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## **Additional Findings Nutrition or Growth Regulator Through The Root and Foliar for Hac Tri Persimmon in Phu Tho, Vietnam**

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Persimmon (*Diospyros kaki* Lim) is a perennial fruit crops, nutritional and economic value and medical significance. Vietnam has a lot of native genetic persimmon resources, including Hac Tri one. Hac Tri persimmon is an indigenous precious genetic resource of Phutho province, Vietnam. However, its quality is being degenerated due to the long applications of inappropriate cultivation techniques by local growers.

This study evaluated influences of different supplementary fertilization formulas on yield and quality of fruit of 8-10-year-old Hac Tri persimmon plants. Results showed that supplementary fertilization had positive effects on yield and yield components of the plants. Of which, fertilization of 50 kg of manure + 0.5 kg N + 0.3 kg P<sub>2</sub>O<sub>5</sub> + 0.5 kg K<sub>2</sub>O per tree significantly increased Brix degrees, dry matter content and sugar content of fruits; income reached 200 million VND per ha and profits rised over 10% compared to the controls.

Research results of supplementations of nutrients and growth regulators through foliar indicated that applications of foliar fertilizer and growth regulator products such as GA<sub>3</sub>, NAA, Super calcium and ecological garden SP significantly reduced fruit abscission, and increased harvesting fruit. Of the applied treatments, spraying GA<sub>3</sub> at concentrations of 40 ppm exhibited the most evident effect with net profit increased by 20% compared to the controls.

Based on results of studies of nutritional supplements, growth regulators through the roots and foliar, this research suggested two following fertilizing formulas that gave best effects to apply for Hac Tri persimmon:

Fertilizing through the root; 50 kg manure + 0.5 kg N + 0.3 kg P<sub>2</sub>O<sub>5</sub> + 0.5 kg K<sub>2</sub>O...

Spraying GA<sub>3</sub> at concentration of 40ppm twice for foliar: the first spraying is after blooming, the second time is after the first 7-10 days.

**Keywords:** persimmon, fertilizers, growth regulator, yield, quality

### **Introduction**

Hac Tri persimmon is one of the best valued genetic resources of Phutho province which is tall trees, grow well, seedless fruit, good forming, turning orange when being ripen, dark yellow flesh, eating crunchy, sweet cool, bland. Large fruit size, average fruit weight 85 - 95g, used rate is 82.73%, dry matter percentage 19.6%, ratio of sugar 13.9%, acid levels of

0.17%, and the rate of carotene 21.95 mg% dry matter. This variety has high yield, long economic cycle, some centenarian trees still being harvested. On the other hand, Hac Tri persimmon has a longer time of harvesting period than other varieties in the region. Therefore, this variety has become one of the famous fruits of Phu Tho province in particular and the North of Vietnam in general.

However, this variety has been degenerated for many reasons, in which the method of cultivation was the biggest issue. In the efforts to restore and improve that valued genetic resource, NOMAFSI has implemented the intergrated solutions, including: selecting original initial plants, building the collection of high quality of mother plants which can supply high quality seedlings for production, research on improving cultivation methods providing high yield, quality, and building the demonstration of applying intensive new cultivation methods. Regarding the area of this article, we will present one of the important parts in the intensive procedure, which is adding nutrition through root system, nutrition and plant growth regulator via leaf system in order to overcome fruit abscission, increase productivity, income and the sustainability of Hac Tri persimmon production in Phu Tho.

## **Methodology**

### ***Effects of different fertilizing formulas through root on growth yield and quality of Hac Tri persimmon***

8-year-old persimmon plants (var. Hac Tri) were treated with one of the 04 following fertilizing formulas:

+ T 1 (Control): As traditional method of local growers: Add 1 kg NPK (5:10:3) after harvesting <sup>(1)</sup>;

+ T 2: 50 kg manure + 0.5 kg N + 0.3 kg P<sub>2</sub>O<sub>5</sub> + 0.5 kg K<sub>2</sub>O<sup>(2)</sup>;

+ T 3: 50 kg manure + 0.2 kg N + 0.12 kg P<sub>2</sub>O<sub>5</sub> + 0.16 kg K<sub>2</sub>O<sup>(3)</sup>.

+ T 4: 30 kg bio-compost<sup>(4)</sup> 0.5 kg N + 0.3 kg P<sub>2</sub>O<sub>5</sub> + 0.5 kg K<sub>2</sub>O.

In the treatments T2, T3 and T4, fertilizers were applied for plants as follow:

#### Note:

(1): *Follow the result of persimmon genetic resources production status survey in the region.*

*Add 1 kg NPK (5:10:3) after harvesting.*

(2): *Procedure of [Phạm Văn Côn], Procedure for planting and care persimmon. Agriculture Publishing house, Ha Noi, 2004.*

(3): *According to the experience of farmers in North Korea.*

(4): *Bio-compost being produced by EM 2 Natural.*

The fertilizers were applied to roots of the plants. The experiment was performed in a completely randomized block design (RCBD) with 03

replicates. Data were collected as parameters of growth, yield and fruit quality

***Effects of foliar fertilizers and growth regulators on yield and quality of Hac Tri persimmon***

One of the 04 following solutions was persistently sprayed for 8-year-old persimmon plants (var. Hac Tri)

- + Control: fresh water;
- + GA<sub>3</sub> concentration 40 ppm;
- + NAA, concentration 10 ppm;
- + Super Calci 20S, concentration 0.5%;
- + Vuon sinh thai ( a ecological garden product), concentration 0.55%

The foliar fertilizers and growth regulators were sprayed over foliar of plants.

The experiment was performed in a completely randomized block design (CRBD) with 03 replicates. Data were then collected as parameters of growth, yield and fruit quality.

**Results**

***Effects of adding fertilizers through root on growth, yield and quality of Hac Tri persimmon***

**Table 1.** Effects of different fertilizing formulas through root on growth and development of Hac Tri persimmon

Treatment	Bud bearing flower rate (%)	Shoot length (cm)	Shoot diameter (cm)	Number of leave (leaf)
T1(control)	37.78a <sup>1</sup>	14.70b	0.58b	4.90a
T 2	36.67a	17.03a	0.68a	5.30a
T 3	35.56a	15.10ab	0.62ab	5.07a
T 4	34.44a	15.03ab	0.60ab	5.03a
<i>LSD.05</i>	<i>16.93</i>	<i>2.18</i>	<i>0.09</i>	<i>0.99</i>
<i>CV%</i>	<i>23.5</i>	<i>7.2</i>	<i>9.8</i>	<i>7.5</i>

<sup>1</sup>Mean of 03 replicates. For each parameter, the same letters are not significantly different among treatments based on Duncan's multiple range tests at P = 0.05

As shown in the Table 3, only plants that were fertilized with 50 kg manure + 0.5 kg N + 0.3 kg P<sub>2</sub>O<sub>5</sub> + 0.5 kg K<sub>2</sub>O increased size of shoot significantly as compared to those of the controls. The other adding fertilizing formulas did not give significant effects on size of shoots of the testing plants. In addition, there was no significant difference in bud bearing flower rates or number of leave among the treatments.

***Effects of different fertilizing formulas on yield and quality of fruit***

Generally, fruit abscission happens widely in many fruit plants, especially in persimmon. It has been a large number of studies showing the reasons leading to and finding ways to reduce that problem. Many research showed that nutrition crisis in the flowering and fruit setting period is one of the reason. Therefore, we evaluated the effects of different fertilizing methods on fruit abscission rate of Hac Tri persimmon, and the results are presented in table 2 below:

**Table 2.** Effects of different fertilizing formulas on fruit abscission and harvested rates of Hac Tri persimmon

Treatments	Fruit abscission rate (%)			Harvested fruit (%)
	15 days	30 days	45 days	
T 1(control)	20.33b	30.50b	45.57b	21.56b
T <sub>2</sub>	21.60ab	31.65ab	45.10b	25.85a
T <sub>3</sub>	23.87a	35.80a	53.63a	23.77ab
T <sub>4</sub>	20.23b	30.35b	43.87b	25.15a
<i>LSD.05</i>	<i>3.44</i>	<i>4.79</i>	<i>6.66</i>	<i>3.51</i>
<i>CV%</i>	<i>8.0</i>	<i>7.5</i>	<i>7.1</i>	<i>7.3</i>

Hac Tri persimmon has highest fruit abscission rate in the time right after flowering. In this period, fruit abscission rate was highest when plants were fertilized with 50 kg manure + 0.2 kg N + 0.12 kg P<sub>2</sub>O<sub>5</sub> + 0.16 kg K<sub>2</sub>O (T 3). Other treatments were not significantly different comparing the control. Meanwhile, plants fertilized with 50 kg manure + 0.5 kg N + 0.3 kg P<sub>2</sub>O<sub>5</sub> + 0.5 kg K<sub>2</sub>O (T 2) gave with the highest rate of harvested fruit .

**Table 3.** Effects of different fertilizing formulas on yield and yield component factors of Hac Tri persimmon

Treatment	Fruit weight (g)	Number of fruit/tree (fruit)	Theoretical productivity (kg/tree)	Actual productivity (kg/tree)	Tăng so với đối chứng (%)
T 1(control)	87.95ab <sup>1</sup>	292.69a	24.67b	22.93b	-
T 2	94.52a	304.71a	28.83a	26.80a	16.87
T 3	85.54b	307.67a	26.15ab	24.32ab	06.05
T 4	90.91ab	304.22a	27.66ab	25.72ab	12.19
<i>LSD.05</i>	8.95	55.97	3.59	3.66	-
<i>CV%</i>	3.6	9.3	6.7	7.4	-

<sup>1</sup>Mean of 03 replicates. For each parameter, the same letters are not significantly different among treatments based on Duncan's multiple range tests at P = 0.05

The supplemental fertilizations for Hac Tri persimmon increased 6 – 17% yield fruit, compared to the control. However, according to Duncan's multiple range tests, only plants that were treated with 50 kg manure + 0.5 kg N + 0.3 kg P<sub>2</sub>O<sub>5</sub> + 0.5 kg K<sub>2</sub>O exhibited significantly higher productivity in comparing with the control plants. Although both organic and chemical fertilizers were used, no adding fertilizing formulas gave higher fruit weight and number of fruits than the control did.

**Table 4.** Effects of different fertilizing methods on chemical contents of Hac Tri fruit

Treatments	Brix	Dry matter content (%)	Total sugar (%)	Carotenes (mg/100g)	Tanin (%)
T 1(control)	20.05	18.71	13.31	0.41	0.35
T 2	21.79	19.69	14.81	0.42	0.36
T 3	21.03	19.37	13.64	0.41	0.36
T 4	20.14	19.02	13.46	0.40	0.35

The biochemical indicators analyzed in the lab showed that Brix, Dry matter and Sugar were highest in treatment 2. The results can be explained that the potassium content in added fertilizer was the good implement driving other nutrition from leave and other parts to fruit. However, doses of 02 fertilizing treatments were different, in which the treatment 2 with a higher dose of fertilizer gave best nutritional targets.

In conclusions, adding fertilizers with suitable amount could enhance the quality of fruit.

***Economic effect of the experimental treatments applying fertilizer dosage through roots***

**Table 5.** Economical effect of applications of different fertilizing formulas

Treatment	Yield (kg/tree)	Total income (1.000đ)		Input costs/ha (1000 đ)	Labour cost (1.000đ)	Interest/ha (1.000đ)	Interest compared with the control (1.000đ)
		For 1 tree	For 1 ha				
T 1(control)	22.93	687.9	226,990.5	1,650.0	22,000.0	203,340.5	-
T 2	26.80	803.9	265,280.4	23,388.8	22,000.0	219,891.7	16,551.2
T 3	24.32	729.5	240,732.4	16,944.8	22,000.0	201,787.5	-1,553.0
T 4	25.72	771.7	254,665.6	41,250.0	22,000.0	191,415.6	-11,924.9

***Note:***

- *The above total income were calculated at the average selling price:30.000 VND/kg (approximately1.4 USD/kg)*
- *Collected data for 01ha with density of 330 trees / ha (distance 5m x 6m)*
- *Quantity and unit prices of raw materials, labor were calculated according to the actual number and unit costs at the time of researching..*

As shown in table 5, Hac Tri persimmon gave very high economic efficiency. However, the cultivation methods of the farmers underutilized its productive potential as well as its economic effect. The study results showed that: fertilization of 50 kg manure + 0.5 kg N + 0.3 kg P<sub>2</sub>O<sub>5</sub> + 0.5 kg K<sub>2</sub>O could give outperformed income compared with the farming practices of local growers. The treatment 4 gave higher yield compared with the control but its input costs were also higher, so that the economic efficiency is low.

The above economic tables were calculated based on the households who had to hire workers and purchase the entire quantity of manure. However, the incomes are potentially increased if the labor and organic fertilizer of households are available.

**Table 6. Effects of foliar fertilizers and growth regulators on growth and development of Hac Tri persimmon**

Treatment	Bud bearing rate (%)	Shoot length (cm)	Shoot diameter (cm)	Number of leaves (leaf)
Fresh water(control)	33.87a <sup>1</sup>	13.84b	0.52b	4.52b
GA <sub>3</sub>	35.12a	15.43a	0.55ab	4.80a
NAA	35.66a	14.94ab	0.64a	4.75ab
Super Calcium	34.65a	14.11b	0.51b	4.61ab
Vuon sinh thai	35.54a	14.25ab	0.52b	4.66ab
<i>LSD.05</i>	4.23	1.24	0.10	0.26
<i>CV%</i>	6.4	4.5	10.1	2.9

<sup>1</sup>Mean of 03 replicates. For each parameter, the same letters are not significantly different among treatments based on Duncan's multiple range tests at P = 0.05

As showing in the table 6, foliar fertilizers and growth regulators did not affect clearly to the bud bearing flower rate of Hac Tri persimmon plants. However, GA<sub>3</sub> clearly increased number of leaves on bud and the length of shoots. In the same way, NAA increased diameter of shoots. Meanwhile, Super Calcium and Vuon sinh thai products did not cause significant effects on any measured parameters.

**Table 7.** Effects of foliar fertilizers and growth regulators on fruit abscission and harvested rates of Hac Tri persimmon

Treatments	Rate of fruit drop after			Harvest rate (%)
	15 days	30 days	45 days	
Fresh water(control)	22.64 <sup>a</sup>	34.35 <sup>a</sup>	50.46 <sup>a</sup>	23.64 <sup>b</sup>
GA <sub>3</sub>	19.76 <sup>b</sup>	28.84 <sup>b</sup>	45.71 <sup>b</sup>	26.49 <sup>a</sup>
NAA	20.63 <sup>ab</sup>	30.38 <sup>ab</sup>	49.57 <sup>ab</sup>	24.82 <sup>ab</sup>
Super Calcium	21.67 <sup>ab</sup>	31.71 <sup>ab</sup>	49.81 <sup>ab</sup>	24.29 <sup>b</sup>
Vuon sinh thai	20.76 <sup>ab</sup>	31.48 <sup>ab</sup>	49.73 <sup>ab</sup>	24.35 <sup>b</sup>
<i>LSD</i> <sub>05</sub>	2.83	5.19	4.74	3.7
<i>CV</i> %	7.1	8.8	5.1	5.4

For persimmon, fruit drop after flowering remnants are very important criteria, the proportion for harvest and yields will be significantly improved if we can overcome this situation. The results of monitoring rate of fruit drop after flowering and the harvested rate of Hac Tri persimmon are showing in Table 7.

The testing foliar fertilizers and growth regulators had positive influences to help curb fruit abscission, increase the proportion of harvested fruit. These results are explained based on the effects of physiological limitations in forming removable floors of the fruit stalk experimental elements. Of these, spraying GA<sub>3</sub> gave the most pronounced effect.



**Table 8.** Effects of foliar fertilizers and growth regulators on yield and quality of Hac Tri persimmon fruit

Treatment	Fruit weight (g/fruit)	No. of fruit/tree (fruit)	Theory yield (kg/tree)	NET yield (kg/tree)	Tăng so với đối chứng (%)
Fresh water (control)	88.71 <sup>a</sup>	294 <sup>b</sup>	26.13 <sup>b</sup>	23.62 <sup>b</sup>	-
GA <sub>3</sub>	90.58 <sup>a</sup>	326 <sup>a</sup>	29.52 <sup>a</sup>	26.08 <sup>a</sup>	10.41
NAA	91.38 <sup>a</sup>	317 <sup>ab</sup>	28.92 <sup>ab</sup>	25.53 <sup>ab</sup>	08.09
Super Calcium	89.52 <sup>a</sup>	297 <sup>b</sup>	26.65 <sup>ab</sup>	24,71 <sup>ab</sup>	04.60
Vuon sinh thai	91.37 <sup>a</sup>	300 <sup>ab</sup>	27.39 <sup>ab</sup>	24.87 <sup>ab</sup>	05.29
<i>LSD.05</i>	4.36	28.61	2.88	1.79	-
<i>CV%</i>	2.6	5.0	5.5	3.8	-

As showing in the table 8, fruit weights were relatively uneven results in all treatments, and had no differences compared to the control. Plants treated with GA<sub>3</sub> had the highest number of fruits per tree, which was clearly different from those treated with fresh water (control) and Vuon sinh thai. Thus, using GA<sub>3</sub> 40ppm was more effective than testing products in increasing fruit productivity of Hac Tri persimmon in Phu Tho.

**Table 9.** Effects of foliar fertilizers and growth regulators on chemical contents of Hac Tri persimmon fruit

Treatment	Brix	Dry matter content (%)	Total sugar (%)	Carotenes (mg/100g)	Tanin (%)
1(control)	21.15	19.31	13.25	0.40	0.35
2	21.39	19.39	13.43	0.42	0.36
3	21.35	19.07	13.36	0,41	0.36
4	21.47	19.14	13.50	0.40	0.35
5	21.32	18.22	13.62	0.41	0.35

Comparison of quantitative indicators, it was found: There was no obvious difference between experimental treatments and the controls. In other

words, the testing foliar fertilizers and growth regulators did not affect chemical contents of Hac Tri persimmon fruit.

**Table 10.** Economic effect of applications of foliar fertilizers and growth regulators

CT	Yield (kg/tree)	Total income (1.000đ)		Input/ha (1000 đ)	Labour (1.000đ)	Interest/ha (1.000đ)	Interest increase compared with the control (1.000đ)
		For 1 tree	for 1ha				
1(control)	23.62	826.8	272,849.9	-	22,000.0	250,849.9	-
2	26.08	912.9	301,256.8	800,0	22,640.0	277,816.8	26,967
3	25.53	893.7	294,915.1	800,0	22,640.0	271,475.1	20,625
4	24.71	864.8	285,388.9	800,0	22,640.0	261,948.9	11,099
5	24.87	870.5	287,281.0	800,0	22,640.0	263,841.0	12,991

In terms of economic efficiency, applications of all testing foliar fertilizers and growth regulators gave higher net income and interest than traditional cultivation methods. Of which, spraying GA3 gave superior economic performance with net profit increased compared with controls: 26.967 million VND / ha / year.

In these technical measures, the costs incurred for raw materials and labor was not too much, it is important that the gardener needs to pay attention to the fields to know the right time of spraying to achieve optimum efficiency.

In conclusions, supplemental fertilizations through roots and spraying of growth regulators foliar fertilizers through foliar via tended to increase yield and quality of Hac Tri persimmon. Moreover, these techniques significantly increased the net profit. Basing on these results, we recommend applying two following techniques for increasing yield, quality and profit of cultivating Hac Tri persimmon in Phu Tho:

- Fertilization through root: 50 kg of manure + 0.5 kg N + 0.3 kg P2O5 + 0.5 kg K2O.

- Spraying GA3 concentration 40ppm twice: first spray after blooming, the second after the first 7-10 days

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