

## **CHAPTER V**

### **COMPARING PRODUCTION SYSTEM OF THE NORMAL AND THE VIRUS-FREE SYSTEMS**

#### **5.1 Introduction**

In order to fulfill the first objective, this chapter explains the production systems of the strawberry and runner production of the virus-free system and the normal system as regards with the experience in production, damage to strawberry plants, farming practices and labor use.

#### **5.2 Strawberry production**

The strawberry is a temperate fruit crop. It can grow well in some parts of the north and the northeast of Thailand. However, the commercial production areas are in the north especially in Chiang Rai and Chiang Mai provinces. In Chiang Mai, the production areas are concentrated in Fang, Mae Rim, Samoeng and Chom Tong (the Intanon RP) districts. For Chiang Rai province, the production area is in Mae Sai district.

The average area of strawberry production using VFS and NS were 0.46 and 2.18 rai/household respectively. The production areas using VFS were less than the areas using NS because the areas using VFS were agricultural upland where did not have sufficient water to increasing the production areas. On average, about 2-3 people per household worked on VFS strawberry farms. Households employed NS hired labors and exchanged labors.

The strawberry is a delicate fruit crop, which requires skill in production. The farmers who have more experience develop good practices, which increase production. The SVFS farmers had have four years of experience in strawberry production. The SNS farmers using NS had have eight years of experience.

### **5.2.1 Damage to strawberry plants using VFS and NS in the cultivation period**

Damage to strawberry plants is assessed by measuring the numbers of plants died by pathogens, pests, and environmental factors such as such as temperature. The assessment of damaged plants is expressed by a percentage. The varieties in the CSPUCS project were P16, P20, P50, P70 and Selva varieties. The estimated damage was assessed by comparing the VFS and NS of P16 and P20 varieties. Table 5.1 shows the percentage of damage. The P16 variety of VFS had percentage of damage of about 24%, which was higher than that using NS (Table 5.1). However, the difference in damages of between both varieties is not significant. By comparing damaged to P20 strawberry plants of VFS and NS, it was found that the damage of VFS was lower than of NS. The percentages of damage of P20 using VFS and NS are about 8% and 14% respectively.

Therefore, it is concluded that using VFS will not relieve the problem of strawberry pathogen. Even using VFS certified runners, they might be damaged by pathogens particularly, virus. They can be infected by carrier insects such as aphids and red mites when climate changes rapidly. Therefore, the cultural practice is method to get rid of carrier insects, which are the cause of virus infection. The other pathogens, which are the cause of the damaged strawberry plants, are Leaf Scorch, Leaf Spot, Red Stele of Root Rot, Powdery Mildew, Gray mold fruit rot, Phytophthora rot and Fusarium wilt. The control of these strawberry diseases centers on four basic concepts: genetic

resistance, pathogen-free propagation and plant material, chemical control of pathogens or vectors and sanitation.

Table 5.1 The percentage of damage strawberry plants

Varieties	The percentage of damaged plants (%)	
	Using VFS	Using NS
Pharadchatan 16	23.6	20.9
Pharadchatan 20	7.9	14.0
Pharadchatan 50	27.2	na
Pharadchatan 70	5.3	na
Selva	86.6	na

*Source: Survey 1998*

*Note: not applicable*

### 5.2.2 Farming practices in strawberry production

This study includes farming practice in order to explain strawberry production using VFS and NS. Farming practices were studied such as soil preparation, planting, mulching, fertilizing practice, watering, plant protection and harvesting. These practices explain cultural management broadly. Moreover, this study points out the difference of practices between the virus-free system and the normal system as follows.

### 5.2.2.1 Land and soil preparation

Land preparation by both the SVFS and the SNS farmers starts from September or October. Most farmers have stopped using buffaloes for agricultural purposes. The soil is mainly ploughed and turned over by machines, which are mostly used by the SNS farmers. 10% of the SVFS farmers had machines; the remainder used household labor. About 57% of the SNS farmers had to spend money for the land preparation by using hired labors or hiring machines.

Strawberries can grow in several soil types in many areas but location selection is an essential point to achieve commercial production. Beside the management of cultural system efficiently and suitable climate, soil condition and soil type are important factors for strawberry production. The strawberry can grow in acid soil (pH 5.8-6.5) and is tolerant in saline soil. Soil types should be sandy soil being deep surface soil and well-drained sandy loam.

Nutrients in the soil are completed so that they can improve productivity therefore soil preparation is essential for strawberry production. The good management of soil preparation depends on three factors; (1) soil type (2) suitability of humidity (3) sufficient nutrients particularly, organism or humus in the soil. If there are more organisms in the soil leading to good soil structure excess is humidity absorbed (Pipattanawong, 1998).

Manure application is a method of soil preparation, which most farmers understand. It was found that about 46% of the SNS farmers applied manure. Only 7% of SVFS farmers applied manure. It could not be concluded that the SVFS farmers did not realize the value of improving soil structure. It might be that most areas using VFS

were highland. Therefore, manure supplies were not sufficient for every farm. However, encouraging manure application is mostly necessary in agricultural development.

### 5.2.2.2 Planting and Mulching

There are several planting systems but in Thailand, the planting system used is a one-year hill system. In this system, runners can develop but they will be cut off in order that crowns can grow.

Spacing patterns were variable depending on the indigenous knowledge of each farmer. In Thailand generally, density of planting is about 8,000-10,000 plants per rai. It is common put Tong Tung leaves in double row with plant 25-30 cm apart and 45-50 cm ridges. The planting system used bed heights of about 30 cm. Most farmers using VFS plant through Tong-Tung leaves on raised beds using a double row at 25 cm apart with plants staggered at 25cm in the row. This spacing pattern which was employed by 88% of the SVFS farmers. The remainders were the SVFS farmers who employed the patterns of spacing shown in table 5.2.

Table 5.2. Spacing patterns used by the farmer using VFS

Spacing patterns	VFS	
	Freq. (people)	Percent (%)
25x25	50	87.7
20x20	3	5.3
30x30	2	3.5
50x50	2	3.5

*Source: Survey 1998*

There were many spacing patterns in strawberry production. The 20x20 cm spacing pattern was employed by about 48% (Table 5.3). The percentage of using this pattern was 47.5%. The other patterns employed were 30x30, 15x15, 20x30, 25x25 cm and so on.

Table 5.3. Spacing patterns used by the farmer using NS

Spacing patterns	NS	
	Freq. (people)	Percent (%)
20x20	29	47.5
30x30	10	16.4
15x15	6	9.8
20x30	5	8.2
15x20	4	6.6
50x50	2	3.3
20x25	1	1.6
10x40	1	1.6
10x20	1	1.6
15x30	1	1.6
25x30	1	1.6

*Source: Survey 1998*

Mulching is an essential practice in strawberry production. The benefits of mulching are the decreased quantities of weeds, soil humidity maintenance, and particularly preventing the strawberry fruit from touching the soil. There are many

mulching materials such as Tong-Tung leave, Imperata (also called Cogon or lalang), and rice straw. Tong-Tung leaves are most frequently used in mulching practice.

### 5.2.2.3 Fertilizer application

The harvesting season of the strawberry is very long, December until March. Therefore fertilizer application is an essential to improve quality of fruit for commercial production. There are three periods of fertilizer application: pre-planting, pre-flowering and bearing until harvesting periods. Fertilizer applications vary according to individual farmers. However, most of the SVFS farmers in the RPF have a similar fertilizing program.

SNS farmers in the RPF, in the pre-planting period used 15N-15P-15K fertilizer with 50 kg per rai. Pre-flowering or one month after planting period, 1 tablespoon per plant were applied (10-20 grams) about 1 or 2 times. Bearing until harvesting period used 13N-13P-21K fertilizer with 10-20 grams per plant about 2-3 times per month. Most SVFS farmers in the Intanon RP used 15N-15P-15K fertilizer throughout the strawberry season.

The fertilizer practices of the SNS farmers vary according to the individual knowledge of each farmer. As well, the types of fertilizer differ depending on the purchasing power of each farmer and supplies in the villages. The fertilizer type mostly applied among a group of the SNS farmers in pre-planting period was 15N-15P-15K fertilizer with 100-200 kg per rai. The other fertilizer types applied in the pre-planting period were shown in Table 5.4.

Table 5.4. Each fertilizer type applied in pre-planting period by percentage.

Fertilizer types	Freq.	Percent (%)
15N-15P-15K	55	90.2
21N-0P-0K	3	4.9
Non use	3	4.9

Source: Survey 1998

In the pre-flowering period, the SNS farmers applied fertilizer about 1 to 2 times per month. The types of NPK fertilizer applied were 15-15-15, 8-24-24, 13-13-21, and 21-0-0 fertilizers. The amount of fertilizer application was about 1 tablespoon (10-20 grams) per plant.

In the bearing until harvesting period, this was applied fertilizer having a high rate of Phosphorus and Potassium were applied such as 8-24-24, 13-13-21, 9-24-24, 14-14-21, 12-12-17 fertilizer. The SNS farmers applied fertilizer about 2 times per month ranging between 1 to 4 times per month. The amount of fertilizer in application was about one handful per four plants.

#### 5.2.2.4 Watering

Water shortage in the bearing period leads to decreasing of productivity. Therefore, if the irrigation system is managed suitably it can reduce the loss of productivity. According to the report of Pipadtanawong (1998), if the water is sufficient, there will be bigger fruit and increased runners in propagation period. The frequencies of watering depend on the amount of rainfall and soil humidity.



In general, irrigation systems presently operated are sprinkler, soaked, furrow irrigation. Moreover, drip irrigation has been used in the Ang Khang Upland Agricultural Research Station. This system can apply and control fertilizer by fertigation.

The irrigation systems, which were worked by the SVFS farmers, were furrow, soaked and sprinkler irrigation 82.4%, 5.2%, and 12.4% respectively. SNS farmers used these irrigation systems as well. The Furrow soaked and sprinklers irrigation was 31.1%, 32.8%, and 36.1% respectively. This result points out that the SVFS farmers, particularly the farmers within the RPF, used mostly furrow irrigation. This system is very easy and convenient in practice. On the other hand, it is the lowest cost system because no labor cost has to be hired (partly because of small production scale).

#### **5.2.2.5 Weeding and runner plucking**

Weeding practices in strawberry production are herbicide application and hand weeding. In general, the farmers apply herbicide in the pre planting period. Hence, it does not damage to the strawberry plants. Mostly, if the farmers have to use herbicide, they will spray between beds so that it will not damage the plants. Most of both SVFS and SNS farmers do weeding and runner plucking at the same time. The runner plucking is very important to practice so that larger crown develops. If the runners grow well, crown development will not be so good.

#### **5.2.2.6 Plant protection**

Many pathogens and pests, which vary in types and symptoms, are attracted to the strawberries. These will depend on the varieties and management as well as the

environment. Plant protection involving chemical use is a practice to increased strawberry production

Chemical use by the SVFS farmers averaged 2 times per month ranging between 1 to 4 times. The SNS farmers used more frequent in chemical application averaged at about 3 to 4 times a month. They explained that mostly the cause of damage was pathogen. Moreover, pests were a cause of damage to strawberry production such as Chilli thrips, Cotton leafworm, Aphids, Snail and White grub.

#### **5.2.2.7 Harvesting**

The strawberries are cultivated mainly from September to April, with the harvesting period between December to April. January to February period is the months with high productivity. In Thailand, the harvesting system is picking method. It is not easy to use machine for harvesting because the scale of production is quite small. So, harvesting skill is very important for picking system. In general, high productivity is in the mid-season period. Most farmers pick the strawberries in the early morning. In the mid-season, the farmers who have more than one rai of the production area will extend picking time starting at night until early morning in the mid-season.

#### **5.2.2.8 Production yield**

This study collected the production yield of both groups. The explanations are shown as yield per plant and yield per rai of individual varieties by comparing between both using VFS and NS. It was found that on average, the strawberry production of using VFS and NS were 1,406 and 2,931 kg per rai. Lower yield of strawberry by using VFS were cause of the damage to strawberry plants. Moreover, the production was not good

quality for fresh market because fruits were very small. The farmers had to forsake this production. Therefore, it might be that damage to plants led to low productivity. The production yields of each variety both using VFS and NS are shown in Table 5.5 and 5.6.

Table 5.5. The production yield of strawberry using VFS

Varieties	Yield (kg/rai)	Yield (kg/plant)
Pharadchatan 16	1,882	0.190
Pharadchatan 20	1,105	0.110
Pharadchatan 50	689	0.068
Pharadchatan 70	1,144	0.110
Selva	577	0.057

*Source: survey 1998*

Table 5.6. The production yields of strawberry using NS

Varieties	Yield (kg/rai)	Yield (kg/plant)
Pharadchatan 16	3,156	0.32
Pharadchatan 20	2,316	0.23

*Source: survey 1998*

### 5.3 Runner production

Strawberries are propagated from runner shoots, which come out from the parent plant and root at alternate nodes. The farmers producing runners using the normal system (RNS) were farmers at Ban Bo Kaew in Samoeng district. They produced runners for their strawberry production and sold the remainder to other farmers in Mae Rim, Fang and Mae Sai districts.

Mother plants of strawberry runners produced by using the virus-free system (RVFS), then were produced by the using tissue culture technique. The production area of VFS propagation was at Kob-Dong, in the area of the Ang-Khang Royal Project Station. Hill-tribe farmers propagated virus-free runners.

### **5.3.1 Experience in strawberry runner cultivation**

The experience in strawberry production of farmers is a factor, which effects to the quality of the runner production. However, knowledge transferred to the farmers can increase the quality. It was that found that the average experience in production of the farmers in Kob Dong, who produced by using VFS, was 4 years ranging between 1 to 13 years. On the other hand, the farmers using NS had 8 years experience ranging between 1 to 20 years.

From this study, it is clear that the skill in runner production is a factor effecting to the quality of runners. Even, if the farmers used VFS (certified runners) their quality and skill in runner production were still important points. If they were not adequate could be damaged strawberry plants.

### **5.3.2 Farming practice in runner production**

In general, runner production in upland is better quality than in lowland because temperature in the upland areas is lower temperature. Moreover, photoperiod is shorter than in the lowland. Both factors can initiate more bud formation than the low land. Besides these factors, farming practice is a factor to improve quality of runners. Farming practices are explained below consisting of soil and land preparation, planting, fertilizer application, watering, plant protection, propagation, harvesting and cutting. Moreover,

these farming practices pointed out the difference of between both virus-free and normal systems.

#### **5.3.2.1 Soil preparation**

Pre-planting period is an important to need for management with soil preparation. In the per-planting period, about 88% of the RNS farmers prepared soil by applying manure with the averaged at about 420 kg per rai. About 41% of this farmer group applied lime for preparing soil.

On the other hand, in the pre-planting period, 94% of the RVFS farmers applied the manure or green manure about 400-500 kg per rai. 70% of this group of farmers used lime for improving soil structure

#### **5.3.2.1 Propagation**

As explained in above, propagation is accomplished by means of runner plants. The slender runner systems in contact with soil in suitable conditions take root at a node and from new plants. The propagation method of strawberry is called as running method. Media for propagation of runner is surface soil in the production areas. Some farmers may mix other media such as organic matters, sand and so on. When the daughter plants grow and run from the mother plants then the farmers will put them in the polyethylene plastic bags containing media.

A method of runner propagation is bare-root system. This method does not use plastic bags leading to save the cost of production. Moreover, it will lead to decrease soil resource utilization. According to Pipadtanawong (1998) said in Bare-root runner plant production of strawberries, each year runner has been produced about 30 millenium

plants. Each runner has to use soil of the upland about 100 per a plastic bag. Therefore, every year has soil resource utilization about 3,000 ton. This consequence has occurred for several years.

This propagation system should be transferred to the farmers. Otherwise, soil conservation and decreasing in cost, this system can control soil borne diseases and leading to develop root system well.

#### **5.3.2.3 Crown division**

The ability of crown division has difference depending on variety. Some varieties are seldom-prolific runner producers. This condition may be expected because the buds that form in the leaf axis often develop into flower clusters and sometime into branch crowns.

For examples of crown division from the survey in 1998 are shown in table 6.7. This information is estimated from runner production and then it is reported as average of crown division per a mother plant. On average, the numbers of runner production of P16 and P20 using VFS were 51 and 30 runners per a mother plant. As comparison with the production of NS, the numbers of runners of NS are less than VFS (table5.7). This result can be explained that according to Cameron (1986) reported that tissue cultured strawberry plants had more runners moreover they had greater truss and flower number, smaller fruit size, higher yield, and increased vigor compared to conventionally propagated plants.

Table 5.7 Average of crown division per a mother plant in each variety both VFS and NS.

Varity	Average of crown division per a mother plant (plants)	
	VFS	NS
P16	51	23
P20	30	17
P50	28	-
P70	35	-
Selva	25	-

Source: survey 1998

#### 5.3.2.4 Fertilizer application

In general, fertilizer used in the vegetative growth was nitrogen fertilizer as well as the runner production. Most farmers applied 15-15-15 fertilizer. Some farmers applied urea fertilizer. The quantity of fertilizer was applied as 20-30 g per plant or one hand full per 4 plants. Times for fertilizer application have difference depending on money in the bag of each farmer. The frequencies of fertilizer application are shown in table 5.8. The RVFS farmers applied fertilizer about 2 or 4 times in a season. The RNS farmers applied fertilizer about 2 or 3 or 4 time a season. There were 2 methods of fertilizer application in among RVFS farmer that were scatter and drop methods. The RNS farmers applied 3 methods in fertilizer application. The percentage of application of each method is shown in table 5.9.

Table 5.8 The frequencies of fertilizer application in VFS and NS

Times for fertilizer Application	VFS		NS	
	Freq.	Percent (%)	Freq.	Percent (%)
2	10	66.7	2	57.0
3	0	0	3	11.8
4	5	33.3	4	41.2

Source: survey 1998

Table 5.9 The methods of fertilizer application for runner production.

Method of fertilizer application	VFS		NS	
	Freq.	Percent (%)	Freq.	Percent (%)
Scatter	8	53.3	12	70.6
Drop	7	4.7	5	29.4

Source: survey 1998

### 5.3.2.5 Watering

Most farmers use water supply from rainfall in late of cultivating season. The other period, the farmers use water supply from water source such as natural and artificial pones. These water supplies have to use irrigation system in order to support for production. The irregation systems, which were worked by the RVFS farmers, were soaked and sprinkler irritations as 6.7% and 93.3% respectively. As well as the RNS farmers, these irrigation systems are used; soaked and sprinkler irrigation used were 23.5% and 76.5% respectively.



### 5.3.2.6 Plant protection

The chemical use was a necessary in order to protect the plant. The chemical use gets rid of the enemies of plant such as pathogens and pests. The frequencies of chemical application depend on virulence of diseases. The RVFS farmers applied 2 and 4 times a month in chemical application as well as the RNS farmers (Table 5.10.). Most farmers applied Furadan--chemical for preventing soil borne diseases using in the pre-planting.

Table 5.10 Chemical use in the runner production of VFS and NS

Chemical Use	VFS		NS	
	Freq.	Percent (%)	Freq.	Percent (%)
2	5	33.4	4	23.5
3	-	-	2	11.8
4	10	66.6	11	64.7

Source: Survey 1998

### 5.3.2.7 Weeding

The weeding methods were used such as herbicide use and hand weeding. Mostly, the farmers applied herbicide use in pre-planting period. In vegetative growth period, the farmers use hand-weeding method because it is not harmful to plants like herbicide use.