THE EFFECT OF WIND SPEED AND WIND DIRECTION ON THE VENTILATION THROUGH RIDGE VENT AND NET COVERED SIDE VENTS IN SINGLE - SPAN VENLO – TYPE GREENHOUSES

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SARATH WARNAKULASURIYA

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ABSTRACT

Protected agriculture means growing perishable crops under controlled environmental conditions. The protecting structures, greenhouses, protect plants from adverse environmental conditions and generate a favourable environment for optimizing major environmenta influences on crop growth. However the "poly tunnels" or film plastic houses used in Sri Lanka entrap radiation during day time leading to temperature hikes to levels that are undesirable for plant growth. Even though various simple cooling methods are practiced their efficacy on greenhouse temperature control is not adequate under hot weather or in low altitudes. Demonstration greenhouses in IBA schools also do not function properly in many regions due to this problem. At this juncture, testing new and modified greenhouse cooling strategies is very much applicable. Hence the effect of modified and conventional ridge vents together with net-covered side vents were investigated under variable wind speeds and directions for effective greenhouse cooling.

In this experiment, four greenhouses namely, A-Frame (venlo type) with alternate ridge vents, A-Frame greenhouse with leeward ridge vent, A-Frame greenhouse without ridge vents, and an arch type greenhouse were used. All these greenhouses were covered with UV-protected clear polythene at the top and at gable sides together with UV-protected insect proof nets at the ridge side sides. In this study, 4 tests were conducted. Each test was designed as Randomized Completely Block Design (RCBD) with three replicates. The test No 1 was composed of three treatments namely, alternative ridge ventilation, continuous leeward ridge ventilation and without ridge vents, keeping external environment as the control. In test No 2, the ridge vents of the greenhouse with alternate ridge vent was arranged in such a manner to compose three treatments where orientation of the ridge vent were either windward, leeward and on both sides. In Test No. 3, the area or the angle of the alternate ridge vent opening was gradually increased. In Test No 4 the shape of the roof, barrel shape (arch roof) was compared with (Venlo shape) slanted roof without roof (ridge) vents.

Using automatic data logger, internal and external temperature, RH, and solar radiation and outside wind speed were recorded at 10-second intervals. These data were utilized to prepare hourly and daily means and standard deviations and later tabulated and graphically expressed using MS Excel. Wind speed data were grouped into four levels based on the wind velocity. The PROC. ANOVA, procedure of SAS was followed to analyze the treatment effects and separate means.

Ridge vent could be used to reduce the internal temperature and relative humidity (RH) significantly during daytime inside net-covered venlo type greenhouses under tropical conditions. Straight roof (in venlo type or A-frame greenhouse) was better than the curved roof and arch roof or barrel shape with respect to ventilation based temperature reduction (cooling) in single span greenhouses. However, the roof shape was not significantly effective in terms of maintaining relatively low internal RH during daytime.

The opening area of the ridge vent within the range between 9.3% and 14% (of the floor area) did not significantly change the rate of ventilation and thus the internal temperature and RH when operated in combination with insect-proof net-covered sides nets and under low wind speeds (0.5+0.5 m s-1). The effect of ridge orientation, with respect to wind direction, on greenhouse ventilation was not obvious in terms of temperature or RH under variable wind direction and low wind speed. Greenhouse ventilation positively responded to initiation of winds by reducing internal temperature as well as RH. But the response of ventilation to further increase in wind speed 0.25- >0.5 m s-1 was not significant.

Finally, venlo type greenhouse with alternate ridge vent and net-covered side vent can be recommended as a cost-effective and user-friendly greenhouse design for tropical climates. It will be highly applicable for the low and medium-scale production and training units in the mid and low country wet zone in Sri Lanka.