MINISTRY OF EDUCATION AND TRAINING
THAI NGUYEN UNIVERSITY

LE TIEN HUNG

STUDYING ON THE AGRO-BIOLOGICAL CHARACTERISTICS OF SOME PUMMELO LINES/ CULTIVARS AND CULTIVATION TECHNIQUES FOR HIGH PROMISING PUMMELO LINES AT THAI NGUYEN

SUMMARY OF DOCTORAL DISSERTATION OF PHILOSOPHY IN AGRICULTURE

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INTRODUCTION

1. The necessity

Currently, pomelo trees in Vietnam also have been considered as one of major fruit trees, because, apart from nutritional and economic values, pomelo trees have other outstanding features such as easy preservation, less damage during transport and easy cultivation, especially, good resistance to Greening disease, that is one of the most dangerous disease for the existence and development many species of citrus fruit trees (Department of plant Protection, 2006; Pham Thi Dung, 2014; Le Luong Te, 2007). But the fact that, pomelo-growing areas in the northern provinces are mostly spontaneous development and are planted empirically existing pomelo varieties. Thus, it is unstable in terms of productivity, quality and forms, standards of products that are not only problems for cultivators, but also for the requirements of the consumption market.

Thai Nguyen Province has climatic conditions and favorable land for growing pomelo trees in particular and some other fruit trees in general. Standing in front of opening market trends and current requirements on improvement of pomelo productivity and quality, research agencies are interested in research and hybridization to select potential lines and varieties, and also focus on research and depth assessment of agro-biological characteristics of promising lines and varieties. On that basis, technical measures of consistent impact on each specified line and variety are developed to meet the specific requirements of cultivators. Studies have both contributed to diversification of the structure of pomelo species and created the substrate materials in serving long-term research and supplement of necessary measures of farming techniques.

From the practical demands of the production and the above-stated reasons, the urgent requirement is to implement research topic of ***"Research on agro-biological characteristics of some pomelo lines/ varieties and technique measures for the promising pomelo lines in Thai Nguyen Province"***

2. Objectives of the study

It is based on research of some agricultural biological characteristics of some lines and varieties of pomelo plants available prospect and consistent with conditions of Thai Nguyen Province,

along with relevant technical measures to improve productivity and quality of the products.

3. Requirements of the study

- It is to assess agrobiological characteristics of some promising pomelo lines and varieties;
- It is to assess the impact of technical measures of sexual hybridization on ability of polyploid formation of the promising pomelo lines and varieties;
- It is to assess the impact of technical measure of chochicine treatment on ability of polyploid formation of the promising pomelo lines and varieties;
- It is to assess the impact of technical measures in use of rootstocks on the growth of some promising pomelo lines and varieties;
- It is to evaluate the impact of technical measures in use of GA3 growth regulator on yield and fruit quality of some promising pomelo lines and varieties;
- It is to evaluate the impact of technical measures in use of foliar fertilizer on yield and fruit quality of some promising pomelo lines and varieties;

4. Scientific and practical significance of the study

- Scientific significance

+ It contributes to the scientific data to supply and perfect the system of agricultural and biological characteristics of pomelo lines/varieties;

+ It contributes to a reasoning part on the relationship between a number of technical measures and genetic characteristics related to ploidy level of pomelo lines/varieties. Thereby, it reinforces further the direction of seedless fruit or few seed fruits of pomelo and citrus trees.

+ The application of technical measures to create polyploids of some prospective pomelo lines and varieties in the research will contribute to increase and to improve the quality of varieties to enhance yield and fruit quality. These technical measures carried out by many countries in the world have been successful. However, these technical measures in our country have not been interested much in implement.

+ The studied results of the research will creating a premise for further studies on technical measures to improve productivity and quality of pomelo trees.

- **Practical significance:**

+ The research results on the impact of technical measures on yield and quality of a number of pomelo lines/varieties are meaningful recommendations and contribute to increase of the production value for growers and improvement of local economics.

+ The conclusions of the dissertation have high practical value that enables orientation, planning for development and production in Thai Nguyen Province in particular and those in some midland and northern mountainous provinces north in general towards commodity production with pomelo varieties available good quality

5. New scientific findings of the dissertation

- The introduction of the new pomelo lines just hybridized on experimental research and evaluation will be an important prerequisite for gradually coming up with new varieties with better quality in service of production;

- Technical measures (colchicine treatment and sexual hybridization) are applied to generate polyploids of some prospective pomelo lines and varieties (creating materials serving for selecting and crossbreeding for seedless fruits), thereby improving the quality of fruits and increasing value to products. This is one of very effective tools in improving cultivar quality.

- The impact of technical measures of the use of rootstocks on the growth of a number of prospective pomelo lines and varieties were studied and assessed. Since then, the most suitable rootstock combination was identified towards serving the multiplication and production development.

Overall structure of the dissertation

Overall dissertation includes 144 pages, excluding appendices, and divided into 5 parts (Introduction, 3 pages, Chapter 1: Literature review, 34 pages, Chapter 2: Contents of research methods, 15 pages, Chapter 3: results and discussion, 90 pages, Part of conclusions and recommendations, 2 pages. The dissertation includes 69 tables, 13 images and 19 illustrations. There are 136 reference documents, of which, 82 documents are in Vietnamese, and 54 documents are in English.

Chapter 1
LITERATURE REVIEW

Pomelo trees (C.grandis) are produced mainly in Asian countries and mainly come from China, Thailand, Philippines, Vietnam, etc. (Dao Thanh Van Ngo, Xuan Binh, 2002). Pomelo varieties in our

country are very diversified and rich with many varieties with high quality such as Nam Roi pomelo, Da Xanh pomelo, Phuc Trach pomelo, etc. However, disadvantages of most varieties are many seeds, and unstable yield (Ngo Xuan Binh, Le Tien Hung, 2010). Therefore, in addition to research to find out the limiting factors to overcome, it is extremely necessary to focus on research and assessment of new selected and created lines (triploid, diploid hybrids) to gradually identify the best varieties in order to add to the existing cultivar sets serving timely production.

Mutagenesis experimental method has important value to create the starting material in the work of selection, creation and improvement of cultivar quality (Ha Thi Thuy, 2005). In recent years, a number of professional agencies in Vietnam such as the Agricultural Genetics Institute, Southern Horticultural Research Institute (SORI), etc. have used mutagenesis experimental methods to create the starting material (generating tetraploids and diploids, from which, it is hybridization between them together to generate triploids) serving for selection and creation of new cultivars and obtained very important initial results. To contribute to the work of selection and creation of new citrus cultivars, it is very meaningful to actively apply mutagenesis experimental methods, especially, mutation treatment with chochicine on some experiment lines and varieties.

According to some authors, method of sexual hybridization and mutation treatment used (treatment with chochicine and gamma irradiation) on some orange varieties, pomelo varieties (King orange and Nam Roi pomelo) gained an significant efficiency (Ngo Xuan Binh, 2009). Thus, it can be confirmed that mutagenesis methods and sexual hybrid approach used are effective tools in improving varieties, enhancing productivity and their fruit quality.

In our country, there are not many studies on growth regulators used for citrus trees, especially pomelo trees. Some studies show that, spraying of GA3 increased ability to flower fructify and reduce the number of seeds on some orange and pomelo varieties (Pham Thi Dung, 2014). However, this is only the preliminary results. It is therefore necessary to continue research in more detail to specified pomelo lines and varieties and in specific ecological conditions, and production.

There were studies on technical measure using foliar fertilizer for pomelo trees. Those studies have found that this measure increasd the growth capacity, productivity, etc. However, there are different conclusions about their impacts on productivity and fruit quality. Therefore, the study is necessary and very meaningful in identifying types of leaf fertilizer consistent with production conditions and soil in Thai Nguyen Province.

There have been many studies on rootstocks for citrus trees. Results of those studies have contributed to solve rootstock for fruit trees consistent with some varieties to propagate and develop production of citrus trees efficiently (Hoang Ngoc Thuan, 1988). However, for new prospective citrus lines and varieties, research, evaluation and selection with good and suitable graft combinations will gain the resonance effect and contribute to improvement of productivity of lines and varieties in specific production and local ecology. This work is essential and highly practical significance.

Chapter 2
MATERIALS, CONTENDS AND METHODS

2.1. Location, duration and materials of the study

2.1.1. Studied location and duration

- Research location was conducted at experimental garden Tuc Tranh Commune, Phu Luong District, Thai Nguyen Province.
- Research duration: 2009 - 2012

2.1.2. Research Materials

• *Varieties include as follows*:

- Pomelo species planted in Vietnam of Da xanh pomelo, Xuan Van pomelo (Tuyen Quang), Thanh Tra pomelo and Red Pomelo (Tuyen Quang).
- Triploid pomelo lines of XB-102, XB-103, XB-106, XB-107, XB-110, XB-111, XB-112, XB-130.
- Diploid hybrid pomelo lines of 2XB, TN2, TN3, TN7, TN16, TN18, TN19, TN20
- The orange lines of TN13, TN17, TN18, XB-2, XB-3, XB-4 and sour pomelo rootstock, scion rootstock, sour pomelo rootstock trees and scion.

• *Other materials used in the study*: gibberellin (GA 3), its pure form manufactured by Fermentate (Germany), a growth regulator with chemical formula of $C_{13}H_{22}O_6$, available stronger activity in 103 different gibberellin with symbols from GA_1 to GA_{103}, chochicine, foliar fertilizers, flower bags, graft wire, etc.

2.2. Contents of the study

2.2.1. It is to research on agrobiological characteristics of some pomelo lines and varieties in Thai Nguyen Province;

2.2.2. It is to research on some technical measures to generate polyploids of some promising pomelo lines and varieties in Thai Nguyen Province;

2.2.3. It is to research on some technical measures for some promising pomelo lines and varieties in Thai Nguyen Province;

2.3. Methods of the study

2.3.1. Studied method on agro-biological features

2.3.1.1. Method of experimental arrangement

In horticultural garden, the five 5-year-old trees were randomly selected for experiment lines and varieties. On each tree, 6 horizontal canopy branches spreading evenly to directions were chosen. Diameters of these branches are from 2.0 to 2.5 cm. Total number of branches is 30

2.3.1.2. Monitoring indicators

- *Branche and trunk indicators*
- *Indicators of leaf features;*
- *Indicators of flower feature;*
- *Indicator of fruit features;*
- *Indicators for growth characteristics.*

2.3.2. Research methods of some technical measures to generate polyploids of some promising pomelo lines and varieties

2.3.2.1. Research on the impact of technical measures of sexual hybridization to ability to generate polyploids

- Research methods:

** Collection of pollen grains;*

** Male infertility and hybridization;*

** Collection of seeds and evaluation of chromosome number of hybrid offspring;*

** Chromosome observation methods ;*

** Methods for testing germination of pollen grains.*

- Monitoring indicators

Indicators on polyploidy levels (diploid rate (%); triploid rate (%); tetraploid rate (%); aneuploidy rate (%). Indicators on polyploid and aneuploid tree growth (high growth process; leaf growth process; the ability to generate fructification, the number of fruits, etc.).

2.3.2.2. Research on the impact of the technical measure of chochicine treatment to the ability of polyploid formation

- Experiment 1: Research on the impact of duration and concentration of chochicine treatment to the ability to generate polyploids of the promising pomelo lines

+ Research methods:

* 30 peeled seeds for a formula were selected randomly. Seeds must be selected evenly and moderately.

* Germs of seeds were treated with chochicine at the time periods (6; 12) at concentrations (0.005%, 0.01% and 0.02%). The time periods (6h, 12h, 24h and 48h) in 3 different concentrations (0.05%, 0.1% and 0.2%) and 2 control formula at 0% for 2 lines.

- Experiment 2: Preliminary assessment of growth of tetraploid and diploid seedlings after treated with chochicine in the first 6 months.

+ Monitoring indicators

Indicators on polyploidy levels: diploid rate (%); triploid rate (%); tetraploid rate (%); aneuploidy rate (%). Indicators on growth of tetraploid and diploid plant (high growth process; leaf growth process; the ability to generate fructification, the number of fruits, etc.).

2.3.3. Research on technical measures for some promising pomelo lines

2.3.3.1. Research on the impact of the preparation (GA 3) spraying on leaves to yield and fruit quality of promising pomelo lines.

Selection of trees for experiment: the 5-year-old trees selected were relatively even in growth capacity and the initial development. The formulas were studied in the same growing and care conditions (method identifying even trees in the production garden. Pham Chi Thanh, 1986).

- **Method of experimental arrangement (1):** the experiments were conducted with 7 formulas:

Formula 1: Control (spraying water)
Formula 2: Without spray
Formula 3: The concentration level of 30ppm
Formula 4: The concentration level of 40ppm
Formula 5: The concentration level of 50ppm
Formula 6: The concentration level of 60ppm
Formula 7: The concentration level of 70 ppm

The formulas are arranged according to randomized complete block, 3 replicates, each plant in each replicate.

One single spray uncombined at the point times (1) 10 days before blooming flowers; (2) When bloomed flowers; (3) 10 days after the bloomed flowers; (4) At the first physiological falling fruits, arranging each spray on different trees, spraying the entire trees, marking flowers at tree's horizontal canopy evenly 4 directions, each monitoring tree ensuring 300 flowers per tree x 3 = 900 flowers.

- Monitoring indicators (1):

Following up fructified rate after each spraying at the time, 4 each tree's branches monitored are distributed evenly directions, counting the total number of flowers on the tracking branches, every

10 days, counting the number of fructified fruits in the tracking trees since the flower remnants.

$$\text{Fructified rate (\%)} = \frac{\text{Number of fructified fruits}}{\text{Numbers of flowers and young fallen fruits + fructified fruits}} \times 100$$

Spraying several times at the points of time: (1) Spraying at the 1st time 10 days before the blooming flowers; (2) Spraying at the 2nd when bloomed flowers; (3) Spraying at the 3rd time 10 days after bloomed flowers; (4) Spraying at the 4th time at the 1st physiological fallen fruits.

- Monitoring indicators and method: as above (1)

Indicators on yield constituent elements and yield:

+ Fructified rate: 4 each tree's branches monitored are distributed evenly directions, counting the total number of flowers on the tracking branches, every 10 days, counting the number of fructified fruits in the tracking trees since the flower remnants.

$$\text{Fructified rate (\%)} = \frac{\text{Number of fructified fruits}}{\text{Numbers of flowers and young fallen fruits + fructified fruits}} \times 100$$

+ Yield constituent elements and yield

+ Number of fruits/tree/formula (fruit): Total actual collected fruits in each formula / total number of trees in each formula

+ Total fruit weight (kg): total fruit weight in each formula/total number of fruit

+ Yield/tree/formula (kg) = Number of fruit * total fruit weight

2.3.3.2. Research on the impact of some foliar fertilizers on yield and fruit quality of some promising pomelo lines and varieties

- Experimental arrangement :

The experiment was arranged in the garden available 5-year-old trees planted in Tuc Tranh Commune, Phu Luong District, Thai Nguyen Province according to the Randomized Complete Block Design (RCBD). There are 4 formulas corresponding to 4 foliar fertilizers and control formula/basic formula that were applied with a fertilizer dose of 50 kg of decomposed organic fertilizer + 500g N + 375g P_2O_5 + 500g K_2O/tree, 3 repeated times, each repeated time for 5 trees. The specific formula is as follows:

Formula 1: Control formula (spraying water)/basic formula: 50 kg of organic fertilizer + 500g N + 375g P_2O_5 + 500g K_2O

Formula 2: Basic formula + Yogen foliar fertilizer

Formula 3: Basic formula + Grow 3 green foliar fertilizer

Formula 4: Basic formula + 209 Mouse foliar fertilizer

Formula 5: Basic formula + Thanh Ha, KH fertilizer

Types of fertilizers used: Urea; phosphate fertilizers: superphosphate; Potassium: potassium chloride

+ The number and amount of fertilizers:

+ The other care:

-***Tracking indicators***:

+ The percentage of fructification:

Number of fruits/tree;

Weight of fruit (g);

Yield (kg / tree);

Edible percentage (%);

Some indicators of fruit biochemistry

2.3.3.3. Research on the impact of technical measures in use of rootstocks on the growth of some promising pomelo lines and varieties;

- Method of experimental arrangement:

Experiment 1: Research on the effect of different types of rootstock on capability of integration and growth of a number of citrus lines.

+ Materials:

* Rootstocks: Sour pomelo, scion, one year old

* Root cutting:

Orange lines: TN13, TN17, TN18, XB-2, XB-3, XB-4

Pomelo lines: TN16, TN19, TN20, XB-106, XB-111, XB-112

The experiment was arranged randomized complete block (RCB) with 3 replications. Each replication consists 10 rootstocks. The experiment was conducted in the best season.

Experimental formulas:

Formula 1: Sour pomelo rootstocks

Formula 2: Scion rootstocks

Experiment 2: Research on the effect of rootstock ages on capability of integration and growth of a number of citrus lines.

+ Materials:

* Rootstocks: Sour pomelo, one year old and three years old

* Root cutting: TN16, TN19, TN20, XB-106, XB-111, XB-112, Red pomelo

The experiment was arranged randomized complete block (RCB) with 3 replications. Each replication consists 10 grafted branches. The experiment was conducted in the spring.

+ Materials:

* Formula 1: Sour pomelo rootstocks, 1 year old

* Formula 2: Sour pomelo rootstocks, 3 years old

- General tracking indicators

Assessment of capabilities and the integration and growth of pomelo lines on rootstock combinations are as follows

Survival rate: a number of living grafted branches/ Total grafted branches;

Germination rate: a number of germination grafted branches/Total grafted branches;

Branch length: Measured from the grafted position to the growth top;

Branch diameter: Measured by the caliper at 2 cm from the grafted position;

The number of leaves/grafted branches;

A number of leaf eyes/grafted branches;

A number of branches at level 1/grafted branches;

A number of branches at level 2/grafted branches;

The ratio of grafted branches/rootstocks diameter;

The monitoring indicators were measured 1 time/week;

2.4. Methods of treatment of the data

The collected data is treated by Microsoft excel, IRISTART and SAS 9.1.

Chapter 3
RESULTS AND DISCUSSION

3.1. Research results of agro-biological characteristics of some promising pomelo lines and varieties in Thai Nguyen Province

3.1.1. Research results of agro-biological characteristics of some pomelo varieties in Vietnam

The study results showed that domestic pomelo varieties have 4 bud sprout periods in a year, mainly summer and spring buds with higher and more focused rate of bud branche rate in year. Bud sprout ability of Red pomelo and Xuan Van pomelo varieties likely are more remarkable than that of varieties participating in experiments. Rates of fructification of Red and Da Xanh pomelo varieties are higher than these of other varieties. Monitoring results of rates of fructification of varieties were shown in Table 3.1.

Table 3.1. Rates of fructification of domestic pomelo varieties

Varieties	Number of pollinated flowers *(Flower)*	Number of fructification *(Fruit)*	Rate of fructification *(%)*
Da Xanh	120	8	6.70[b]
Xuan Van	120	10	8.33[a]
Thanh Tra	120	6	5.00[c]
Do	120	11	9.23[a]
CV%			***6.44***

Some indicators of fruit biochemical composition of varieties are not the significant difference compared to the former production place. Varieties grew well in the ecological conditions in Thai Nguyen Province. Fruit quality obtained still retains characteristics of varieties.

Comment: Pomelo varieties grew and developed well, have 4 bud sprout periods in a year, mainly summer and spring buds with higher and more focused rate of bud branche rate in year. The varieties were flowered and fructified, of which, Red pomelo and Da Xanh pomelo varieties have high fructification rate. Fruit quality of varieties were achieved at delicious and very tasty level. Da Xanh pomelo and Red pomelo varieites are both the most promising varieties.

3.1.2. Research results of agro-biological characteristics of some triploid pomelo lines

Triploid pomelo lines in a year have 4 bud sprout periods, mainly summer, spring, autumn and winter buds. In which, the highest bud rate achieved from 75.66% to 82.18%. The bud rate decreased gradually under seasons from spring, summer to winter. Fructification rates varied from 1.07% to 2.59%, of which, fructification rates of XB-106, XB-107 lines are the highest (Table 3.2)

Table 3.2. Rates of fructification of triploid pomelo varieties

Varieties	Number of pollinated flowers *(Flower)*	Number of fructification *(Fruit)*	Rate of fructification *(%)*
2X-B (Đ/c)	496.40	6.20	1.25[c]
XB-102	217.60	4.20	1.93[b]
XB-103	375.00	4.00	1.07[d]
XB-106	318.80	8.20	2.57[a]
XB-107	370.00	9.60	2.59[a]
XB-108	390.60	5.60	1.43[c]
XB-110	295.60	6.80	2.30[b]
XB-111	365.60	4.00	1.09[d]
XB-112	338.30	5.40	1.59[c]
XB-130	325.80	7.90	2.42[b]
CV%			***12.7***

Triploid pomelo lines have seedless fruits or little seeds, 3 triploid lines available seedless fruits, the remaining lines available very little seeds; there were only 0.5 -2.1 big seeds/fruit and 0.5 -1.4 small seeds / fruit. The average fruit weight gained from 700 g to 1501g. Fruit biochemical indicators: total sugar content reaching from 8.65% to 9.31%; reducing sugar reaching from 7.93% to 8.61%; vitamin C reaching from 65.6 mg to 84.5 mg/100 g fruit pulp. Fruit quality indicators have no significant difference compared with 2XB control line assessed relatively good quality fruit. The study results also

showed that it can continue to select and improve some promising triploid lines to gradually become new varieties for seedless fruit.

Comment: experimental pomelo varieties were good growth and development. In which, it is worth noting that XB-106 and XB-107 lines have the highest fructification rates and delicious fruit and very tasty fruit quality (sloughing and crispy odiferous vesicles, seedless or little seeds). Potential of seedless fruit of triploid pomelo lines showed very high. They are promising lines and can develop good varieties for production in the near future.

3.1.3. Research results of agro-biological characteristics of some diploid hybrid pomelo lines

Diploid hybrid pomelo varieties were good growth and development, have 4 sprouting bud periods in a year, mainly summer and spring buds with the highest rate of bud branches on total bud branch in year. In the ecological conditions in Thai Nguyen Province, lines were also flowered and fructified. However, fructification rates of lines were different and ranged from 3.3% to 6.7%. 2XB, TN2 and TN7 lines have high fructification rate, of which fructification of TN2 line is the highest rate and accounted for 6.7% (Table 3.3). Although fruit weight of TN2 line was a moderate level. Its edible part accounted the highest rate; little seeds, good fruit quality. This pomelo line has many outstanding features compared with other lines in the experiment, there are prospects for development.

Table 3.3. Rates of fructification of diploid hybrid pomelo lines

Varieties	Number of pollinated flowers *(Flower)*	Number of fructification *(Fruit)*	Rate of fructification *(%)*
2X-B(D/c)	120	7	5.8
TN2	120	8	6.7
TN3	120	5	4.1
TN7	120	6	5.0
TN16	120	4	3.3
TN18	120	5	4.1
TN19	120	5	4.1
TN20	120	4	3.3
CV%			***9.0***

3.2. Research results of technical measures to generate polyploids for some promising pomelo lines in Thai Nguyen Province

3.2.1. Research results of the impact of technical measures of sexual hybridization on ability of polyploid formation of the promising pomelo lines and varieties

- Hybrid combinations are capable of generating of seeds. With type I hybrid combination (diploid parental trees), a number of firm seeds (big seeds) were from 86.7 to 134.5 seeds/fruit, a number of small seeds were 0 to 3.7 seeds/fruit, of which, when XB-106 line used as the maternal trees, there were a certain quantity of small seeds (from 1.5 to 3.7 seeds/fruit; With type II and III hybrid combinations (diploid maternal trees, triploid paternal trees or vice versa), a number of big seeds (big seeds) were from 0 to 80.2 seeds/fruit, a number of small seeds were from 0 to 1.7 seeds/fruit; With type IV hybrid combination (triploid parental trees), there were a few big seeds and small seeds (from 0 to 1 big seeds/fruit and from 0 to 1.1 small seeds/fruit). However, quantity of floaters had relatively; Type V hybrid combination (triploid maternal trees, tetraploid paternal trees or vice versa) showed that big seeds and small seeds formed in few. However, it also similar to type IV hybrid combination, a number floaters were relatively high.

- Germination checking results showed that germination rates of pollen grains of diploid and tetraploid trees were relatively high (from 31.2% to 52.5%), while the germination rate of pollen grains of triploid germination was very low (from 0% to 3.2%). This shows that, when using triploid lines as the paternal trees in hybridization, it is necessary to check the germination of pollen grains to determine the germination capacity.

- With the hybrid combination No. 4 and No. 5 (diploid parental implants), the next generation of seedlings created 3 categories of diploidy, triploidy and tetraploidy, of which, the highest rate is diploid (93.5% in the combination No. 4 and 98% in the combination No. 5). The separation of chromosome number of hydrid seedlings of hybrid combination No. 6 (triploid paternal trees, diploid maternal trees) was very abundant and formed haploids, diploids, triploids and tetraploids, In which, the highest rate was diploidy with 67.1%, then the rates of triploid, tetraploid, haploid and aneuploidy were 3.5% , 3.5%, 1.2% and the remaining, respectively (table 3.4). Results also showed that sexual hybrids are effective tools in improving varieties, especially in selecting and generating triploidy and aneuploidy that likely produce seedless fruit or very few seeds.

Table 3.4. A separation of chromosome number in some combinations of cross-pollination

Seq. \ hybrid pair	Hybrid combination No. 4 : 2x (2XB) × 2x (Da Xanh)			Hybrid combination No. 5: 2x (Da Xanh) × 2x (2XB)			Hybrid combination No. 6: 3x (XB-112) × 2x (Da Xanh)		
	Chr. number	Ind. quantity	Rate (%)	Chr. number	Ind. quantity	Rate (%)	Chr. number	Ind. quantity	Rate (%)
1	18 (2x)	116	93.5	18 (2x)	97	98.0	9 (x)	1	1.2
2	19	0	0.0	19	0	0.0	10	0	0.0
3	20	0	0.0	20	0	0.0	11	1	0.0
4	21	0	0.0	21	0	0.0	12	0	0.0
5	22	0	0.0	22	0	0.0	13	0	0.0
6	23	0	0.0	23	0	0.0	14	0	0.0

7	24	0	0.0	24	0	0.0	15	0	0.0
8	25	0	0.0	25	0	0.0	16	2	2.4
9	26	0	0.0	26	0	0.0	17	1	1,2
10	27 (3x)	5	4.1	27 (3x)	0	0.0	18 (2x)	57	67.1
11	28	0	0.0	28	0	0.0	19	3	3.5
12	29	0	0.0	29	0	0.0	20	1	1.2
13	30	0	0.0	30	0	0.0	21	0	0.0
14	31	0	0.0	31	0	0.0	22	0	0.0
15	32	0	0.0	32	0	0.0	23	0	0.0
16	33	0	0.0	33	0	0.0	24	0	0.0
17	34	0	0.0	34	0	0.0	25	1	0
18	35	0	0.0	35	0	0.0	26	3	3.5
19	36 (4x)	3	2.4	36 (4x)	2	2.0	27 (3x)	3	3.5
20	37	0	0.0	37	0.0	0.0	28	3	3.5
21	38	0	0.0	38	0.0	0.0	29	1	1.2
22	39	0	0.0	39	0.0	0.0	30	2	2.4
23	40	0	0.0	40	0.0	0.0	31	0	0.0
24							32	0	0.0
25							33	1	1.2
26							34	0	0.0
27							35	2	2.4
28							36 (36)	3	3.5
29	**Total**	**124**	**100**	**Total**	**99**	**100**	**Total**	**85**	**100**

3.2.2. The impact of technical measure of chochicine treatment on ability of polyploid formation of some promising pomelo lines

3.2.3.1. Impact of durations and chochicine concentrations on ability of seed germination (lines of TN2 and TN7)

- *Treatment for TN2 line:*

It proceed to treat many seeds with different points of time at 6h (hours), 12h, 24h, 48h and 0.005%, 0.01%, 0.02%, 0.05%, 0.1 % and 0.2% of chochicine concentration, respectively. Seeds, after treatment, were observed to determine the effects of time and chochicine concentration on ability of seed germination in TN2 line.

The expression of inhibition of the seed germination of Chochicine at concentrations of 0.1% and 0.2% is very significant. When the concentration and duration of treatment increases, increase of the impact of chochicine for treated samples reduced seed germination.

With processing time in 6h at concentrations of 0.005%, 0.01%, 0.02%, germination ability and germination morphology compared to control group were affected and gained 83.3% - 86.7% . Processing time in 12 hours at concentrations of 0.005%, 0.01%, 0.02%, 0.05%, germination ability and germination morphology compared to control group were affected and gained 90.0% - 96, 7%.

- *Treatment for TN7 line:*

With processing time in 6h at concentrations of 0.005%, 0.01%, 0.02%, germination ability and germination morphology compared to control group were affected and gained 60.0% - 93.3%. Processing time in 12 hours at concentrations of 0.005%, 0.01%, 0.02%, 0.05%, germination ability and germination morphology compared to control group were affected and gained 70.0% - 90.0%.

3.2.3.2. Research results on the impact of concentrations and durations of chochicine treatment on ability of polyploid formation of seed germination (TN2 and TN 7 lines)

- Treatment for TN2 line:

Impact of durations and chochicine concentrations on ability polyploids of buds in TN2 variety showed that diploid tree rate observed decreased gradually when concentrations and durations increase for treating samples. Total tetraploid trees getting in lines TN2 were 18 trees. In which 5 out of 7 tested samples accounted for 71.4% at 0.1% of chochicine concentrations in 12h; 2 trees on total tested sample gained 100%, tetraploid remaining trees achieved from 10% to 50%. Currently these trees are ongoing to be taken care and monitored stability of ploidy level.

- Treatment for TN7 line:

During chochicine treatment in 6h at 0.02% concentration, 1 tetraploid tree obtained accounted for 10% of total 10 samples tested the ploidy level. At 0.1% concentration, three tetraploid trees oobtained accounted for 30% of total 10 samples. At 0.2% concentration, 1 tetraploid tree and one obtained accounted for 12.5% of total 8 samples tested ploidy levels.

During chochicine treatment in 12h at 0.02% concentration, one tetraploid tree and one unidentified ploidy level tree obtained accounted for 20% of total 5 tested samples.

During chochicine treatment in 24h at 0.005% concentration, 1 tetraploid tree obtained accounted for 14.3% of total 7 samples tested. At 0.01% concentration, one tetraploid tree obtained accounted for 117.7% of total 6 samples tested. At 0.02% concentration, two tetraploid trees obtained accounted for 40% of total 5samples tested. At 0.01% concentration, three tetraploid trees obtained accounted for 100% of total 5samples tested.

3.2.3.3. Preliminary results of growth evaluation of tetraploid and diploid seedlings after chochicine treatment in the first 6 months

The growth of tetraploid seedlings of TN2 and TN7 pomelo lines was stronger than that of diploid seedlings. With the same external conditions and similar care conditions, growth capacity of each line were different. That is the difference among lines.

Apart from generating leaves, thickness of leaves of tetraploid trees was higher than that of diploid trees. Leaves of tetraploid trees usually increased width, and length changes slightly. By the naked eyes, it can distinguish between tetraploid trees and diploid tree through leaf shape.

Comment: a total of tetraploid trees through technique measure of chochicine treatment has obtained 31, TN2 lines created 18 trees accounting for 58.06%, TN7 lines TN7 created 13 trees accounting for 41.94%.

The growth rate of tetraploid trees of both TN7 and TN2 lines was also stronger than that of diploid trees. Tetraploid trees was a good material source serving for training triploid seedless citrus seedlings. This is one of technique measures very effective in selecting and generating seedlings with high yield, good quality, especially for seedless fruit varieties.

3.3. Research results on the impact of technique measures for some promising pomelo lines

3.3.1. Research results on the impact of preparations sprayed on leaves (GA_3) on yield and fruit quality of promising pomelo lines

The application of four times spraying of growth regulators at the periods, namely 10 days before bloomed flowers, the bloomed flowers, 10 days after bloomed flowers and the 1st physiological fallen fruits at 50 ppm concentrations for TN2 pomelo lines will have the highest fructification rate accounting for from 4.24% to 4.71%, higher than the control group (spraying water) and was very significantly (Table 3.5) and also obtained the highest fruit yield in experiment formula and significantly higher than that of control group. Fruit quality of TN2 pomelo lines was not significant changes when spraying GA_3 .

Table 3.5. The impact of times spraying of GA_3 on fructification rate (%) when combining spray repeatedly.

Unit: %

Formula	GA_3 concentration (ppm)	1 time spray 10 days before bloomed flowers (A)	Spray 10 days before bloomed flowers + bloomed flowers (B)	spray 10 days before bloomed flowers + bloomed flowers + 10 days after bloomed flowers (C)	Spray 10 days before bloomed flowers + bloomed flowers + 10 days after bloomed flowers + 1 time spraying before the 1st phy. fallen fruits (D)
1	Water spray (Control)	2.70	2.64	1.34	1.23

2	Without spray	2.65	2.52	1.43	1.20
3	30 ppm	3.94	3.72	2.80	2.61
4	40 ppm	3.82	3.64	3.45	3.20
5	50 ppm	4.71	4.65	4.6	4.24
6	60 ppm	3.64	3.12	3.02	2.56
7	70 ppm	2.93	2.65	2.01	1.97
CV%		***14.1***	***11.3***	***14.0***	***4.2***

3.3.2. Research results on the impact of foliar fertilizer on yield and fruit quality of TN 2 promising pomelo line

Table 3.6. The impact of foliar fertilizer on ability of fruit yield of TN 2 pomelo trees

Formula	Number of fructification *(Fruit)*	Fruit weight (kg)	Fruit yield/tree (kg)
1(Control)	35.6	0.796	28.33
2	41.5	0.829	34.40
3	37.3	0.800	29.65
4	36.9	0.803	29.63
5	42.0	0.837	35.15
CV%	***2.3***	***5.5***	***2.0***

Thus, it can see that the additional spraying of foliar fertilizers was certain impact on number of fructification /trees and fruit weight of TN2 pomelo lines, especially Formula 2 and 5 are very significantly affected to the constituent elements of productivity and fruit yield of TN 2 pomelo lines.

The additional spray of Yogen foliar fertilizer and Thanh Ha, KH fertilizer on basement containing 50kg of organic fertilizer + 500 kg N + 375kg P_2O_5 + 500g K_2O_5 increase fruit yield of TN2 pomelo line. Fruit yield from use Yogen foliar fertilizer gained 34.4 kg of fruit/tree, and increased 21.4% compared to the control group with 28.33 kg of fruit/tree; Fruit yield from use of Thanh Ha, KH fertilizers were 35.15 kg fruit /tree and increases 24.07% compared to the control group is 28.43kg / fruit.

3.3.3. Research results on the impact of rootstocks on growth of some promising pomelo lines

3.3.3.1 The impact of rootstocks on ability of integration and growth of some citrus lines in the Spring season

a. Impact of rootstock types on survival rate of a number of citrus lines

Comparing the survival rate of grafted lines on 2 rootstock types showed that survival rates of almost orange lines (TN13, TN17, TN18, XB - 2, XB - 3 and XB - 4) grafted on scions were higher than that on sour pomelo rootstocks. Survival rates of almost pomelo lines (TN16,

TN19, TN20, XB - 106, XB - 111 and XB - 112) grafted on scions were lower than that on on sour pomelo rootstocks

Thus, we can see that the ability of integration of orange grafted branches on scion rootstocks is better than that sour pomelo rootstocks. In contrast, the ability of integration of pomelo branches on sour pomelo rootstocks is better than that on scion rootstocks

b. Impact of rootstock types to germination rates of grafting combinations

Germination rates of grafting combinations gradually increased with time. 28 days after grafting, there were 6 lines on sour pomelo rootstocks germinated in which, XB - 111 line had the highest germination rate reaching 40%. On scion rootstocks, there were 6 germinated lines, in which germination rate of TN18 line has reached 50%. 42 days after grafting, all grafting combinations have germinated, in which, XB-106 line on sour pomelo rootstocks has the highest germination rate reaching 93.3%, and the lowest germination rate was TN16 line on scion rootstocks and reached 10% .

Until the 70th day, the germination rate of all grafting combinations was over 60%, in which, that of XB-106 line grafted on sour pomelo rootstocks reached a maximum of 100% and two TN19 and TN20 lines grafted on scion rootstocks have the lowest germination rate that was only 60%.

c. Impact of rootstock types on the length growth status of grafted branches

- The length growth status of grafted branches of some citrus lines on sour pomelo rootstocks

Table 3.7. The length growth status of grafted branches of some citrus lines on sour pomelo rootstocks

Unit: cm

Duration (Days) / Lines	35	49	63	77	91	105	119	133
TN13	0.65	5.47	8.92	10.21	11.71	12.30	19.85	20.90
TN17	0	1.23	4.16	6.33	7.33	10.21	14.35	15.12
TN18	1.00	4.16	5.63	6.60	8.14	10.80	14.14	16.50
XB - 2	1.50	4.67	6.17	7.60	9.33	9.55	14.35	15.25
X B - 3	1.43	3.65	6.89	7.41	8.65	12.67	15.03	16.09
X B - 4	1.67	2.03	6.14	7.42	8.38	14.83	17.41	18.83
TN16	0.73	3.05	5.13	5.65	6.42	13.31	19.03	20.13

TN19	2.00	4.87	7.18	8.35	11.53	18.38	23.25	23.55
TN20	1.67	3.87	6.29	6.81	9.59	13.11	17.11	18.31
XB - 106	2.16	5.09	6.01	8.07	8.66	14.64	22.15	23.25
XB - 111	2.00	6.01	7.06	8.06	8.60	17.86	22.25	23.15
XB - 112	2.75	4.55	7.18	8.33	11.98	17.13	21.50	22,50
CV%								14.61

The data in Table 3.7 showed that, in general, grafting combinations also underwent 2 sprout bud periods. The 1st sprout period was from 35 days to 91 days after grafting. At the time of 35 days after grafting, the lowest branch length was TN17 line; the longest branch length was XB - 112 line. By the end of the 1st sprout period, the branche length of lines was not significantly different. The growth of the 2nd sprout period was after 91 days. The active status of growth of the 2nd sprout period was faster than that the 1st sprout period, especially in the period from 91 to 119 days after grafting. From 119 to 133 days after grafting, the length growth of lines was slow. This proves that the lines are prepared to finish growth of the 2nd sprout period.

133 days after grafting, branch length of combinations was relatively different. The largest branch length was TN19 line, then XB - 106 line and the lowest branch length was TN17 line

- *The length growth status of grafted branches of some citrus lines on scion rootstocks*

Monitoring results showed that the length growth status of branches of orange lines (TN13, TN17, TN18, XB - 2, XB - 3 and XB - 4) grafted on scion rootstocks was more powerful than that on sour pomelo rootstocks. In contrast, branch length of pomelo lines (TN16, TN19, TN20, XB - 106, XB - 111 and XB - 112) grafted on pomelo rootstocks was larger than that on scion rootstocks.

d. Impact of rootstock types on some growth indicators of grafting trees (after 6 months)

Length of grafted branches of the same line on 2 types of different rootstock was different. Branch length of orange lines grafted on scion rootstocks was greater than that on sour pomelo rootstocks. In contrast, pomelo lines grafted on sour pomelo rootstocks were stronger growth than that on grafted scion.

The diameter of branches of lines grafted on sour pomelo rootstocks was not significantly different. In particular, the largest diameter of grafted branches of XB - 106 line was 0,88cm, the smallest diameter of NT 17 orange line was 0,71cm. Diameter of

branches grafted branches on sour pomelo rootstocks was greater than that of corresponding lines on grafted scion.

3.*3.3.2. Impact of rootstock age on ability integration and growth of a number of diploid and triploid pomelo lines*

a. Impact of rootstock age on survival rate of grafted branches

The highest survival rate of grafted combinations was XB-106 on one-year-old rootstock, XB-106 on 3-year-old rootstock, rootstock TN19 on 3-year-old rootstock, XB-112 on 3-year-old rootstock and reached 100% . The lowest survival rate of TN20 combination grafted on one-year-old rootstock was 73.33% .

It showed that when comparing the survival rate of pomelo lines grafted on 2 rootstock types, survival rates of all lines grafted on the 3-year-old rootstocks were higher than that of the corresponding line grafted on the 1-year-old rootstock. It was only XB-106 line to have equal survival rate on 2 rootstock types and have reached a maximum of 100%.

b. Impact of rootstock age on germination of grafted branches

Germination rates of combinations grafted on the 3-year-old rootstocks were higher than those on the one-year-old rootstock. Particularly, XB-106 line had the highest germination rate reaching a maximum of 100% on 2 types of 1 and 3 -year- old rootstock .

c. Impact of rootstock age on length growth status of grafted branches

Table 3.8. Length growth status of grafted branches of some citrus lines on sour pomelo rootstock at one year old

Unit: cm

Duration (Days) / **Lines**	**21**	**35**	**49**	**63**	**77**	**91**	**105**	**119**	**133**
TN16	0	0.75	3.05	4.76	12.53	13.05	21.25	23.16	23.45
TN19	0.25	1.75	4.87	9.76	14.25	14.75	19.36	26.45	27.12
TN20	0	1.67	5.29	9.75	12.11	14.52	20.16	21.35	21.5
XB-111	0	1.35	6.01	8.26	8.52	10.35	17.86	20.64	20.9
XB-112	0	2.75	6.55	7.18	8.33	14.98	19.13	20.52	21.06
XB-106	0.75	2.16	5.09	9.01	9.27	11.56	17.64	22.23	24.26
CV%									**10.48**

Data in Table 3.8 showed, the length of grafted branches of lines grafted on the 3-year-old pomelo rootstocks was growing much faster than that on the 1-year-old rootstocks. The most obvious growth was TN16 line, 133 days after grafting the branch length on the 3-year-

old rootstock reached 40,01cm, but on the 1-year-old rootstock was only 1 23,45cm.

d. Impact of rootstock age on growth characteristics of grafted branches after 6 months

Comparison of growth characteristics of grafted branches was showed that the ability of growth as well as harmony capacity of combinations grafted sour pomelo rootstocks at the 3 years old was better than that on sour pomelo rootstocks at 1 year old.

It is proved that the impact on the growth of the 3-year-old rootstock was more positive than that of 1-year-old rootstock. However, in practice of seedling production, in order to reduce durations and take care and transport rootstocks, majority of growers producing seedlings were only to use on 12 to 18 -month-old rootstocks.

3.3.3.3. Research results of correlation between diameters of rootstocks on some growth indicators of grafted branches of XB-106 line.

a. Results of correlation analysis between diameters of the 1-year-old rootstocks on some growth indicators of grafted branches

Linear correlation between the diameter of rootstocks and that of grafted branches (6 months after grafting) reached r = 0.615 that expressed a moderate positive correlation.

Linear correlation between the diameter of rootstocks and the length of grafted branches reached r = 0.388 that expressed a weak correlation.

Linear correlation between the diameter of rootstocks and leaf number indicator/number of leaf eyes reached r = 0.437 that expressed a moderate correlation.

This shows that growth indicators of branches grafted on the 1-year-old rootstocks (0.6 cm - 1.05 cm in diameter) are not affected much from diameter indicators of rootstocks. Therefore, to enhance the growth indicators, in addition to the selection of appropriate rootstock diameter, it is necessary to be interested in cultivation techniques.

b. Results of correlation analysis between the diameter of the 3-year-old rootstock and some growth indicators of grafted branches

Tracking results of diameters of the 3-year-old sour pomelo rootstocks when grafting and growth indicators of grafted branches of XB-106 line after 6 months of age showed that diameters of rootstocks were relatively large fluctuations in the range of 1.1 - 2cm and reached an average value of 1.46cm. 6 months after grafting, diameters of grafted branches also reaches relatively high values in the range of 1.2 - 2.3cm. Of which, there was 30% of grafted branches with diameters greater than or equal to 2 cm.

- Results of correlation analysis between the diameter of the 3-year-old rootstock and some growth indicators of grafted branches

There was tight correlation between diameters of the 3-year-old sour pomelo rootstock and diameters of grafted branches. The correlation coefficient r = 0.828 means that correlation expressed in the forward direction. If diameters of rootstock were large, diameters of grafted branches also were large.

- The results of correlation analysis between the diameter of the 3-year-old rootstocks and the length of grafted branches:

The length indicator of grafted branches on the 3-year old sour pomelo rootstock 6 months after grafting was fairly uniform, only in the range of 29.2 - 42.5cm and reached a average value of 33.79cm. The correlation between the diameter of rootstocks and the length grafted branches represents at the average level in the forward direction with r = 0.514.

- The results of correlation analysis between the diameter of the 3-year-old rootstocks and the ratio of leaf number/number of leaf eyes:

The correlation between the diameter of the rootstock and the ratio of leaf number/number of leaf eye was not significant with r = -0.036. This demonstrates defoliation of branches grafted on the 3-year-old rootstocks are not affected by the diameter of rootstocks.

Comment: integration and growth of pomelo lines grafted on pomelo rootstocks were better than these lines grafted on scion rootstocks. It is only XB-106 triploid pomelo line that had the survival and germination rates of 100% on 2 types of rootstocks. Other growth characteristics were good. The integration and growth capacity of branches grafted on the 3-year-old rootstock were better than that on the 1-year-old rootstock. XB-106 line is the best result in grafting.

The diameter of rootstocks has the forward correlation with the diameter of grafted branches, length of branches, number of leaves / number of leaf eyes. In which, the correlation of the diameter rootstocks with that of branches was the tightest correlation (r = 0.828). This correlation was different in 2 ages of rootstocks. The

best combination was XB-106 line grafted on the 3-year-old sour pomelo in the spring season.

CONCLUSIONS AND RECOMMENDATIONS

1. Conclusions

1.1. Domestic pomelo varieties were good growth and development in the ecological conditions of Thai Nguyen Province, had 4 sprouting periods in a year, mainly spring sprouting period accounting for from 67.5% to 72.5 % and sprouting was quite focused. All varieties were to flower and fructify. Of which, fructification rates of Red pomelo and Da Xanh pomelo varieties accounted for the highest rates (6.7% - 9.23%). Fruit quality achieved at delicious and very tasty. These two pomelo varieties are promising to develop production with conditions in Thai Nguyen Province.

1.2. In a year, triploid pomelo lines had 4 sprouting periods at spring, summer, autumn and winter. Of which, spring sprouting period accounted for the highest percentage reaching from 70.29% to 83.38%. The lines also were to flower and fructify; fruit quality was delicious and very delicious. The potential for seedless fruits of the triploid lines was very high. XB-110 and XB-106 lines were the most dominant lines.

1.3. The diploid hybrid pomelo lines all had 4 sprouting periods in the year, in which, the spring sprouting period was dominant and gained from 73.54% to 80.84%. There was the highest ratio between sprouting branches/total sprouting branches in the year. The lines were all to flower and fructify, of which, the fructification of TN7 and TN2 lines was the highest rate (5.0% - 6.7%); delicious fruit quality and a few seeds. These are the lines promising to develop good varieties in the near future.

1.4. Technical measures of sexual hybridization generated very abundant hybrid seedlings and produced forms of haploidy, diploidy, triploidy and tetraploidy, in which, rates of diploidy, triploidy, tetraploidy, haploidy and aneuploidy were 67.1%, 3.5%, 3.5% (5 trees), 1.2% and remaining percentage, respectively. Results also showed that sexual hybridization are effective tools for improving variety quality, especially selection and creation of triploidy selected and generated is capable of seedless fruits.

1.5. With chochicine treatment, a total of 31 tetraploid trees were generated, TN2 line generated 18 tetraploid trees accounting for 58.06%, TN7 line generated 13 tetraploid trees accounting for 41.94% (with treatment durations from 6 to 24 hours at concentrations of 0.1- 0.05%). The growth rate of tetraploid trees of both TN2 and TN7 lines are stronger than that of diploid trees. This

is a source of precious materials to serving for improving varieties and generating triploid seedless citrus varieties with good quality.

1.6. The application of GA3 spray implemented four times at the periods 10 days before blooming flowers, the bloomed flowers bloom, 10 days after bloomed flowers and the 1st physiological fallen fruits at concentration level of 50 ppm will give the highest fructified rate (gaining 4.24%), much higher than that of the control group (water spray, reaching 1.23%).

1.7. Spraying of foliar fertilizers (as recommended by manufacturers) had affected fruit yield of TN2 pomelo line, in which, spraying Yogen foliar fertilizer and Thanh Ha, KH fertilizers on basement of 50 kg organic fertilizer +500g N + 375g P_2O_5 + 500g K_2O increased fruit yield. With Yogen foliar fertilizer, increased fruit yield is 21.4%; with Thanh Ha, KH fertilizers, increased fruit yield is 24.07%.

1.8. Integration and growth of pomelo lines grafted on pomelo rootstocks were better than that of these lines grafted on scion rootstocks. In particular, survival and germination rates of XB-106 triploid pomelo line were 100% on the 2 types of rootstocks. Other growth characteristics are good. Ability of integration and growth of grafted branches of the 3-year-old rootstocks were better than that of the 1-year-old rootstocks. XB-106 line had the best result in grafting.

There was the forward correlation between the diameter of rootstocks and the diameter of grafted branches, branch length and leaf number/ number of leaf eyes. In which, there was the tightest correlation with the diameter of branches (r = 0.828). This correlation was different at 2 ages of rootstocks. The best grafted combination was XB -106 lines grafted on the 3-year-old sour pomelo rootstock in the spring season

2. Recommendation

- The capacity of growth and flowering, fructification of Red and Da Xanh pomelo varieties was good in the ecological conditions of Thai Nguyen Province. Therefore, it is necessary to build a model for experimental production at a larger scale. On that basis, there are replication plan to produce in growing areas planned;

- The new pomelo lines selected and generated available promising feature (XB-106, TN2 andTN7) should continue to monitor and deeply assess the possibility of flowering, fructification, fruit quality in subsequent years in some different ecological zones of Thai Nguyen Province ;

- The tetraploid seedlings generated from technical measures of sexual hybridization and chochicine treatment should continue to be taken care and monitored. Since then, it hybridizes with diploid trees to create triploid trees with seedless fruits or very few seeds in the near future;

- GA 3 can be used in spraying at phases such as 10 days before the blooming flowers, when bloomed flowers, 10 days after flowering and the 1st physiological fallen fruits at concentration level of 50 ppm to improve pomelo productivity; it can use Yogen foliar fertilizer and Thanh Ha, KH fertilizer (as recommended by manufacturers) on the basement of 50 kg organic fertilizer + 500g N + 375g P_2O_5 + 500g K_2O that will increase fruit yield;

- It can be used sour pomelo trees for rootstocks to propagate for promising lines identified.

LIST OF PUBLICATION RELATED TO PhD. DISSERTATION

1. Le Tien Hung, Nguyen Thị Xuyen, Ngo Xuan Binh (2011), "The results of correlation analysis between rootstock diameter and some growth indicators of grafted branches of XB-106 line in Thai Nguyen Province" *Journal of Science and Technology for Agriculture and Forestry*, Ho Chi Minh City University of Agriculture and Forestry (1), page 23 - 27.
2. Bui Thanh Phuong, Le Tien Hung, Ngo Xuan Binh, Nguyen Thi Lan Huong (2010), "Research on some biological characteristics of some promising triploid pomelo lines in Thai Nguyen Province", *Journal of Science and Technology*, Ministry of Science and Technology (612), page 29 - 31.
3. Le Tien Hung, Bui Dinh Lam, Ngo Xuan Binh (2015), "Study on the possibility of seed creation and polyploidy formation by sexual hybridization technique in some citrus lines and cultivars", *Journal of Agriculture and Rural Development* , (11), page 75 - 81.
4. Hoang Thi Thuy, Nguyen Huu Tho, Le Tien Hung, Ngo Xuan Binh, Akira Wakana (2014), "Self-incompatibility in Pumelo (Citrus grandis L. Osbeck) with focus on Vietnamese cultivars with and without Parthenocarpy", *Journal Fac. Agriculture, Kyushu University*, 59, pp. 65-70.