C H I N A

Potassium Improves Yield and Quality of Mulberry Leaves

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Mulberry leaves are the food of silk worms used in producing raw silk. The mulberry growing area in Zhejiang province, People's Republic of China, has expanded to more than 90,000 hectares as a result of high income opportunities from exporting silk products. Newly developed mulberry production is located mainly in river basin areas, on coarse textured soils with low fertility. In these soils, balanced fertilization is necessary to obtain high yield and good quality leaves.

Recent research shows potassium (K) has positive effects on yield and quality of mulberry leaves used as food for silkworms. Higher K rates appear profitable and deserve further study in field trials.

This report presents recent research results to show the effects of K on both yield and quality of mulberry leaves.

A field trial was conducted on a sandy clay soil derived from alluvial deposit with soil pH of 4.4, organic matter 3.6 percent, and readily available nitrogen (N), phosphorus (P) and K of 205, 44, and 78 parts per million (ppm), respectively.

Potassium treatments, applied as KCl, were: K_0, K_{45}, K_{90} and K_{135}, where subscript numbers indicate K_2O rates, kg/ha. An equal application of 310 kg N and 42 kg P_2O_5/ha was given to all treatments. All P, K and half of the N fertilizer were applied into the furrow between the rows, then covered with soil, on June 5, after pruning of the bushes. The remaining N was applied as topdressing on June 27.

A local mulberry variety, "Tong Xianqin", was used. Leaves were harvested from the first week in July until the first week of October when feeding by the autumn silk worm ended. On average, mulberry leaves were harvested every three days. Fresh leaf weight is reported in **Table 1.**

Potassium markedly increased fresh leaf yield and economic return. Data show that with K application rates of 45 and 135 kg K_2O/ha, total fresh leaf weight increased by 13.1 and 33.4 percent, respectively, compared to the unfertilized check plot. Respectively, the net economic benefit over the control was increased by 823 and 2,101 yuan/ha (US$1=approximately 8.5 yuan). The value:cost ratio (VCR) ranged from 11.7 to 13.7.

The 135 kg K_2O/ha rate on mulberry

TABLE 1. *Potassium improves yield and economic return of mulberry.*

K_2O treatment, kg/ha	Yield, kg fresh leaf/ha	Yield increase, kg/ha	Yield increase, %	K cost, yuan/ha	Net profit, yuan/ha	VCR
K_0	20,957	-	-	-	-	-
K_{45}	23,700	2,743	13.1	60	823	13.7
K_{90}	26,314	5,357	25.6	120	1,607	13.4
K_{135}	27,946	7,007	33.4	180	2,101	11.7

gave the highest net profit at a high VCR (11.7). This is consistent with findings from other crops and suggests the need for further increasing the rate of K fertilization on this type of soil, even though soil analysis did not indicate extreme K deficiency.

Table 2. *Potassium affects growth of mulberry plants.*

K_2O treatment, kg/ha	Number of branches/ plant	Height of branches, cm	Diameter of branch base, cm	Leaf area, cm^2	Dry weight of leaves, g
K_0	27	124.5	0.76	15.3	1.32
K_{45}	25	131.5	0.90	16.4	1.48
K_{90}	26	176.1	1.04	18.2	1.51
K_{135}	28	180.5	1.05	19.5	1.46

Potassium promoted the growth of mulberry plants. It was clearly observed that plants treated with K had more uniform growth and erect branches with bigger, fresher, green colored leaves. Data measured at the last harvest indicated that with K application branch height increased by 7 to 56 cm, branch diameter by 0.14 to 0.29 cm, number of leaves per branch by 4.5 to 16.5 (data not shown) and leaf area by 1.1 to 4.2 cm^2. Dry weight of leaves was also improved (**Table 2**). All these contributed to increasing yield.

Potassium also improved quality of mulberry leaves (**Table 3**). In newly matured leaves treated with 90 and 135 kg/ha K_2O, the K content increased by 60 and 80 percent, N by 10.9 and 12.1 percent and P by 8.3 and 16.7 percent, respectively. Calcium (Ca), sulfur (S) and boron (B) tended to increase also in comparison with the K_0 treatment, which demonstrates that balanced fertilization improves the use of nutrients by plants. High K content in leaves enhances production of protein (**Table 3**). In the K_{90} and K_{135} treatments, leaf protein content was 2.7 and 3.0 percent higher compared to the K_0 treatment, while total amino acids increased by 1.9 and 2.0 percent. Specific amino acids such as glutamic, glycine, alamine, valine and isoleucine appeared to be particularly responsive to additional K among those tested.

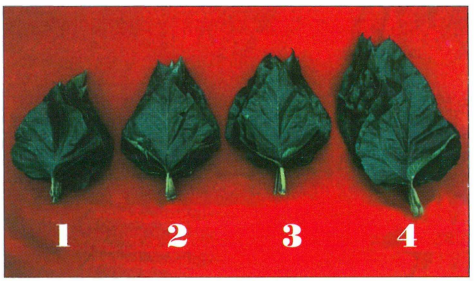
From results presented, it can be concluded that in coarse textured alluvial soils, increasing K fertilizer input is very profitable. The data also indicate that the level of 135 kg/ha K_2O may not be high enough and that additional rates should be tested to determine the maximum economic yield for mulberry leaves. Since silk production is currently a highly profitable agricultural business, there is urgency to obtain this information.

These data are consistent with results obtained in other crops. It appears that new field trials need to be estab-

Table 3. *Potassium affects quality of mulberry leaf (dry weight basis).*

K_2O, kg/ha	N	P	K	Ca	Mg	Zn	Fe	Mn	B	S	Amino acids, %	Protein, %
			%					ppm				
K_0	4.04	0.24	1.36	1.21	0.37	34	114	99	44	499	19.4	25.3
K_{45}	4.03	0.23	1.32	1.30	0.31	41	113	134	46	450	18.8	25.2
K_{90}	4.48	0.26	2.23	1.50	0.29	35	111	50	50	552	21.3	28.0
K_{135}	4.53	0.28	2.45	2.17	0.29	32	145	51	57	617	21.4	28.3

Note: Value of mulberry leaf is 0.3 yuan/kg; KCl cost is 0.8 yuan/kg (K_2O 1.33 yuan/kg).



MULBERRY LEAVES *show positive effects of increasing K_2O rates. From left to right; 1 (no K_2O), 2 (45 kg/ha K_2O), 3 (90 kg/ha K_2O), and 4 (135 kg/ha K_2O).*

lished with the various economic crops to establish the maximum economic rate for K_2O. BC

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MULBERRY PLANTS *shown at left did not receive K fertilization, while plants in photo at right were fertilized. In this research, rates up to 135 kg K_2O/ha were compared. Stems were thicker and stronger with K.*

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