Studies on the Resistance of Mulberry against Tetranychid Mites (I)

Relation between the Amount of Protein and Glucose contained in the leaves of Mulberry and the Difference among the Varieties of Mulberry on the infestation of Tetranychid Mite.

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INTRODUCTION

Many references can be found about the studies concerning to the resistance within the varieties against injurious insects.

For example, as for, European red mite, *Panonychus ulmi*, and Two spotted spider mite, *Tetranychus telarius*, there are reports from Blair & Groves(1952), Chapman et al. (1952), Garman(1921, 1923), Hey(1944), Kuenen(1946), Lewis(1945), Lienk et al. (1956), Moli(1956) and Newcomer & Yother(1929), while Fleschner(1952) reported the difference of resistance among the varieties of orange trees against citrus red mite, *Panonyhus citri*.

Kuwayama(1928, 1938) and other Japanese entomologists reported the difference of resistance among the varieties of soybean against *Leguminivora glycivora*(Matsumura), and about the resistance of rice plant applied with silicic acid against the injurious insects, we can find the reports from Sasamoto(1959).

Osakabe(1959) reported the difference among the varieties of tea plant against the damage of tea red spider mite, *Tetranychus kanzawai*.

In Korea, we have experienced the severe damage of European red mite, *Panonychus ulmi*, two spotted spider mite, *Tetranychus telarius*, pacificus mite, *Tetranychus pacificus* and clover mite, *Bryobia praetiosa* against the apple trees.

Recently, we found the damage of tetranychid mite on mulberry, and considering the upcoming damages in future, we planed the studies on resistance of mulberry against these plant-feeding mites, first got some results of studies on the difference of the damage of tetranychid mite among the varieties of mulberry and on the amount of protein and glucose contain in the leaf of mulberry and here we report it.

About the tetranychid mite damage on the mulberry, Lee, one of the authors, reported 5 varieties at the committee of Zoological Society of Korea in Nov. 1961; *Panonychus ulmi*, *Tetranychus telarius*, *Eotetranychus suginamensis*, *Brevipalpus ovobatus*, and *Tenuipalpus japonicus*.

But other reports concerning the mites of mulberry can be found in Korea.

METHOD OF STUDYING

SETTING THE PLOTS-The mulberry specimen farm of Sericultural Experimental Station in Chinchoo, Kyungnam and that of Sangchoo, Kyungpook

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were selected as the investigating plots, along with the idea that the two plots mentioned had relatively many varieties of mulberry and its environments were equal. So, they were the fittest plots for this study. At the plot in Chinchoo, total of 150 varieties of mulberries, 5 trees per each variety in a small block approximately 2 square meters, were planted and the east and southward fence was consist of trifoliate orange trees almost as high as the mulberries mentioned and other high trees took no part. In Chinchoo, at the first time of investigation carried out on July 29~31, 1963, the lengh of twigs was around 120 cm and there was almost no difference among the varieties. The second investigation was held on August 19~21, 1963 and the standard length of twigs increased to 160 cm. At the Sangchoo, total of 65 varieties were placed in 2 files across the east and west bound, and number of each variety and the area that each variety took was almost the same as that of Chinchoo. The environment of specimen farm also was almost the same. And the investigation was held on August 29~31, 1963 in Sangchoo.

SAMPLING–In the two plots above mentioned, 30 leaves per one variety, one fifth below the leaf at tip were picked by random sampling method and by dissecting microscope the number of larvae and adults of Tetranychid mite was counted.

In the leaves from Sangchoo, we could find only *Tetranycus telarius* while in those from Chinchoo, at the first investigation *Panonychus citri* was dominant and at the second investigation *Tetranychus telarius* was dominant. The others except these two varieties, took so little a part that were excluded from invstigation. So the "Tetranychid Mite" indicates the two varieties mentioned. In all the two plot, not any kind of chemicals were used until the investigation and the mulberries on both plots were cultured accoding to the guidance of each Experimental Station, and the area of both plots were cleaned that almost no weeds could be found.

ANALYTICAL TECHNIQUES

DETERMINATION OF GLUCOSE—Grinding 5 g of fresh samples with 0.5 g Na_2CO_3 and some of sea sand dipping with some distilled water, wash into 100 ml-mesh flask. Heated for 5 minutes at 80°C in water bath, let it stand for 30 minutes and heated again for 5 minutes. On the next day fill up to menicus with distilled water and then heated for 5 minutes at 80°C in water bath. After cooling to room temperature, filter it.

REMOVAL OF PROTEIN—5 ml filtrate is mixed with 40 ml of protein-removing-solution and 5 ml 1/N-NaOH solution, shake it and filter. This filtrate is used for determination of glucose by micromethod of Hagedorn-jensen.

DETERMINATION OF CRUDE PROTEIN—Digestign 0.3 g of dry sample with 10 ml c-H_2SO_4 and 2 g of catalystm selenium mixture, replace on the Wagner-Parnas apparatus and determine nitrogen with N/10-NaOH solution, as this used modified method of Micro-Kjhld.

RESULTS AND DISCUSSION

THE DISTRIBUTION TYPES OF TETRANYCHID MITE IN THE MULBERRY FARM—On Fig. 1-a, b, c, the number of insects damaging among the range of varieties is shown by means of dots on the ground plan of plot to pick out the distribution types of Tetranychid mite per each plot. At the time of first investigation(July 29~31), only some varieties planted along the fringe were damaged and others were not.

Only 28 varieties among 150 were damaged by more than one mite in the 30 elaves, and the varieties most extremely damaged were as follows.

On the base of above facts, it can be assured that the Tetranychid mite does not be distributed equally within the varieties in mulberry specimen farm.

Table 1. The frequency numbers of distribution of the adults of Tetranychid mites at the mulberry orchards and the results tested the type of distribution

	Chinchoo 31-VII, 1963		Chinchoo 21-VIII, 1963		Sangchoo 31-VIII, 1963	
	O.	T.	O.	T.	O.	T.
0	111	105.0	91	90.26	40	42.3
1	32	36.7	26	31.69	19	19.3
2	3	6.4	10	14.18	3	4.6
3	0	0.7	8	7.32	2	1.3
4	1	0.0	6	3.01		
5	1		3	1.78		
6	1		1	0.50		
n	149	148.8	145	148.74	65	67.5
Type of Distribution		poisson		polyá-Eggenberger		poisson
X^2 test		$Pr\{X^2 \geqq 9.21^{**}\} = 1\%$		$Pr\{X^2 \geqq 6.60^{**}\} = 1\%$		$Pr\{X^2 \geqq 3.02^{**}\} = 1\%$

** Significant at the 1% level.

STRAIN OF MULBERRY VARIETIES AND THE INFESTATION OF TETRANYCHID MITE —Many varieties of mulberry are cultured recently in the Sericulural Experiment Station of each district of our country. But a most of them are originated from bombycis strain, Lhou strain and alba strain. So, on the purpose of our study, all the varieties in each plot were divided into the three varieties above mentioned, and the number of varieties attacked were counted and Table 2 shows it. By the result of first investigation in Chinchoo. 28 of all 150 varieties were attacked by the Tetranychid mite and among that 28 varieties 9 were bombycis strain, 4 were Lhoustrain and 3 were alba strain And the result of the second inves tigation shows that among 150 varieties 146 attacked 26 were bombycis strain among 28 strain, 27 were Lhou strain among its 29, and were alba strain among 21 its strain. The result of Sangchoo investigation shows that all the 65 varieties were sttacked.

Table 2. The number of damaged varieties of 3 strains of mulberry in each plot(1963). The figures showed in each parenthesis indicate the number of varieties belonging to each strain of mulberry.

Localities and dates observed	No. of Varieties observed	No. of varieties injured				Total
		bombycis strain	Lhou strain	alba strain	unknown strain	
Chinchoo 31-VII	150	9(28)	4(29)	3(22)	12(21)	28(150)
Chinchoo 21-VIII	150	26(28)	27(29)	22(22)	21(21)	146(150)
Sangchoo 31-VIII	65	12(12)	17(17)	16(16)	20(20)	65(65)

What notably startle us is the fact that in Chinchoo the trees were much attacked by the *Panonychus citri*, while in Sangchoo the same species could not be found except *Tetranychus telarius*. The cause of this fact is considered to be the geographical environment and the exact cause is yet to be studied since there is no special evident report except the fact that relatively *Panonychus citri* are found in the southern part of Korea (Taegu contained). To pick out the difference among the 3 strains of mulberry varieties on the damage of Tetranychid mite, the mulberry varieties were divided into 3 strains and at each strain the number of Tetranychid mite was counted per each variety and was tested by the method of analysis of variance of 3 groups(Table 3 shows this). All the sources used for this were from the result of second investigation of the plot in Chinchoo, which was damaged by the most number of Tetranychid mite. As Table 3 shows, between the 3 strains, bombycis, Lhou and alba, "F"being 5.038, so they signified at the 1% level and between alba strain and bombycis strain, the "F" being 39.78, also they signified at the 1% level. Between Lhou and alba strain, they did not signified at all.

Summing up these, we can find out that the

strain which has the most damaging ratio is bombycis strain and the next is Lhou strain and alba strain has the least damaging ratio.

Table 3. **The statistical tables of the differences of infestation by the Tetrauychid mite among the 3 strains of Mulberry** (1963).

a. Between the strains, bombycis Lhou and alba

Source of Variation	Sum of Square	Degrees of Freedom	Mean Square	F.
Between the strain	8476.23	2	4238.12	$F=\frac{4238.12}{841.19}=5.038^{**}$
Within the strain	47947.7	57	841.19	F. 99(2.59) 4.49
Total	56423.93	59		

b. Between the strains of alba and bombycis

Between the strain	23525.84	1	23525.84	$F=\frac{23525.84}{591.33}=39.78^{**}$
Within the strain	22470.54	38	591.33	F. 99(1.38) 7.31
Total	45996.38	39		

c. Between the strains of alba and Lhou

Between the strain	176.4	1	176.4	$F=\frac{176.4}{618.86}=0.285$
Within the strain	33516.5	38	618.86	F. 96(1.38) 4.08
Total	33692.9	39		

** Significant at the 1% level.

THE INFESTATION OF TETRANY CHID MITE AGAINST THE RECOMMENDED VAR IETIES—The recommended varieties, in recent days, of mulberry in Korea are Sipyung(市平) Keryang-suban(改良鼠返), Lhou-sang(魯桑), Done (島內), Suwon-No. 4(水原4號), Suwon-taeyab(水原大葉) and Iljire (一之瀨). Almost all the varieties of these have been the kinds which were relatively much damaged from Tetranychid mite but Suwon-taeyab(水原大葉) has not so much.

RELATION BETWEEN THE AMOUNT OF PROTEIN AND GLUCOSE CONTAINED AND THE DAMAGE OF TETRANYCHID MITE.—Many reports can be found concerning the relation between the resistance of tree against the injurious insects and the ingredient of the leaf which is a chemical mechanism of resistance. For example, Rodriguez (1951, 1958), Rodriguez et al. (1952), Fritzsche et al. (1957) reported the relation between the *Tetranychus telarius* & *Panonychus ulmi* and the N, P, K, Ca, Mg, S, Si, B, glutamine, glutamine acid, glucose and Vitamine B in the leaf of apple trees. The report that the varieties that contain N and glucose in the leaf of soybean were much more damaged by *Tetranychus telarius* was made from Fritzsche et al.(1957). Breukel & Post(1959) reported that that the leaf of apple trees which contains much "N" were damaged by *Tetranychus telarius* very much.

To find out what kind of relation exist between the varieties of much damaged and less damaged on the amount of protein and glucose, the authors, analysised the amount of protein and glucose in the leaves of the 2 groups above mentioned taken at every time of investigation. The relation of it is showned on Table 4.

Table 4. The comparison of the amount of protein and glucose between the heavily damaged varieties and the less damaged varieties by Tetranychid mites and the number of Tetranychid mite damaging the 30 leaves of each varieties(1963).

		Varieties	No. of Mite (per 30 leaves)	protein %	glucose %
31-Ⅶ. Chinchoo	Varieties, heavily infested	Hwajo-joseng	64	35.53	0.388
		Suwan-No. 1	24	34.51	1.226
		Whan-sang	22	29.27	1.540
		Idu-joseng	110	28.10	0.842
		Samduck-Rosang	600	39.58	1.046
	Varieties, none infested	Ilijre	—	34.17	0.794
		Suwan-Taeyop	—	37.07	1.280
		Daho-joseng	—	34.94	1.000
		Itaene-No. 1	—	45.91	1.460
		Kyobe	—	31.84	0.230
		Taeyop-Sipmunja			
21-Ⅷ. Chinchoo	Varieties, heavily infested	Hwajo-joseng	29	19.94	0.968
		Suwan-No. 1	121	20.75	1.018
		Whan-sang	76	21.38	0.972
		Idu-joseng	138	20.88	1.050
		Samduck-rosang	66	22.06	1.026
		No. 13 (Ae)	230	15.19	1.156
		Keryang-chujan	212	19.44	0.618
		Silyu-sang	272	21.31	1.086
		Juckmok-sipung	192	20.88	0.400
		Palchung-sipung	222	20.69	1.026
	Varieties, none or lightly infested	Iljire	10	19.94	0.454
		Suwan-taeyop	10	21.31	0.554
		Daho-joseng	10	18.19	0.508
		Itaene-No. 1	10	23.06	0.804
		Kyobe			
		Taeyop-sipmunja	10	22.63	0.918
		Kumun-young	10	23.44	0.834
		Sin-sun	—	20.75	0.536
		Lock-sang	—	23.06	0.454
		Bitan-sang	—	14.75	1.150
		Sabang-sak	—	19.94	0.868
31-Ⅷ. Sangchoo	Varieties, heavily infested	Suwan-No. 1	44	26.75	0.898
		Keryang-suban	74	27.31	0.758
		Pillipine-No. 1	40	24.75	0.874
		Wonju-kojo	42	24.75	0.924
		Suwhak-No. 1	76	28.31	0.816
	Varieties, lightly infested	Samduck	2	24.75	1.064
		Yuchun 4	4	25.88	0.930
		Taeka-choung	2	25.88	0.956
		Keyup-joseng	2	24.75	0.608
		Hung-pyung 2	2	24.19	0.536

What was summarized from Table 4 and the test of the comparison between the 2 groups is shown Table 5. In the first investigation of Chinchoo and Sangchoo. both protein and glucose did not signified at all but in the second investigation of Chinchoo, glucose only signified at 5%.

Table 5. Mean of the amount of protein and glucose between heavily damaged varieties and less damaged varieties by Tetranychid mite, and test of its comparison between the two groups.

		31-Ⅶ, Chinchoo		21-Ⅷ, Chinchoo		31-Ⅷ, Sangchoo	
		Protein %	Glucose %	Protein %	Glucose %	Protein %	Glucose %
Variaties, heavily infested	M±sm	33.398±2.110	1.008±0.019	20.252±0.608	0.932±0.008	26.374	0.345 0.854±0.003
		4.729	0.431	1.922	0.262	0.766	0.067
Variaties, none or heavily infested	M±sm	36.786±2.427	0.953±0.018	20.707±0.885	0.708±0.008	25.09±0.338	0.819±0.104
		5.427	0.406	2.799	0.252	0.756	0.234
Test		F=1.102	F=0.826	F=0.187	F=4.827*	F=2.67	F=2.161

*Significant at the 5% level.

But it can't be determined assuredly that just according to this result, varieties of mulberry heavily attacked by Tetranychid mite contain much amount of glucose, since glucose contained in the leaves are apt to variate seasonally and by other various causes. So, authors feel more studies for the determined result of this are left.

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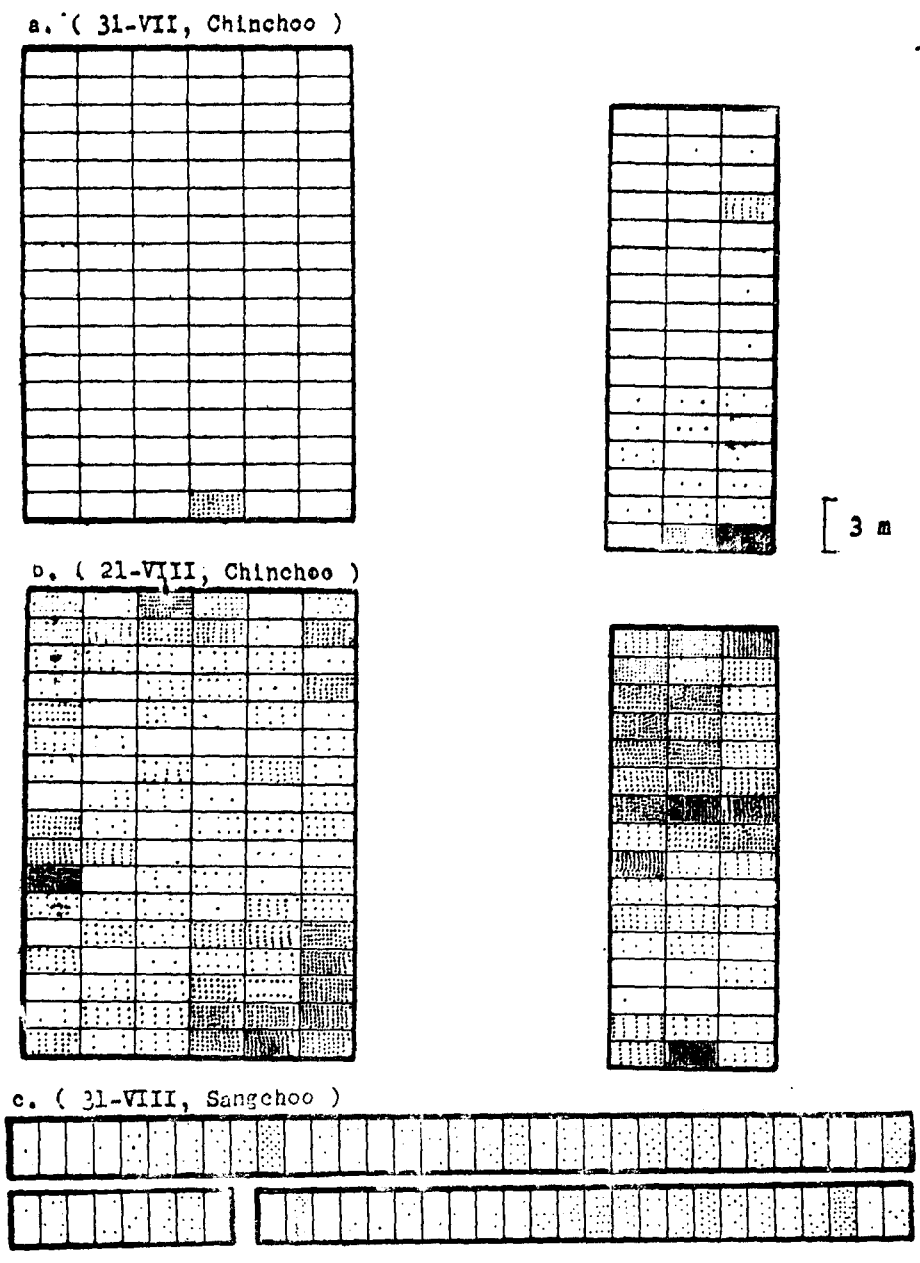

Fig. 1. — Positions and degrees of infestation by Tetranychid mites in specimen farm of mulberry. Small blocks within the farm indicate each variety of mulberry(1963)

摘　　要

Tetranychid Mite에 對한 뽕나무의 抵抗性에 關한 硏究 (I)

Tetranychid Mite에 對한 뽕나무의 品種間差異와 뽕나무잎의 Protein 및 還元糖 含量과의 關係

李 義 涼·韓 敎 弼

慶南 晋州蠶業試驗場과 慶北 尙州蠶業試驗場의 뽕나무 見本園을 調査區로 定하여 各時期마다 Tetranychid Mite의 寄生分布를 檢討한 結果는 發生初期에 있어서는 $X^2=9.21$로서 1%의 有意性을 나타내어 Poison 分布型이였고, 發生盛期에는 Polyá-Eggenberger 分布型에 더욱 잘 適合하였다. 即 $X^2=6.60$으로서 1%의 有意性이었다. 그리고 發生初인 7月 19~21日에는 晋州에서 150品種中에 28品種만이 寄生을 當하였고 發生盛期인 8月 19~21日에는 4 品種을 除外한 146品種에 寄生하였다. 또 晋州에는 Tetranychid Mite 中에 Panonychus citri가 相當數 寄生하였는데 反하여 尙州에는 Tetranychus telarius만이 寄生되어 있었다. 調査한 150 品種을 山桑, 魯桑, 白桑의 3系統別로의 寄生差異를 調査한 結果는 3系統間 差異의 分散分析의 F는 5.038로서 1%의 有意性이 있었고 또 山桑과 白桑間에는 역시 F=39.78로서 1%의 有意性이 있었다.

그러나 魯桑과 白桑間에는 有意性이 없었다. 다시 말하면 Tetranychid Mite의 寄生은 山桑이 가장 甚하고 다음이 魯桑이며 白桑이 가장 적은 편이었음을 알았다.

다음에 寄生이 甚한 品種과 적은 品種의 2群에 있어서의 Protein 및 glucose의 含量을 比較해 본 結果는 모두 다 有意性을 찾아 볼 수 없었으나 但是 發生盛期인 8月 19~21日 晋州 調査時에 Glucose에 대해서는 2群間에 5% 의 有意性이 있었다.

Hwajo-joseng(和助早生), Suwon-No. 1 (水原1號) Whan-sang(圓桑), Idu-joseng(伊豆早生), Samduck-rosang(三德魯桑), palkyo-ina(八橋伊那) and Sangsan-sipyung(上舟市平).

And at the time of the second investigation, it was the time of much damage(August 29~31), on 146 varieties except the 4 among 150 varieties. And the damage ratio increased very much and the varieties not damaged was as follows.

Sin-sun(新選), Lock-sang(綠桑), Bitan-sang(飛彈桑), and Sabang-sak(四方咲).

In Sangchoo, at the time of investigation(August 29~31), all the 65 varieties were damaged, and the varieties much damaged were Suwon No. 1(水原1號), Keryang-suban(改良再返), Pillipine No. 1 (필립핀 1號), Wonju-kojo(遠州高助) and Suwhak No. 1(收獲 1號).

Generally there were less damaged at the time of investigation at Sangchoo than et that of the second investigation at Chinchoo and damaged indiscriminately. Table 1 shows the distridution types of Tetranychid mite at the two plots on the bases of the results above made. The results of the first investigation in Chinchoo showed it just fitted at Poisson Distribution, and the chi-square value(X^2) being 9.21, it signified at the 1% level. And the second investigation's result signified at the 1% level. at Polya-Eggenberger Distribution rather than Poisson Distribution. The result of Sangchoo investigation fitted at the Poisson Distribution well, i. e. it signified at the 1% level with chi-square value(X^2) 3.02.

The fact that prior to the peak of the outbreak, the frequency curves of distribution of the eggs and larvae of the Common Cabbage butterfly were some what skew and allied to those of Poisson's or Poyá-Eggenberger's Distribution was also indicated by Matsuzawa, Okamoto & Kanamaru(1955).