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NUTRIENT REQUIREMENT SCREENING FOR CHINESE CABBAGE IN AN EAST TEXAS ACID, SANDY SOIL

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INTRODUCTION

The Asian population of the United States, including Texas, is increasing. By the year 2000, it is predicted that this segment will represent approximately 4% of the U.S. population. A population of 662,400 was estimated in Texas in 1985, with the majority residing in the Houston, San Antonio, and Dallas/Ft. Worth metropolitan areas. An estimated $31 million dollars were spent for oriental vegetables in food stores and restaurants in these metropolitan areas. These factors have created a demand for oriental vegetable production. Oriental vegetables have shown good potential in preliminary field trials at Overton, however, further plant nutrition experimentation was needed (1, 2). The objective of the experiment was to screen the effects of boron (B), calcium (Ca), potassium (K), magnesium (Mg), copper (Cu), molybdenum (Mo), phosphorus (P), sulfur (S), zinc (Zn), and iron (Fe) on the growth of Chinese cabbage (*Brassica rapa* L. Pekinensis) on a sandy East Texas soil.

MATERIALS AND METHODS

The indicator crop used in the glasshouse experiment was a hybrid Michili type Chinese cabbage, variety 'Monument'. A randomized complete block design with four replications was used. The elements, rates, and sources are presented in Table 1. Sources were selected to supply single nutrients except K and Mg which also supplied chloride. Experimental treatments consisted of a check (0) where no nutrients were incorporated, all nutrients incorporated at medium (1X) rates, and all nutrients at estimated high (2X) rates. In addition, each nutrient was tested individually at the 0 and 2X rates while the remaining nutrients were held constant at the 1X rate. Blanket nitrogen treatments equivalent to 40 lb/ac were applied at approximately 3-week intervals. These plant nutrients were incorporated in soil from the Ap (surface) horizon of the Darco series (loamy, siliceous, thermic, Grossarenic Paleudult). Initial soil test results showed a pH of 5.9, high levels of S, Fe, Zn, and Cu, medium levels of Ca, and low to very low levels of N, P, K, Mg, and B. The cabbage was seeded into pots containing the nutrient amended soil on 17 March 1989, and harvested approximately 70 days post planting on 25 May 1989.

RESULTS AND DISCUSSION

The analysis of yield, measured as head weight, showed response to 6 of the applied elements, including K, P, S, Zn, B, and Mo. Response was positive for K, P, S, and Zn, which indicates increasing yields with increasing application rates. Boron and Mo incorporation decreased yield. Regression analysis using variables which affected yields (significance level, $\alpha = 0.01$ by ANOVA) resulted in the following prediction equation which explained 63% of the variation in yield:

$$\hat{Y} = 41.49 + (4.73)S - (0.058)S^2 + (0.95)P - (0.0019)P^2 - (137.34)B + (61.74)B^2 + (16.51)Zn - (4.07)Zn^2 + (0.51)K$$

Table 2 presents the percent change in plant fresh weight due to applied plant nutrients compared to the yield of the check (0 rate). The first column shows a 323% increase in head weight over that of the check when all 10 elements were applied at the 1X rate, and a 433% increase with all elements applied at the 2X rate. Dramatic increases in plant weights occurred due to P and S fertilizers. The applied P rates of 50 and 100 lb/ac linearly increased yields, with the plants receiving the high rate having head weights 0.2 lb greater than at the 0 P rate. A rate calculated from the response curve showed 225 lb P/ac should give maximum production, although economics would dictate the P rate. This rate, although far beyond the experimental range of observations, is expected for soils containing very low levels of soil test P.

Application of S also increased head weights dramatically. Yields were increased approximately 0.2 lb with a calculated rate of 35 lb S/ac over that of the check (0 lb S/ac). Application of S rates greater than 35 lb/ac decreased yield. The increase in yield was unexpected as the soil test showed high S concentrations. This indicates a high requirement for S by the Chinese cabbage, although some of the S may have been leached from the pot during the course of the experiment, making it unavailable to the plant.

Plant response to K was linear, much like the P response. Within the range of observations, the high rate of K again increased head weights 0.2 lb over the yield from the 0 K rate. This implies relatively high K rates would be required to produce high cabbage yields, as long as they remained economically feasible.

Zinc was the only micronutrient that increased plant yields. The response curve showed an application of 1.75 lb Zn/ac was sufficient to reach maximum yields. A head weight increase of 0.04 lbs was gained with 1.75 lb/ac Zn over that of the Zn check. Yields dropped sharply as Zn rates were increased above this calculated rate. This yield increase to a relatively low application rate is most probably due to the high soil test levels of Zn which were available to the plant.

CONCLUSIONS

The inclusion of Chinese cabbage in a vegetable diversification may be a viable alternative. The plant responded positively to applications of P, S, K, and Zn. Regression analysis showed individually calculated rates of 225 lb P/ac, 35 lb S/ac, and 1.75 lb Zn/ac with overall N and K applications reached maximum yield. Negative yield responses to B and Mo were measured. Expanded investigation into field experiments with plant populations and intercropping along with market evaluations are needed.

Table 1. Rates and sources of selected nutrients incorporated into an East Texas sandy soil.[1]

Element	1X	2X	Source
	------lb/ac------		
B	1.00	2.00	Boric Acid
Ca	690.00	1380.00	Hydrated Lime
K (K_2O)	66.00 (79)	132.00 (159)	Potassium Chloride
Mg	30.00	60.00	Magnesium Chloride
Cu	0.11	0.22	Copper Chelate
Mo	0.19	0.38	Sodium Molybdate
P (P_2O_5)	50.00 (115)	100.00 (230)	Phosphoric Acid
S	30.00	60.00	Sodium Sulfate
Zn	3.00	6.00	Zinc Chelate
Fe	2.00	4.00	Iron Chelate

[1]Blanketed treatments of 40 lb N/ac were applied at approximately 3-week intervals.

Table 2. Percent change in plant fresh weight over check.

Rate	All	B	K	Mo	P	S	Zn
1X	323	-19	56	- 9	111	122	23
2X	433	-17	48	-13	104	61	-37

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