

11. RESEARCH RESULTS OF A TECHNICAL PROTOCOL FOR BANANA PRODUCTION IN VIETNAM

Trinh Khac Quang*, Nguyen Van Nghiem
Fruit and Vegetable Research Institute (FAVRI)

ABSTRACT

The project entitled “Research and recommend scientific and technological solutions and economic and marketing for Cavendish banana development for export in Vietnam” was executed by the Fruit and Vegetable Research Institute (FAVRI). This project was implemented in the Red River Delta, Northern Midland and Northern Central during 2008 - 2010. Some of project outputs are establishment and accomplishment of some technical protocols for banana production meeting export requirements including:

- Protocol for tissue culture propagation of Pink Cavendish and Phu Tho Medium Cavendish cultivars to meet requirements of free disease, high uniformity and application to large scale production.
- Protocol for Cavendish banana intensive cultivation for export with expected yield of 40 tons/ha, export standardized fruit rate of >85% and >20% higher efficiency than soybean and groundnut production.
- Protocol for Integrate Pest Management of anthracnose and fruit borers with high control efficiency, easy application, >85% of fruit without damage of fruit borers, anthracnose below level 1, good fruit appearance, economic efficiency of VND 6-9 million/ha.

Keywords: Banana, fruit crop, technical protocol, Pink Cavendish, Cavendish banana

INTRODUCTION

In Vietnam, banana is an annual fruit crop with large scale production which is being evenly distributed in the whole Vietnam. In recent years, banana growing area and annual production has got increased at 105-110 thousand ha and 1.4-1.6 million tons, respectively. It is also one of the few fruit species that can be developed in concentrated areas of 400-500 ha.

However, mean banana yield in the whole country reached only 14.5 tons/ha. On the other hand, the uniformity and quality of banana commodity is not high. As a result, banana production mainly meets domestic demand, export accounts for a small percentage.

This report briefly presents research results of a technical protocol for *in vitro* banana propagation, plantation, cultural practices and plant protection carried out by the Fruit and Vegetable Research Institute in order to overcome some constraints in banana production in Vietnam.

1. Research on establishment of technical protocol for tissue culture banana propagation

1.1. Identification of BAP (Benzyl Adenine Purine) concentration suitable for Cavendish banana rapid propagation

Adding BAP to MS medium could increase Cavendish banana rapid propagation coefficient which was highest at 4.5 times at additional BAP concentration of 2.5ppm by Phu Tho Cavendish banana cultivar. This figure was 4.66 times at additional BAP concentration of 3.0 ppm by Pink

* Email: quangvrq@gmail.com

Cavendish banana cultivar. Adding BAP to MS medium had no significant effect on leaf number growth and shoot height.

1.2. Effect of Casein addition on growth, development and Cavendish banana shoot propagation in vitro

Tissue culture medium was MS + 2.5 ppm BAP. Compared with the Control, treatments with addition of Casein at 10 - 50 mg/litre gave the higher propagation coefficient. Addition of Casein at 30 mg/lit gave the highest propagation coefficient at 8.15 times with shoot height of 6.73cm after 4 weeks. Addition of Casein at 10 - 40 mg/litre gave better shoot quality than that at 50 mg/litre.

1.3. Effect of yeast addition on growth, development and Cavendish banana shoot propagation coefficient

Tissue culture medium was MS + 2.5 ppm BAP. The yeast dose of 10mg/litre added to medium achieved the highest propagation coefficient at 7.56 times. The higher yeast dose up to 50mg/litre added to medium tended to increase leaf number growth and shoot height. The best shoot quality after 4 weeks was given by treatments with yeast added at 10 - 40 mg/litre.

1.4. Effect of α - NAA on rooting ability and root system quality of Cavendish plants

Tissue culture medium was MS + 2.5 ppm BAP added α - NAA 0.2 - 1.0 ppm. The results showed that Phu Tho Medium Cavendish and Pink Cavendish banana cultivars had the shortest rooting stage at 3 days at 0.2 - 0.4 ppm, especially at 0.4 ppm concentration, plants had the most and longest roots. In the range of this concentration, plants not only had more roots but also bigger roots with more hairs and secondary roots.

1.5. Identification of suitable growing media for tissue culture banana plants at nursery stage I

In all growing media with soil and sand mixed with husk, banana plants gave better growth and development than the control (soil only). For growing medium with sand mixed with husk, banana plants gave the best growth, followed by the medium with soil mixed with husk and the lowest was given by treatment soil only. The best ratio of sand : husk was 1:3. At 30 days after planting, plant was 8.29 cm high, with diameter of 0.79 cm and active leaves of 5.62 leaves/plants.

1.6. Identification of suitable transplanting media for tissue culture banana plants at nursery stage II

Banana plants have better growth in growing medium of alluvial soil mixed with manure and best growth in growing medium of alluvial soil mixed with manure and coir at 1:1:1 ratio. At 75 days after transplanting, Phu Tho Medium Cavendish cultivar had plant height of 18.67 cm, diameter of 1.39 cm and active leaves of 6.33 leaves/plants. For Pink Cavendish banana cultivar, these figures were 16.01 cm, 1.34 cm and 6.67 leaves/plants, respectively.

1.7. Effect of foliar fertilizer on growth and development of Cavendish plants at nursery stage II

Foliar fertilizers as Dau Trau 902, Komix were sprayed for banana seedlings at nursery stage II and water was sprayed for the control. At 50 days after spraying Dau Trau 902 fertilizer, banana seedlings of Phu Tho Medium Cavendish cultivar had the highest plant height at 17.34 cm, most number of active leaves of 6.82 leaves/plant, and biggest stem diameter of 13.54 mm. Pink Cavendish banana cultivar gave the similar results at 16.71 cm, 6.82 leaves/plant and 13.54 mm, respectively.

Applying foliar fertilizer Dau Trau 902, banana seedlings had the best number of and length of primary roots for both Phu Tho Medium Cavendish and Pink Cavendish banana cultivars. At 50 days after planting, seedlings of Phu Tho Medium Cavendish cultivar achieved 13.08 primary roots with primary root length of 11.48 cm. For Pink Cavendish cultivar, it was 11.44 primary roots and 10.59 cm, respectively. While, these figures were low at 10.56 - 10.57 primary roots and 8.21 - 9.14 cm, respectively.

2. Research on establishment of technical protocols for Cavendish banana production

2.1. Identification of planting density

** Effect of planting density on yield components*

The higher density we planted, the lower hands/bunch we achieved and vice versa. Among planting densities, there was no significant difference in terms of number of fruits/bunch ranging from 14.13-14.38 fruits. However, lower planting densities tended to increase number of fruits/bunch. Planting densities of 2,500-2,525 plants/ha achieved fruit weight of 127.32-128.04g and bunch weight of 22.07-22.47 kg, which were higher than higher densities but not significantly lower than lower densities.

** Effect of planting density on yield and fruit size*

The higher density we planted, the smaller fruit size we achieved and vice versa. For planting density of 3,086 plants/ha, 3rd hand of the bunch had fruit length of 16.25 cm and fruit diameter of 3.39 cm. While these figures of planting density of 2,066 plants/ha were 17.29 cm and 3.67 cm, respectively.

Planting density of 2,500-2,525 plants/ha gave yield of 55.81-56.25 tons/ha, which was higher than lower planting densities and non-significantly lower than higher ones. Percentage of export standardized fruits was 85.4-86.2%. The lowest planting density of 2,066 plants/ha gave the lowest yield of 48.14 tons/ha and export standardized fruit percentage was 87.3%. The highest planting density of 3,086 plants/ha gave the highest yield of 59.57 tons/ha but with only 78.5% of export standardized fruit percentage.

2.2. Identification of suitable fertilizer dosage for Pink Cavendish Banana

** Effect of fertilizer dosages on yield*

Fertilizer dosage of 240N:60P:480K g/plants (for both Chinese single and synthesis fertilizers) gave much higher bunch weight and yield than lower fertilizer dosage but non-significantly lower than higher dosages. In Hung Yen province, bunch weight and yield reached 22.98 kg and 45.96 tons/ha, respectively. In Phu Tho province, these figures were 21.37 kg and 42.74 tons/ha, respectively. In Thua Thien Hue, they were 20.24 kg and 40.48 tons/ha, respectively. At this dosage, export standardized fruit percentage was all >85%.

** Efficiency of fertilizer application for banana*

The highest yield was obtained at fertilizer dosage of 260N:65P:520K g/plants (for both Chinese single and synthesis fertilizers). At this dosage, yield increased by 6.33- 6.60 tons/ha. However, fertilizer efficiency only reached 12.98 - 13.54 kg banana/kg fertilizer. At the dosage of 240N:60P:480K, yield increased by 5.48 - 5.58 tons/ha but fertilizer efficiency was very high, reaching 16.86 - 17.12 kg banana/kg fertilizer.

2.3. Identification of quantity and time for banana shoot pruning

** Effect of quantity and time for banana shoot pruning on yield*

Leaving one shoot, fruit number/bunch, fruit weight and bunch weight at all shoot pruning times were significantly higher than leaving 2 shoots. Leaving 1 shoot, fruit number/bunch, fruit weight and bunch weight were 150.45-157.15 fruits, 137.13-148.15g and 23.85-24.69 kg. While leaving 2 shoots, these figures were much lower at 134.35-138.82 fruits, 93.21-94.18g and 13.85-15.25 kg. During 15 Oct. - 15 Dec., among treatments leaving one shoot and among treatments leaving 2 shoots, there was no significant difference in terms of fruit number/bunch, fruit weight and bunch weight.

2.4. Identification of planting time

** Effect of planting time on banana yield*

In Hung Yen province, planting in summer and autumn gave significantly higher yield of Pink Cavendish cultivar than planting in winter and spring. Planting in August gave the highest bunch weight of 25.85 kg and the highest yield of 51.70 tons/ha. Planting in April gave the lowest bunch weight of 17.67 kg and the lowest yield of 35.34 tons/ha.

In Thua Thien Hue province, planting in April gave the highest bunch weight of 23.53 kg and the highest yield of 47.06 tons/ha. Planting in August gave the lowest bunch weight of 19.11-19.35 kg and the lowest yield of 38.22-38.70 tons/ha. Among other planting times, there was no significant difference in bunch weight and yield.

2.5. Identification of cultural practices for winter harvested banana production

Climatic conditions in Northern Vietnam allow plant and harvest banana year round. Harvesting in summer season gives higher yield than other seasons in a year. However, fruit appearance and quality of Cavendish cultivars is low. Whereas Cavendish banana harvested in winter give low yield but good fruit appearance, good taste, firm pulp.

** Effect of some cultural practices on banana yield*

In both Hung Yen and Phu Tho provinces, application of basestem covering cultural practice combined with foliar and fruit nutrition spray gave significantly higher bunch weight and yield than the control. For the control, bunch weight and yield were 18.92-19.53 kg and 37.84-39.06 tons/ha, respectively. Whereas, respective figures for treatments were 20.77-21.97 kg/bunch and 41.54-43.94 tons/ha.

3. Research on IPM of fruit borer and anthracnose disease

** Symptoms*

Fungi survive and damage on old leaves, bunch stalk and fruit skins. The initial symptoms of the disease on fruit skin are brown or black ringspot, then spreading and many spots link together. After disease incidence, sunken lesions form many small pink adhesives that is the reproductive organ of the pathogen (acervuli). Lesions on old leaves and bunch stalks are usually black and forms acervuli as on fruit skin.

** Causes and development stage of the disease*

- Colletotrichum musae (Berk and Curt) belonging to Melanconialae order, Melanconiaceae family, Fungi imperfecti group has been identified as the fungus to make anthracnose on banana
- Development stage of the fungus is 3 days

** Evaluation of efficiency of some chemicals to inhibit growth, development of Collectotrichum musae on PDA medium*

Experiment was conducted at 300C in PDA medium for three low toxic chemicals as Topsin M 70WP, Bavistin 50FL and Anvil 5SC. Results showed that three of them were highly effective, 100% of Petri disks with chemical treatments did not establish colonies. The Petri disks without chemical treatment had strong growth and development with mean diameter of the colony of 1.54 cm after 24 hours 6.48 cm after 72 hours.

** Evaluation of fruit post harvest handling efficiency of some chemicals*

Five days after harvest, banana fruit ripened when percentage of diseased fruits with chemical treatment was 3.26 - 12.09% compared with 21.11% of the control disease index was 0.54 - 2.02% compared with 5.78% of the control. Eight days after harvest, percentage of diseased fruits with chemical treatment was up to 12.09 - 24.18% compared with 38.89% of the control and disease index was 3.93 - 10.99% compared with 14.05%. There was no significant difference between dipping fruits in Bavistin 50 FL and Topsin M 70 WP solutions.

Either dipping banana fruits in hot water at 470C for 15 minutes or dipping fruits in Bavistin 50 FL 0.10% solution or Topsin M 70 WP 0.10% solution for 2 minute inhibited well *Collectotrichum musae* to damage ripen banana fruits and ensured food hygiene and safety. The practice of dipping banana fruits in hot water 470C for 15 minutes also reduces environmental pollution.

** Evaluation of IPM of anthracnose in demonstrations*

Application of some IPM practices of anthracnose on banana has reduced the disease damage in three concentrated banana growing regions. Post harvest fruits from the demonstrations were treated with hot water 470C for 15 minutes. Diseased fruit accounted for only 13.38 - 15.44% with disease index of 3.21 - 4.51% at 3 days after ripening. While the control orchards, the respective figures were 36.17 - 49.25% and 14.03 - 18.20%.

Demonstrations gave similar yield to the control orchard. However, due to good fruit appearance, it was easy to sell and at higher price, thereby obtaining VND 8.45-9.29 million/ha higher income than the control.

3.2. Research on IPM of fruit borers

** Symptoms*

The symptoms are clearly and easily seen with the naked eye. On young fruit and leaves, there are some blackened scars of 0.5cm -1cm length which could be seen more clearly on the older fruits and leaves, especially on ripen fruits. Damaged fruits with many linked blackened spots make fruit skin not have good appearance which is difficult to sell even for domestic consumers.

Basilepta balyi Harold belonging to Chrysomelidae family; Coleoptera order has been found as the damage pest on banana.

** Identification of most effective chemicals to control fruit borers*

Experiment with 4 chemicals at recommended concentrations mixed with adhesive HPC 0.15% which was sprayed on Pink Cavendish banana cultivar orchards in early morning in Tan Chau commune, Khoai Chau district - Hung Yen province.

Javitin 36 EC at 0.05% and Abamectin 2% at 0.02% were worse effective in controlling adults than Trebon 10 EC 0.20% và Antafos 100 EC at 0.10% at all monitoring times. 10 days after spraying, Trebon efficiency reached 87.62% and Antafos efficiency reached 81.42%. Respective values of Javitin and Abamectin were 66.24 - 61.52%. 15 days after spraying, efficiency of 4 chemicals

reduced to 66.72 - 51.32%. Thus, Trebon 10 EC at 0.20% and Antafos 100 EC at 0.10% are suitable for controlling adults of banana fruit borers.

** Practice of banana bunch bagging*

- Identification of suitable bunch bagging time

Experiments were carried out in Pink Cavendish orchards, using light blue PE tube 0.02mm thick, 1.4m long, 0.9 m wide with perforated holes 2%, 1.5mm in hole diameter to bag bunch at 10, 20 and 40 days after flowering.

Results showed that the earlier we bag the bunch, the lower damage rate by fruit borers we obtain. Bagging bunch at 10 days after flowering, damage rate by fruit borers was 15.07% which was significantly lower than three other treatments (24.02-29.37%). There was no significant difference between treatments (bagging at 20 and 40 days after flowering) and the control (without bagging). Hence, in order to avoid damage by fruit borers by bagging, it is needed to bag at 10 days after flowering.

- Identification of suitable bunch bagging materials

Bagging can reduce damage of fruit borers. Bunch damage rate by fruit borers of treatments with bagging was 53.33-56.67% and fruit damage rate by fruit borers was 17.59-19.39%. Whereas respective figures of the control were much higher at 76.67% and 27.64%.

Bunch bagging doesn't change natural color of fruit skin. Treatments with bagging had brighter and nicer skin color than of the control. physiological and bio-chemical criteria such as Brix, total sugars are not affected by bagging materials.

- Identification of chemical spraying times to effectively control adults of fruit borers from flowering to harvesting with PE bagging

10 days after flowering, bagging bunch with light blue PE tube 0.02mm thick, 1.4m long, 0.9 m wide with perforated holes 2%, 1.5mm in hole diameter was done. Trebon 10EC at 0.20% + adhesive HPC at 0.15% were sprayed in early morning.

Treatments with 2-3 spraying times, percentage of damaged bunch and fruits remarkably reduced compared to treatment with 1 spraying time and the control. Treatment with 2 spraying times was identified as the most effective practice due to lower cost than treatment with 3 spraying times.

REFERENCES

- Agustin B.Molina, V.N. Roa and M.A.G. Maghuop. 2000. *Advancing banana and plantain R & D in Asia and the Pacific – Vol.10*. Proceeding of the 10th INIBAP-ASPNET Regional Advisory Committee meeting held at Bangkok, Thailand.
- Inge Van den Bergh and Agustin B.Molina. 2007. *A basket full of options for sustainable banana production in Asia and the Pacific*. Bioersivity International, Regional Office for Asia and the Pacific, Los Banos, Laguna, Philippines.
- Recel, M.R. 2004. *Banana production manual*. Philippines Council for Agriculture, Forestry and National Resources R & D - Department of Science and Technology, Los Banos, Laguna, Philippines.

Receiving date: 5/7/2012

Reviewing date: 27/7/2012

Reviewer: Dr. Nguyen Van Viet

Approved for publishing date: 29/7/2012

12. FRUIT BREEDING FOR THE SOUTH OF VIETNAM

Tran Thi Oanh Yen*, Dao Thi Be Bay, Nguyen Ngoc Thi, Nguyen Nhat Truong,
Nguyen Thi Ngoc Diem, Nguyen Thi Muoi, Bui Xuan Khoi, Nguyen Minh Chau
Southern Horticultural Research Institute (SOFRI)

ABSTARACT

Fruit breeding program at Southern Horticultural Research Institute (SOFRI) has been conducted and strongly developed from 2001 on some main fruit trees such as Pineapple, Orange, Pummelo, Mango, Dragon fruit, and Longan. By selection of elite individuals one variety of seedless sweet orange, one individual of Da Xanh pummelo variety, two individuals of Long Co Co pummelo variety, four individuals of Queen Pineapple, one individual of Hoa Loc mango, and one individual of Cat Chu mango variety have been selected. Application of gamma rays to induce mutation has been conducted on King mandarin and Hoa Loc mango and Longan. As a result one variety of seedless king mandarin LD6, and one variety of few seeds Duong La Cam pummelo LD4 have been released in December, 2010. Traditional hybridization has been conducted on Dragon fruit, Mango, Longan, Citrus, Pineapple, ect. So far, two varieties of Dragon fruit: LD1 and LD5 dragon fruit with red and pink violet flesh have been released in December, 2005 and December 2010, respectively. In the near future, some new varieties of Pineapple, Mango, Longan and Dragon fruit will be released.

Keywords: Fruit breeding, gamma rays, traditional hybridization

I. INTRODUCTION

During 2006-2011 period, the fruit breeding program at the Southern Horticultural Research Institute focused mainly on pummelo, orange, mango, dragon fruit, longan and pineapple.

There is immense diversity of fruits in Vietnam and their genetic resources are rich. Many of these fruits such as dragon fruit, mango, pummelo, longan, etc. are exported to other countries. However, some of these fruits have shortcomings such as high number of seeds in citrus, thin peel in Cat Hoa Loc mango, only white flesh dragon fruit grown popularly, longan with thin flesh and big seed and fruit shape of queen pineapple, which need further improvement for processing. The fruit breeding program at SOFRI concentrated on improving these traits to enhance their marketability and processing efficiency.

II. MATERIALS AND METHODS

2.1. Research activities

The fruit breeding activities included the following:

- Breeding for cylinder fruit shape and good quality in pineapple;
- Breeding for seedless fruits in citrus;
- Breeding for thick fruit skin and good quality in Cat Hoa Loc mango;
- Breeding for different peel and flesh colors in dragon fruit;
- Breeding for bigger fruit size, smaller seed, thick flesh and sweet in longan.

* Email: tranthioanhvien@gmail.com