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Growing vegetables and flowering plants in a greenhouse supplied with swine-building exhaust air.

J K. Greig

C K. Spillman

B A. Koch

Growing Vegetables and Flowering Plants in a Greenhouse Supplied with Swine-building Exhaust Air

J. K. Greig[1], C. K. Spillman[2], and B. A. Koch[3]

Summary

Exhaust air from a Kansas State University swine-finishing house provides CO_2 and possibly other gases that are being used by vegetable plants in a KSU green house. In addition, a rock-storage system reduces fuel requirements of the greenhouse. Tomatoes and cucumbers have been the major food crops studied, but transplant production of geraniums, marigolds, snapdragons, and calendula also has been studied. Poinsettias were grown as a fall crop in 1980.

Introduction

The project objectives are: 1) To evaluate the production, quality, and acceptance of greenhouse crops grown in hog house air. 2) To determine if exhaust air from a hog house can be used economically to improve use of solar energy in a greenhouse by recirculating air between the greenhouse and the hog house. 3) To compare the fossil fuel needed to maintain temperature in a conventional greenhouse with that needed in a greenhouse supplied with exhaust air from a swine building. 4) To estimate the reduction in fuel per unit of cucumbers, tomatoes, or other crops produced in a greenhouse-hog house unit equipped with solar-energy storage, compared with that used in a conventional greenhouse.

Procedures

Two greenhouses, both 6 m x 7.3 m (20 ft x 24 ft), double layered, inflated polyethylene, were used in 1980-81 to grow Sandra cucumbers in the fall and Tuckcross 520 tomatoes in the spring. In the fall study, V-14 poinsettias were also grown. Instead of using soil for a growth medium, we used a synthetic soil medium and fertilized the plants by applying Osmocote 14-14-14 (a slow-release fertilizer) at various rates. In the spring we compared 3 spacings in Speedling flats for four kinds of bedding plants: geraniums, calendula, marigolds, and snapdragons.

One greenhouse attached to a swine-finishing unit received exhaust air from the swine building. Excess solar energy collected in that greenhouse was stored in a rock-storage system containing about 1 cubic meter of rock for each 6 square meters of greenhouse floor space. The control greenhouse, attached to a headquarters building, had neither energy storage nor air from the swine-finishing building.

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[1]Department of Horticulture

[2]Department of Agricultural Engineering

[3]Department of Animal Science and Industries

Results and Discussion

The cucumber, tomato, poinsettia, and bedding plants grown in the experimental house all had darker leaves than those grown in the control house.

The greenhouse-forcing cucumbers and tomato plants all grew and set fruit abundantly. The foliage, however, became necrotic and the yields were unfavorable, probably because of mineral nutrition, which was more pronounced in the experimental house.

In the spring, tomato yields in both greenhouses were low because of blossoms end-rot, but were lower in the experimental house. More deformed tomatoes in the experimental than in the control greenhouse could have resulted from excess nitrogen, part of which was probably from ammonia in the swine-building ventilating air.

In the fall, poinsettias which had different nutrition levels applied at different times, all produced high-quality plants in both experimental and control greenhouses. The plants in the control house with the lowest fertilizer level had yellowish leaves, indicating a nitrogen deficiency. That did not occur for plants in the experimental house, either because of the higher CO_2 level or because ammonia was taken up by the plant and converted to nitrogen. Bract color of the plants was comparable between the houses. Plants removed from the experimental house had a typical swine-house odor and the bracts appeared more pink than red. The plants had been watered by applying water only to the pots. Using a hose to spray the plants with water removed dust from the bracts; the pink became red and the odor (which evidently was in the dust) was gone.

The results of this study indicated that high-quality poinsettias can be grown in the experimental house, but an overhead irrigation system or hosing down of the plants prior to removing them from the house will be necessary to remove the dust and odor from the plants.

To report on our success with the four kinds of flowers, we have chosen geraniums.

'Mustang' hybrid geranium seeds, planted in the greenhouses February 3, 1981, were transplanted into Speedling flats on 1-, 2-, or 3-inch cells containing Jiffy Mix Plus as a medium. The plants were set in a sandy loam soil on May 14, 1981 (approximately 100 days after seeding). The study was terminated August 17 (approximately), 95 days after field setting. During the growing period, number of open flowers per plant was counted periodically.

Transplants previously grown in the experimental greenhouse (swine-house air) were larger and were in a more advanced stage of flower development than were plants grown in the control greenhouse.

During growth in the field, plants that before transplanting had grown in the experimental greenhouse continued to have more open flowers than the control plants until about 10 weeks, when the control plants had more open flowers. It appeared that flower buds initiated before transplanting opened, but due to transplant shock additional buds were not initiated immediately. After 2 weeks, additional flowers opened and the flower numbers per plant increased during the remainder of the growing period. Plants from the 3-inch cells had the most blooms for the first 40 days after transplanting. Eventually, plants from the 1- and 2-inch cells had about the same number of blooms per plant. In summary, plants grown in swine-house air produced as well as or better than those grown in the control house. References have stated that plants grown in high CO_2 don't grow so well after they have been removed from the CO_2. Results of this study contrast with these previously reported studies, though our previous studies have also shown that broccoli transplants grown in the experimental house are also superior to those grown in control houses.