55 Million) for the province. Grafting technology indeed has increased tomato productivity, household incomes and created job opportunities at tomato production areas of southern Vietnam.

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With grafting tomato yields increase by 50-75%, a village collector in Duc Trong district, Da Lat grading and standardizing fruits for transport to Ho Chi Minh City, Vietnam.



Commercial AVRDC developed rootstock 'Hawaii 7996' is available in Lam Dong province, Vietnam (US\$7.5 for 50 g).

Source and photos:

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