Constant Ideal Weather is Aim Of Greenhouse

W. P. Bemis

The purpose of a greenhouse is to create and maintain consistent desirable growing conditions for plants during the changing seasons of the year. Specifically, desirable growing conditions mean that the temperature range should be maintained between 50° and 95° F depending on the type of plants being grown. The relative humidity should be between 50% and 90% depending on the temperature, and the light intensity should remain high.

To create these conditions inside a greenhouse provisions must be made for cooling during the summer days and for heating during the winter nights. To understand better the problems of maintaining a greenhouse with desirable growing conditions let us consider the factors affecting conditions inside a greenhouse on a typical summer day, summer night, winter day and a winter night.

Those Hot Summer Days

During a summer day we can expect outside air temperatures to reach 110° F or higher, with relative humidity below 15% and intense sunlight. A non-shaded and non-ventilated greenhouse under these conditions will easily have inside temperatures greater than 130°F, which would severely injure or kill plants. The reason a greenhouse reaches these temperatures is because the heat from the sun (solar radiation) is trapped inside the greenhouse.

Radiant heat from the sun passes through clear plastic or glass and is absorbed by the floor, benches and plants inside. Most of the radiant heat is then converted and released in a form (convection heat) which will not pass through clear plastic or glass, and thus it becomes trapped inside. Methods of controlling this heat build-up are by shading, ventilating and introducing cool air inside the greenhouse.

Shading reduces the amount of radiant heat passing through the clear plastic or glass, but shading is not desirable for best growth of most plants. Ventilating permits the escape of the trapped heat but cannot reduce the temperature below that of the outside air. The most efficient method is by forcing cool air into the greenhouse by forced ventilation through an evaporative pad system.

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When the Sun Sets

On a summer night as soon as the sun has set, the source of heat buildup in a greenhouse has been removed. The heat inside a greenhouse will then slowly radiate out through the plastic and temperatures inside the greenhouse will approach those of the surrounding outside air, which usually are within the range for desirable growing conditions.

During a clear winter day a greenhouse will warm up inside much the same as on a summer day, except the amount of heat from the sun is less, and for a shorter period of time. If the temperature inside becomes greater than 90° to 95° F it can be effectively reduced by forced ventilation with the cooler outside air. During overcast winter days the amount of heat from the sun is reduced and artificial heating may become necessary.

Heat Needed on Winter Nights

The winter nights may easily drop to 30° F or lower, and since heat is lost by radiating through the clear plastic or glass, the introduction of artificial heat is necessary to maintain the minimums of 50° to 70° depending upon the type of plants being grown.

Considering the factors affecting greenhouse conditions a plastic greenhouse was designed and constructed which main-

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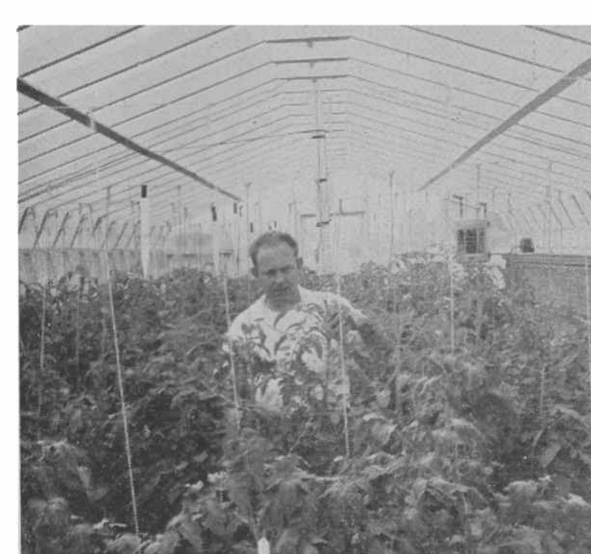
A TOMATO experiment has complete weather control in the plastic greenhouse.



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were measured, all varieties growing under the short, natural daylengths had wider crowns. This would indicate that short days encourage vegetative growth, whereas the long daylength promotes flowering and a reproductive-type growth.

Response of Northern Varieties

During the winter months, when natural daylengths were shortest, the winter hardy varieties grew at a more rapid rate, were taller, and were more upright or erect in growth under long photoperiods. The nonwinter hardy varieties that were adapted to this area were affected very little by length of day.

These experiments will give understanding and fundamental knowledge on the behavior of alfalfa under different lengths of day. Such information can be of value to the farmer interested in growing alfalfa hay, to the seed grower and to the scientist who seeks to improve this important forage crop.

Tuberculosis In Cattle - 1960

Dr. Raymond Watts

In the days when the Model T Ford had a brass radiator it was found that about 5% of the cattle in the United States had bovine tuberculosis. Nearly 50,000 beef carcasses were condemned annually as unfit for human food.

We all know that the new Ford no longer resembles the old Model T, as it has been greatly improved. However, the tubercle bacillus, the cause of tuberculosis has not changed in all this time. In fact, it has not changed since Biblical times.

Through the cooperation of federal and state authorities, cattlemen and veterinarians, we in the United States declared war against this disease which affected both cattle and man and in a little over 20 years reduced the amount of TB in cattle from 5% to an incidence of less than 0.5% or less than one out of 200, and in some areas less than one out of 1000.

Dr. Watts is an Associate Animal Pathologist.

Tuberculin Skin Test

This big reduction in the number of affected cattle was brought about by the identification of infected cattle thru the injection of a substance called tuberculin between the layers of the skin.

This tuberculin has an interesting history. Back in the latter part of the nineteenth century a German bacteriologist by the name of Robert Koch worked feverishly to produce a vaccine against tuberculosis in man. He figured that if he could grow some of the tubercle bacilli, then kill them, he would be able to inject these killed bacilli into a person and thus produce some immunity against the disease. Unfortunately this did not produce the desired immunity but it was noted that sometimes a swelling would occur at the place of injection.

This was later found to be the result of a sensitivity produced by an infection by the tubercle bacillus sometime before the injection. Since that time we have used the so-called skin test to locate TB infected cattle.

Those of us interested in animal health have not forgotten tuberculosis, but public interest has dropped considerably because the number of infected cattle was reduced so greatly.

TB on Upsurge Again

In recent years the number of reactors to this skin test has again started to climb. In fact, one state reported as high as 2.4% reactors in 10,000 animals tested. Not all the animals slaughtered showed large areas of disease in the tissues, but we must remember that the skin test is a sensitive one and has proven to be quite specific for the TB infection. It is the best tool we have for locating the disease and through its continued use we can eliminate tuberculosis from cattle.

In addition to the periodic area tests we should also check all new additions to a herd before placing them into our herds. It will require the effort of all laboratory workers and field men to accomplish our goal.

In the last 20 years considerable progress has been made in laboratory diagnosis of tuberculosis. Newer and more efficient ways of growing the tubercle bacillus in the laboratory have been developed and these procedures have borne out the usefulness of the tuberculin test in control of TB.

Learning More About It

Also, new means of differentiating bovine, human and avian strains of the tubercule bacillus have been developed and this has led to a better understanding of the infection. Currently considerable research work is being conducted in the physiology or growth characteristics of the tubercle bacillus and this may lead to an enlightened understanding of this complex and troublesome microorganism which has wreaked such havoc upon man and animals.

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tained desirable growing conditions for plants. This particular greenhouse was 41 by 17 feet. The sides were 6′4″ tall with a 9 foot eave. The foundation was 4 x 4 redwood anchored by thirteen 4 x 4 redwood posts buried 2½ feet into the ground. The stud and rafter sections were made of 2 x 4 pine, prefabricated and rigidly held together by nailed and glued plywood gussets. The prefabricated sections were then placed on the foundation at 20½ inch centers. The frame was glazed with a 10 mil clear semi-rigid plastic sheeting.

A 36 inch exhaust fan was located in the center of the south side, and an 18 inch wide evaporative pad system was placed along the center of the entire north side. Plastic covered panels were constructed to fit over the outside of the evaporative pad area for use during the cool season of the year. The cost of this 700 square foot greenhouse, fully equipped, was $1,400.

Fan and Pump Automatic

The exhaust fan and circulating pump for the evaporative pad system are thermostatically controlled. The fan is activated when the inside temperature reaches 92° F, and the pump activated at 95° F. With this type of control system, when the temperature reaches 92° F the exhaust fan is turned on and forces the cooler outside air through the dry evaporative pads into the greenhouse. If the temperature continues to rise, then at 95° F the pump is turned on and the pads become wet, causing the temperature of the entering air to drop as the water is evaporated.

In actual operation during the summer the fan should be activated about 8:30 a.m. and operate periodically until about 10:30 a.m., when the pump would be activated. During the hottest period of the day (11:00 a.m. - 4:00 p.m.) the fan and pump would run continuously. Under these conditions, when outside temperatures reached 110° F, the inside of the greenhouse was kept below 90° F.

Raises Level of Humidity

The evaporative pad system also increased the relative humidity from below 15% outside to around 50% inside and maintained it at this level during the entire day. During the cooler periods of the season when the maximum temperatures remain below 80° F the pump was not activated and the exhaust fan was able to keep inside temperatures below 95° F by forcing the cooler outside air through the greenhouse. If the humidity becomes too low during the day, the pump is activated and the wet pads will correct the low humidity.

As a source of heat, a 40,000 B. T. U. output gas heater was installed. The heater was set to maintain temperatures inside the greenhouse at 65° to 70° F. A circulating fan built into the heater kept the air moving, thereby keeping a uniform temperature distribution within the greenhouse.