# Experiment Summary of the Effect of Yongye Plant Nutrient on Tobacco

Soil and Fertilizer Station of Lichuan

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I. Purpose of Experiment

Regular field experiment in small plots is carried out to assess the yield-increasing effect of Yongye Plant Nutrient (general name: water soluble fertilizer containing humic acid; advertising name: Yongye Plant Nutrient; product name: plant growth nutrient solution) on tobacco under the natural field environment of Hubei Province, so as to provide scientific bases for registration and popularization and application of the product in large area.

II. Place of Experiment

The experiment was arranged at the tobacco field of Liu Xingjia, a farmer in Group 11, Laochang Village, Liangwu Township, Lichuan City, Hubei Province. The field, located at E 108: 49: 46.204 N 30: 16: 49. 934, is 1130m high in altitude. It boasts convenient transport conditions and flat terrain, requiring no irrigation. The village situates at the western end of Lichuan City, 10km away from the downtown and 1km away from the market town of Liangwu. It is a core tobacco plantation area of Lichuan and the farmer's family is also a large plantation family and scientific model family of the city. In the year, tobaccos planted by the family reach 102 mus.

The experiment land covers an area of 1.2 mus(1 mu ≈1/6 acres),in total. The soil belongs to the variety of mud soil, the local type of limestone mountain yellow brown loam, the subgroup of mountain yellow brown loam, the group of yellow brown loam evolved from limestone parent material. Such loam soil features medium and consistent fertility (see Table 8). The soil is a main soil variety of the city and a type of soil with relatively high fertility.

III. Design of Experiment

As required in the experimental program of the provincial soil and fertilizer station, the experiment has three processes and four replications, and plots are arranged randomly. The area of each plot: 2.2m×18m=39.6$m^2$ (see plot arrangement diagram). Each plot has two rows × 30 plants = 60 tobacco plants.

Process 1: Conventional fertilization + Yongye Plant Nutrient. Diluted by 500X, the solution was applied 100mL/mu each time, and it was sprayed four times during the whole period of growth, namely: during the recovering stage (5-7 days after transplantation), root spreading stage (25-30 days after transplantation), vigorous growing stage (40-45 days after transplantation), and ripening stage (15 days before the tip pruning of tobacco plants). The labeled nutrient contents of Yongye Plant Nutrient: humic acid ⩾ 50g/L, $N+P_2O_5+K_2O$ ⩾ 200g/L, and Mn+Zn+B+Mo ⩾ 10g/L.

Process 2: Conventional fertilization + equivalent clean water.

Process 3: conventional fertilization.

<table>
<tr><td></td><td colspan="3">Replication I</td><td colspan="3">Replication II</td><td></td></tr>
<tr><td rowspan="3">Protected row</td><td>Process 1</td><td>Process 2</td><td>Process 3</td><td>Process 2</td><td>Process 3</td><td>Process 1</td><td rowspan="3">Protected row</td></tr>
<tr><td>Process 3</td><td>Process 2</td><td>Process 1</td><td>Process 3</td><td>Process 1</td><td>Process 2</td></tr>
<tr><td colspan="3">Replication III</td><td colspan="3">Replication IV</td></tr>
</table>

Plot arrangement diagram of tobacco experiment field

**IV. Field Management**

1. Cultivation: the variety of tobacco is 20128 and the planting specification is 110cm×(). Plastic mulching cultivation is adopted, plastic films were mulched on May 11 and tobacco plants are transplanted on May 22.

2. Fertilization: The basic fertilizer is applied on May 10 through furrow dressing of 12% calcium superphosphate (40kg) + 10-10-20 special complex fertilizer (50kg) + 5% potassium sulphate (7.5kg) each mu; top dressing is carried on June 3 through hole application of 34% ammonium nitrate (5kg) + 50% potassium sulphate (10kg) + magnesium sulfate (7.5kg).

In Process 1, 500X Yongye Plant Nutrient was sprayed four times respectively on June 18 and 30, and July 10 and 22; in Process 2, equivalent clean water was sprayed; and in Process 3, no application was made.

3. Disease and insect control: pesticide was applied three times across the year. On May 20, beta-cypermethrin+phoxim (240mL/mu) was sprayed for controlling underground insects, and Propamocarb (100mL/mu) for controlling root rot before transplantation; on June 25, Bao Gong (150mL/mu) was sprayed for controlling pieris rapae; on July 10, Bao Gong (150mL/mu) was sprayed for controlling aphides and Flumetralin (50g/mu) for preventing tobacco leaves from splitting.

4. Earthing up and weeding: the experiment field was earthed up once on May 15 and no weeding was made due to plastic mulching.

5. Observation: According to the observation of Lei Bisheng, Director of Agricultural Service Center of Liangwu Township, and Liu Xingjia, the farmer engaged in the experiment, compared with Process 2 and 3, the spraying of 500X Yongye Plant Nutrient did not lead to obvious changes in the color and size of tobacco leaves and plant height. In Process 1, nonetheless, the row clearance was narrower than those in Process 2 and 3. The possible reason lies in the increased weight and extended length of tobacco leaves after the spraying of 500X Yongye Plant Nutrient. Upon harvesting, the leaves in Process 1 touched thicker.

6. Harvesting: Tobacco leaves were harvested as from August 16 and the harvesting was concluded on October 2. At the interval of about 8 days, tobacco leaves were harvested six times and the yield was computed in terms of fresh leaves and dry leaves.

**V. Result of Experiment**

1. Yield: Tobacco leaves were harvested six times and the yield was calculated respectively in terms of fresh leaves and dry leaves. See Table 1-2 for yield. As is shown in Table 3, 85kg fresh leaves were increased after the application of 500X Yongye Plant Nutrient on tobaccos compared with the spraying of equivalent clean water, up by 7.77%; the yield of dry leaves increased 17kg each mu, up by 10.43%. The yield of fresh leaves increased 117kg compared with conventional fertilization, up by 11.02%; and the yield of dry leaves increased 27kg, up by 17.65%.

Based on the variance analysis over the yield of dry leaves, there are significant differences between processes (see Table 4); with the verification based on new multiple range method, there are significant differences between the spraying of 500X Yongye Plant Nutrient and Process 2 and 3; whereas the difference between spraying of clean water and conventional fertilization is small (see Table 5). This fully indicates that spraying 500X Yongye Plant Nutrient may obviously increase yield compared with spraying clean water and conventional fertilization.

Table 1 Yields of fresh tobacco leaves in all processes at every time

Unit: kg

| Replication | I | | | II | | | III | | | IV | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Process | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9.4 | 8.0 | 7.9 | 7.9 | 7.6 | 5.9 | 10.5 | 5.8 | 8.6 | 9.3 | 7.2 | 7.5 |
| 2 | 9.6 | 8.5 | 6.7 | 7.2 | 7.0 | 6.8 | 6.3 | 8.5 | 6.3 | 7.8 | 7.9 | 6.6 |
| 3 | 10.2 | 10.3 | 10.1 | 11.6 | 12.3 | 13.6 | 13.4 | 12.1 | 10.2 | 11.8 | 11.6 | 11.3 |
| 4 | 11.7 | 10.9 | 10.8 | 13.5 | 11.2 | 10.5 | 11.9 | 11.2 | 12.4 | 12.4 | 11.2 | 11.2 |
| 5 | 15.6 | 14.9 | 13.7 | 12.8 | 12.9 | 12.7 | 15.3 | 13.1 | 14.3 | 13.4 | 12.7 | 11.7 |
| 6 | 13.9 | 13.1 | 13.4 | 15.4 | 15.1 | 14.1 | 13.8 | 12.5 | 12.1 | 15.3 | 14.3 | 14 |
| Total | 70.4 | 65.7 | 62.6 | 68.4 | 66.1 | 63.6 | 71.2 | 63.2 | 63.9 | 70.0 | 64.9 | 62.3 |
| Yield/mu | 1185 | 1106 | 1054 | 1152 | 1113 | 1071 | 1199 | 1064 | 1076 | 1215 | 1127 | 1082 |

Table 2 Yields of dry tobacco leaves in all processes at every time Unit: kg

| Replication | I | | | II | | | III | | | IV | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Process | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| 1 | 0.90 | 0.68 | 0.67 | 0.67 | 0.63 | 0.61 | 1.12 | 0.61 | 0.74 | 0.9 | 0.65 | 0.67 |
| 2 | 0.89 | 0.79 | 0.64 | 0.73 | 0.68 | 0.64 | 0.65 | 0.72 | 0.63 | 0.76 | 0.72 | 0.64 |
| 3 | 1.56 | 1.53 | 1.51 | 1.54 | 1.79 | 1.97 | 2.12 | 1.76 | 1.51 | 1.75 | 1.7 | 1.7 |
| 4 | 1.78 | 1.61 | 1.60 | 2.30 | 1.67 | 1.57 | 1.81 | 1.67 | 1.72 | 2 | 1.65 | 1.62 |
| 5 | 2.83 | 2.67 | 2.39 | 2.14 | 2.46 | 1.86 | 2.79 | 2.63 | 2.53 | 2.5 | 2.28 | 2.1 |
| 6 | 2.70 | 2.57 | 2.12 | 2.82 | 2.76 | 2.51 | 2.69 | 1.83 | 1.79 | 2.79 | 2.7 | 2.5 |
| Total | 10.7 | 9.85 | 8.93 | 10.2 | 9.99 | 9.16 | 11.2 | 9.22 | 8.92 | 10.7 | 9.70 | 9.23 |
| Yield/mu | 180 | 166 | 150 | 172 | 168 | 154 | 188 | 155 | 150 | 186 | 168 | 160 |

Table 3 Comparison of yields of tobacco leaves in the experiment Unit: kg

| Process | | Yield of fresh leaves | | | Yield of dry leaves | | |
|---|---|---|---|---|---|---|---|
| Replication | | 1 | 2 | 3 | 1 | 2 | 3 |
| Plot yield | I | *70.*4 | 65.7 | 62.6 | 10. 66 | *9.* 85 | 8.93 |
| | II | 68. 4 | 66. 1 | 63. 6 | 10. 20 | 9. 99 | 9.16 |
| | III | 71. 2 | 63. 2 | 63. 9 | 11. 18 | 9.22 | 8.92 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | IV | 70. 0 | 64. 9 | *62.* 3 | 10. 70 | 9.70 | 9.23 |
| | Average | *70.* 0 | 65. 0 | 63. 1 | 10. 69 | 9.69 | 9.06 |
| Yield/mu | | 1179 | 1094 | 1062 | 180 | 163 | 153 |
| Increased yield | Compared with Process 2 | 85 | - | - | 17 | - | - |
| | Compared with Process 3 | 117 | 32 | - | 27 | 10 | - |
| Rate of increase | Compared with Process 1 | 7. 77 | - | - | 10. 43 | - | - |
| | Compared with Process 3 | 11. 02 | 3.01 | - | 17. 65 | 6.54 | - |

Table 4 Result of variance analysis

| Source of variation | Degree of freedom | Quadratic sum | Mean square | F value | $F_{0.05}$ | $F_{0.01}$ |
|---|---|---|---|---|---|---|
| Process | 2 | 5.37 | 2.69 | 18.44** | 5.14 | 10. 92 |
| Replication | 3 | 0.02 | 0.01 | 0.04 | 4.76 | 9.78 |
| Error | 6 | 0.87 | 0.15 | | | |
| Total | 11 | 6.26 | | | | |

Table 5 Comparison of differences between all processes

| Process | Average value | Significance of difference | | P | SSR value | | LSR value | |
|---|---|---|---|---|---|---|---|---|
| | | 5% | 1% | | 0.05 | 0.01 | 0.05 | 0.01 |
| 1 | 10. 7 | a | A | 2 | 3.46 | 5.24 | 0.66 | 1. 00 |
| 2 | 9.7 | b | B | 3 | 3.58 | 5.51 | 0.68 | 1. 05 |
| 3 | 9.1 | b | B | Verification based on new multiple range method Sx=0.19 | | | | |

2. Change in output value: Suppose the unit price of dry tobaccos is RMB 15.00/kg, increased incomes per mu reach RMB 255 with the application of 500X Yongye Plant Nutrient compared with the spraying of equivalent clean water, and RMB 405 compared with conventional fertilization; the increased

incomes per mu reach RMB 150 with the application of clean water compared with conventional fertilization.

3. Change in output-input ratio: the retail price of 100mL Yongye Plant Nutrient in the city is RMB 14, and the solution was sprayed four times altogether, costing RMB 56. For spraying the Yongye Plant Nutrient, labor input was increased RMB 80, and altogether RMB 136 was increased. Compared with the spraying of equivalent clean water, the net incomes increased per mu reach RMB 119; and compared with conventional fertilization, the net incomes increased per mu reach RMB 269. the increased output-input ratio is 1:2.98.

4. Dry-wet ratio of tobacco leaves: From Table 6, we can see that there are regular changes in the dry-wet ratio of tobacco leaves between different harvesting periods, and the changes in each process are basically consistent, namely, the moisture content in tobacco leaves growing at the upper parts of plants and dry-wet ratio decrease with the transition of harvesting time. The average dry-wet ratio after the spraying of 500X Yongye Plant Nutrient is smaller than those in spraying clean water and conventional fertilization. This shows that 500X Yongye Plant Nutrient may better help the accumulation of dry matter in tobacco leaves.

Table 6 Comparison of plot yields of dry leaves and fresh leaves in all process of the tobacco field experiment at each harvesting period (weight of fresh leaves / weight of dry leaves)

| Process | Harvest 1 | Harvest 2 | Harvest 3 | Harvest 4 | Harvest 5 | Harvest 6 | Average |
|---|---|---|---|---|---|---|---|
| 1 | 10.3 | 10.2 | 6.7 | 6.3 | 5.4 | 5.5 | 6.6 |
| 2 | 11.1 | 11.0 | 6.8 | 6.7 | 5.6 | 5.3 | 6.7 |
| 3 | 11.1 | 10.4 | 6.8 | 6.9 | 6.6 | 5.6 | 7.0 |

5. Changes in plant characteristics: there was no change in the number of tobacco leaves in different processes; the leaf area and thickness were not measured. Harvesting personnel felt the leaves in Process 1 were thicker than those in Process 2 and 3. Visual inspection found no changes in leaf area. Based on Table 7, we can see that there are no obvious changes in the plant height in the three processes.

Table 7 Comparison of plant height in all processes of the tobacco field experiment (Unit: cm)

| Process | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 158 | 156 | 155 | 157 | 156 | 155 | 154 | 154 | 157 | 152 | 1555 |
| 2 | 154 | 158 | 153 | 160 | 152 | 155 | 160 | 153 | 155 | 151 | 1553 |
| 3 | 156 | 154 | 146 | 158 | 158 | 149 | 158 | 159 | 156 | 157 | 1554 |

6. Changes in soil nutrients: Based on the results of soil test in the experiment (Table 8), water-leached pH after the experiment increased in all processes compared with that before the experiment; the changes in brine-leached pH were irregular, but the changes were very small. There were no obvious

changes regarding organic matter in soil in all processes. Soil alkali-hydrolysis nitrogen, available phosphorus and available potassium all decreased and the decrease extent was almost the same in all processes. The influence of different processes in the experiment to nitrogen, phosphorus and potassium in soil as well as pH and organic matter did not show obvious differences.

Table 8 Soil nutrition in the field for experiment

| Process | | Organic matter (g/kg) | Alkali-hydrolysis N (mg/kg) | Available P (mg/kg) | Available K (mg/kg) | | |
|---|---|---|---|---|---|---|---|
| | | | | | | Water-leached | Brine-leached |
| 1 | Before experiment | *21.* 0 | 111 | 21 4 | 156. 3 | 5.90 | 4. 97 |
| | After experiment | 21. 4 | 103. 6 | 12. 3 | 138. 2 | 6.11 | 5.04 |
| 2 | Before experiment | 20.8 | 107 | *21.* 8 | 155. 7 | 5.71 | 5.25 |
| | After experiment | 20. 5 | 102. 9 | 25. 6 | 139. 8 | 5.92 | 5.20 |
| 3 | Before experiment | 20. 4 | 127 | 28. 6 | 160. 3 | 5.90 | 5.16 |
| | After experiment | 20. 6 | 118 | 25. 2 | 135. 7 | 6.15 | 5.10 |

VI. Conclusions

1. Good yield-increasing and incomes-increasing effects are achieved by spraying 500X Yongye Plant Nutrient on tobacco. Compared with spraying equivalent clean water, dry tobacco leaves increased 17kg/mu, up by 10.43%; incomes increased RMB 255/mu, and net output value RMB 119; the increased input-output ratio reached 1:4.55. Compared with conventional fertilization, dry tobacco leaves increased 27kg, up by 17.65%; incomes increased RMB 405, and net output value RMB 269; the increased input-output ratio reached 1: 2.98. Compared with conventional fertilization, by spraying equivalent clean water, dry tobacco leaves increased 10kg, up by 6.53%; incomes increased RMB 150, and net output value RMB 70; the increased input-output ratio reached 1: 1.88.

2. From the ratio between fresh and dry tobacco leaves, the main source increased yield lied in that spraying 500X Yongye Plant Nutrient contributed to the accumulation of dry matter in tobacco leaves, increased the leaf thickness and decreased moisture contents in fresh leaves. In the experiment, the leaf area and thickness were not measured. The measurement of plant height indicated that it had no influence to plant height to spray 500X Yongye Plant Nutrient.

3. Based on the results of soil test in the experiment, spraying 500X Yongye Plant Nutrient did not have obvious influence to NPK nutrients in soil as well

pH and organic matter, and the range of variation was almost the same as that in spraying equivalent clean and conventional fertilization.

4. It is recommended to have more experiments and demonstrations so as to provide more sufficient bases for the popularization and application of Yongye Plant Nutrient to tobacco.

November 11, 2010

Soil and Fertilizer Station of Lichuan